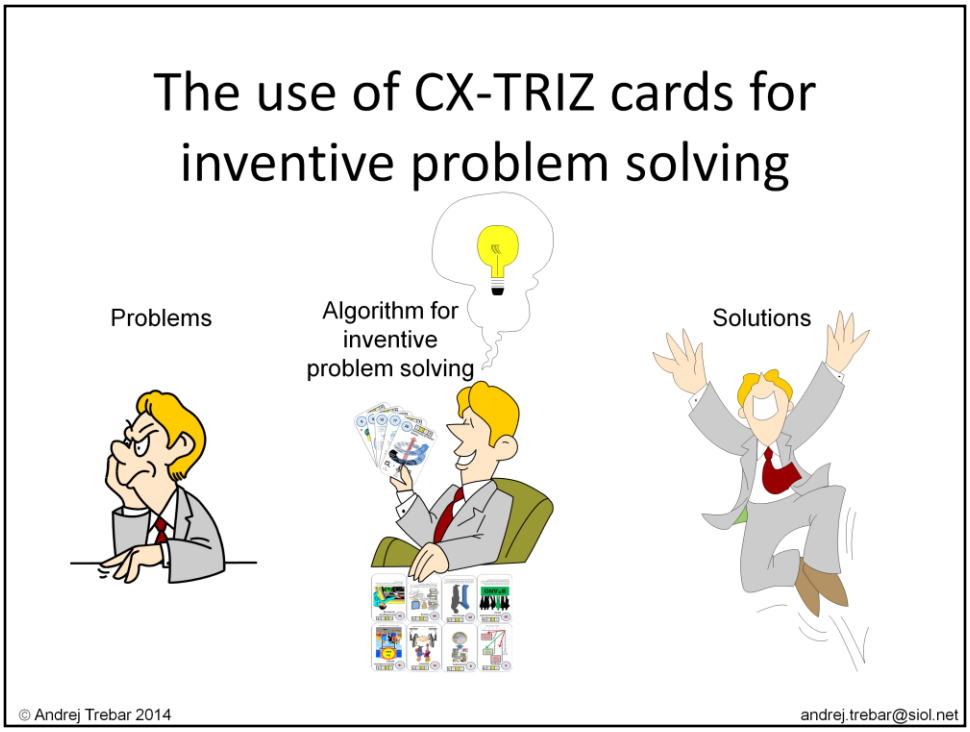


CX-TRIZ cards: letter X designates the process.

CQ-TRIZ cards are intended to seek solutions for inventive problem-solving in the field of quality assurance.

CS-TRIZ cards are intended to seek solutions for inventive problem-solving in marketing and sales.

CD-TRIZ cards are intended to seek solutions for inventive problem-solving when designing products and services.

As we become old, our ability to find creative solutions diminishes. We lean towards using our experiences with solutions that were successful in the past, but the question is whether the same solutions are going to give us good results in present and future situations. CX-TRIZ cards were developed on the basis of a theory of inventive problem-solving (TRIZ), which is a very effective tool for overcoming psychological inertia and finding solutions using already available resources.

Why do we need another set of TRIZ cards?

The majority of card sets are based on TRIZ inventive principles. Usually there are forty cards in a set, each card printed with a graphic presentation of a principle, some explanation, and an example of the principle. The inventive principles are used as a brainstorming tool.

Because

TRIZ offers much more than this. The new card set is based on a simplified algorithm for inventive problem-solving (ARIZ) and includes the concepts of ideality, contradictions, resources, patterns of evolution, DTC operator, etc.

Problem-solving is often teamwork, where team members are selected with multi-disciplinary knowledge. Because TRIZ is a complex method, we can't expect every team member to be a TRIZ expert, so the set of cards was developed as a tool to help team members use TRIZ tools effectively without extensive TRIZ knowledge. It requires only one team member to have knowledge of TRIZ and some practical experience. The effect of using CX TRIZ cards is that a team will be able to find solutions to their problems while at the same time becoming familiar with TRIZ tools, so this card set also has an educational purpose.

The CX TRIZ card set is comprised of the following concepts and tools:

a) Ideality: this gives an understanding of the Ideal Solution that is desired for problem analysis. Besides, ideality also guides the main patterns of system evolution and problem solution.

b) Contradictions: this states why it is not possible to achieve an IFR or desired result. In other words, what are the contradictions to achieve the goal? The first contradictions are identified and analyzed. Afterwards, the contradictions are removed to solve the problem.

c) Inventive Principles: to solve contradictions.

d) Resources: in order to explore all the resources available within the system and the possibility of solving contradictions by using the available resources.

e) Using the knowledge base: one purpose is to learn how others have solved similar problems in other domains so that similar methods can be used to solve a given problem. Scientific effects and inventive principles are also used for the same purpose.

f) Patterns of evolution: to predict the next generation of the current product.

g) Operators: DTC (Dimension, Time, Cost) Operator, System Operator (nine windows)

References to some commercially available card sets:

http://ishiirikie.sakura.ne.jp/sblo_files/ishiirikie/image/TRIZ_Card_workshop_En.pdf

http://www.leadership-services.com/media/311/GnhAn/die_40_triz_innovations-prinzipien_als_kartenspiel_leseprobe.pdf

https://www.innovationmanagement.se/imtool-articles/triz-solution-cards-an-effective-catalyst-for-innovative-problem-solving-and-generating-ideas/

http://www.ideationtriz.com/Innovation_Planner.asp

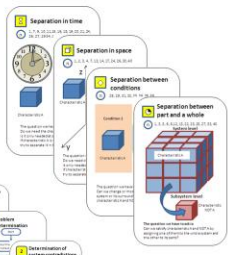
http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/eTRIZ/epapers/e2011Papers/eHanaoka-TRIZSymp2010/eHanaoka-TRIZSymp2010-110924.html

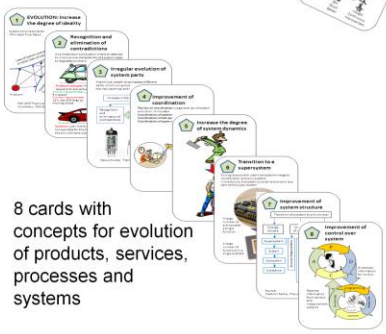
CX-TRIZ card set

CX-TRIZ cards are designed to solve problems and to provide framework for evolutionary improvement of products and services. Deck of cards consists of four types of cards:

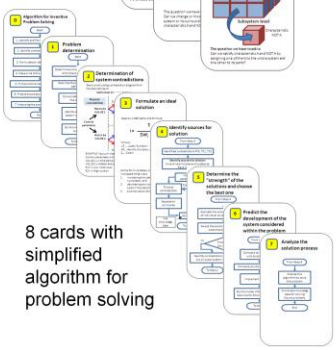
40 cards, which contain the inventive principles
a) CD for product design,
b) CQ for quality and
c) CS for sales

4 cards with separation principles





8 cards with concepts for evolution of products, services, processes and systems



8 cards with simplified algorithm for problem solving

The purpose of the CX-TRIZ card set is problem-solving and improvements in products and services:

to solve problems with a simplified ARIZ algorithm we use a set of cards designated with the number in an oval square (number 0 gives the overall flowchart of the algorithm, numbers from 1 to 7 show the diagrams of individual steps of the simplified ARIZ algorithm); and

for evolutionary improvement we select cards designated by a number in a pentagon.

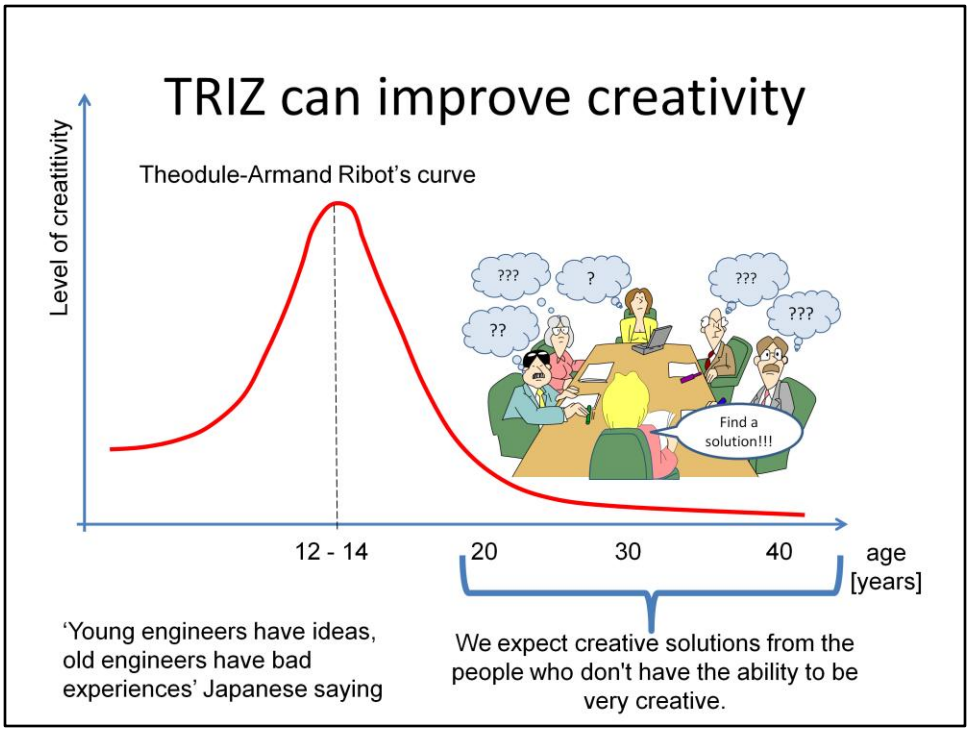
Activities carried out by the team are listed at the front of each card while a detailed explanation is given on the back of the cards. The Team Leader, prior to each step of the algorithm, presents a certain card to the team members and describes the method of work in this step.

The cards can be used in three ways:

If we use only 40 cards with inventive principles, the team can use the guided brainstorming method to find solutions to problems and opportunities for improvement.

If we use 40 cards with inventive principles, 4 cards with separation principles and 8 cards with a simplified ARIZ algorithm, we can successfully solve inventive problems.

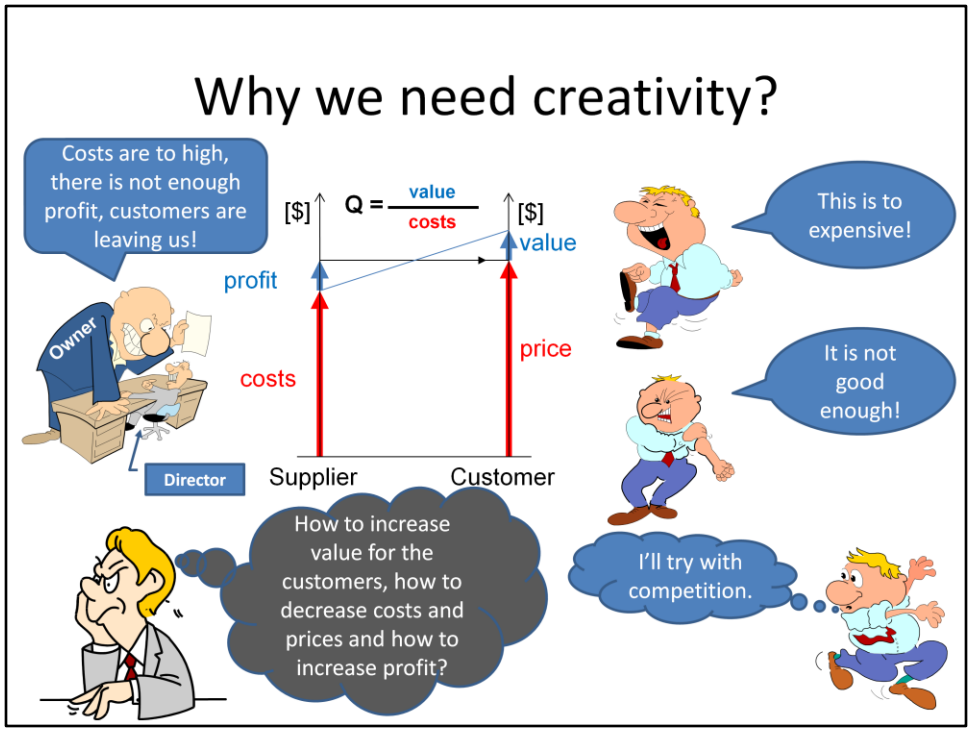
If we use 40 cards with inventive principles, 4 cards with separation principles and 8 cards with the procedure for improvement of the product, services and processes, we can find improvements that will help us boost competitiveness.



Our ability to find creative solutions decreases with age. We are the most creative between the ages of 12 to 14 years. During that time, we have more ideas but, unfortunately, we do not have access to resources. Therefore, young people are most productive in areas that do not require a lot of resources (i.e. the field of music, painting, literature, sports, programming, etc.). Over the years, our access to resources is increasing but, unfortunately, we are no longer creative and we run out of ideas.

In a turbulent business environment, we need to find creative solutions in response to rapidly changing market demands. From people who are no longer able to provide creative ideas we expect creative solutions. Management is not in a position to generate creative ideas, nor are they able to understand the creative ideas of younger workers, so they restrict their ideas, blocking their access to resources. The result is stagnation and a decay of organizations. Currently, the situation is such that young people do not even get the opportunity to work in organizations where they can gain practical experience in demanding tasks.

Therefore, we need a tool that will help us to improve creativity. Genrich Altshuller, author of "Creativity as an Exact Science", discovered TRIZ (theory of inventive problem-solving), which can help us to solve complex problems in various areas of human activity.



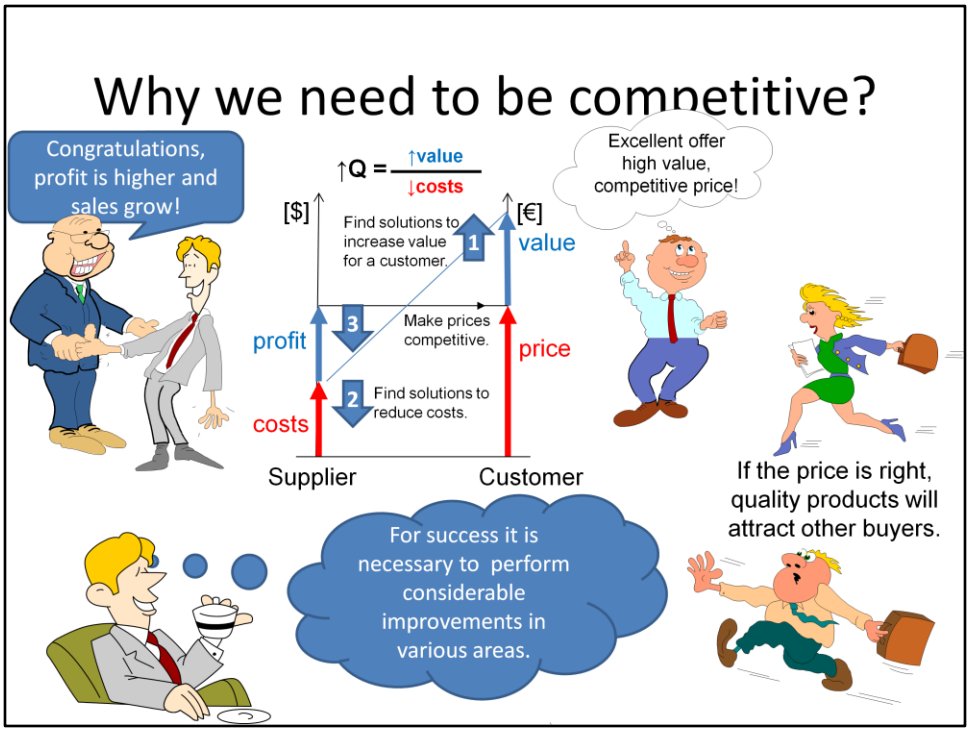
Creativity is needed because it is necessary to offer customers competitive products and services. This means these services and products that are more aligned with their requirements, needs and expectations and cheaper than products and services provided by the competition, but they must enable the organization to achieve maximum return. The figure above shows the market situation where the value of the product is only slightly higher than its price. It does not seem attractive to customers so they turn to the competition. On the supplier's side there are high costs and low profits. The result is low competitiveness.

Competitiveness is defined by two parameters –value and price – which is determined by the following two questions:

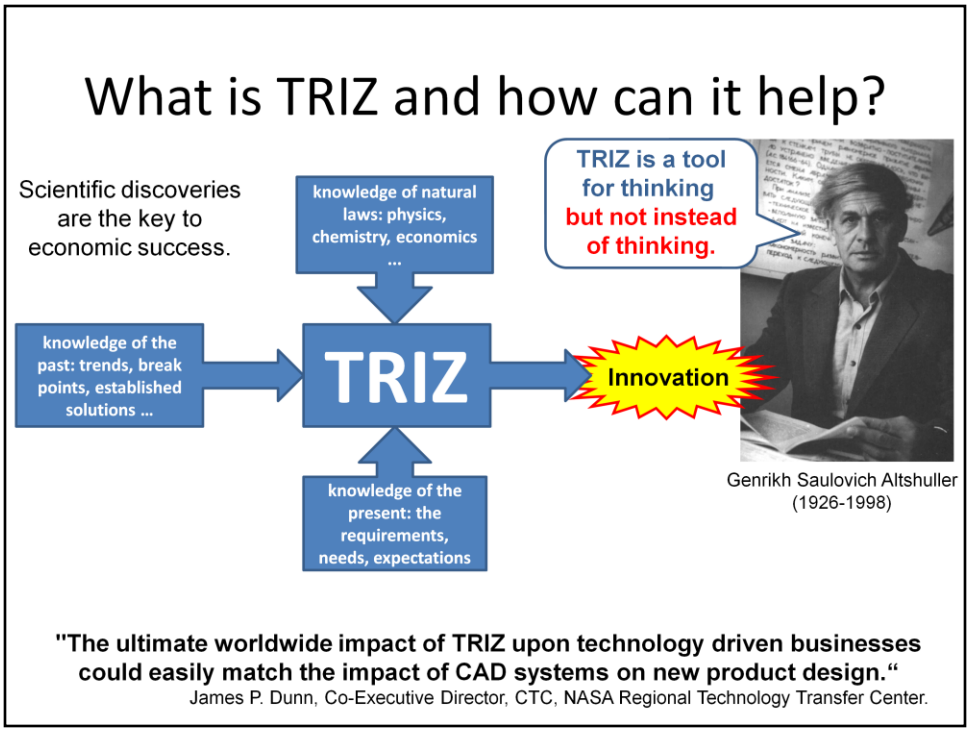
Does the product/service meet our requirements, needs and expectations?

