Subscription 0080

# Systematic Innovation

# e-zine

Issue 10, November 2002

In this month's issue:



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.

Our guarantee to the subscriber is that the material featured in the e-zine will not be published elsewhere for a period of at least 6 months after a new issue is released.

Readers' comments and inputs are always welcome.
Send them to **darrell.mann@systematic-innovation.com**

# TRIZ and Jet-Lag

## Introduction

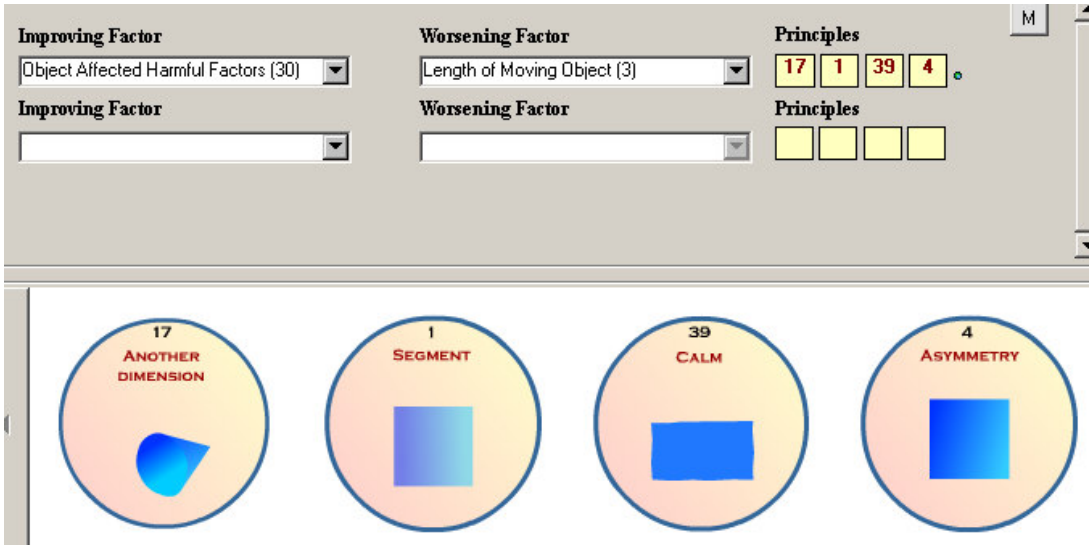
We're doing a lot of long distance traveling these days, and jet-lag has become a bit of a problem at times. We thought we would see if TRIZ had anything to offer the weary traveler. One of the constraints we imposed on the problem was that anything we did would have to use existing resources – thus, for example, despite the fact that we knew that judiciously timed use of bright lights shone in the eyes can help, we precluded this from consideration as we were not in possession of such a device. Nor did we wish to purchase one.

## A Contradiction

Flight BA25 from London to Hong Kong (hey, we sound like Edward de Bono) and, thinking about the problem, we fire up our new version of CreaTRIZ 3.0 and plug in the following contradiction:

The thought process being that the thing we'd like to improve was jet lag (object (us) affected harmful factor) and the thing that was stopping the problem was the fact that we were about to fly several thousand miles across seven time zones (length of moving – 550mph – object).

The answers suggested by the Matrix were a mixture of comfort and surprises. Comfort, first off came with a rare appearance of Principle 39 'Inert Atmosphere' – which immediately suggested the use of the sorts of things that airlines tend to give us – eye-shades, wine, etc – plus some of the things a doctor might prescribe to help.




Principle 1, Segmentation, also seemed instinctively correct, albeit a little unhelpful, in suggesting that we might perhaps choose to split the journey into different segments. But then, we thought about the other possible interpretations of segmentation – those relating to TIME and INRERFACE/RELATIONSHIP issues (see our TRIZ Journal article on Re-

thinking the Principles for the importance of connecting the Principles to all three of SPACE, TIME and INTERFACE issues).

