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Systematic Innovation

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In this month's issue:

Article – Connections & Directions Towards The More Ideal System

Article – On 'Preliminary Actions'

Humour – The Towering Inferno

Patent of the Month – Laser Cooling

Best of The Month – Adaptive Enterprise

Conference Report – IMechE Fan Conference

Investments – Nanogels

Biology – Pond Skaters

The Systematic Innovation e-zine is a monthly, subscription only, publication. Each month will feature articles and features aimed at advancing the state of the art in TRIZ and related problem solving methodologies.

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Connections And Directions
Towards The More Ideal System

TRIZ is one of only a very few methodologies that avoids the 'insert miracle here' moment. The 'insert miracle here' step usually occurs in most methods at around the point where some good ideas are needed. A typical scheme will feature a whole bunch of sophisticated problem definition, data acquisition and solution evaluation steps, but somewhere between 'definition' and 'evaluation' there will a moment where we are instructed to 'now go and think of some good ideas'. As if all of the sophisticated surrounding stuff will somehow lead us to where the good ideas might be. TRIZ replaces this 'now think of some good ideas' stage with a series of strategies, operators, templates or whatever term appears fashionable this week. Whatever we chose to call the Inventive Principles, Standard Solutions or Trends of Evolution, they are intended to act as signposts, there to tell us 'the good stuff happens when you go in this direction'.

Use of any of these solution signposts requires a degree of practice and familiarity. Full competence usually requires an ongoing programme of use. It is not always possible to do this, however, since the majority of users of TRIZ will only pick up the tools when there is a problem to solve. For new users and occasional users alike, there is a need for improved strategies if we are to achieve the strongest possible solutions.

One of the keys to achieving such improved strategies is to recognize that all of the TRIZ solution signposts work in essentially the same way. This way is not always explicitly evident, however, and consequently few people are aware of it. The aim of this article is to describe the method.

Any useful idea has to be both simple and capable of handling the highest levels of complexity that may exist in a problem. A contradiction perhaps? Let's see if we can start to do something to solve it.

The proposed method involves two basic stages. The first stage is all about 'connections'; the second is all about 'directions' – Figure 1.

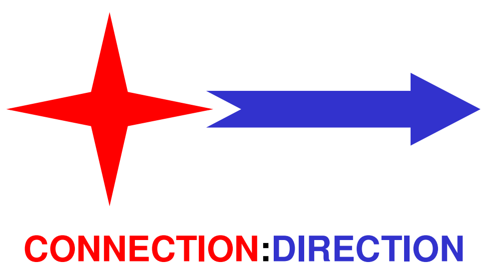


Figure 1: Connection:Direction Solution Generation Strategy

The connection part of the method is all about making connections between the problem we are trying to solve and the solution generation strategy. To take a simple example, Inventive Principle 4, Asymmetry contains the instruction

'where an object is symmetrical or contains lines of symmetry, introduce asymmetries'

in order to make any kind of meaningful use of this suggestion, we first need to make some kind of connection between the Principle and the system we are looking to improve.

In this case, such connections depend on our ability to find things in or around our system where there is a line of symmetry. When we can find a line of symmetry, then we have made a connection.

The next stage is then about direction. This is the 'signposts to the more ideal system' part of the story. It says that, wherever we have made a connection (i.e. found a line of symmetry in the case of Principle 4), then the direction we should be heading is 'introduce asymmetries'.

Although not always explicit, the Inventive Principle statements all contain this kind of connection:direction pair. In the case of Principle 4, Asymmetry it looks like this:

'where an object is symmetrical or contains lines of symmetry, introduce asymmetries'

Exactly the same idea applies to both the Standard Solutions and the Trends. With the Standard Solutions, things work in almost exactly the same way as with the Inventive Principles. To pick a standard at random, we see:

1.1.2
Incorporate an external additive (which may be temporary) into either of the substances

With the trends of evolution, the connection job requires us to make a link between something in the system under evaluation and a stage along one of the trends; the direction part then becomes shifting along to the next trend stage (or one after that – there is nothing to say that we have to only make one jump at a time). Many people – especially those using the evolution potential concept – find the connection:direction job somewhat easier with the trends than with the other solution generation tools.

Since the Inventive Principles tend to be simultaneously the most commonly and least well deployed of the TRIZ solution generation tools, Table 1 presents a basic connection:direction breakdown of each of the 40 basic Principles.