Can we afford it?

If the answer to both questions above is "YES", then our product/service is competitive.



The seemingly simple request really means improvements in various areas. In order to increase the value of a product or service, we should understand the needs and expectations of our customers and develop our products, services and processes to be able to (1) increase value for a customer, (2) reduce costs, and (3) lower prices and still be able to retain a margin that allows higher profit.



"TRIZ" is the abbreviation of "теория решения изобретательских задач", translated into English: Theory of Inventive Problem-Solving. It was developed by G.S. Altshuller and his colleagues in the former Soviet Union between 1946 and 1985. TRIZ is a theory describing tools, techniques and databases together with an algorithmic process of finding inventive solutions to various types of problems. It was developed on the study of a patents database, analyzing the patterns of problems and solutions. More than 400,000 patents were analyzed to discover the patterns that predict breakthrough solutions to problems and the following were observed:

a) 98 percent of inventions were made using known methods of solution;

b) only 2 percent of solutions are fully original;

c) inventors subconsciously use the model solution; and

d) the innovation process can be systematically organized.

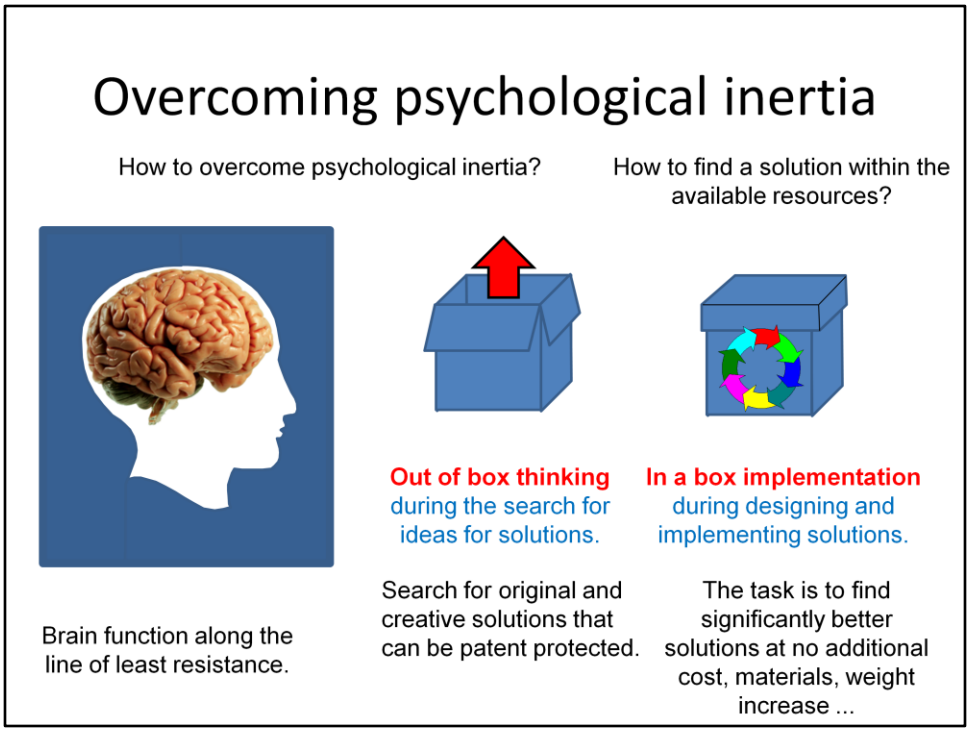
TRIZ allows algorithmic solutions to inventive problems while maintaining the freedom of choice and human creativity.

References:

TRIZ, http://en.wikipedia.org/wiki/TRIZ

TRIZ A Powerful Methodology for Creative Problem Solving, http://www.mindtools.com/pages/article/newCT_92.htm

40 Inventive Principles With Examples, http://www.triz-journal.com/archives/1997/07/b/index.html



James Kowalick defines Psychological Inertia (PI) as follows:

The psychological meaning of the word "inertia" implies an indisposition to change – a certain "adhesion" due to human programming. It represents the inevitability of behaving in a certain way – the way that has been indelibly inscribed somewhere in the brain. It also represents the impossibility – as long as a person is guided by his habits – of ever behaving in a better way.

Psychological Inertia (PI) represents the barrier to personal creativity and problem-solving ability. In solving a problem, it is the inner, automatic voice of PI whispering "You are not allowed to do that!" Or, "Tradition demands that it be done this way!" Or even, "You have been given the information, and the information is true."

References:

James Kowalick, TRIZ Master, Renaissance Leadership Institute, PSYCHOLOGICAL INERTIA, http://www.triz-journal.com/archives/1998/08/c/

What are contradictions?

A contradiction literally means saying "No" but more generally refers to the proposition that asserts apparently incompatible or opposite things. Using TRIZ methods it is possible to turn “No” into “Yes” by eliminating contradictions.

There are three basic topics of TRIZ:

a) the existence of laws of evolution of products, services, processes and systems;
b) contradiction as an obstacle to the realization of the objectives until we find the right solutions; and
c) the concept of specific situations which sets out the conditions and resources to eliminate contradictions and enable the realization of goals.

Examples of contradictions in the sales process:

a) Customers need the products/services but do not have enough money.
b) Customers need the products/services but these do not meet their requirements (they do not like them, they do not comply with customer requirements, the price is too high, etc.).
c) Customers want products/services, but the supplier is unable to deliver (the supplier can’t offer the right solution, or can’t deliver on time, etc.).
d) Miscellaneous.

The proposed method of using CX-TRIZ cards also allows TRIZ to be used by people who do not have an in-depth knowledge of the methods and algorithms to solve problems. They can begin immediately with the use of 40 inventive principles as a guideline for simple brainstorming.

This way of working allows them to focus on solving their problem using 40 inventive principles and selecting the ones that enable a solution to their specific problem. Once they become familiar using inventive principles, they can begin to use an algorithm for inventive problem-solving (simplified ARIZ) and different TRIZ tools for the improvement of products, services and processes.

Altshuller and his coworkers distinguished the following three types of contradictions:

Administrative Contradiction - we speak about administrative contradiction when it is necessary to do something, but we do not know how to do it.
Example: increase sales by 30 %. What to do?

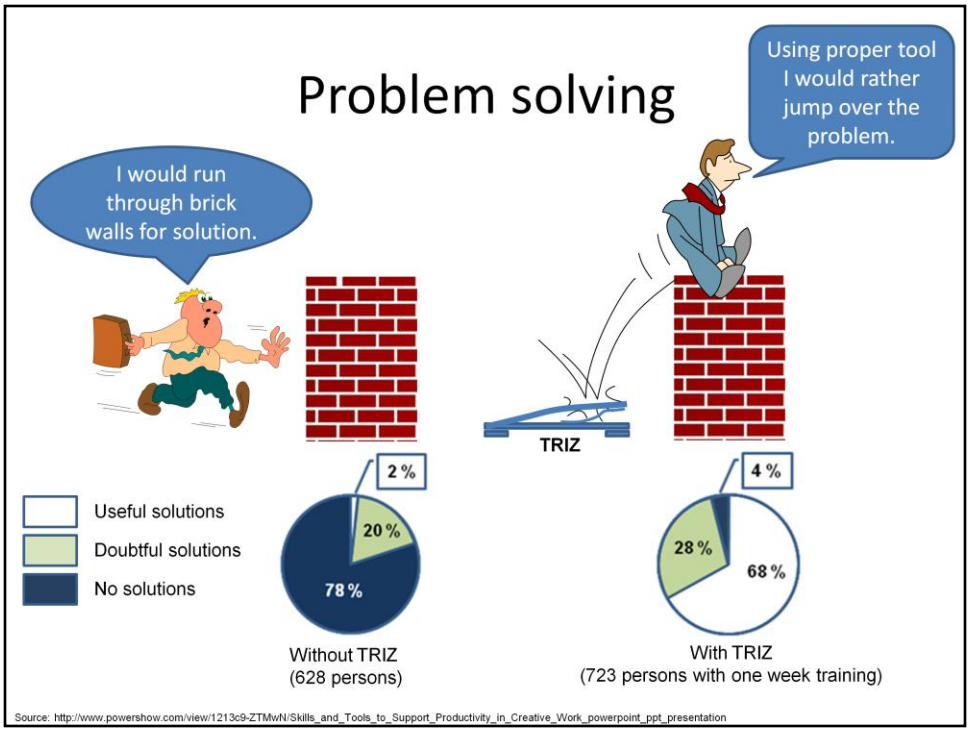
Technical Contradiction - we speak about a technical contradiction when we improve one part (an evaluation parameter) of the technical system with the help of known methods, but that entails the worsening of other part (another evaluation parameter) of the technical system.
Example: time of presentation to the customer is shorter but the number of complaints has increased.

Physical Contradiction - we speak about a physical contradiction when we impose mutually opposed requirements on the same control parameter of the system.
Example: keyboard should be small, but keys should be large.

Source: Gaetano Cascini (University of Florence), Francesco Saverio Frillici (University of Florence), Jürgen Jantschgi (Fachhochschule Kärnten) Igor Kaikov (EIFER), Nikolai Khomenko, TETRIS project and the Lifelong Learning Programme.

After the problem has been defined, the next step is identification of contradictions that prevent us from achieving the desired result. If we know the contradiction, then we can begin to solve the problem.

Administrative contradictions are usually a list of unrealistic desires. Therefore, it is necessary first to conduct a survey of the available resources of the system and perform an analysis of the existing problems faced by the organization. Only on the basis of this information it may be possible to identify the physical or technical contradictions that define the real problems and identify solutions which could lead to the resolution of administrative contradictions. Unfortunately, the administrative contradictions within organizations are most often defined by management as the requirements to be realized by employees.



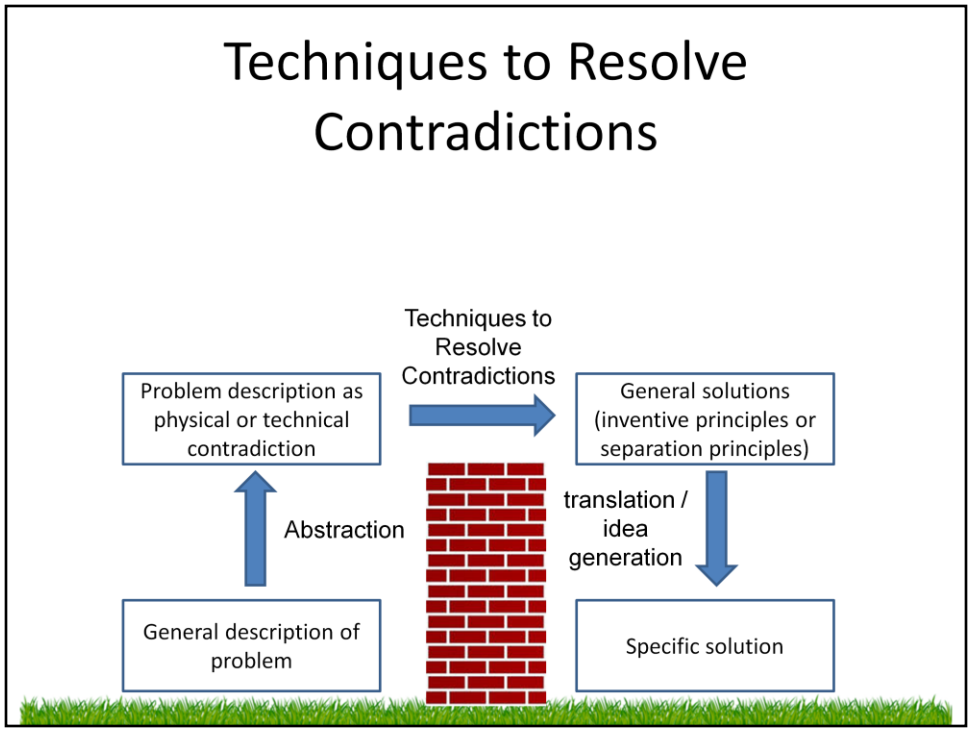
Various psychological tools have been suggested and practiced to find new ideas and overcome psychological inertia: brainstorming, lateral thinking, etc. However, contrary to the expectations of their authors, they are not so efficient as TRIZ which is a systematic methodology that overcomes "psychological inertia" and produces innovative solution concepts that utilize available resources. This directly results in an improved product at reduced cost.

One of the most effective TRIZ tools is the Algorithm for Inventive Problem Solving (ARIZ). According to Janice Marconi, ARIZ is a logical structured process that incrementally evolves a *complex problem* to a point where it is *simple to solve*. ARIZ is a very complicated tool intended for solving most complicated problems. For the purpose of effective group work we use a simplified algorithm for problem solving.

References:

Janice Marconi, The Algorithm for Inventive Problem Solving, http://www.triz-journal.com/archives/1998/04/d/

Umakant Mishra, An Introduction An Introduction to ARIZ, file:///C:/Documents%20and%20Settings/Administrator/My%20Documents/Downloads/An%20Introduction%20to%20ARIZ.pdf



The model for resolving contradictions is comprised of the following steps:

a) General description of the problem.

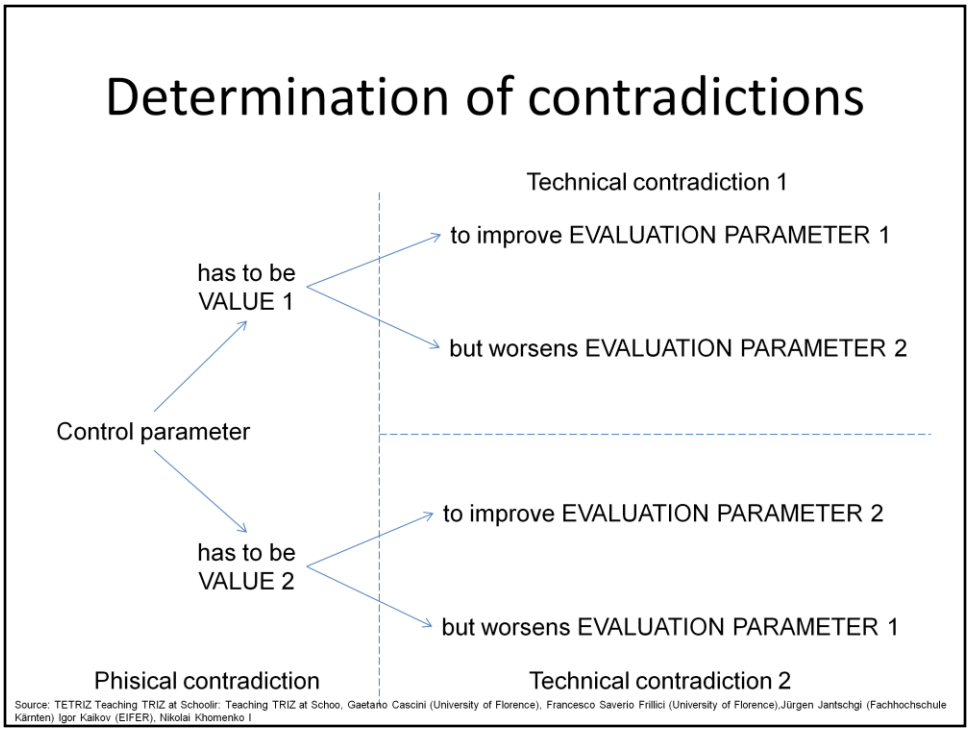
b) Abstraction of the problem – problem definition as a technical or physical contradiction.

c) Application of the TRIZ techniques to resolve (technical or physical) contradictions – general solutions.

d) Idea generation for specific solutions to a specific problem.

References:

Source: TETRIZ Teaching TRIZ at Schoolir: Teaching TRIZ at School, Gaetano Cascini (University of Florence), Francesco Saverio Frillici (University of Florence), Jürgen Jantschgi (Fachhochschule Kärnten) Igor Kaikov (EIFER), Nikolai Khomenko

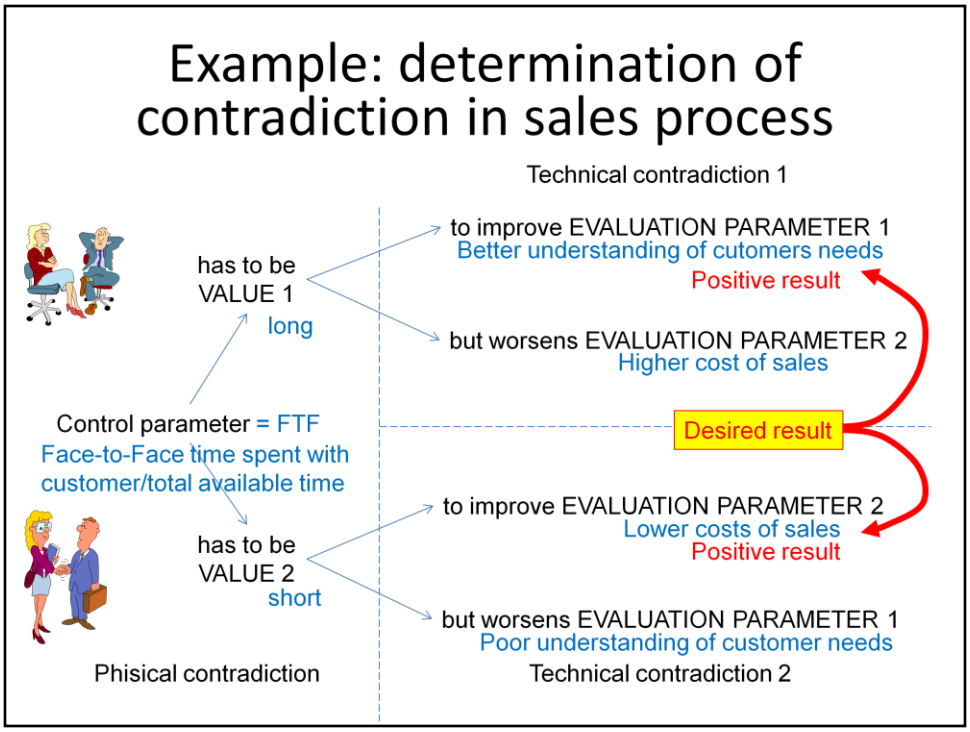


In order to define contradictions, we have to find one Control Parameter and two Evaluation Parameters of the system:

a) The control parameter of the physical contradiction is a means to make the situation change. This parameter should be measured in order to be able to control the system.

b) The two evaluation parameters of the technical contradictions are defined as taking part in describing the objective.