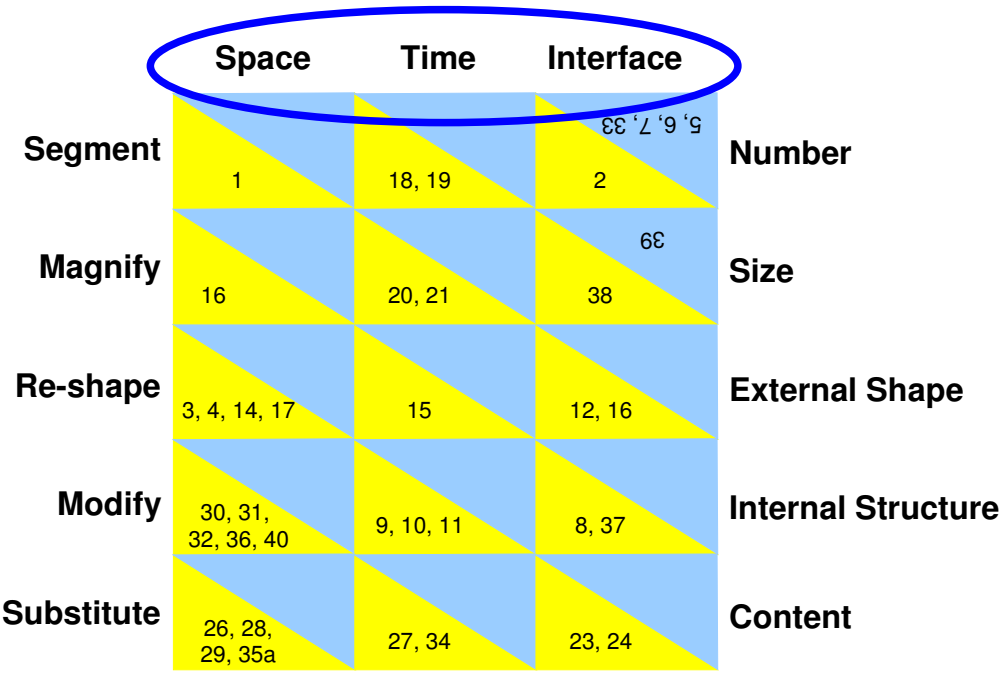
These additional connections of the Principle in turn suggested the following:-

TIME – time-related things that could be segmented

- time between scheduled activities on the plane – meals, lights-out, etc
- time on the clock
- time zones
- film showing times

INTERFACE - relationship-related things that could be segmented

- communication with adjacent people
- communication with cabin staff
- flight plan screen information




While none appeared to be immediately obviously offering an advantage by being segmented, we persevered for a while and thought about how we might change our strategy regarding altering our watch to take account of the new time zone at the destination. What happens, we thought, if instead of just making one adjustment to the watch at the end of the journey, we made a number of smaller adjustments during the flight?

As we were thinking of this, we also thought about the (similarly un-promising sounding) Asymmetry Principle, and thought about how we might best make the adjustments in the time of the watch – initial instinct being to shift the watch by one hour for every time zone crossed. The primary asymmetry in the system, we surmised, was another TIME related element – the likely time that we would spend asleep. There was little point in altering the watch during this time (or little ability) – due to the fact that we wouldn't be conscious of what the watch was saying – an important element in the psychology surrounding whether

any of this would work – i.e. we decided that our brain had to be as conscious of the changing time as possible.

As a consequence of this thinking, we decided to alter the clock in accordance with our level of consciousness. Thus the seven one-hour clock adjustments we made traveling East were as follows:-

1) at the start of the first film
2) when dinner arrived
3) when dinner was cleared away
4) (lights out) – soon after the above
5) (lights up ready for breakfast)
6) start of descent
7) touchdown.

Travelling West, we shifted the time-segmentation again (another use of Asymmetry!) and found that biasing the clock shifts towards the initial stages of the journey (on an overnight flight we made a one hour shift as soon as we got on the plane, followed by a single other shift to the destination time after dinner) was most likely to help.

**Results**

Although it might not sound like a very significant change, the effects we felt in both Easterly and Westerly directions coming back were not far short of amazing. For the first time ever, a good night's sleep was had at both destinations.

Please give it a try next time you get a chance. And let us know what happens.