Inventive Principle	Connection	Direction
1, Segmentation	An individual entity A segment of an entity	Segment it Make it easy to assemble/dis-assemble Segment it some more
2, Taking Out	Two or more functions being delivered by a system	Separate or take out one of the functions
3, Local Quality	A uniform entity Something uniform around the system Different parts of a system	Make it non-uniform Locally optimize each Different (possibly opposite) functions
4, Asymmetry	A line of symmetry Find an external asymmetry Find an asymmetry	Break symmetry Match it Make it more asymmetrical
5, Merging	Two or more identical/related objects	Physically join or merge them
6, Universality	Any object or system	Make it perform multiple functions
7, Nested Doll	Any object or system A hole in an object or system	Put one inside the other Pass something else through the hole
8, Anti-weight	Weight of an object	Combine with something to provide lift

		Use other forces to provide lift
9, Preliminary Anti-Action	An action with useful and harmful effects Harmful working stresses	Precede the action with an opposite action Introduce pre-stresses
10, Preliminary Action	An action or system	Introduce an action before it is needed Pre-arrange actions
11, Beforehand Cushioning	A low reliability object or system	Introduce emergency back-up
12, Equi-potentiality	Object or system exposed to external forces	Re-design environment to eliminate or balance these forces
13, Other Way Around	An action A moving object A stationary object	Introduce opposite or upside-down action Stop it moving Make it move
14, Curvature	A straight edge or flat surface Linear or rotary motion A system	Curve it Switch to the other Make use of centrifugal forces Add rollers, balls, spirals, domes
15, Dynamics	A system A rigid/inflexible system	Allow it to change/re-optimise Divide or split it Make it movable or adaptable Allow free motion
16, Partial/ Excess Action	An action for which it is difficult to achieve the right amount	Use slightly less or slightly more of the action
17, Another Dimension	A straight line A plane A single level object/system An object	Move outside the line Move outside the plane Stack multiple levels Lay it on its side Use another side
18, Vibration	An object A vibrating object	Cause it to vibrate Increase vibration frequency Make use of resonance Add piezoelectric vibrators Use combined field oscillations
19, Periodic Action	A continuous action A periodic action A gap between actions	Make it periodic Change the frequency or magnitude Perform a different function during gap
20, Continuous Action	An object or system that is not working all the time Idle or non-productive actions	Make it work all the time Eliminate
21, Skipping	An action (with harmful side-effects)	Perform it at high speed
22, Blessing in Disguise	A harmful action	Transform it into a positive thing Add a second action to counter it Increase to a level that is no longer harmful
23, Feedback	A process or action A process with feedback	Add feedback Make the feedback adaptive

SYSTEMATIC INNOVATION

24, Intermediary	Two or more objects /systems/actions	Add an intermediary between them Add a temporary intermediary
25, Self-service	An object or system	Enable to perform functions by itself Identify and make use of waste, energy or substances
26, Copying	A (fragile) object or system	Replace with a copy Replace with an optical copy Make use of IR/UV
27, Cheap, short-living	An (expensive) object or system	Replace with cheap, short-living alternatives
28, Mechanics Substitution	An existing (mechanical) means	Use other senses Introduce fields Movable/variable/structured fields Introduce fields plus field activated substances
29, Pneumatics/ Hydraulics	Solid parts	Replace with fluids and/or gases
30, Flexible Shells	Solid structure	Shift to flexible shell/thin-film Isolate using thin films
31, Porous Materials	A (solid) object A porous object	Add holes/pores/porous materials Add something into the pores
32, Colour Changes	An object	Change its colour Change its transparency Add coloured or luminescent additives Change emissivity properties
33, Homogeneity	Two or more interacting objects or systems	Make from similar materials Make from materials with matching properties
34, Discarding & Recovering	An object (that has fulfilled its function) Something consumed or degraded during a process	Make it disappear Make it appear to disappear Restore them
35, Parameter Changes	An object	Change physical state Change concentration/consistency Change flexibility Change temperature Change pressure Change other parameters (attributes)
36, Phase Transition	A solid, liquid or gas	Make use of phenomena occurring during phase transition
37, Thermal Expansion	A material Several materials	Make use of changes that occur during thermal change Make use of differences in changes
38, Strong Oxidants	The atmosphere around an object or system	Replace with oxygen-enriched air Replace with oxygen Use ionizing radiation Use ionized oxygen Use ozone
39, Inert Atmosphere	The atmosphere around an object or system	Replace with an inert one Add neutral parts or inert elements
40, Composite	A (uniform) material	Change to a composite of multiple

SYSTEMATIC INNOVATION

Materials		materials

The connection:direction idea works even more effectively with the alternative Inventive Principles structure outlined in Hands-On Systematic Innovation (page 200). This 5x3 matrix is intended to offer a richer array of connections and directions than the 40 Principles, while at the same time being easier to remember. Figure 2 illustrates this 5x3 matrix from a connection:direction perspective.