An essential step in solving the problem is a description of the problem in terms of contradictions. Formulation of these contradictions helps us understand the root cause of the problem.

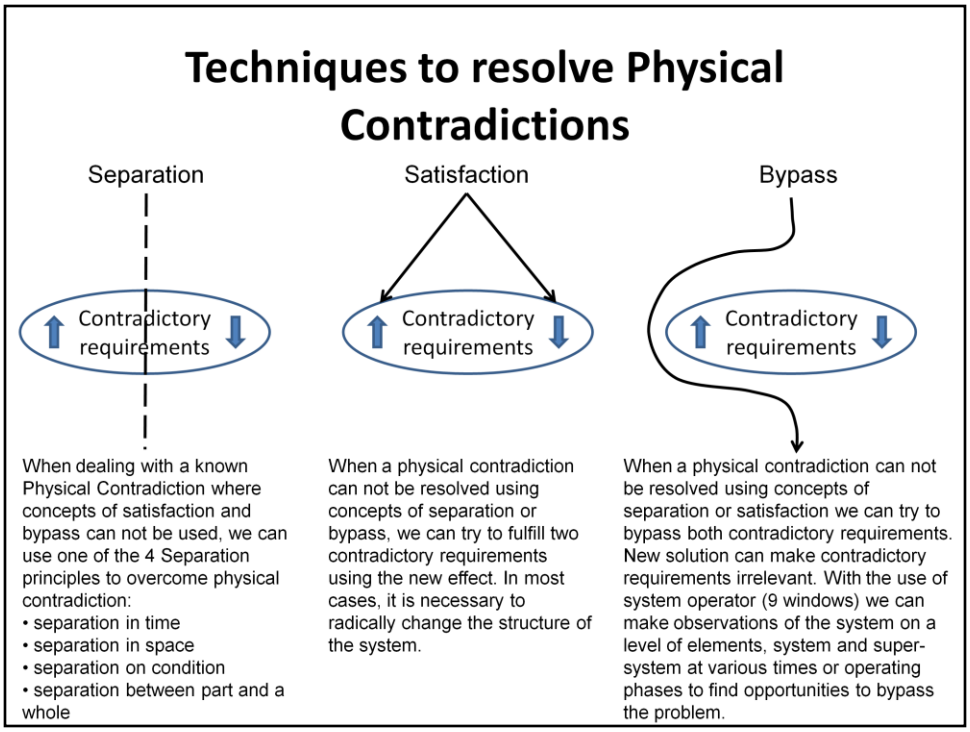


The example shows how you can identify physical and technical contradictions in the sales process. It also shows the connection between the physical and technical contradiction. The control parameter is what affects the operation of the system as it has different values during its operation. In the example above we used Face-To-Face ratio as the control parameter, which shows how long the vendor spends in personal contact with customers. We need to communicate with customers, but the duration of communication can be short or long.

The effects of communication show the technical contradiction:

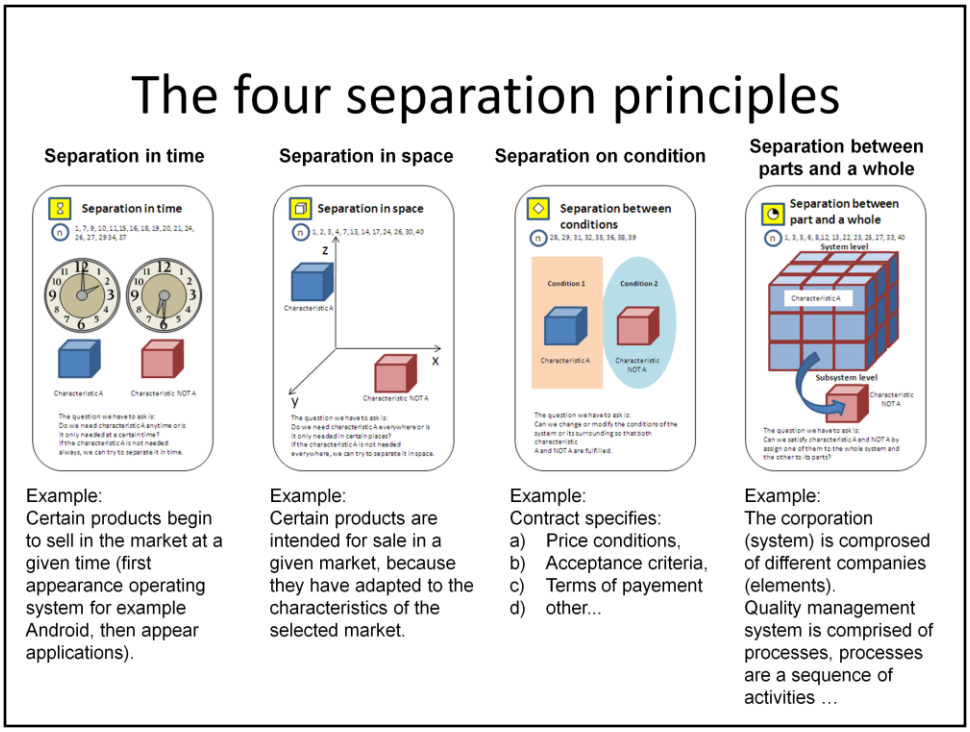
a) The effect of longer communication is a better informed customer and the seller will better understand customer requirements, needs and expectations, but more time is needed and thus the cost of communication with the customer is higher.

b) The effect of shorter communication is lower sales costs, but the customer will be less informed and the seller will not be able to get detailed information about customer requirements, needs and expectations.



As a matter of principle a physical contradiction can be resolved by three concepts:

- Separation of contradictory requirements (see 4 Separation Principles)
- Satisfaction of contradictory requirements
- Bypass contradictory requirements



Separation in time

The concept is to separate opposite requirements in time. If a system or process must satisfy contradictory requirements, perform contradictory functions or operate contradictory conditions, try to schedule system operation so that requirements, functions or operations that conflict take effect at different times. The concept of "separation in time" is based on the definition of the so-called "operational time“. That means exactly when – at what time – do we need the opposite requirements.

Separation in space

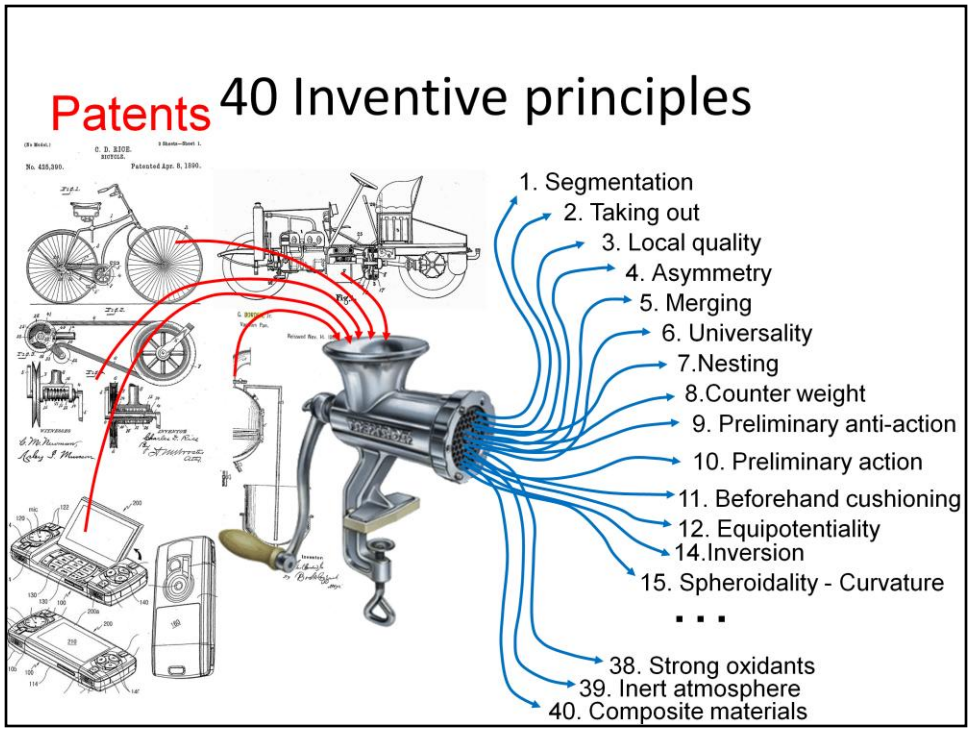
The concept is to separate opposite requirements in space. If a system must perform contradictory functions or operate under contradictory conditions, try to partition the system into subsystems. Then assign each contradictory function or condition to a different subsystem. The concept of "separation in space" is based on the definition of the so-called "operational space". That means exactly when – at which place – do we need the opposite requirements.

Separation on conditions

The concept of separating the opposing requirements of a condition can resolve contradictions in which a helpful process takes place when special conditions exist. Consider changing the system or the environment so that only the helpful process can take place.

Separation between part and whole

The concept is to separate opposite requirements within a whole object or its parts. If a system must perform contradictory functions or operate under contradictory conditions, try to partition the system and assign one of the contradictory functions or conditions to a subsystem (or several subsystems). Let the system as a whole retain the remaining functions and conditions.



Altshuller with coworkers extracted 40 inventive principles from the worldwide patent data base. These are hints that will help team members to find a highly inventive solution to the problem.

There are three sets of inventive principles in the CX TRIZ card set:

a) Inventive principles with examples for products and services
b) Inventive principles with examples from sales and marketing
c) Inventive principles with examples from quality management

This is important because team members should work on improving the processes of an organization's management systems. Thus not only the knowledge of inventive principles is required, but also the knowledge concerning concepts and tools of management consulting.

A solution to the problem can be found by defining the contradiction which needs to be resolved and systematically considering which of the 40 principles may be applied to provide a specific solution to overcome the contradiction, enabling a solution that is closer to the Ideal Final Result (IFR).

The procedures used by team members are:

1) the analysis of the contradiction,
2) the pursuit of an ideal solution, and
3) the search for one or more of the principles to overcome the contradiction,

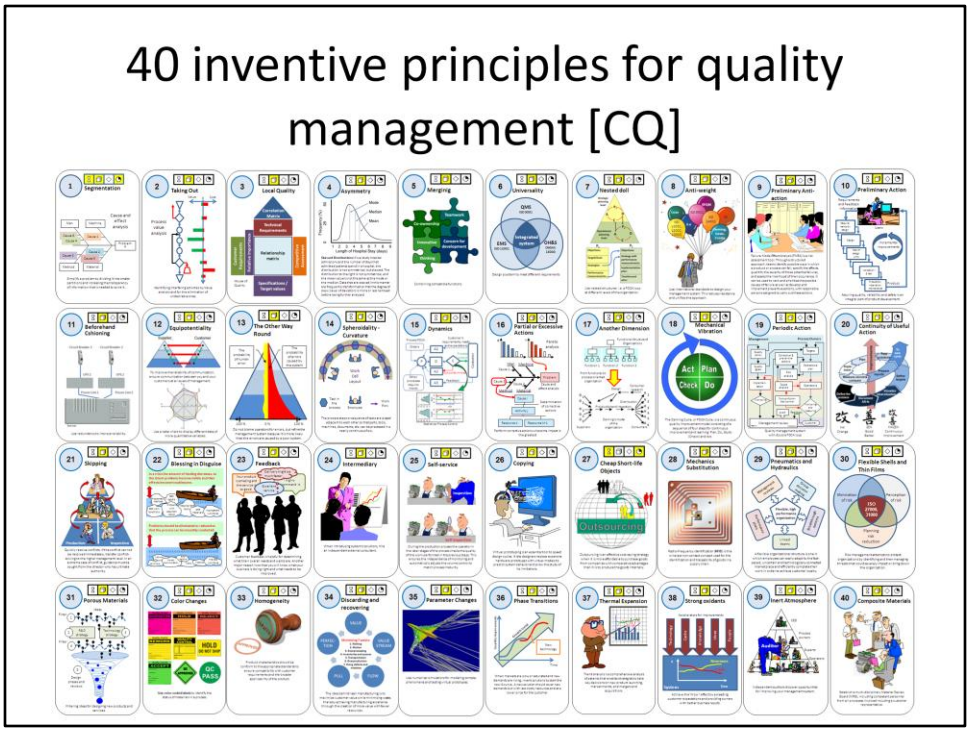
are the key elements in a process which is designed to help the team engage in the process with purposefulness and focus.

This approach is easy to understand by team members, so it was selected to enable organizations to be creative when solving their problems in a field of general management. Cards with inventive principles are used because they enable TRIZ inventive principles to be merged with concepts of processes where inventive principles areapplied (i.e. sales and marketing [CS], quality management [CQ] and design of products and services[CD]).

Further development of TRIZ and ARIZ led to a different approach for problem-solving which is more efficient for solving demanding technical problems. It uses the concept of physical contradictions, creating and analyzing Substance-Field (SuField) models, and using 76 standard solutions to overcome contradictions.

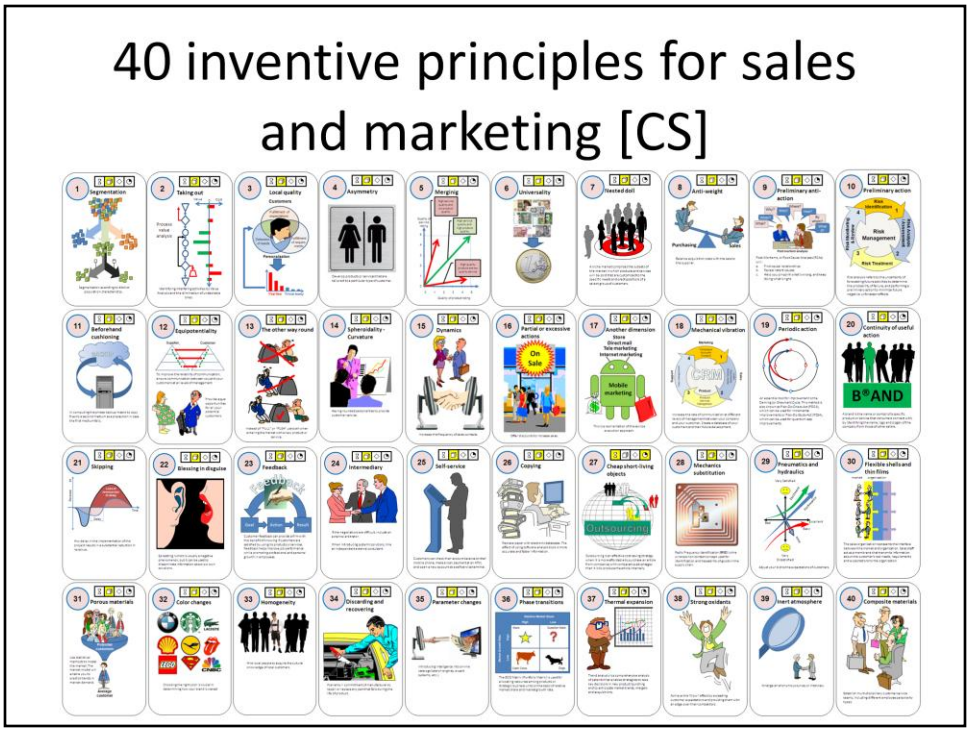
CD-TRIZ cards show inventive principles to resolve contradictions in the design of new products and services.

The number in the circle represents the serial number of inventive principles followed by the title of the principle in its original form. Above the title are four fields that tell which separation methods can be realized with a certain inventive principle. In the centre of the card is the image that displays topics using a specific principle. On the back of the cards there is additional information for employing these principles in the design of products and services.



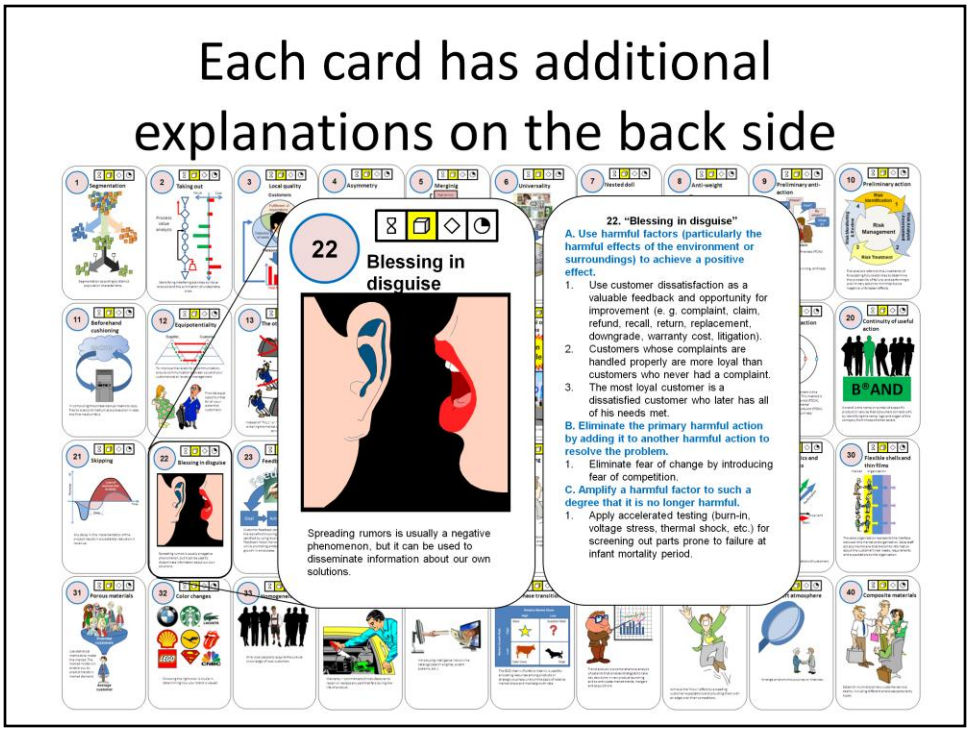
CQ-TRIZ cards show inventive principles to resolve contradictions in the field of quality management.