# Case Studies in TRIZ: Breaking Hicks Law

## Introduction

The theme of this article involves 'laws'. At least in their technical context, a law is defined as an incontrovertible truth. Hicks Law (Reference 1) relates to the design of, amongst other things, user interfaces in software design. Hicks Law expresses a relationship between the amount of information presented to a computer user and the amount of time required for the human brain to process that information. Perhaps not surprisingly, the Law identifies a positive correlation between the two things such that more information requires more processing time. We will examine the Law in some detail, but the main theme of the article is a belief that some laws – and certainly Hicks Law – may simply be a case of relationships that exist only within a certain trade-off based mode of thinking. In other words, there is a case for examining the possibility that if we are able to change our mode of thinking, there are some 'laws' that might not turn out to be incontrovertibly true, and that changes to a system can change the Law.

## Hicks Law

Expressed mathematically, Hicks Law is usually represented as:

Processing Time = Constant x log(number of pieces of information)

In graphical terms it looks like the illustration provided in Figure 1.

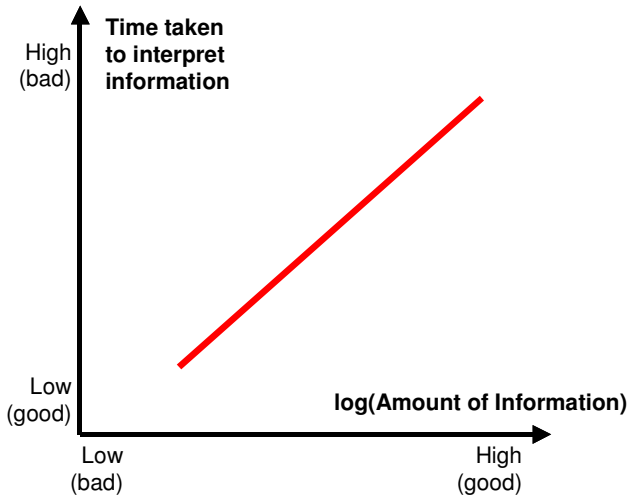



**Figure 1: Graphical Representation of Hicks Law**

Re-drawing the graph by reversing the direction of one of the axes then gets us to the revised graph shown in Figure 2. We have made this shift as an example of something that we often do when trying to identify the contradictions within systems – essentially, if you think about a contradiction (a technical one at least) as a hyperbolic relationship between two variables of the type $xy^n$=*constant*, and can plot a pair of variables associated with your problem in this way, then you have found a contradiction. In this particular case, we have re-cast the graph axes such that the direction of 'good' in the case of both x and y axes is pointed towards the origin of the graph. There are no absolute rules here of course, but this form of axis definition gives the useful additional

image that as things get closer to the origin, they are getting more and more ‘ideal’ (similarly, we can define the origin itself as our ‘ideal final result’).

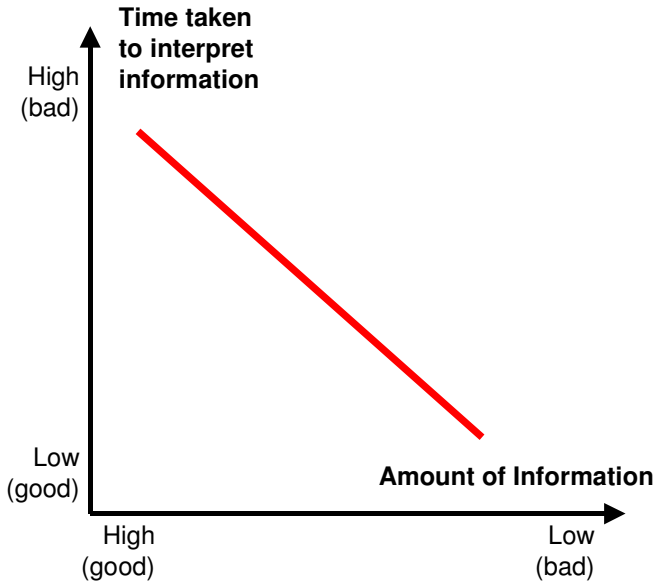



**Figure 2: Modified Graphical Representation of Hicks Law**

Drawn with a log scale (albeit, we have deliberately left the numbers from both axes), Hicks Law represents a special kind of straight-line rather than hyperbolic contradiction relationship.