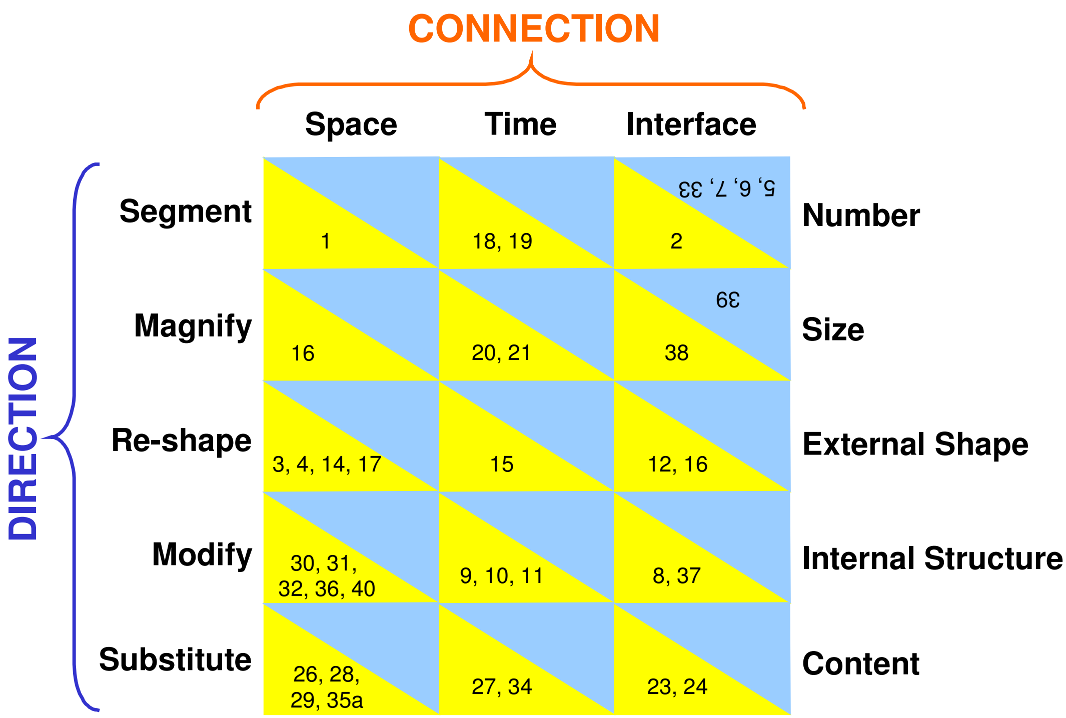


Figure 2: Connection:Direction And The Alternative Principle Structure

The Space-Time-Interface side of the matrix is all about the connections part of the story. It is there to remind us that when we are looking to make connections between the system under examination and means of improving it, that we need to be looking at all three of physical, temporal and interfacial aspects that may be present in that system. The direction dimension on the Matrix is then trying to tell us that there are basically only five such directions that are available to us when we are trying to improve a system – segment/merge, magnify/shrink, re-shape externally, modify internally, or substitute for something else.

Connections

The human brain is a funny thing. We all tend to enjoy generating solutions to problems, but at the same time we tend to enjoy even more the point where we have 'solved' the problem. Our preference for 'finished' over 'let's generate solutions' often means that we are very happy to believe we have 'finished'. Thus, if we make a connection, we tend to fool ourselves that we have finished, and likewise, if we find a useful direction, again we think we have finished. The key word in this sentence is 'a'; we make *a* connection and our brain is inclined to tell us to go on to the next stage.

There is no doubt, however, that the more connections we can make and the more directions we can take, the stronger will be the eventual solution we derive. Figure 3 illustrates an example of at least a start to the sort of exhaustive search for connections that the method would like us to be making. The example used in the figure is a simple product, but it could have been literally any kind of system – either technical or non-technical.

Time ('Actions'):
Buying the tee
Putting it into storage location
Taking tee out of bag
Placing ball on tee
Pushing tee into the ground
Retrieving the tee
Re-storing the tee

Interfaces:
Tee to storage location
Tee to hand
Tee to ball
Tee to ground
Tee to golf-club
Tee to atmosphere