The number in the circle represents the serial number of inventive principles followed by the title of the principle in its original form. Above the title are four fields that tell which separation methods can be realized with a certain inventive principle. In the centre of the card is the image that displays topics using a specific principle. On the back of the cards there is additional information for employing these principles in the design of products and services.

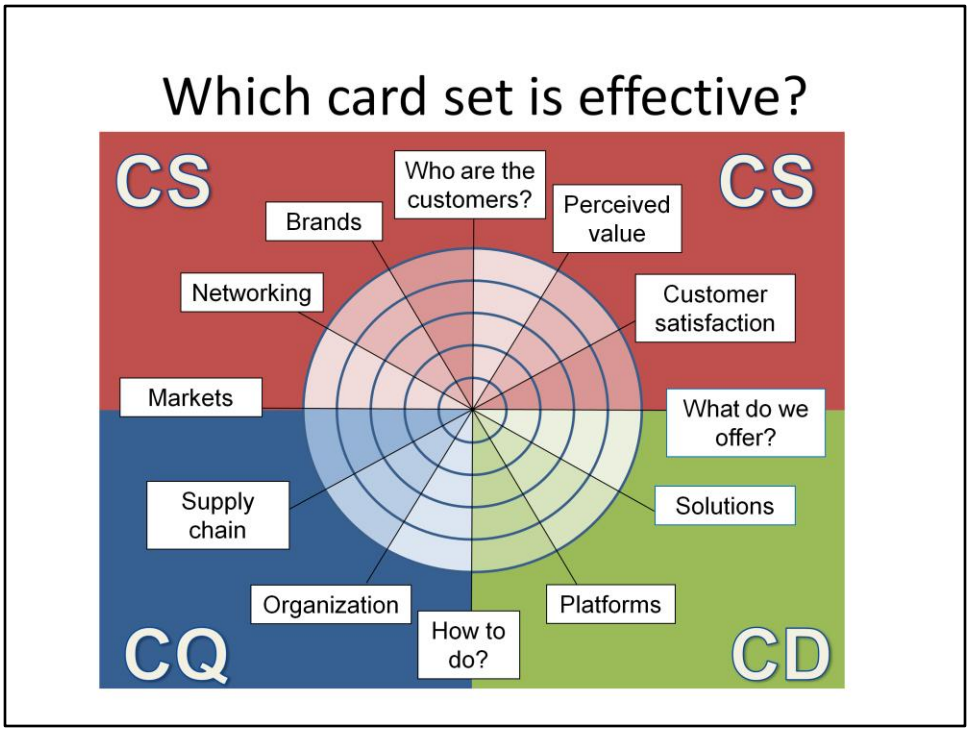


CS-TRIZ cards show inventive principles to resolve contradictions in sales and marketing.

The number in the circle represents the serial number of inventive principles followed by the title of the principle in its original form. Above the title are four fields that tell which separation methods can be realized with a certain inventive principle. In the centre of the card is the image that displays topics using a specific principle. On the back of the cards there is additional information for employing these principles in the design of products and services.



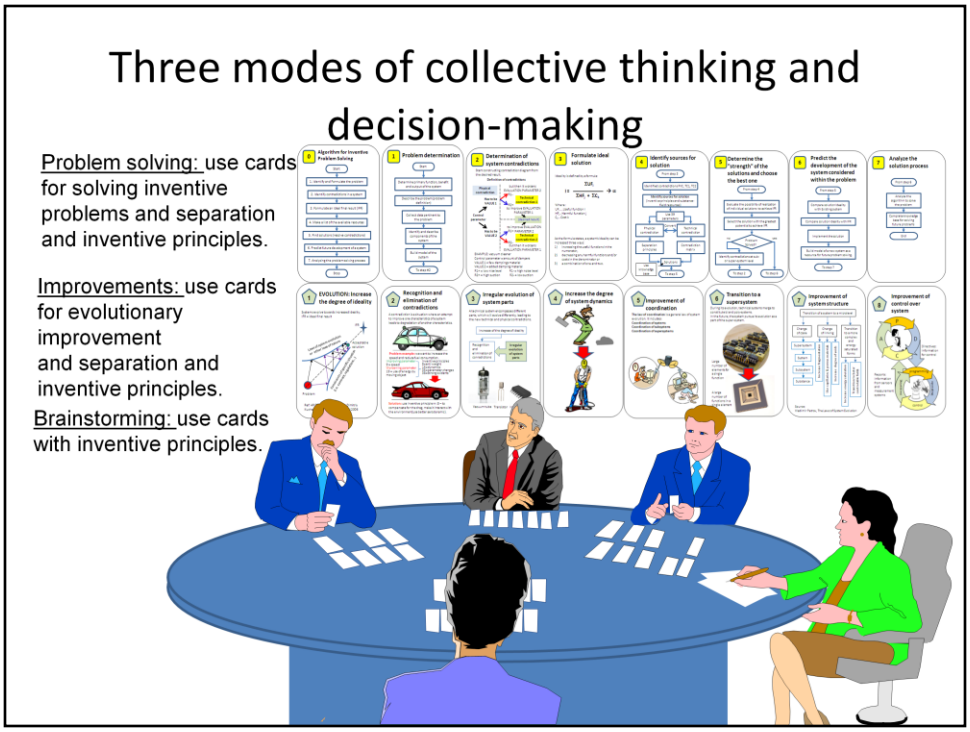
The front of each card is intended to give team members an idea on how to use the inventive principle represented by a picture on the card. It also serves as a navigation tool to show which individual inventive principle can be used for resolving a particular physical contradiction. When inventive principles are identified, the back of each inventive principle shows additional information for using a particular one.



The set of cards has been designed so that it is able to cover all the areas of organization. This is particularly important in the design of management systems, organizational changes, the introduction of improvements and the like.

CX-TRIZ cards: letter X designates the process.

1) CQ-TRIZ cards are intended to seek solutions for inventive problem-solving in the field of quality assurance.
2) CS-TRIZ cards are intended to seek solutions for inventive problem-solving in marketing and sales.
3) CD-TRIZ cards are intended to seek solutions for inventive problem-solving when designing products and services.



These examples illustrate the advantages of the presented method:

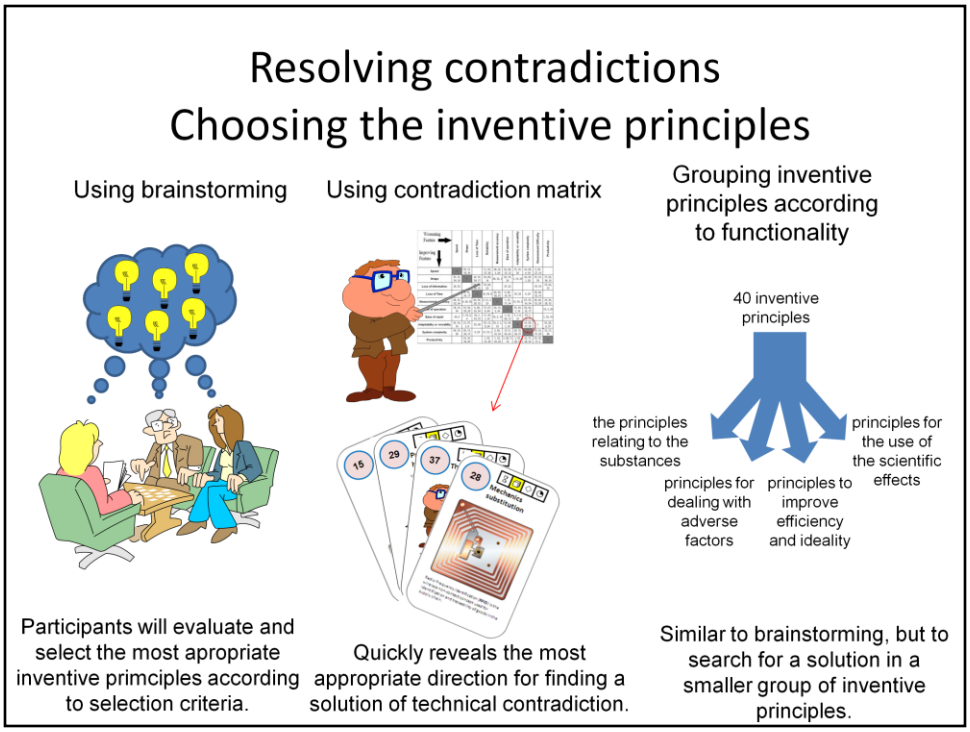
a) The use of CX-TRIZ cards increases the creativity and productivity of the entire team.

b) Visual information presented on the front of the CX TRIZ cards gives the whole team an overview of the inventive methods available that can be used to determine breakthrough strategies.

c) The use of an algorithm for problem-solving or an algorithm for improvements leads the team along the optimum path to success.

d) 40 inventive principles with explanations allows you to use the most effective principles as resources for your application.

e) Ideas that the team acquired by observing the most effective principles and other resources can be used immediately to determine a successful strategy for improvement or problem-solving.



Brainstorming is a method by which a team can find inventive principles that permit solution contradictions. The team must examine all the 40 inventive principles. Each member of the team examines several inventive principles. The usefulness of such a mode is that people become familiar with them. A team member who finds a principle that will solve a particular problem should explain to other team members his/her findings.

It should be noted that the use of the contradiction matrix is successful only in solving technical problems. Darrell Mann has developed a matrix that is intended to resolve contradictions in business processes. The matrix is published in the book: "Hands on Systematic Innovation for Business & Management", published by IFR Press in 2004.

There are several ways of grouping inventive principles that enable you to work with a smaller (thematically selected) set of inventive principles, which significantly speeds up the process of finding solutions. Below we discuss an example of grouping inventive principles into four groups according to the proposal of S. Fayer.

Source: TETRIZ Teaching TRIZ at Schoolir: Teaching TRIZ at School, Gaetano Cascini (University of Florence), Francesco Saverio Frillici (University of Florence),Jürgen Jantschgi (Fachhochschule Kärnten) Igor Kaikov (EIFER), Nikolai Khomenko.

Group #1: the principles relating to the substances

Selection of inventive principles sugested by S. Fayer
Group #1: quality, quantity, structure and form
Inventive principles: 1, 2, 3, 4, 7, 14, 17, 30, 31, 40

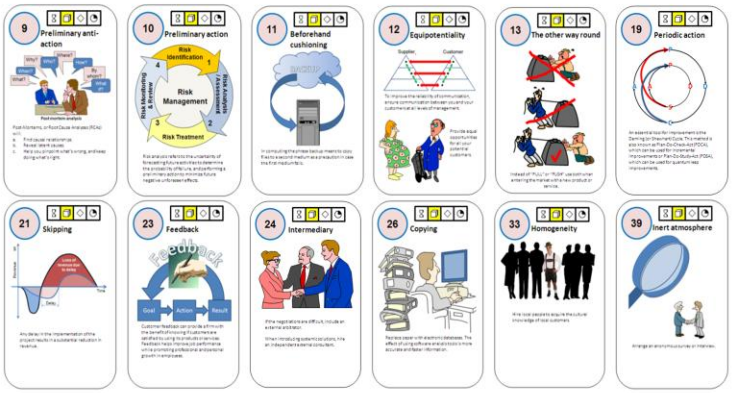
Source: TETRIZ Teaching TRIZ at School, Gaetano Cascini (University of Florence), Francesco Saverio Frillici (University of Florence),Jürgen Jantschgi (Fachhochschule Kärnten) Igor Kaikov (EIFER), Nikolai Khomenko

Refereces:

http://www.triz-online.de/uploads/media/40_Prinzipien_Literaturueberblick.pdf

Group #2: how to deal with adverse factors

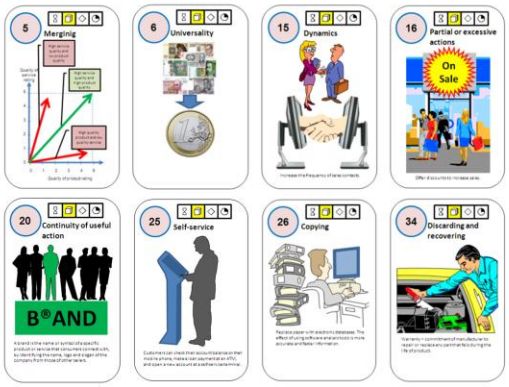
Inventive principles: 9, 10, 11, 12, 13, 19, 21, 23, 24, 26, 33, 39



Source: TETRIZ Teaching TRIZ at School, Gaetano Cascini (University of Florence), Francesco Saverio Frillici (University of Florence),Jürgen Jantschgi (Fachhochschule Kärnten) Igor Kaikov (EIFER), Nikolai Khomenko

Group #3: how to improve efficiency and ideality

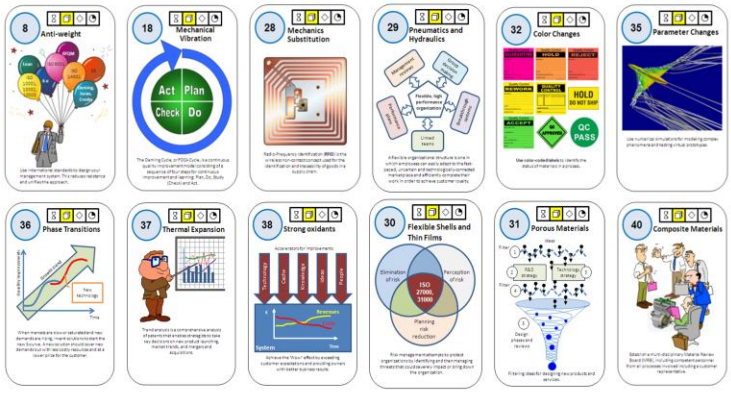
Inventive principles: 5, 6, 15, 16, 20, 25, 26, 34



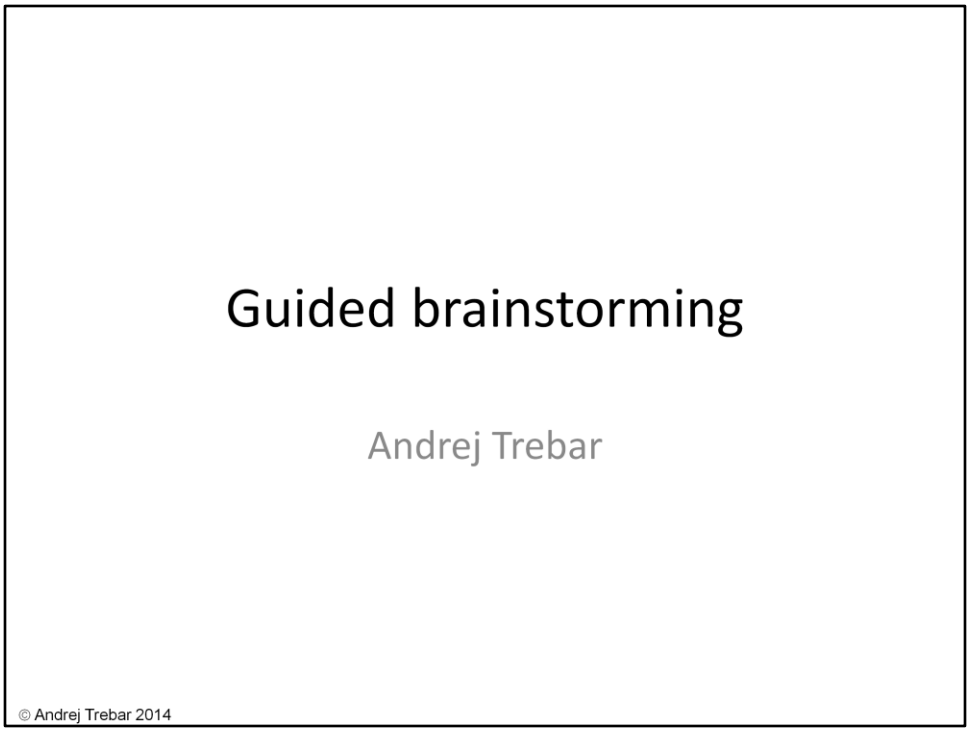
Source: TETRIZ Teaching TRIZ at School, Gaetano Cascini (University of Florence), Francesco Saverio Frillici (University of Florence),Jürgen Jantschgi (Fachhochschule Kärnten) Igor Kaikov (EIFER), Nikolai Khomenko

Group #4: the use of scientific effects, fields and substances

Inventive principles: 8, 18, 28, 29, 32, 35, 36, 37, 38, 30, 31, 40

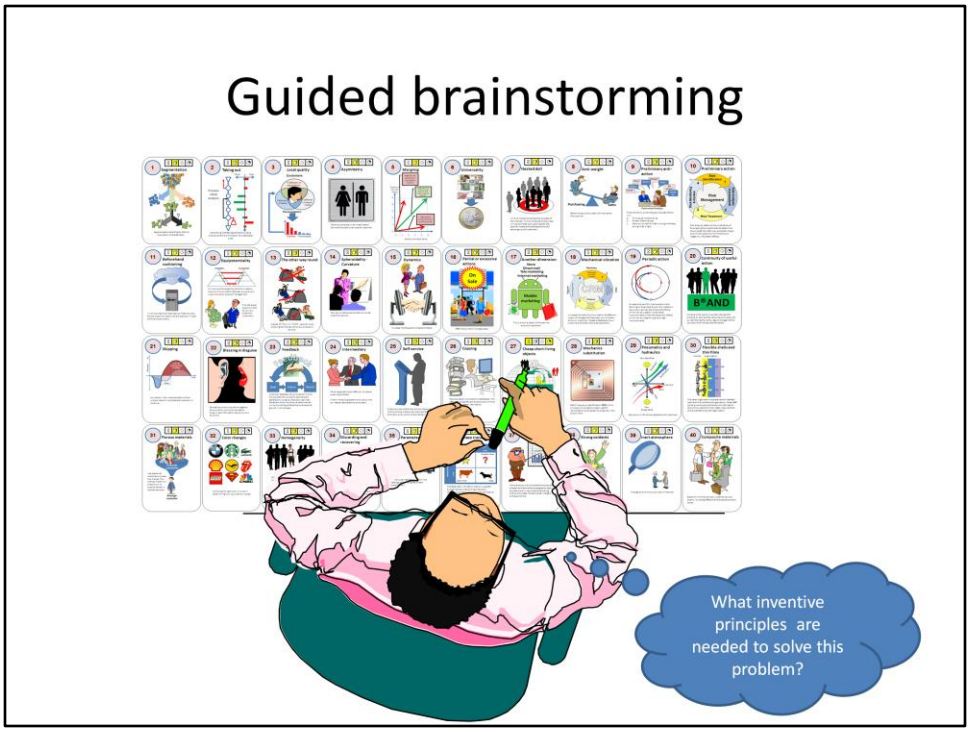


Source: TETRIZ Teaching TRIZ at School, Gaetano Cascini (University of Florence), Francesco Saverio Frillici (University of Florence),Jürgen Jantschgi (Fachhochschule Kärnten) Igor Kaikov (EIFER), Nikolai Khomenko



When in need of ideas for a solution to a particular problem or to develop new products or services, we can use the method of brainstorming. If possible we organize a brainstorming session with individuals capable of generating creative ideas needed to solve the problem. Often it turns out that employees do not have fresh ideas. In this case, we find ourselves in a situation where we are alone and urgently need to seek ideas to solve our problems.

