TRIZ Takes the Biscuit (and makes the Biscuit)
Solving the RIGHT Problems with TRIZ - from Food to Aero-engines

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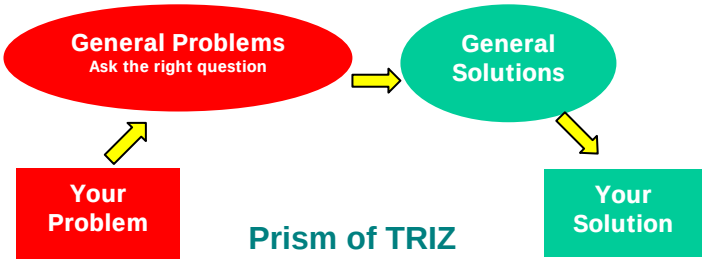
TRIZ was created by engineers for engineers, to help them problem-solve. One cry from those learning TRIZ is - please tell us about successfully solved problems, for processes as well as products. A TRIZ-solved problem frequently produces such an obvious answer that even when the TRIZ part was preceded by months of work and fruitless brainstorming sessions, there is still a tendency to shrug off the good TRIZ solutions as too self-evident to make a big fuss about. Sometimes we are asked to complicate the answer up a bit to justify all the pre-TRIZ weak options which were produced. Sometimes the answers are so obvious they seem more like common sense than TRIZ.

Everyone understands the importance of solving the right problem – although sometimes teams get lost in the details of a problem and can't see the wood for the trees – this is something TRIZ helps us put right. TRIZ tools help us understand the context of problems and what we want. The simplest and most powerful TRIZ Tool -Thinking in Time and Space- (often called the "System Operator" or "9 Windows") helps us understand the many big issues related to a problem and particularly helps us see when prevention is better than cure - so we can deal with the problem not symptoms and again use our common sense. I hope it's not sexist to say that female engineers are particularly good at this. Although it is too rare I really enjoy working with fellow (is this the right word?) women engineers on TRIZ. When I learned TRIZ from Ellen Domb in California in 1997 I remember one wonderful girl in the class (who I'll call Jenny, not her real name) who had several industrial baking problems to solve for a very large company. It struck me then how much TRIZ was needed to get the much underrated female wisdom and knowledge from our mothers and grandmothers for process industries involved in food, cleaning products, laundry, organisational skills etc.

Jenny told us a story about sharing problems, knowledge and solutions in her company. One problem in making biscuits was that the edges of large batches were burnt. The engineers involved in the process were at the final stages of approval for an edge trimming machine (to remove the burnt bits very neatly). They then used the fundamental route to TRIZ problem solving - the Prism of TRIZ. A simple route for problem solving to encourage us to look beyond our first solutions, as someone else has probably solved the problems before and found the best solutions, we need to access these. The Prism of TRIZ helps us look outside our area of expertise and our own ideas (we might want to stick to our imperfect solutions because they are ours) as the best solutions probably already exist, and are documented, but in other disciplines and industries, outside our experience.



The engineers never got their large, expensive, complex trimming machine because one of the female chemists from another department happened to hear about the problem and said all we need to do is change the flour, to one which won't burn at this temperature, even at the edges – most good bakers (home and industrial) could have solved this with their knowledge. The engineers had a solution but it was far from ideal. Any amount of problem-solving time and brainstorming from the engineers for solutions would probably not have produced this good cost effective solution; as they were only using their own knowledge, and engineering approaches for solutions.

Another problem we helped solve involved emptying of cake moulds without damaging the cake or leaving any behind. Two days of TRIZ function analysis showed the problem to be an insufficient action when removing the cake, which was solved using the TRIZ Standard Solutions which suggested adding a field – they chose vibration. I wonder if any of them noticed their mothers gently tapping the cake tins at home to get their cakes out intact.

At a TRIZ meeting in Manchester a glass manufacturer talked about the problem of identifying one or two damaged rollers, in a large array, which scratch the glass they are supporting. A company which made photographic paper said they had solved this problem using TRIZ – their rollers support photographic paper and TRIZ function analysis had led them to look at the TRIZ Standard Solutions which list all the possible available fields. They needed to identify the best field to help them detect the occasional damaged roller, and their successful low-cost, effective solution was to use ultrasound detectors, a solution which the glass manufacturer then investigated and adopted.