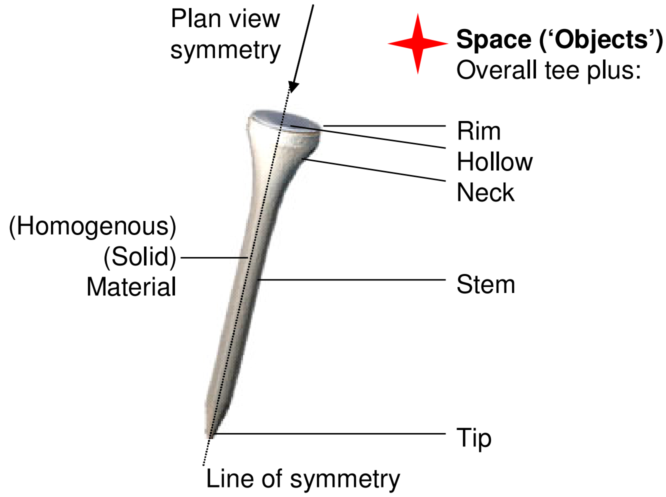


Figure 3: Making As Many Connections As Possible On A System Under Evaluation

When looking at the figure, notice the use of the space/time/interface perspectives and pay particular attention to the way in which the connection triggers identified in the earlier Principle table have been used.

Directions

Having made lots of connections, the direction part of the Principles is then trying to act as a 'signpost'. We need to say a little more about this, because specifically in every part of the 5x3 matrix – where we see that every direction has its opposite as a possible alternative, but also visible if we examine Principle 1, Segmentation and 5, Merging, we can see that we can see some signposts pointing in precisely the opposite direction to others. How, for example then, can both Principles 1 and 5 both be pointing to 'the more ideal solution' at the same time?

There are several answers to this question, each working on a different level. At the simplest level – the one that is most applicable if we are simply using, say, the 40 Principles as foci for brainstorming – we assume that TRIZ has no idea which of any pair of conflicting directions is correct, and that we should try both. The only down-side to this approach is that we may 'waste' a little time having to explore double the number of directions than might turn out to be appropriate.

At a slightly more sophisticated level, then, is a recognition that the answer to questions like 'should it be segmentation or merging?' may be 'both'. If TRIZ teaches us one thing, it is that any time we start making either/or decisions, we are usually doing something wrong. The answer to the either/or conflict in this kind of solution direction problem is that different aspects of the problem may require different solution directions. A very common such example is that applying a merging strategy may be appropriate at the macro-level, while a segmentation strategy may simultaneously be appropriate at the micro-level (e.g. I solve the conflict of having to carry around a camera and a mobile phone by merging the two things into one, while simultaneously then solving the problem of operating the combined camera-phone by segmenting the operation of the device into two modes).

Looked at more generally, this kind of ‘both/and’ direction strategy is best viewed through the 9-Windows operator; and the recognition that what might be a good solution direction in one window, may be different to what might be a good solution direction when viewed from another.

At the third, most sophisticated level, the opposing signposts problem can be solved by the process itself. The basic idea at this level is that when we use the Contradiction Matrix tool, it will tell us which directions are the ones that others have found to point towards greater ideality. The Matrix becomes the signpost. This is a slightly more difficult concept to grasp, especially if you are using the original Contradiction Matrix, since recent evidence has shown this tool has a very low (25%) level of accuracy when examined against present-day successful solutions. The new, 2003, Matrix, on the other hand, was constructed with the signpost idea much more in mind. We can be much more confident when using this tool that the directions being suggested to us are the ones that are highly likely (95% according to the 2004 re-validation exercise) to be the ‘right’ ones. Interestingly in this regard, keen-eyed users may occasionally notice that Matrix 2003 occasionally features conflicting Principles (most usually 1 and 5) as solutions for the same conflict pair. When this happens, it is intended to be a clear sign that we are in a ‘both/and’ situation and that the above second rule applies when we are trying to use the Principles to generate solutions.

Whichever of these strategies is going to work best for you, the overriding rule is that we avoid getting ourselves into the ‘it didn’t work’ mode of thinking. If you are failing to make connections, or finding yourself getting frustrated that the method simultaneously recommends two or more directions that you ‘know’ are inconsistent, it is very easy to accuse the method rather than yourself. The best strategy if (when!) this happens is to go and do something completely different for a few minutes (preferably involving some fresh air), and then come back and try again. The worst that can happen is that you come out with a few bad ideas amongst what will eventually turn out to be the good ones.

Summary & Conclusions

All of the solution generation tools contained within TRIZ may be seen to work in a way that requires us to first make connections between a system under consideration, followed by directions that we should travel to achieve a more ideal solution. Explicit recognition of the connection and direction aspects should help new and occasional users of the method to get the best from them.

The more connections we can make; the more good solutions we are likely to generate. There is no such thing as a bad connection.

Where suggested directions appear to conflict with one another, chances are that both directions will produce something useful. In such situations, take especial care to explore the 9-windows and the possibility that a good direction in one window may be matched by an opposite direction in another.