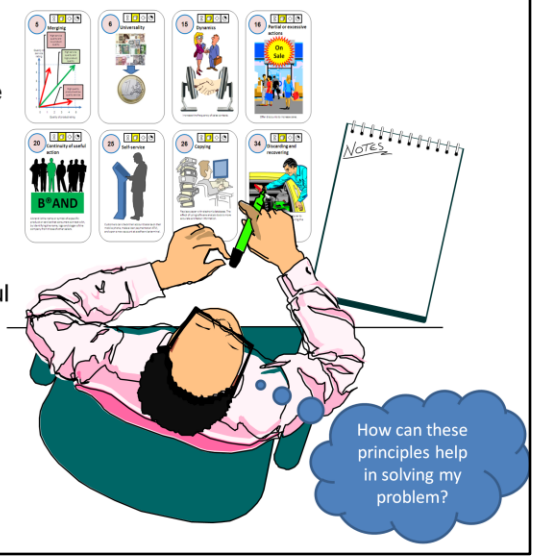
Using the CX-TRIZ cards will guide our thinking in line with the chosen algorithm: solving problems or evolutionary development towards an optimum solution taking into account the 40 inventive principles to find solutions to our problem. Even using only 40 inventive principles will ensure that we find solutions addressing each of the inventive principles.



When we need to find a solution to a complex problem, a variety of possible solutions should be considered. The deck of cards contains 40 cards with the inventive principles. This is an important resource which you can use to try to solve your problem. For the solution, you can select one or more inventive principles and combine them in a method that is able to solve your specific problem. The problems become difficult when, in the case of certain parameter improvements, deterioration occurs in another parameter. This is a contradiction that requires an inventive solution.

Guided brainstorming

1. Define the problem.
2. Find out what we need to improve and what may therefore worsen.
3. Select a group of inventive principles relating to resolve your problem.
4. Study each card with inventive principle.
5. If you find certain card to be useful for solving your problem, study also the back side of the card.
6. Select inventive principle cards that will help you solve your problem.
7. Formulate proposal of solution.



When you do not have enough time to review all 40 cards with inventive principles, you can use the grouping of inventive principles, as suggested by S. Fayer:

Group #1: quality, quantity, structure and form

Inventive principles: 1, 2, 3, 4, 7, 14, 17, 30, 31, 40

Group #2: how to deal with adverse factors

Inventive principles: 9, 10, 11, 12, 13, 19, 21, 23, 24, 26, 33, 39

Group #3: how to improve efficiency and ideality

Inventive principles: 5, 6, 15, 16, 20, 25, 26, 34

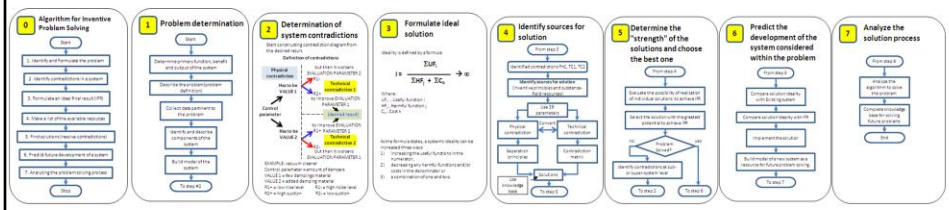
Group #4: the use of scientific effects, fields and substances

Inventive principles: 8, 18, 28, 29, 32, 35, 36, 37, 38, 30, 31, 40

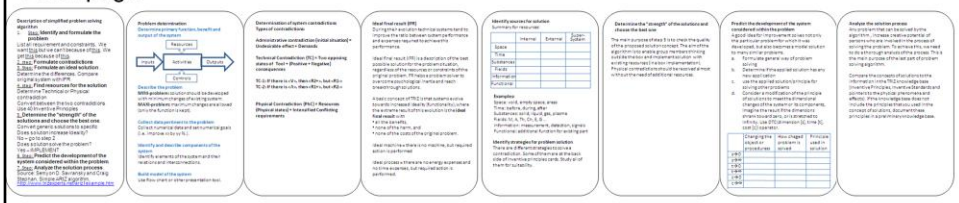
Problem solving procedure guideline

Andrej Trebar

Front page

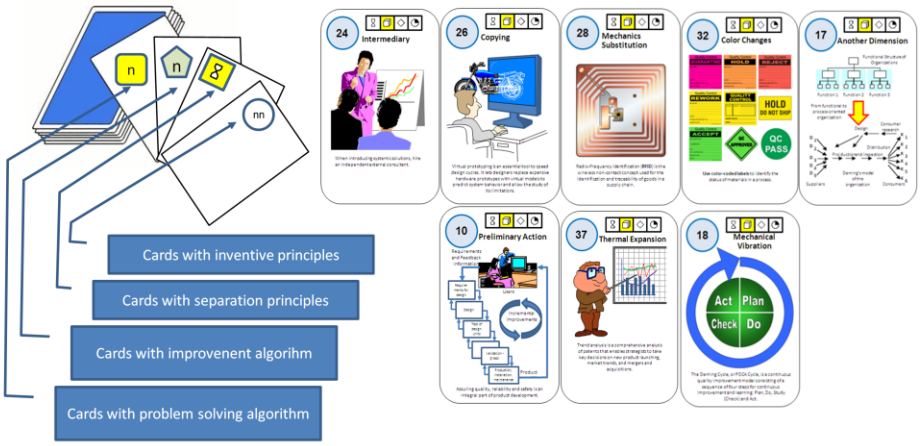


Back page



Distribution of cards

Each participant will receive a certain number of cards that represent the inventive principles. The team leader keeps cards with problem-solving and for the improvement algorithm. Four cards with separation principles are placed at a location visible by all team members.



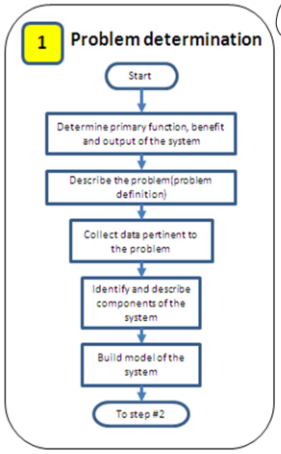
CX-TRIZ cards can be used by one person (individual user) or a team.

When the cards are used by an individual, they are placed in an 8 × 5 matrix. If there are more persons present, distribute 40 cards with inventive principles among them.

The team can be comprised of two, four, five, eight or ten persons. Team members are selected on the criteria of process or product/service knowledge so that they can contribute to a solution of the task. On the front side of each card representing inventive principles is a number written in a circle, symbols that tell what kind of separation principle (at the time, place, condition, or between parts and the whole) can be solved by using an inventive principle.

1. Problem definition

The team leader has eight cards that provide a problem-solving algorithm. The team leader presents the first card to the team and jointly conducts a debate on the issue.



The CEO requested that costs of all processes (including QMS) should be reduced. Each of the process owners should present a solution.

There is only one person managing QMS. A third party audit has shown no non-conformities.

QMS must retain the ISO 9001 certificate (customer requirements).

QMS is documented with QM, 4 SOPs and 27 WI and all records required by ISO 9001. Each of the process owners is responsible for SOP of his/her process

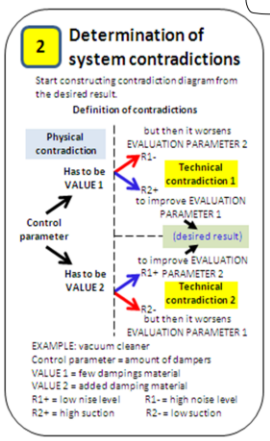
The problem is:
How to reduce costs by 20% to maintain QMS and at the same time retain its functionality?

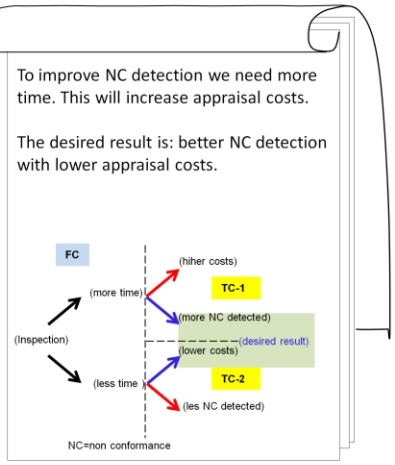
The team leader writes a conclusion of the debate on a flip chart.

Cards with an algorithm for problem-solving include activities that must be performed by the team in order to solve the problem with a high probability.

2. Determination of system contradictions

The team determines the contradiction in a system that needs to be resolved.





All team members now know what the problem that must be resolved is.

Contradiction presents conflicting requirements that prevent or hinder the operation of the system. It is therefore necessary to determine which contradictions appear in the system. More than one contradiction can be present in a system.

3. Formulate ideal solution

The team determines the ideal solution or ideal final result. This may not be realized, but the direction in which we should look for solutions is defined.

3 **Formulate ideal solution**

Ideality is defined by a formula:

$$I = \frac{\Sigma UF_i}{\Sigma HF_j + \Sigma C_k} \rightarrow \infty$$

Where:
UF_i....Useful function i
HF_j...Harmful function j
C_k...Cost k

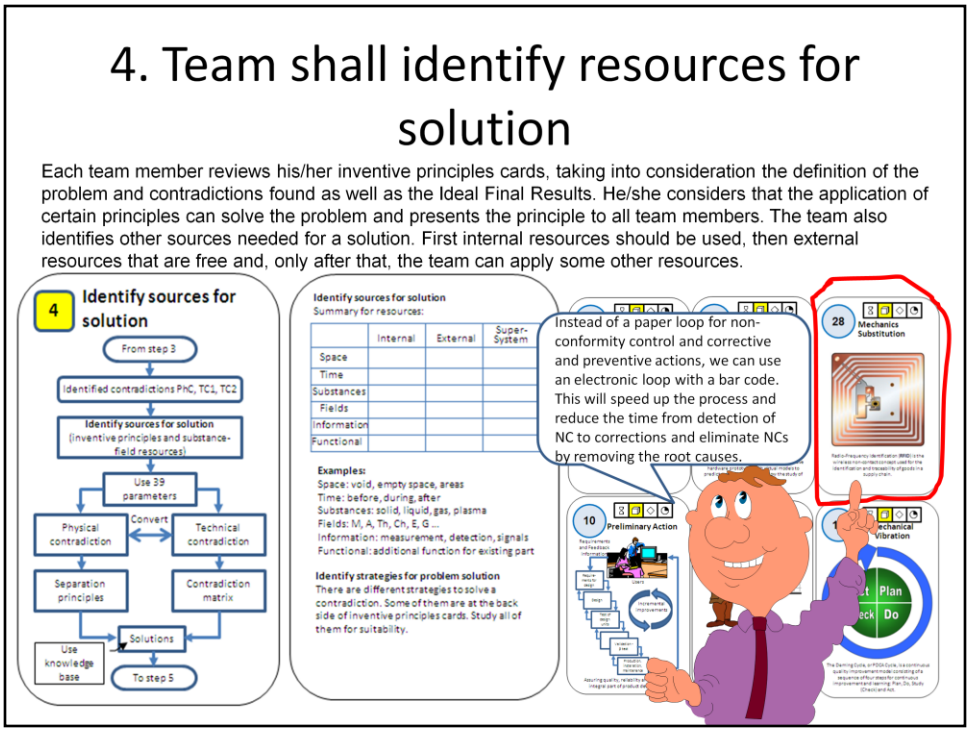
As the formula states, a system's ideality can be increased three ways:
1) increasing the useful functions in the numerator,
2) decreasing any harmful functions and/or costs in the denominator or
3) a combination of one and two.

The main goal is to prevent non-conformities from happening. If they happen, than corrective action should be applied so that costs are minimal.

The current costs of non-conformities (internal and external loss) are 2,750 $/month
The cost of appraisal is 3,800 $/month.
The ideal end result would be 0 $/month

It is now clear to everyone in the group in which direction they should look for a solution.

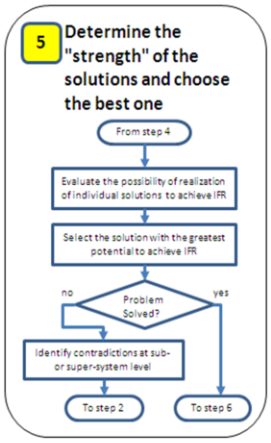
The team should agree on what result would represent the success of their work. Often the Ideal Final Result (IFR) cannot be achieved at the existing level of development, but it clearly gives guidance in solving problems.



Since the problem lies in the field of quality management, we use CQ cards. Team members will learn inventive principles and an algorithm for solving problems. Each inventive principle card will show concepts in quality management that can be applied for the implementation of certain inventive principles. Since this problem is a management problem and not a technical one, the contradiction matrix will not be used. Team members are going to scan all 40 inventive principles cards and select those that will most probably have a positive effect on the solution.

5. Select the best solution

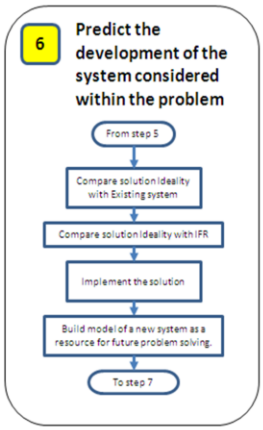
Usually it is possible to find a greater number of inventive principles that allow different solutions. The team estimates the ideality of each possible option and selects the one that gives the best results. If a solution cannot be found at the system level, the team can try to find a solution at the level of system elements, or at the level of the super-system.

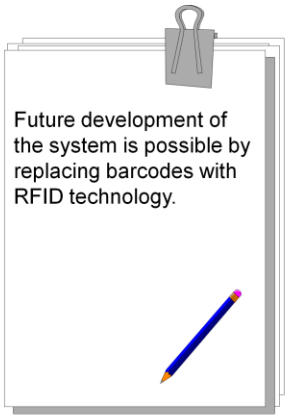


On the basis of available resources team forms of one or more alternative solutions. Each of the solutions are evaluated in order to choose the most appropriate for a given problem. If solutions are not found, it is necessary to return to the second step of the algorithm and to address the problem at the component level or at the level of the super-system.

6. Posibilities of further developmnet

The solution chosen will have an impact on the future applicability of the system. This provision should be made, and it is also necessary to provide for the possibility of future development.



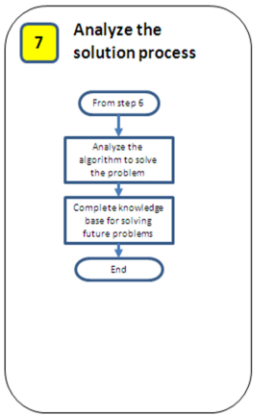


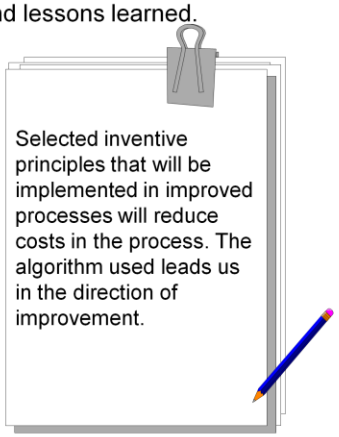
If we introduce a feedback loop to resolve contradictions using a paperless loop in real time, we will achieve a significant shortening of the time of human involvement. It is still possible to further develop the use of RFID, which will reduce the need for human intervention in data acquisition.

We used a simplified algorithm for solving inventive problems. After completion of the task, the team assesses whether the results obtained by using a simplified algorithm were acceptable. If our expectations have not been met, it is necessary to use a stronger algorithm.