At one of our public TRIZ classes, a female engineer who was working on a small domestic product with a small engine had the problem of reducing its noise. She was the only one from her company but the class included aerospace engineers. When she drew up her problem the aerospace (male) engineers laughed and said the answer is easy, just look at the airflows – they had the relevant expertise – she did not. She was delighted with their solutions they worked on for her, and quite rightly was not embarrassed that they knew the answer, which was obvious in their industry, but not hers. The Prism of TRIZ encourages us to look outside our own industry and expertise because someone else probably has the answer.

We have used TRIZ in many companies for process problems (including some major food companies) and once everyone understands what is wanted, and where and when the system does not deliver this, then the solutions are often a simple mix of

The right, relevant knowledge
AND
TRIZ solution triggers**
AND
Common sense

****The TRIZ Solution Triggers** TRIZ is the only problem-solving process and tool-kit which actually helps us problem solve. In the Prism of TRIZ above the 

can be

represented by the TRIZ simple lists of distilled knowledge. These are the very general lists of all the solutions to engineering and scientific problems as recorded in the world's patent data base.

There are four separate lists of TRIZ TRIGGERS for solutions available for helping to solve any problem.

1) *40 Inventive Principles for solving contradictions*
2) *8 Trends of Evolution for system or process development (each with many lines of evolution)*
3) *76 Standard Solutions (how to deal with insufficiency, harm or excess in systems or processes)*
4) *2,500 TRIZ effects (concepts and scientific theories arranged in useful categories for problem solving)*

{Editor's note: The TRIZ Journal has had many articles on all these subjects, so rather than an extensive bibliography, we refer readers to the "Archive" page and our search engine."}
These are easy to understand and use provided we really understand what problem we are trying to solve (many problems can be defined as the gaps between what we want and what our system delivers)

Hindsight in Problem Solving

When a solution is simple and obvious, the telling of the problem story can make the problems look trivial in retrospect; however, before it is solved no problem appears easy – and the fun of problem solving, especially inventive problem solving (when we don't know how to get to the best answer), is the challenge of uncovering really good solutions.

We enjoy using our brains, our knowledge, and experience to come up with good answers. If we can come up with answers before anyone else, it's even more fun. There are lots of good solutions in the world and it is not relevant whether these were originally arrived at through TRIZ because one of the purposes of TRIZ is to capture the routes to all good solutions, and the solutions themselves in their most general form for our future and repeated use. These are the TRIZ Triggers to help us access (remember) the relevant knowledge from our brains when we need it, and have the courage to go beyond what we know, to seek new knowledge and locate good solutions.

Altshuller said solving problems was like solving a murder mystery – and he said the Sherlock Holmes approach was a very good one, with methodical, systematic searches to help isolate, recognise, and concentrate on the relevant facts. In an analysis of the UK's favourite jokes the top one concerned this talent of Holmes.

"One night Holmes and Watson were camping – and they both woke up in the middle of the night. Holmes asked Watson what he could see and what that made him think of … Watson looked at the stars and said they made him think of eternity. Holmes said when he looked at the stars he realised their tent had been stolen"

Problems are solved once we can locate the relevant information, then the right TRIZ Triggers and processes take us to the right places to solve the problem. Our brains then can be creative about the right areas and find innovative solutions. For engineers particularly, TRIZ makes all the answers accessible – and helps any good engineer come up with the good answers fairly quickly – of which some will be new. All it requires is that they know their TRIZ and are well practised at it. Eventually with lots of problem solving, running through the TRIZ processes becomes almost

second nature and the answers sometimes seem to come spontaneously from nowhere. (This varies with everyone –Altshuller once said that TRIZ made the very creative people 3 times more creative but the non-creative people were made 10 times more creative.)

TRIZ problem solving is like detective work, we need to isolate and recognise the relevant information and use great clarity of thought to find the right solutions from our TRIZ Triggers.

Sugar Sprinkle (only on the biscuit - a sticky problem)

Another biscuit problem was that after baking, and cutting, the round biscuits were sprinkled with sugar from above, when the sugar missed the biscuit there was a mess and cleaning the excess sugar from the conveyor belt and its surroundings was a sticky problem for the engineers. By this time the engineers had been TRIZ trained and they knew that they needed to use the right knowledge, the TRIZ solution triggers and common sense – and being engineers they wanted their solution from their brains quickly.

Now one of the engineers had listened to one piece of advice we give everyone on training – if you want to find a quick, obvious solution its always worth trying one of the most used TRIZ Triggers, the TRIZ Principle 13 - the Other Way Round (I generally receive lots of rude suggestions from delegates in response to this) but I still suggest that everyone should know and try this principle on any problem in their life.