On 'Preliminary Actions'

A quick survey of the frequency with which the Inventive Principles feature in the various Contradiction Matrix tools reveals that Principle 10, 'Preliminary Action' is the second most common strategy in the classical TRIZ Matrix. In Matrix 2003, it has fallen from 2nd to 8th. In the business matrix it rises to 4th, and in the newest tool – the software matrix – it is actually the most common Principle. This article is a brief exploration of why this Principle is featured so commonly.

We begin that exploration with the following imaginary scenario: You are a project manager responsible for putting together a competitive bid for an important piece of work for your employer. Given the importance of winning the bid, you have been encouraged by senior management that lowest price will play a significant role in determining which of the bids will be successful. As a consequence, you construct and cost a programme with contingencies pushed to a minimum, and a low profit margin. The bid you eventually make is received well by the client, and you are informed that you have made the short list. Along with this news comes a suggestion that you may like to revise your bid and present a best-and-final-offer. With the advice of your management, who are still pushing to ensure that you win the business, a revised bid which chops a further 10% from the overall price of the bid. A Few weeks later, you are told that your bid has won the competition, and that you will be invited to commence work as soon as the new financial year begins. Come the new year, your management revises the cost rates at the company and you now find yourself in the position of facing a 5% shortfall in the budget required to conduct the work. To add insult to injury, within a few weeks of commencing the work, one of the key risks identified during the proposal preparation phase becomes a reality, but the contingency you wanted to include for the eventuality is no longer there.

Does this sound familiar in any way? Perhaps, given a global average of 90% of projects finishing either late, below specification or over budget, it rings more than a few bells.

The net consequence of this kind of pressure? We take short-cuts. Unfortunately, many of those short-cuts – especially those implemented with a trade-off based mindset – end up compromising the originally intended outcome.

UK infrastructure projects are increasingly prone to these kind of outcomes; road bridges that get built with one less traffic-lane to save a small percentage of the budget, buildings that go so far over budget that the interiors end up being supplied with inferior quality materials, high speed train tracks that don't quite get all the way to their destination (the Channel Tunnel is a great example – emerge from the tunnel in the direction of London and you will feel the train visibly slow as it hits the non-high-speed train track), mobile phone networks with antennae positioned too far apart, leaving frustrating dead zones (usually along train tracks), the list is nearly endless.

So great are the pressures at the beginning of many projects that there is a considerable tendency to build in a whole bunch of problems that are going to cause big problems in the future. In many ways the whole system of governance – whether it be political or corporate – is set up to support the short term at the expense of the long. A government that cuts a financial corner by authorizing a bridge that will turn out to be too narrow is likely not to be in power anymore when the bridge is completed, so why would they care? Similarly, if they build it wide enough, they still won't be in power when it is completed and then the opposing party will get the credit. This endemic emphasis on the short term builds in a massive proportion of the contradictions that will need to be solved in the long term.

This phenomenon offers us yet another reason behind the complexity-increases-then-decreases trend of evolution; complexity increases as we find ourselves adding stuff to the systems that were inadequately specified, or had corners cut in the short term.

While it is useful to be aware of these short-termism problems, in that it might allow us to see at least some of the reasons for the high frequency of the Preliminary Action Principle as a contradiction elimination strategy, it is not always very helpful when we are using TRIZ to solve a problem, and the answer that comes back to us is 'introduce a useful action into a system before it is needed'.

Very often, the constraints present in a problem will make it impossible to follow this 'do something earlier' solution strategy. Take the Channel Tunnel train problem, for example. The conflict present (on the British side of the Tunnel at least) is that we would like to be able to increase the speed of the trains, but the thing preventing us is that the tracks have not been constructed with sufficient precision to allow it:

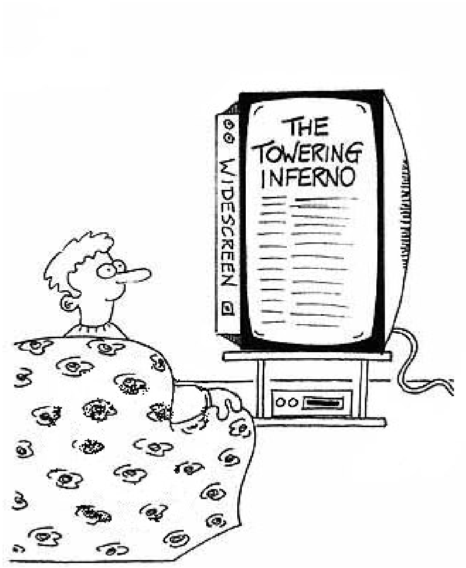
Thing we would like to improve: SPEED
Thing preventing improvement : MANUFACTURING PRECISION

Matrix recommends : 10, 28, 32, 25

Principle 10 is our first solution direction suggestion. At first sight, it would be very easy to dismiss this Principle as irrelevant by saying that going back and writing a decent specification is of no help to the thousands of passengers that are forced to live with an embarrassing 50 mile crawl from the tunnel to the centre of London. Making this kind of connection to the Principle is likely where our psychological inertia will point us. At the very least, this kind of connection might plant in our minds the idea that we should avoid making the same short-termism mistakes in the future, but it still doesn't help today's passengers.