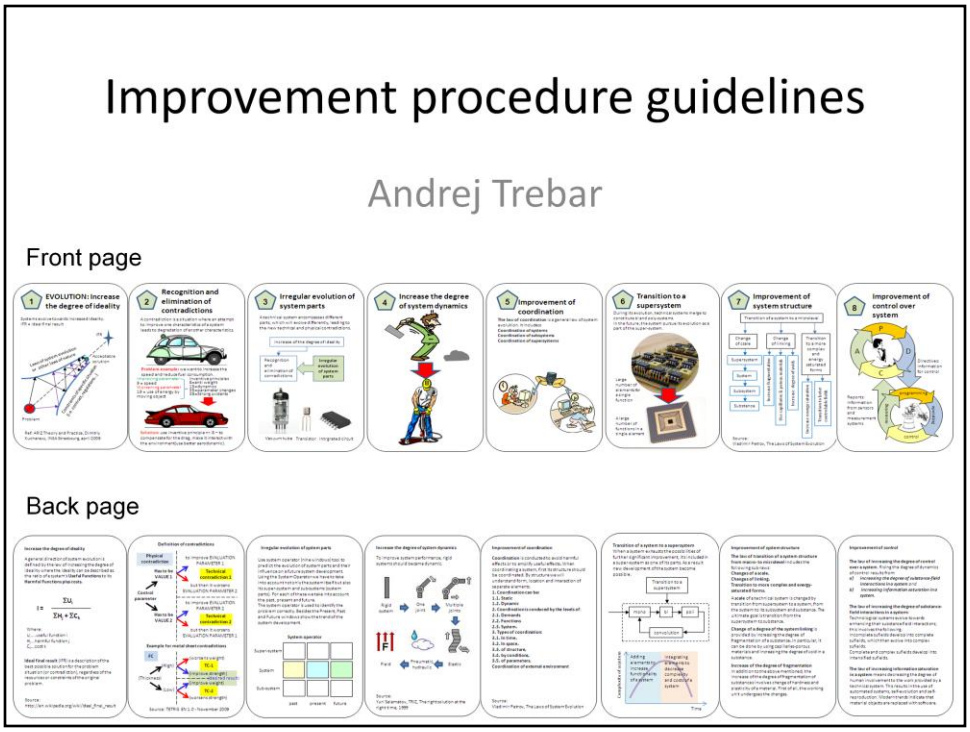
7. Analyze the solution process

Working with CX-TRIZ cards, the team has learned how to use a simplified algorithm for inventive problem-solving. They have also gained some practical knowledge on using certain TRIZ tools. Next they have to evaluate the usefulness of the method and lessons learned.

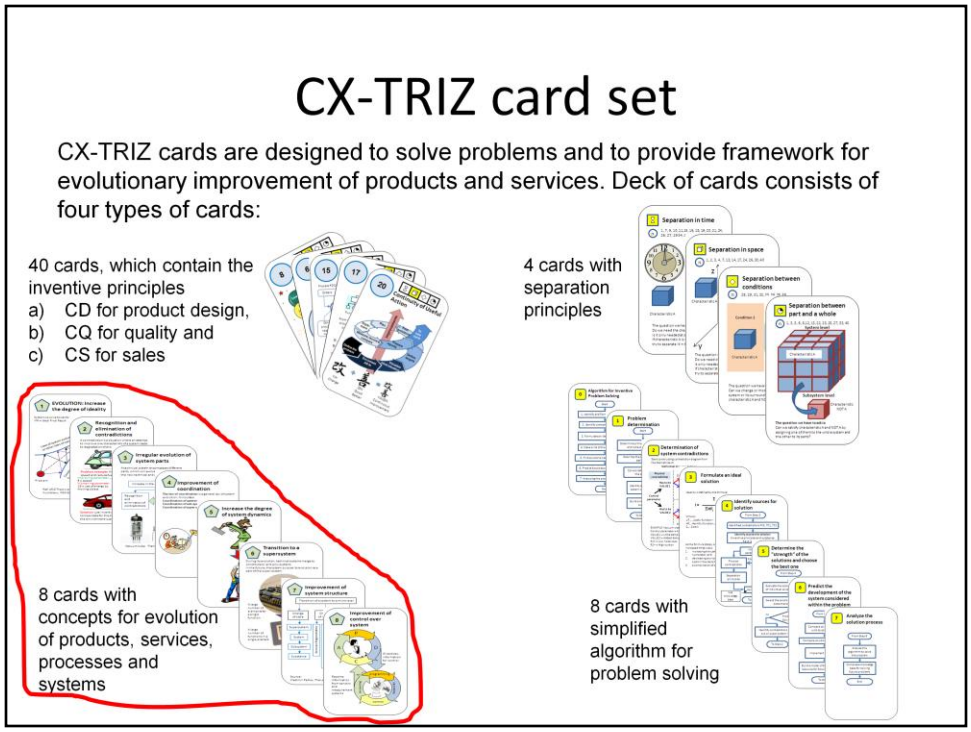




During the problem-solving task, the team came to certain findings in terms of both the methods and results obtained. The team analyzes the benefits and weaknesses and evaluates the lessons learned.

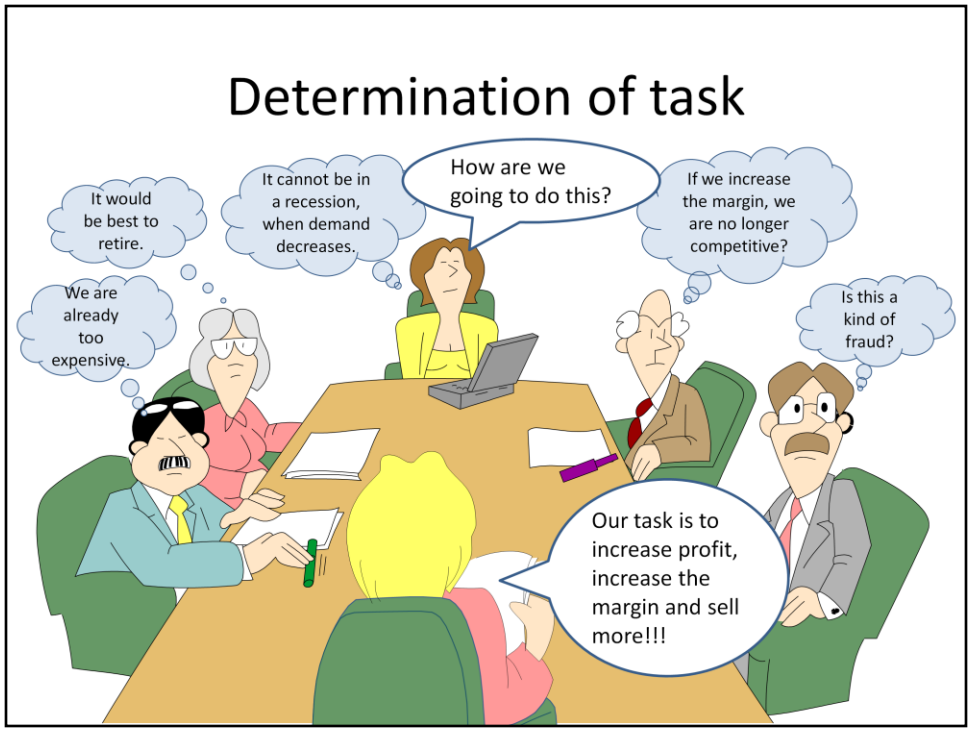


The procedure can be used for evolutionary improvement. This is an update of the existing products in accordance with the progress of the development of science and technology and to adapt to the customer's changing requirements. In fact, we try to improve the competitiveness of our products and/or services so as to achieve a perceptible advantage over the competition.

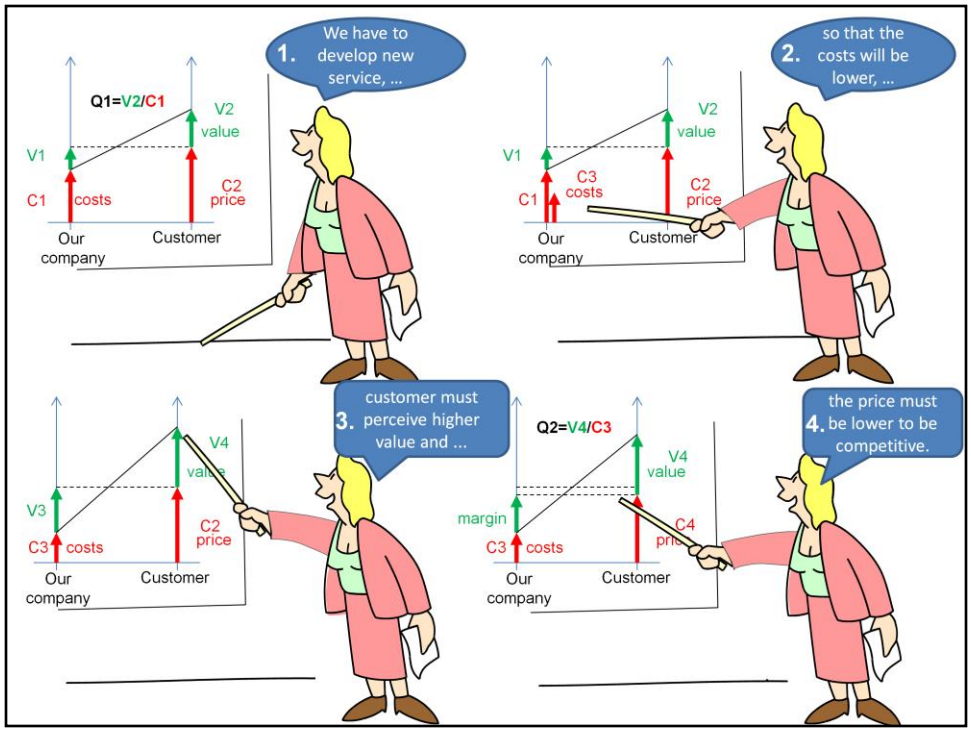


Cards with concepts for the evolution of products and services will be used for our next case. Each card represents a step in the procedure to find a possible improvement.

1) Increase the degree of ideality (for a given task, the team determines the ideal final result)
2) Recognition and elimination of contradictions (if contradictions exist in a system, the team attempts to eliminate them)
3) Irregular evolution of system parts (the team reviews the system in order to find any outdated or inappropriate parts of the system that should be replaced)
4) Increase the degree of system dynamics (the team investigates whether it is possible to increase system dynamics)
5) Improvement of coordination (the team investigates whether it is possible to improve system coordination)
6) Transition to a super-system (the team investigates whether there is the possibility of integration in order to transform some or several subsystems into a super-system)
7) Improvement of the system structure (the team investigates whether it is possible to simplify the system structure)
8) Improvement of control over the system (the team investigates whether it is possible to improve system control)



Often management has contradictory requirements that are difficult or sometimes impossible to fulfill with available resources. Those kinds of contradictions are administrative ones. An administrative contradiction reveals the problem, but does not provide solution. For that reason it is necessary to convert an administrative contradiction into physical or technical contradictions which can be resolved with TRIZ tools.



The task for all process owners:

Our main product line is to provide customers with the training of professional skills. Improve our procedure for training so that customers will perceive a higher value; the price of training seminars should be significantly lower, cost for providing seminars lower, and company profit higher.

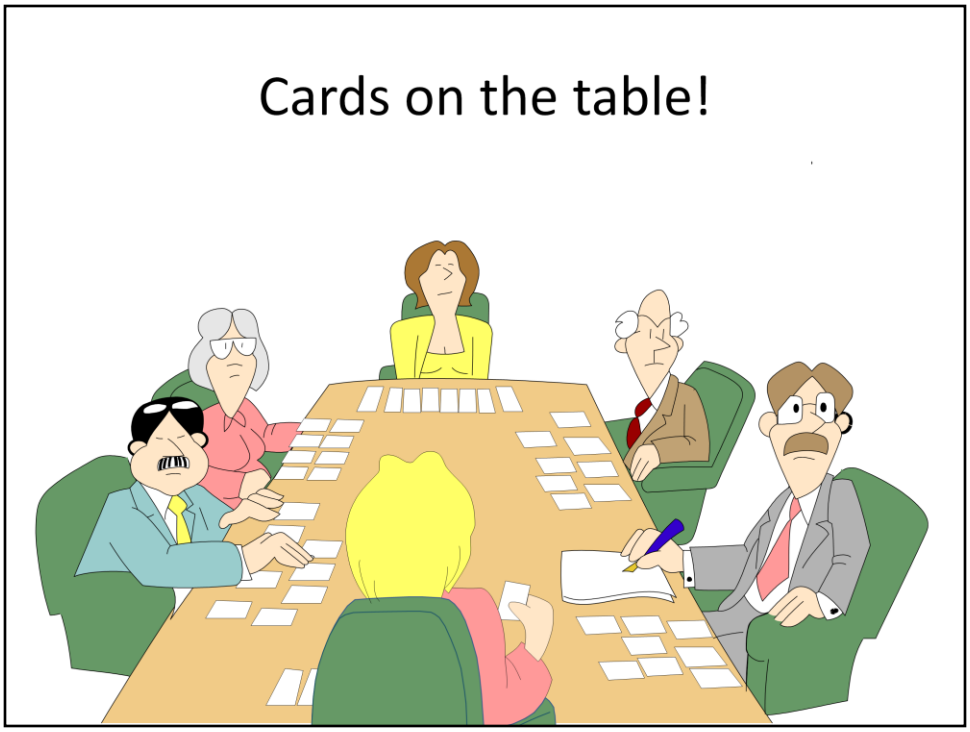
Thus the relations should be as follows: $Q_2 > Q_1$, $C_3 < C_1$, $V_3 > V_1$, $C_4 < C_2$ and $V_4 > V_2$

Explanation:

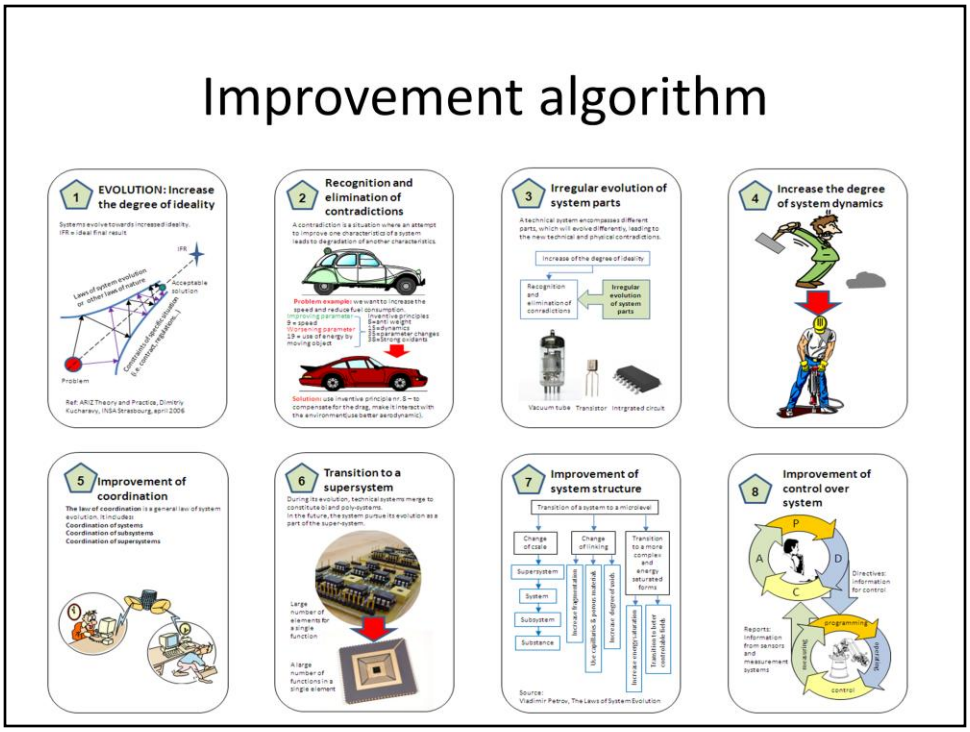
The task is comprised of various contradictory requirements which are represented by a diagram showing the relation between cost of service, margin, price and perceived value for the customer.

We would like to achieve an improvement to satisfy the requirements of both: our company owners and our customers. Moreover, our offer must be so appealing to the customer that we will attract new customers even in a recession.

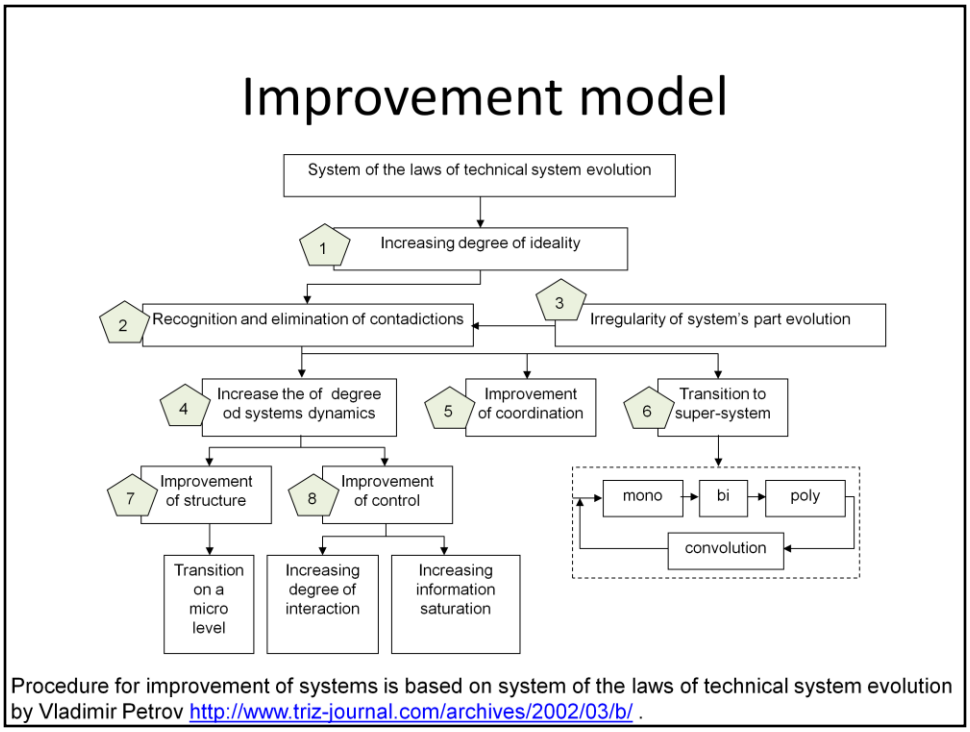
Now the task is better defined, but the solution is still unknown. Since we don't know how to solve the problem, we shall use TRIZ (Theory for Inventive Problem Solving). In this case we shall use CX-TRIZ cards.