The main point of Figure 2 (or the mathematical description of Hicks Law if you prefer) is the definition of a trade-off situation between processing time and the amount of information present, such that as one thing improves, the other gets worse. From a TRIZ perspective, we have a contradiction. And having a contradiction means an opportunity to tap into the contradiction-challenging solutions of other people, and as such, we then have an opportunity to shift to a more ideal state – Figure 3.

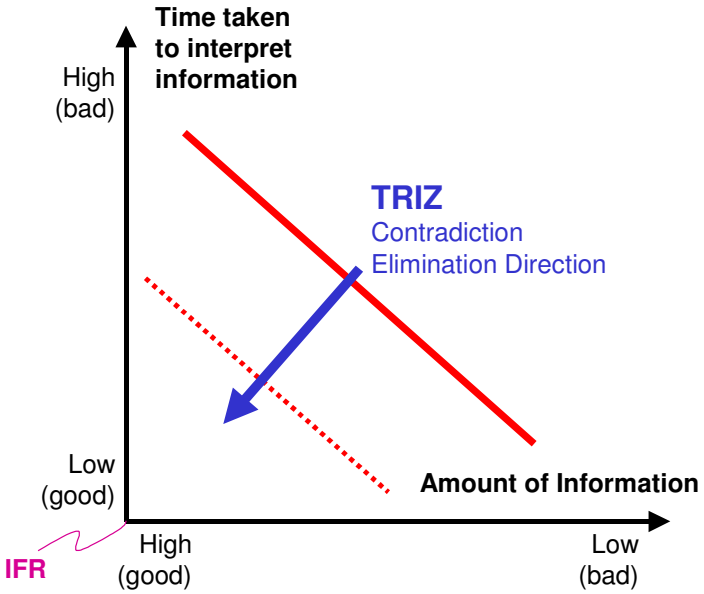



**Figure 3: Challenging the Hicks Law Contradiction**

Of course, if Hicks Law is a law in the true sense of the word, we will not be able to challenge the contradiction. But if it isn't, then we may just be able to create some significantly better software design solutions.

## Hicks Law as a Contradiction in Software Design

There are a number of different ways that Hicks Law could be expressed as a contradiction. From the Classic TRIZ Technical Contradiction Matrix the most likely contradiction would be:

| | |
|---|---|
| Things I am trying to Improve: | Loss of information |
| Things getting worse: | Loss of time |
| Matrix suggests: | (24) Intermediary, (26) Copy, (28) Mechanics Substitution, (32) Color Change |

(One could also argue for other formulations of the contradiction, but this is the most direct connection to the Matrix)

**Figure 4: Hicks Law as a Contradiction**

Based on our ongoing work to update the Contradiction Matrix (Reference 3), it is clear that if we look across the range of other patents tackling this same contradiction – Figure 5 – that there are several other Inventive Principles that have been used.