TRIZ Inventive Principle 13. The other way round

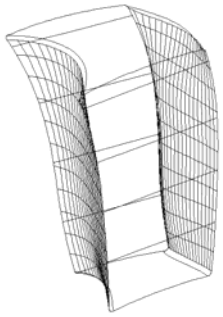
A. Invert the **action** – **cool** it instead of **heat** it
Freeze dry instead of heat dry,

B. Invert the **parts** - Make movable parts (or the external environment) fixed, and fixed parts movable
Rowing or jogging machines, small swimming pool with moving water, Rolling road test

C. Turn the **object** (or **process**) the other way round or upside down
Tomato sauce bottle, Internet shopping, Garage pit

One look at this Principle together with his problem and the engineer did the engineer's equivalent of shouting EUREKA - he said quite quietly "how about turning THE BISCUITS THE OTHER WAY ROUND. We could have a bed of sugar on the conveyor belt and the biscuits could be face down to collect the sugar sprinkling– less mess, better sugar adhesion to the biscuit and a simple answer"

I wish I could have a pound for everytime Principle 13 solves a problem. It is used far beyond process and food problems even for new engine problems at Rolls-Royce. The next example is not food but a software problem. After teaching hundreds of engineers in Rolls-Royce in Bristol and Derby –they started to take my advice that Principle 13 THE OTHER WAY ROUND is a good starting point for any problem.



Solid of the air in the passage with filleted edges

The Use of TRIZ in Rolls-Royce for Solving Throat Area Problem

An automated method for calculating turbine throat areas was developed but it would not work reliably due to the complex geometry.

Despite much effort the problem was still not fixed after 6-8 months of development. After fruitless work it was decided that a new approach required and TRIZ was used.

One afternoon the TRIZ 40 Principles were used as a stimulus for brainstorming with a group of engineers. The TRIZ Principle 13 "The Other Way Round" yielded idea of modelling air in passage rather than the metal itself. The problem was solved – the answer was very obvious in retrospect, very simple and very cost effective.
(Dave Knott – Rolls-Royce Derby)

The Other Way Round for Coffee – Zones of the Problem

When problems are described to a fresh set of eyes and ears obvious solutions can sometimes be uncovered. Often however the problem situation is so complex when described, that it needs time, effort and the TRIZ process to understand all the problems and what is required and then we need to move it from a problem situation to a simple TRIZ problem list. Once we have a problem list we can prioritise the problems and solve them one at a time, having first understood exactly what causes the problem and where and when the problem occurs (TRIZ Problem Map) and where and when it can be solved (TRIZ Solution Map).

The problem situation was that a new squishy squeezable coffee box had been designed to have all the advantages of a rigid package and a soft package. The functionality of a traditional tea tin was needed, in that it was rigid, re-useable, and easy to open and close and scoop out coffee with a large spoon. It also had to have the advantages of a soft coffee pack in that when in the supermarket - you could squeeze it to get the coffee aroma from a small one-way valve which was there to allow the coffee to de-gas. The package was simple cardboard and attractive. The problem was that the boxes were difficult to assemble - if the package was made more rigid to ease the assembly problem then it lost its squishiness / squeeziness.

We were called in to help solve this problem, to have the advantages of both a rigid packet and a soft packet. (A classic TRIZ contradiction problem which needs the TRIZ contradiction solving tools – we used the contradiction matrix and the 40 Principles to find solutions)
The essential problems were the where and when. It only needed to be squishy in the supermarket, and it only needed to be rigid in the home. Also it needed to be rigid in the lid area (the lid had to held on very firmly so that it could be opened and closed repeatedly but not lose its seal as air needed to be minimised) and it needed to be squishy where it was squeezed on the packet sides (but only in the supermarket)

Before the coffee was inside the packet the sides were too flexible to attach the lid to it, after the coffee was inside the packet it was rigid enough to attach the lid, but we needed to attach the lid

before putting in the coffee because of the glues and contamination. All the proposed solutions detrimentally affected the reliability of the re-useable lid. It was complicated but we needed get the lid on, without stressing the box, fill with coffee from the top and then seal the complex lid with the coffee in the pack and then activate the seal.

The solution came from Principle 13 the Other Way Round which was one of several Principles suggested by the problem solving session. The problems stemmed from fitting a rigid top to a flexible box, before loading the coffee from the top, and from having the valve in place and active while filling. Give good engineers the right TRIZ Triggers for their problems which they understand and the results are often very quick and powerful.