The problem can be solved using an innovative approach. Team members are selected from processes that will most likely be involved in a final solution. Each team member knows the resources of his/her process and is for this reason the most competent for the task. CX-TRIZ cards are a tool to be used in order to find the best solution without introducing new resources in a system. CX-TRIZ cards are used because only the team leader is familiar with TRUZ while other team members have knowledge and experience in their own field of expertise.



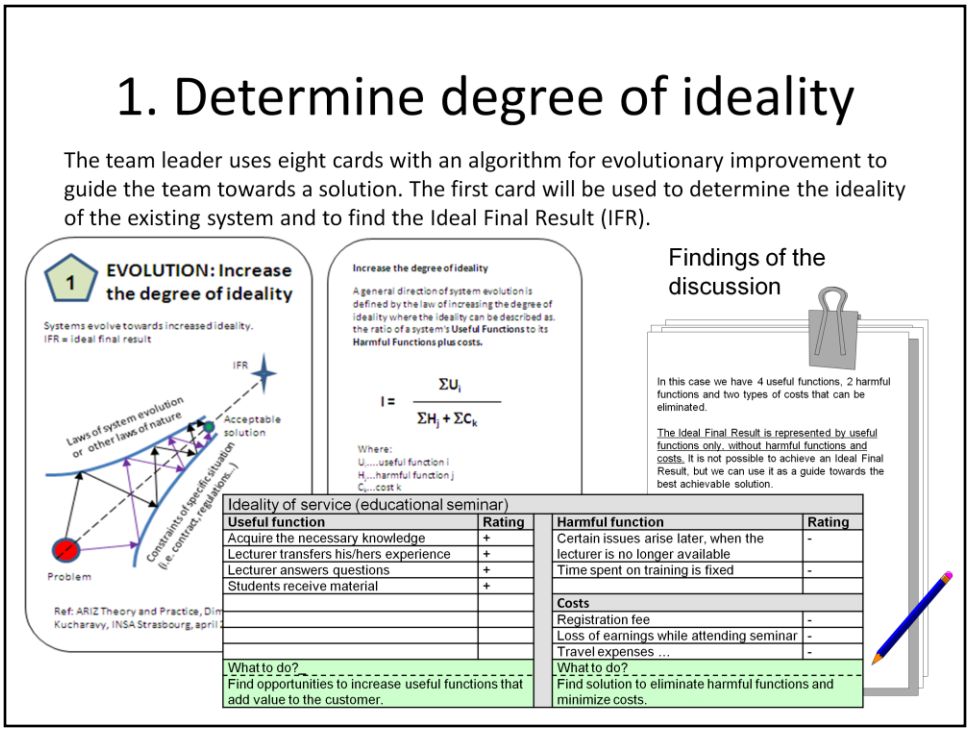
The algorithm improvement is shown with eight cards, designated by a pentagon in the upper left corner of each card. The team leader informs other team members with the procedure prescribed by each card. On the back of the cards is additional information to help the team find an appropriate solution.



Improvements in products and services are conducted on the basis of the laws of system evolution. The general direction of technology evolution is defined by the law of increasing the degree of ideality of technical systems. Vladimir Petrov in his article "The Laws of System Evolution" describes a system of the laws of technical system evolution that can be used for the evaluation of an existing system and by using a method suggested in the same article improved in the direction of an Ideal Final Result (IFR). The article describes the evolution of technical systems, but can just as well be used for management systems (i.e. quality management systems, environmental management systems, production systems, logistics systems, etc.).

References:

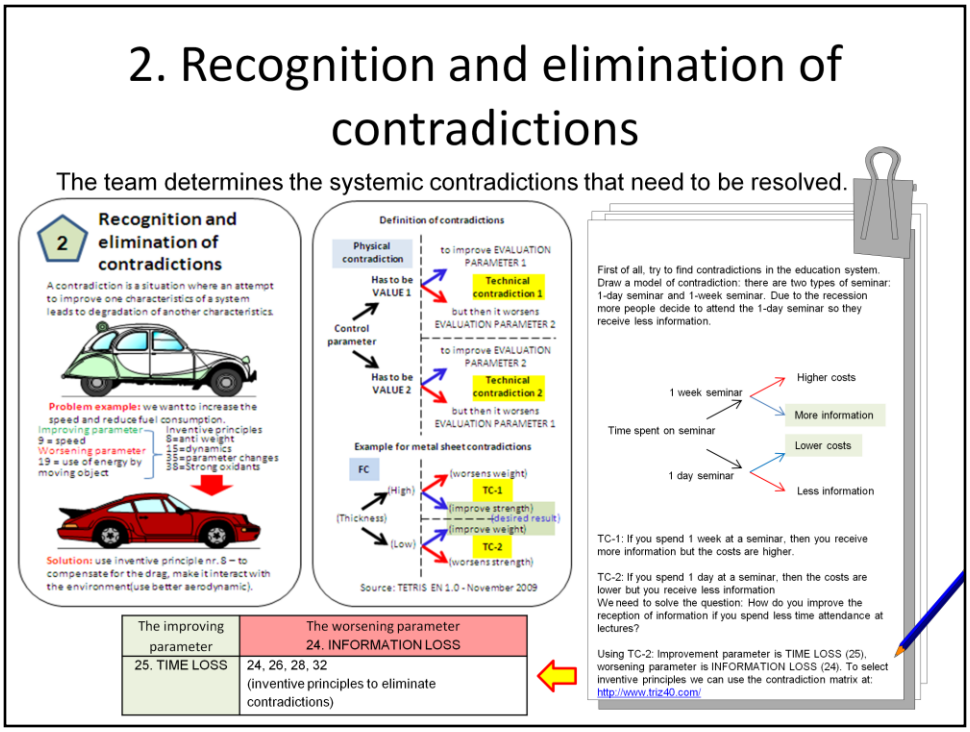
Vladimir Petrov, The Laws of System Evolution, http://www.triz-journal.com/archives/2002/03/b/



Guiding cards with an algorithm for evolutionary improvement will help the team to improve their product or service to be more competitive on the market by providing more and better useful functions and eliminating harmful functions and costs.

Systems are evolving in the direction of the Increased Ideality Index (I). The path to IFR is constrained by the laws of system evolution and other laws of nature and with contractual requirements (and limitations) and administrative regulations. The closer we can get to IFR, the better.

Algorithmic procedure for the application of the laws of evolution systems is summarized by The Laws of System Evolution, Vladimir Petrov, ISRAEL, http://www.triz-journal.com/archives/2002/03/b/index.htm#top. It can be used for improvements of processes, products and services.



The contradiction presents conflicting requirements that prevent or hinder system operation. It is therefore necessary to determine which contradictions appear in the system. At the same time there can be more contradictions present within a system.

References:

Contradiction matrix at http://www.triz40.com/

2a Inventive principle #24 Intermediary

The team reviews the options that are listed on Card No. 24 and concludes with a discussion on whether and how they can use this principle to shorten the training time and reduce costs.

Inventive principle #24 Intermediary

A. Use an intermediary carrier article or intermediary process.

1. Third party audit.
2. External laboratory testing.
3. Change agent at reengineering.
4. Customer contact person.
5. Facilitator for quality circles.
6. External calibration laboratory.

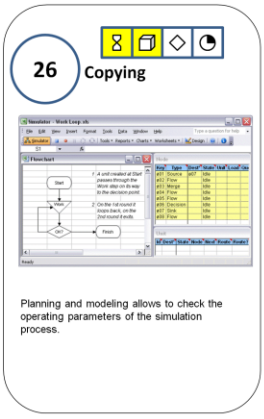
B. Merge one object temporarily with another (which can be easily removed).

1. Implement interim containment action (D3 at 8D).
2. Introduce external experts in MRB or CAPA team.
3. Hire consultant to implement QMS, EMS ....
4. Introduce moderator to a focus group.
5. For difficult customers complaints introduce lawyers into a process of resolving legal matters.

Possible solution: Item A5 on the back side of Card No. 24 – Intermediary states "facilitator“. In a training process the mentor can be assigned to a trainee. His/her role will be to ensure that the trainee receives additional explanations, examples, etc.

2b Inventive principle nr. 26 - Copying

The team reviews the options that are listed on Card No. 26 and concludes with a discussion on whether and how they can use this principle to shorten the training time and reduce costs.



Inventive principle nr. 26 - Copying

A. Instead of an unavailable, expensive, or fragile object or system, use simpler inexpensive copies.

1. Benchmark competitors.
2. Use EFQM excellence model.
3. Design and process modeling.
4. Instead of prototypes testing, use CAD models and use simulation tools.
5. For rapid prototyping use 3D printers.
6. Using reference at experiments.

B. Replace an object or system with optical copies.

1. Instead of paper documents use electronic documents.
2. Use numerical simulation.
3. Use videoconferencing instead of physical travel.

C. If optical copies are used, change to IR or UV. (Use an appropriate, out-of-the-ordinary illumination and viewing situation).

1. Evaluate customer satisfaction using multiple techniques.
2. Respond to perceived customer needs.
3. Use simulations, games, case-studies instead of lecture-style training.

Possible solutions: Item B3 refers to the use of video conferencing. Education can take place through the use of video conferencing, which allows real communication between the instructor and the students. Thus travel expenses for both the lecturer as for students are eliminated. C3 is also a useful point which refers to the use of simulations, games and case studies, rather than lecturing.

2c inventive principle nr. 28 – Mechanics substitution

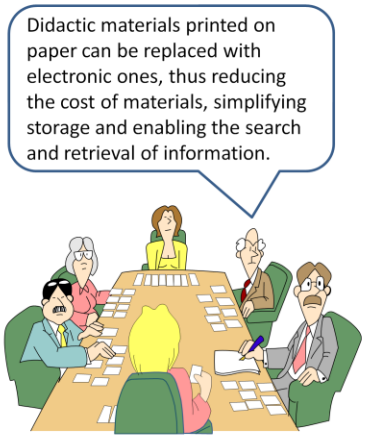
The team reviews the options that are listed on Card No. 28 and concludes with a discussion on whether and how they can use this principle to shorten the training time and reduce costs.

Inventive principle nr. 28 – Mechanics substitution

A. Replace a mechanical means with a sensory (optical, acoustic, taste or smell) means...).
1. When communicating with customers and suppliers take into consideration informal organizational structure (who are persons with power of making decisions).

B. Use electric, magnetic and electromagnetic fields to interact with the object or system.
1. Electronic communication
2. Computer data processing
3. Electronic data transmitting
4. Replace bar code with RFID systems
5. Use electronic voting

C. Change from static to movable fields, from unstructured fields to those having structure.
1. Instead of paper based information loop use electronic records in connection with information system.
2. Instead of manually gathering and writing data to control charts use automatic measuring systems and software solutions for entering data to control charts.
3. Use computer vision instead of human inspection.
4. Use FFA (Force field analysis).



Possible solutions: Lines B1, B2, B3 and B5 provide solutions which can replace paper with electronic didactic materials. Reduce the cost of manufacturing materials; simplify the storage and retrieval of information.

2c inventive principle nr. 32 – color changes

The team reviews the options that are listed on Card No. 32 and concludes with a discussion on whether and how they can use this principle to shorten the training time and reduce costs.

Inventive principle nr. 32 Color changes

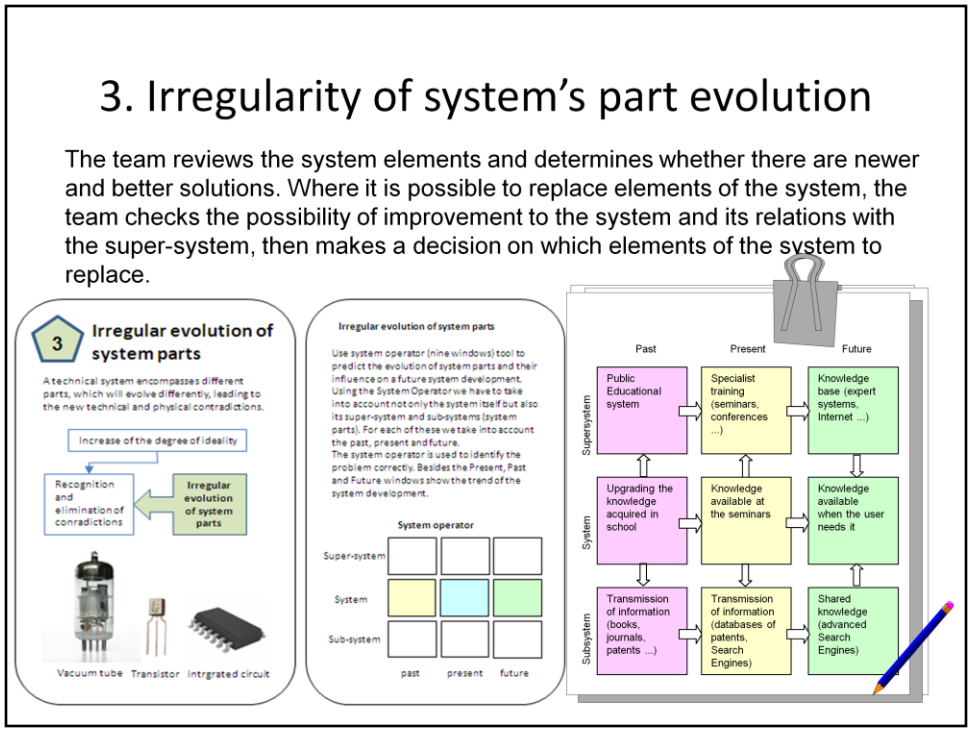
A. Change the color of an object or its external environment.

1. 'Corporate colors' - create a strong brand image through use of colors.
2. Foster employee diversity.
3. Use various colors in a sense of Poka-Yoke solutions, to prevent unintended use.
4. Use colors for status identification(green = good, yellow = unknown status, red = not for use)
5. Use sensors for process monitoring and color signals for status report.

B. Change the transparency of an object or its external environment.

1. Clear, concise vision and mission statement.
2. Use smoke-screen to hide information from competition.

Possible solutions: Line A2 gives the suggestion that more teachers are involved with a variety of skills and experience. This makes training more interesting for students and allows the presentation of a variety of views on the same issue.



Any improvement must evolve in the direction of the ideal final solution. The system must maintain or even upgrade its functions while it should decrease the price, increase the speed of operation, etc.

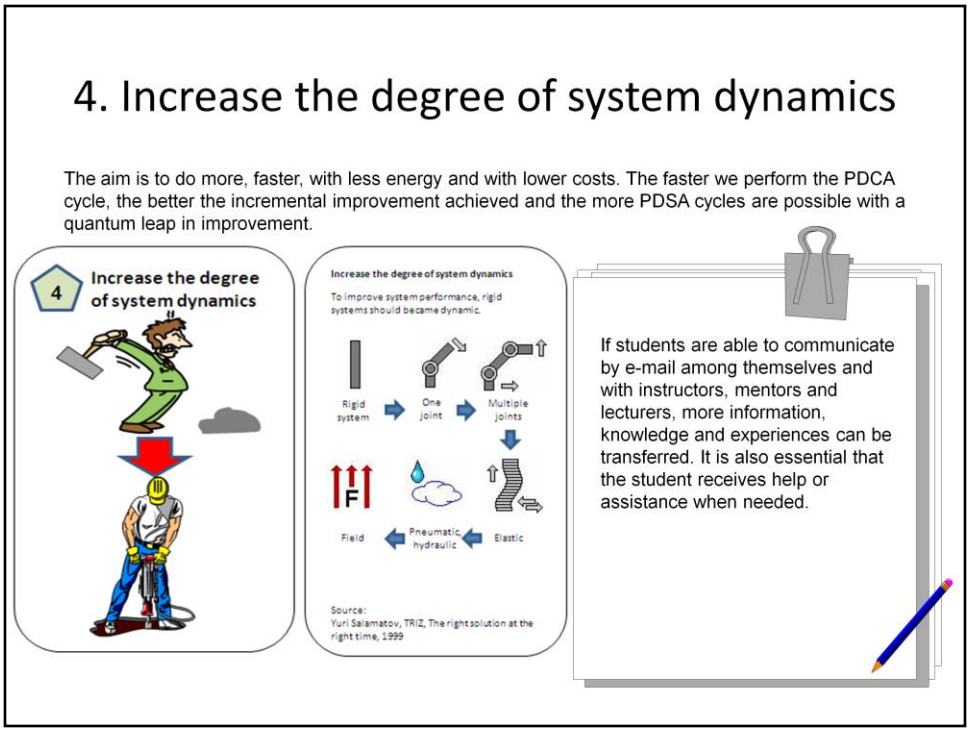
System Operator Concept

Darrell Mann defines System operator tool as follows:

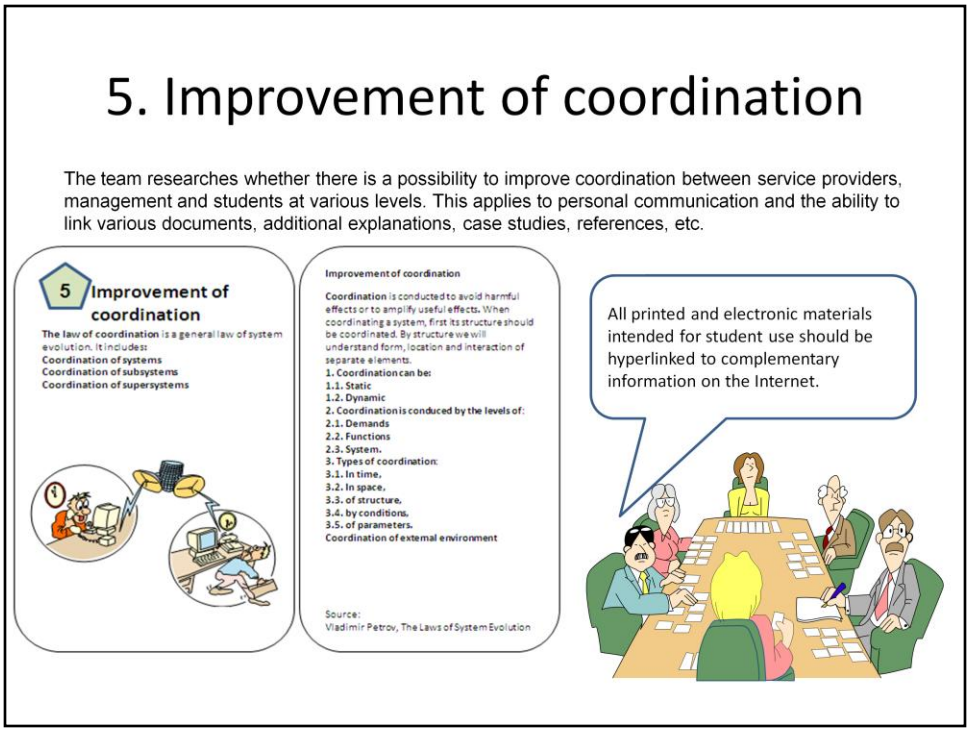
The System Operator 'tool' is a simple means of helping users to think in terms of TIME and SPACE. The basic principle of operation divides 'the world' into nine segments. The central box of the nine - system, present - is the one our brains naturally migrate to whenever we are given a problem situation. In other words, asked to think about 'designing a better pen', our brains are likely to immediately conjure up the image of a pen ('the system') being used to write ('the present'). What the system operator tool is trying to get us to do is also think about the pen in the bigger ('super-system') context - the person holding the pen, the paper, the desk, etc; the smaller ('sub-system') context - the components of the pen, the ink molecules, etc; the pen in the past - manufacture, shipping, un-packing, preparing to write, etc; and the pen in the future - what happens to the pen immediately after we've finished writing, right through to it's disposal after it has run out. The System operator tool is to help us overcome the psychological inertia of present and system level only thinking.