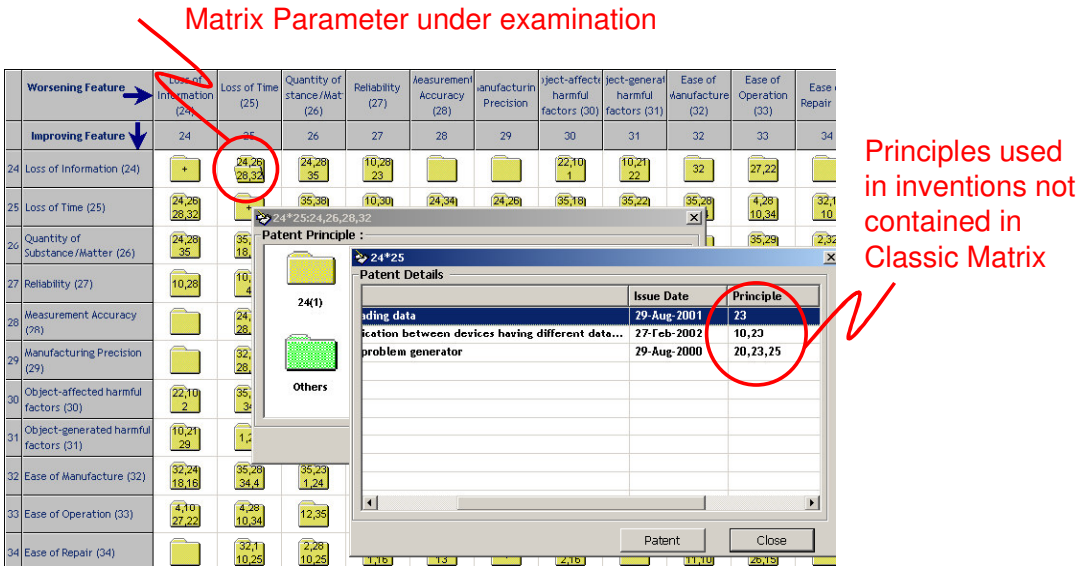



**Figure 5: Hicks Law as a Contradiction**

## Contradiction Resolution and Implications for Software Design

Undoubtedly, one of the reasons for the increase in the use of software is its shift towards increasing ideality; it provides greater control, user interfacing and dynamic features when compared with traditional 'hard' methods for transferring information such as newspapers and books. In other words, software can be more 'Perfect' and more 'Now' (some software is also more 'Free'). These features provide great scope when trying to resolve the conflict of time vs. information present in Hicks Law.



SYSTEMATIC INNOVATION

In fact, a large number of methods are already currently in use that do effectively side-step Hicks Law when presenting information for human processing. The suggested principles are very effective for guidance towards these different methods.

Use of an Intermediary suggests the use of graphs and pictures to represent a lot of data, and analogy to express the purpose of a complicated situation. Colour changes are already widely used to separate points of interest (on condition), divide up a screen into different areas (in space) or fade items not recently used (in time). Copying could imply a virtual reality setting where appropriate information can be found faster by representing them with objects and settings from common experience. Finally, mechanics substitution could lead to adding sound (increasing use of senses), simulation of textures to add context to information or dynamic content.

From the new Matrix findings illustrated in Figure 5, it is possible to imagine that Principle 25, Self-Service (which is very closely linked to the increasing Ideality trend) could be used in several ways – most notably in devising systems that 'learn' how the user interfaces with a piece of software in order to then be able to adapt to suit individual quirks and methods of operation. A combination of Principles 10, 25 plus 24 could also get us to the creation of user interfaces based on mind-mapping type constructions – a presentation format specifically designed to assist in the ordering and access of information.

Several of these methods can be seen to be appearing in much new software and high quality websites.

The contradiction of time vs. information is of paramount importance in the field of software design where, in particular for web page design, the amount of relevant information that can be transferred in a short visit can dramatically affect business. It is clear however, that this contradiction has many more fundamental implications in other areas, specifically learning and knowledge transfer, where breaking it effectively could provide potent benefits. (Interestingly, these methods are all conspicuously absent from most traditional teaching methods). We will explore some of these in future articles – including a look at how the same sort of information versus time contradiction has been successfully challenged in a business context.

## Conclusions

One of the problems with the word 'law' is that we very frequently interpret is as precisely that; an incontrovertible truth that cannot be challenged. While this article is in no way suggesting that, for example, the Laws of Thermodynamics or gravity, etc are 'wrong' (they represent a working description of the world as we understand it and they work very well for the systems we design within the paradigms we operate), it very much is saying that there are times when we should think about challenging them. In this case of Hicks 'Law' for example, it was quite clear that the researchers who introduced us to the law were suffering from acute psychological inertia with regard to the word. 'Law' had explicitly told them that here was something that was 'inevitable' and 'impossible to avoid' and therefore they didn't even think about trying.

We are reminded at this point of the statement by Lewis Wolpert in his book 'The Unnatural Nature of Science' (Reference 2) that every important scientific discovery has run counter to the prevailing wisdom of the time.

This is not to say that we should all run off and start challenging the Second Law of Thermodynamics at every opportunity (for a start, the Patent Office's of the World won't

think much of us), merely that, when a 'law' is beginning to impede progress – like Hicks Law in the design of better software – we might like to start thinking about challenging some of the assumptions on which it is built.

**References**

1) Helander, M.G., Jiao, J., 'Coupling In Design of Human Computer Interaction', ICAD2002, MIT, Boston MA, June 2002.
2) Wolpert, L., 'The Unnatural Nature of Science', Faber & Faber, London, 1992.
3) Mann, D.L., 'Matrix 2003; Updating the TRIZ Contradiction Matrix', CREAX Press, December 2002.