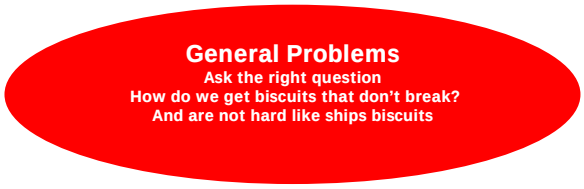
One designer looked at Principle 13 and said lets make the boxes with the lid assembled and sealed, and hold the sides in place during this operation, then load from the bottom (the bottom of the pack was a separate part), then attach a stiff bottom with an integral valve. The Problem was solved.

Biscuits Breaking Problem – zones of the problem – where and when to solve it

Another biscuit problem was that supermarkets were complaining about the percentage of broken biscuits in a packet (after normal handling) when they had finally been opened by the customer. There are lots of places to solve a problem like this and protecting the biscuits by good and bulky packaging is one, even if it is an expensive solution.

So what do we want? A cost effective solution to protecting biscuits? Or …Biscuits that don't break?– how can we get to the best solution? By asking the right question.

The answer was similar to the burnt edges on biscuit batches and it needed the relevant specialist knowledge -



Once this question was asked a clever young chemist found the answer which is….
Cool the biscuits very slowly and they will be much less vulnerable to breaking.

Chicken and egg

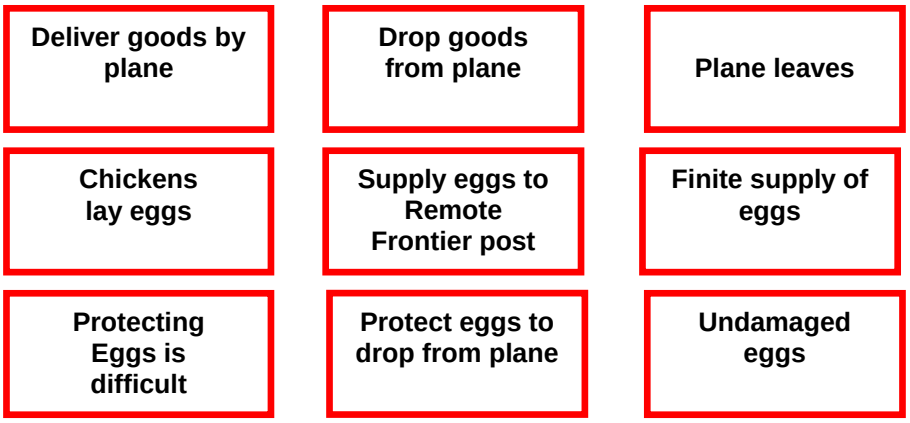
The approach of thinking in time is very powerful for problem solving. As we have never found a way of making egg shells less vulnerable we still protect them well with good packaging – and it was an automotive engineer looking at egg boxes in the 1940's who used his analogous thinking skills to make cars safer – realising that we couldn't reduce car accident fatalities by making humans tougher.

A good solution involving fragile eggs was used in the second world war and thought up by the SOE (Special Operations Executive). It was not found by TRIZ but I thought it involved TRIZ

thinking and clever use of resources. The SOE had to solve problems fast and used great scientific brain power; the one below is more domestic than to do with much of their secret agent work.

On the North West Frontier in India an isolated outpost asked for a supply of eggs to be dropped to them. Dropping eggs from low flying aircraft creates challenges – think about how you would do this before reading the answer below.

TRIZ would take you to the excellent SOE solution through the tool of Thinking in Time and Space and the use of resources and in the case studies for next month we will cover these tools.



OR

**The solution was to put a chicken in a paper bag and drop it from the aircraft. The simple brown paper bag stayed on long enough to protect the chicken from the slipstream, the fluttering chicken having cast off the bag then safely reached the ground. (*Reference page 40 SOE - the scientific secrets by Frederic Boyce & Douglas Everett)*

One other story from the same time concerned the German Enigma machine. The British had to break the code and put together top brains in a secret location – Bletchley Park. The code was broken in 1942 (completely by British endeavours and not because of USA intervention as recently portrayed in a Hollywood Blockbuster!) BUT no- one asked some really simple common sense questions upfront- and it turned out that the Enigma was patented in the London patent office in 1933 and we had in our possession at least 2 enigma machines in the UK. Knowledge sharing is difficult when intense secrecy is involved.

Being English I like good stories from our clever scientists and in a month where we are celebrating the brilliant UK rescue of the Russian submariners the same day as the safe return of Discovery – we have much to be proud of in our scientific and engineering community. To be helping that community solve problems better, faster and cheaper with TRIZ has been a great joy and satisfaction in the seven years since Ellen Domb introduced me to TRIZ.