Reference

Darrell Mann, System Operator Tutorial , http://www.triz-journal.com/archives/2001/09/c/index.htm



An increased level of dynamics during and after the seminar will enable participants to move from solving simple problems to more complex ones, if help from instructors and mentors is provided. The same effect happens when participants can communicate among themselves to transfer experiences gained during a seminar or while solving their own problems.



5.1 Improving coordination between content materials

Example: Sample hyperlinks within the text in teaching materials and links to references on the web.

5.2 Improvement in coordination between the instructor and students

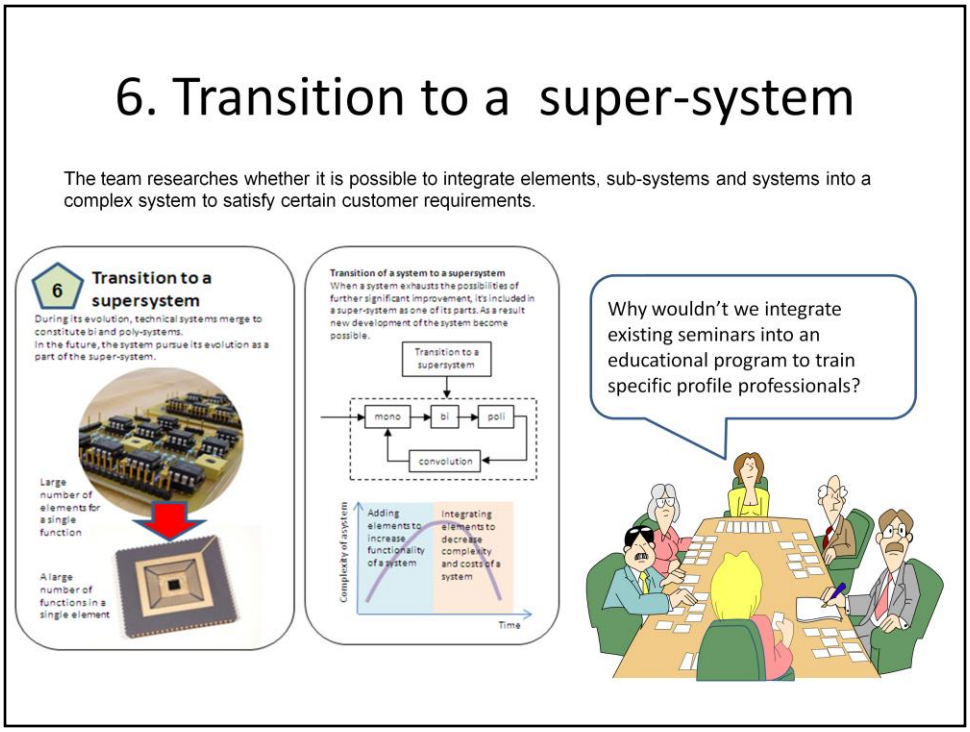
In the proposed solution for training a situation occurs where trainees enter the education process at different times. In classical training, coordination between the instructor and a group of students happens while conducting a seminar (at the same time). Therefore, in the proposed solution, the coordination takes place between the instructor and each participant individually. Participants receive material that consists of a lecture in the form of text, images, spoken word, videos and supplementary materials such as methods, practical examples, sample solutions and the like. This material is used by students for independent study. If necessary, they may contact the instructor in the following ways:

a) Via e-mail they can forward any questions or requests for additional material.

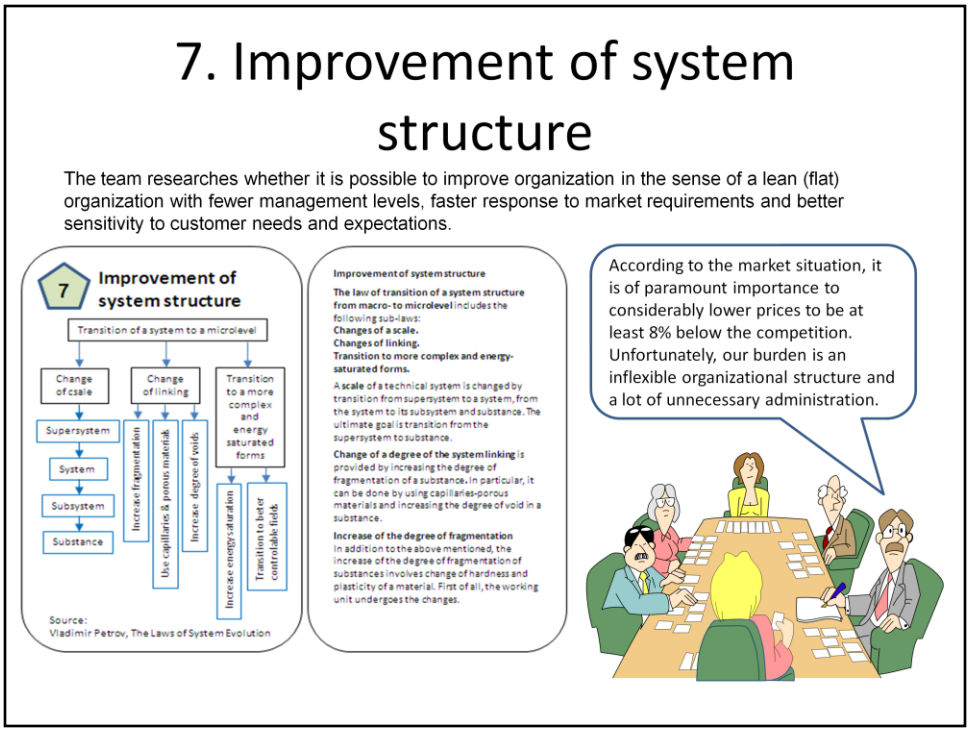
b) Meet with the instructor when they need additional information, which cannot be transmitted via e-mail.

c) Agree with the instructor for advice, which comprises working together on tasks that are thematically consistent with the training material for gaining experience.

With the assistance of the lecturer establish contact with other participants for the direct exchange of experience, which requires the instructor to monitor the status of the development of competencies for each participant entering the training process.

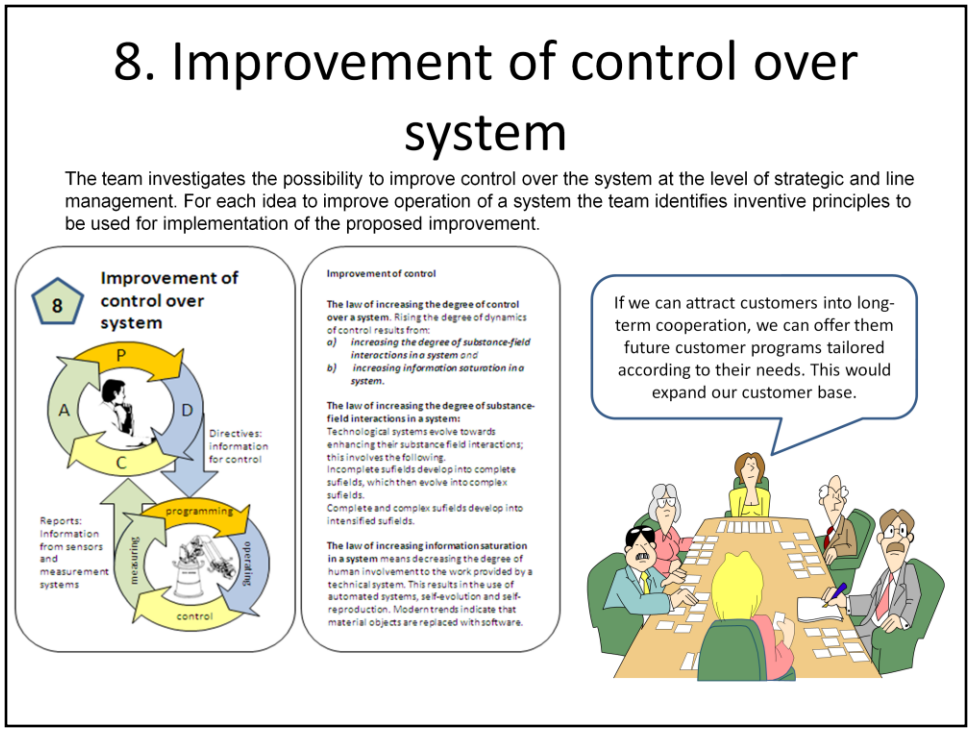


The transition to a super-system would represent the gradual upgrading and integration of seminars that are necessary to gain particular knowledge and all supporting materials (methods and practical examples) that allow the trainee to independently apply the acquired knowledge to solve real problems.



The training process involves a certain organization which comprises the following activities:

a) identifying the need for specific training,
b) determining the content that participants will receive,
c) determining the persons who will do the training, mentoring, etc.
d) determining training materials, materials for exercises and other data sources which are necessary to transfer knowledge, gain practical experience and ensure the retention of knowledge,
e) methods for monitoring the effectiveness and efficiency of the transfer of knowledge and necessary tools,
f) process of program validation,
g) assuring resources for implementation,
h) informing the participants,
i) implementation of training,
j) control over the execution of training,
k) miscellaneous.



8.1 Increasing the level of interaction between the instructor and trainees

The implementation of educational services must ensure the transfer of knowledge, so the communication link must be established between lecturer and students during training, as well as later on when trainees are faced with problems in a real environment.

Probably the communication between lecturer and students via e-mail is sufficient, but there are also other forms such as the engagement of lecturers in the organization of the participant in the form of advisory services, other trainings or similar.

8.2 Increasing information saturation

The provider of educational services can supply trainees with materials that may be necessary for their further work. It is helpful to provide trainees with the greatest possible number of practical examples that they can use directly in their work. Such an approach used by manufacturers of electronic components, in addition to component specifications, is to publish a set of application solutions which can be used by engineers in the realization of certain functions.

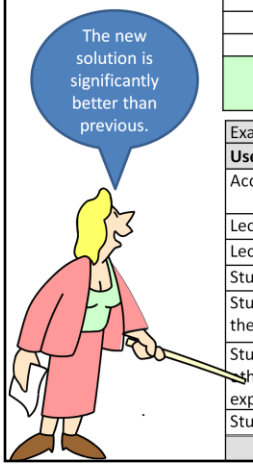
Assessment of ideality for a new solution

The proposed solution is as follows:
The training system, which is based on a combination of remote training set of documents, methods and sample documents on the web, links to speakers and linkages between participants, and advising at the location of the participant.
The extent and quality of materials received by students is higher than in traditional training, the cost of the registration fee for students is approximately 50% lower, and there are no travel expenses and loss of earnings due to absence from the workplace.

Example training using multimedia (webinar, webcast, videoconferencing)			
Useful functions	**Rating**	**Harmful functions**	**Rating**
Students acquire the necessary knowledge	+	Certain issues arise later, when the training is no longer available	-
Lecturer transfers his experience	+		
Lecturer answers questions	+		
Students receive material	+		
Students can communicate with the instructor via e-mail	+	**Costs**	
		Registration fee	-
Students communicate with each other to exchange practical experiences	+		
Students choose the time	+		
Sum	**7 × +**	Sum	**2 × -**

The TRIZ method is intended to find new concepts for solutions, so it is not advisable to do a numerical rating of useful and harmful functions and costs at this stage.

Evaluating the level of ideality

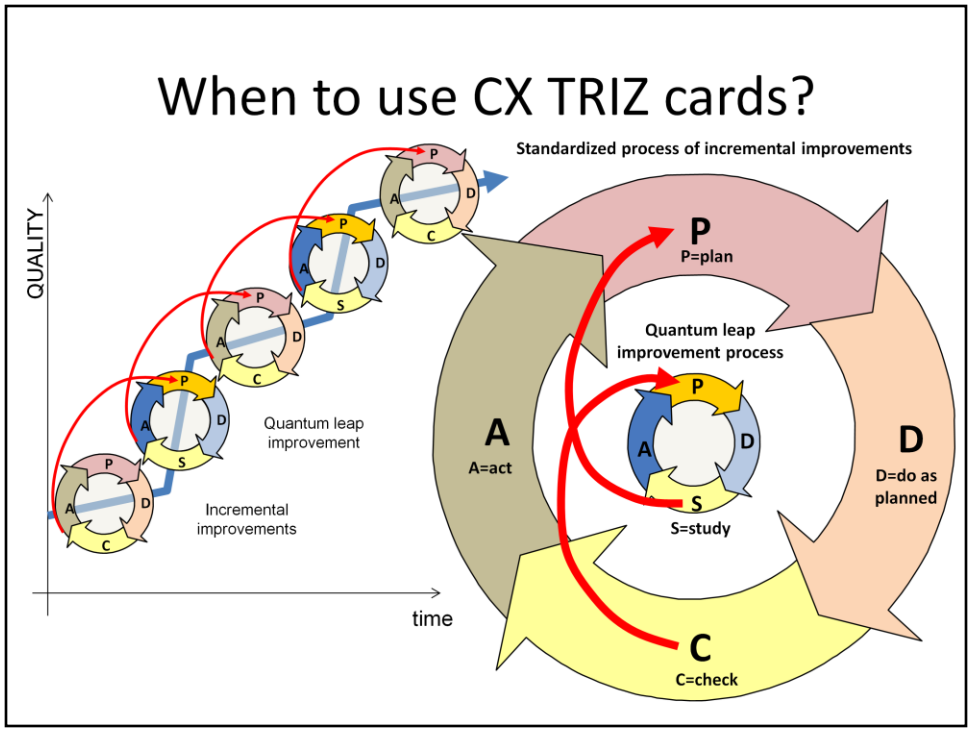


An example of a classic seminar			
Useful functions	**Rating**	**Harmfil function**	**Rating**
Acquire the necessary knowledge	+	Certain issues arise later, when the lecturer is no longer available	-
Lecturer transfers his experience	+	Time spent on training is fixed	-
Lecturer answers questions	+		
Students receive material	+	**Costs**	
		Registration fee	-
		loss of earnings	-
		Travel, subsistence ...	-
	4 × +		5 × -

Example training using multimedia (webinar, webcast, videoconferencing)			
Useful functions	**Rating**	**Harmful functions**	**Rating**
Acquire the necessary knowledge	+	Certain issues arise later, when the training is no longer available	-
Lecturer transfers his experience	+		
Lecturer answers questions	+		
Students receive material	+		
Students can communicate with the instructor via e-mail	+	**Costs**	
		Registration fee	-
Students communicate with each other to exchange practical experiences	+		
Students choose the time	+		
Sum	7 × +	Sum	2 × -

Assessment of the solutions shows that the number of useful functions increased from 4 to 7, whereas the number of harmful functions was reduced from 2 to 1. They have also reduced the cost of 3 to 1.

With the above example, we have shown that the method, which is designed to improve the technical systems, can be used to improve services. Services today are complex and require a combination of technical means (i.e. software, hardware and communications equipment) and the activities carried out by people.



IIncremental improvement is an improvement within the existing paradigm. These are minor improvements that do not require large-scale technological change of the processes. This results in slight cost reductions of the process, product or service, time optimization, improved capacity utilization and the like.

Quantum leap improvement represents a shift to a new paradigm. Revision of the concept of a product or technology is required. This produces a completely new solution (i.e. replacement of electronic tubes with transistors or replacement of transistors with integrated circuits ... or replacement of CD with MP3 and the like). Indeed, it is the evolution of the product in the direction of the Ideal Final Result (IFR).

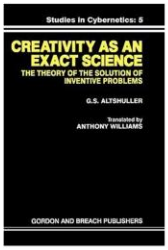
Additional information is available from:

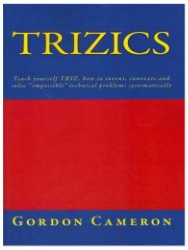
CREATIV

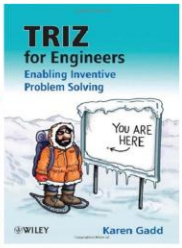
PLUS d.o.o., Ljubljana

Instructions for use CX TRIZ cards as a tool for teamwork, for innovative problem solving, for development and improvement of the quality management systems.
http://www.creativ-plus.si/triz/

References:







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