What we need to do if we are to make pro-active use of all of the Inventive Principles (but especially Principle 10) is to recognize that 'doing something earlier than is needed' might mean five years ago when the specification was written or the short-cuts got made or it might mean 5 nanoseconds before the wheel of the train reaches a particular section of rail. The Contradiction Matrix cannot know which of these (or any other intermediary moment in time) is the one where the solution to our problem might lie. All it can do is point us to the 'past' and leave it up to us and our creativity to work out how a solution meeting our constraints might be generated.

Humour



Principle 17D, ‘Re-orient the object or system, lay it on its side’.

Patent of the Month

Our award this month sees us zooming in to the world of atoms and specifically that of atomic cooling:

United States Patent	**6,822,221**
Kumagai , et al.	**November 23, 2004**

Method for laser cooling of atoms and apparatus therefore

Abstract

A method for cooling atoms, having a plurality of magnetic sublevels, involves a laser. Specifically, multiple polarized coherent light sources of a predetermined wavelength are sequentially emitted to atoms to move the electrons of the atoms to a lower magnetic sublevels, hence cooling the atoms. The sequentially emitted laser light can be applied at predetermined time intervals, whereby it becomes possible to laser-cool a variety of atoms including semiconductor atoms, such as silicon and germanium.

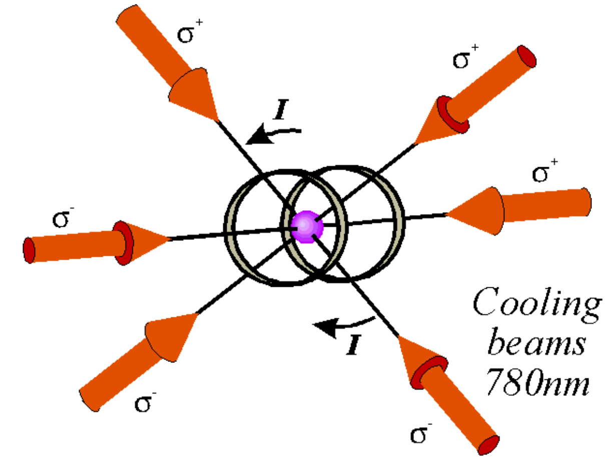
Inventors: **Kumagai; Hiroshi** (Wako, JP); **Midorikawa; Katsumi** (Wako, JP)

Assignee: **Riken** (Saitama, JP)

One of the most exciting developments in physics over the past 15 years has been the use of lasers to produce ultra-cold temperatures samples of neutral and charged atoms. The very low temperatures obtainable by these techniques (as low as 1 millionth of a degree above absolute zero) permit one to perform extremely precise spectroscopic measurements free from most perturbations and with very long interaction times. For these reasons, laser cooling is being employed in the latest generation of neutral atom clocks, yielding dramatic improvements in precision.

The reason why laser cooled atoms are so useful is that the atoms move extremely slowly - a few cm per second - and can manipulated just with light and magnetic fields. No other technique gives access to such temperature regimes or can surpass the accuracy of the measurements possible. Examples of novel applications of this technology are highly collimated beams of atoms for nanolithography, fountains for the new generation of time-keeping, ultra-accurate gravity measurements and extremely precise tests of quantum mechanics.

Laser cooling is most easily achieved by illuminating a vapour of atoms in a high vacuum with 6 orthogonal intersecting laser beams, tuned slightly to the red of a particular atomic absorption line. Atoms moving in any direction at the intersection see the light blue-shifted into resonance, and consequently absorb a photon from that direction and get a momentum kick backwards, slowing it down. Re-emission of the photon occurs in a random direction, averaging out to zero momentum change. The time-averaged result is a friction-like force due to the light whichever direction the atom moves in - this is known as optical molasses. However, the random nature of emission means that in simple laser cooling systems the lowest temperature obtainable, known as the 'recoil temperature', is limited by this process. More advanced techniques can get around this, obtaining temperatures of less than 1 nK. An additional magnetic field is usually used to tightly confine the cooled atoms at the centre of the laser beam intersection. The general apparatus is called a Magneto-Optical Trap (MOT).



In the laser cooling field, if it becomes possible to realize laser cooling of semiconductor atoms, such as silicon and germanium, instead of alkaline metal atoms and the like (which have been heretofore an object of laser cooling), novel developments can be expected from an engineering point of view. Hence, expansion in the possibilities of application are inestimable.

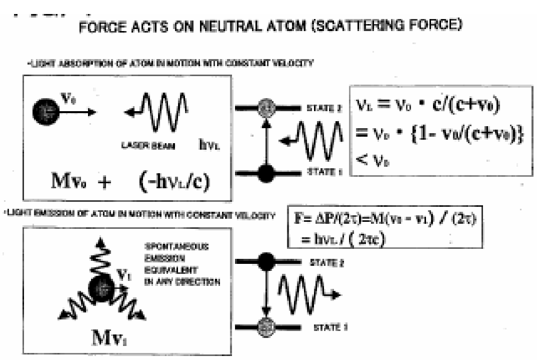
It is precisely this capability – laser cooling of semi-conductor materials – that has been the focus of the US6,822,221 inventors' activities. The method by which the invention emerges may be seen from the Claim 1 description:

1. A method for laser cooling atoms each involving a plurality of magnetic sublevels as its cooling lower level being in a ground state in energy level, comprising:

emitting sequentially coherent light of a predetermined wavelength containing a plurality of differently polarized lights to the atoms in response to the plurality of magnetic sublevels being the cooling lower level in the ground state in an atom, which is an object to be laser-cooled, while keeping a predetermined time interval.

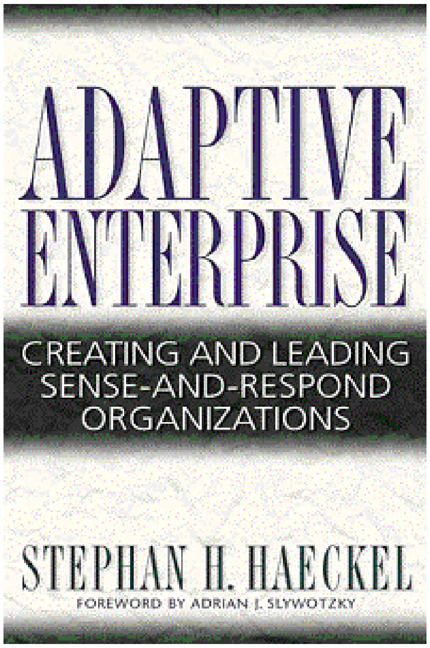
What is perhaps interesting about this inventive step from the TRIZ perspective is that it describes a double application of the Segmentation Principle – firstly a segmentation of 'differently polarized lights', and then a (hierarchical) segmentation of magnetic sub-levels.

Thus, not only does the invention represent an important (Level 4) step forward in the field of laser cooling – one that is likely to spawn a host of lower level inventions in due course – but it also serves to remind us about the importance of both looking for multiple connections between Principles (in this case Segmentation), but then also looking to combine multiple solution directions.



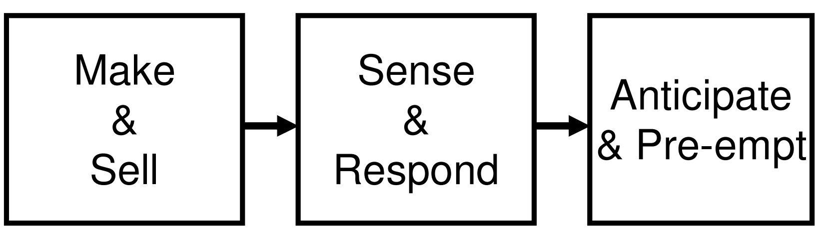
Best of the Month

A Principle 15 recommendation this month – another business book – 'Adaptive Enterprise' by Stephan Haeckel. The theme of the book is an almost exact interpretation of the exhortation contained in Principle 15 – where a system is rigid or inflexible, make it movable and adaptive.



Actually, that probably does the book a major dis-service, since it brings together a number of other important elements, not least of which is a re-casting of the work of John Boyd on modern warfare – the main reason we picked the book up again, after initially working through it three or four years ago.

Although not explicitly identified as such, the book also identifies an important discontinuous business evolution trend. We're still trying to work out how best to integrate it with existing trends (since it both overlaps with existing trends and also presents important new ideas), but for the time being, it is worth distilling the essence of the trend identified by Haeckel in this forum:



The trend operates at the very highest organizational level, relating to the manner with which the organization interfaces with the world at large. The first stage of the trend is the paradigm operated by the majority of manufacturing organizations on the planet – that is, they are set up to make goods and sell them. Organisations that have shifted to a 'pull' mode of operation may be seen to have shifted (in the crudest sense at least) to the second stage. This is the stage where the organization is geared up to sensing shifting market needs and conditions and then responding accordingly to them. The third stage is then one that receives barely more than an introduction in the book, but may nevertheless be seen to be emerging as an important strategy in leading edge companies (particularly those using the trend prediction parts of TRIZ!). This stage involves the deployment of strategies that seek to know what customers want before the customers themselves know what they want.

As stated earlier, more on aspects of this book to come in future articles, but for the moment, the book is yet another of the Harvard Business School Press offerings that deserves detailed attention for anyone in management or a position of influence.

Conference Report – I Mech E International Conference on Fans
November 9-10, London

In theory this event was an opportunity to present an application of TRIZ in a field very close to a large part of my career. For six years I called myself an aerodynamicist, and spent my time either writing CFD software or using it to design turbomachinery. That was in the days before I became aware of TRIZ. At the very least, then, the opportunity to present a paper at this prestigious event in the fan calendar was one to apply some TRIZ to a subject I knew 2 PhDs-worth about. It should also have been an opportunity to expose TRIZ to around 80 industry professionals, of which, as it turned out, well over 70 had never heard of the method before. The results of the first part of the opportunity can be found reproduced in the December edition of TRIZ Journal. Alas, with respect to the second aim, the event can only be described as a wash-out.

Perhaps the 15 minute allotted presentation time didn't help. Or perhaps it was a prior days' worth of frustration at how the industry seemed to be less advanced now than the work that we were doing in the 1980s. In some ways, this frustration could have been viewed as TRIZ-predicted evolution in progress. Albeit all within the same industry – heaven forbid that anyone attending the conference look to other industries for any inspiration – but nevertheless, there was ample evidence of certain sectors reporting on aerodynamic and reliability discoveries that other sectors had already discovered 20 years ago. Is this industry really so comfortable that innovations are taking such a long time to shift from one sector to another?

How are we supposed to deal with a company presenting a paper on their (extremely complicated, extremely expensive) active fan-balancing equipment when we know there are 'self-balancing' fan patents sitting there in the patent database?

How are we supposed to deal with a different paper about a company dreaming up a fan casing distortion solution that you first saw (a better version of) in 1986?

Or yet another paper about reducing noise on a fan system by dreaming up a solution that was well known in the gas-turbine industry (and, again, far better and more cheaply implemented) over 20 years ago?

Does this sound like sour grapes about a presentation that completely failed to connect? Difficult to say, Probably 10% yes. But that still leaves us with the 90% gnawing feeling that quite a few of the companies present at the conference who will not be living the same comfortable existence when 'someone' takes advantage of some of the low-hanging fruit innovation opportunities that currently exist.

Thinking about it, it could turn out to be an interesting race. The blind versus the deaf. Who will make the connection first? The companies blind to the solutions that already exist in other sectors? Or the companies that already own those solutions, but are deaf to the cries from those with the problem?

Maybe the answer will be neither. Maybe making the connections becomes the domain of a third party who just happens to use TRIZ. Time will tell.

Investments – Nanogels

While silica gels (mostly comprised of air pores, fractions of microns in diameter) have been known about for several decades now, they have typically been associated with expensive manufacture. This has limited their otherwise undoubted attractiveness in a number of insulation/weight related applications.

Patent portfolio owners, Cabot (www.cabot-corp.com/nanogel) have recently developed a capability to deliver ‘nanogels’ at a bulk price of 2.8 Euros per litre. This price level has already opened up opportunities in a variety of commercial products. Once visibility of the extraordinary properties become more widely known, it looks likely to open other significant doors in the not too distant future.

Anyone with any kind of thermal management task to perform is advised to take a look.

Biology – Pond Skaters (*Gerris remigis*)

Pond skaters walk on water. They achieve this remarkable feat by extremely water repellant legs. According to recent research, the level of repellence is such that the insect could carry 15 times its own weight on each leg. Initial theory suggested that the water repellant capability was achieved by a waxy secretion. This theory has now been superceded thanks to electron microscope pictures showing that the pond skater leg is covered in densely packed, downward pointing micro-bristles, each of which is in turn sculpted with nano-scale grooves. The grooves serve to trap air, which in turn acts as a protective barrier, preventing the leg from wetting.

The excess load carrying capability is believed to allow the pond skater to maintain its 'walk-on-water' capability even after it has been impacted by raindrops and other falling objects.

The pond skater thus not only provides us with another example of the surface segmentation trend in action ('somewhere there is an advantage in adding protrusions'), but also an excellent reminder about the 9 Windows tool, and the need to consider not just a steady state 'present' condition, but also such extremes as 'being hit by a raindrop'.