**Humour**

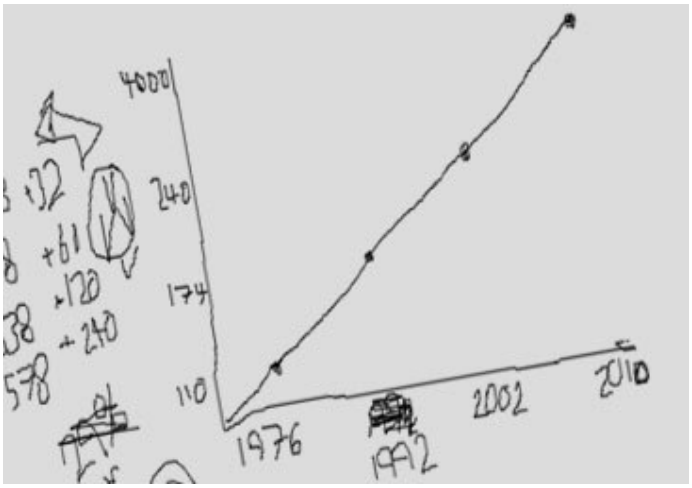
Inspiration for our humour section this month comes via a tip-off from a friend to visit the 'Sniff Petrol' website (**http://www.sniffpetrol.com/** ) – an excellent way to wile away a couple of hours on a dreary Friday afternoon.

Our attention was particularly drawn to an article in Issues 29 entitled '4000BHP GOLF BY 2010' SAYS MAN, which links very nicely to a question posed by another newsletter reader asking whether it was possible that jokes could come from the TRIZ Standard Solutions as well as the Inventive Principles.

The simple answer to that question is yes. Referring back to last month's patent of the month – which was also based on the Standard Solutions – we saw from the Standards for Measurement problems, Standard 4.1.3

*"Transform the problem into one involving successive measurement of changes"*

As detailed in the graph and description extracted from Sniff Petrol below, we can see precisely this Standard in action. Well, okay… maybe not precisely what the Standard had in mind, but the idea is there. Sort of.




*The Volkswagen Golf will have over 4000bhp by 2010, according to calculations carried out by an automotive maths expert. Professor Ken Freeply of Nigel Havers College, Kettering claims to have reached this stunning conclusion after studying the increasing power outputs of successive Golf models launched since the original GTi model of 1976. 'If we look at the way the output of the most powerful Golf increases over time it is possible to extrapolate future power ratings for the future,' Prof Freeply explained. 'So, where the original Golf GTi had just 110bhp,' the unamused brainiac continued after Sniff Petrol had apologised for laughing at him, 'The MkII GTi 16 valve offered 139bhp which is 126% of that original output. Then the MkIII VR6 put out 174bhp, 158% more, and a percentage point increase of 32. But when we get to the new MkIV R32 we find 240bhp, meaning a 218% increase, which is 60 percentage points more than the previous power peak increase. Thus we see that the percentage point increase pretty much doubles with successive generations which means we can look forward to a 120% increase for the MkV Golf, from which I have calculated 338% of 240bhp, or a stunning 811bhp. But, the real shock comes with the MkVI model which will enjoy a 240% increase, or 578% in total, and that means a staggering power output of 4688bhp for the top of the range variant.' Professor Freeply later denied that his maths was 'rubbish'.*

(For anyone interested, this example also uses Inventive Principle 16 – just in case you were worried that our previous rule about all jokes containing resolved contradictions was no longer valid. The point here, then, (there had to be some value in this, right?) is that sometimes there is overlap between the different solution generation tools within the TRIZ toolkit, and that different solution triggers can get us to the same solution.

## Patent of the Month

Patent of the month this month is US 6,459,855 granted to Minolta on 1 October 2002. The patent features several hopefully useful learning points. The first of these concerns its one word title ‘actuator’. We are seeing an increasing number of patents being presented with either very simple or very non-informative titles like this. We suspect that the strategy behind such titles is that they are unlikely to attract interest. In actual fact, our experience suggests, this type of title can in actual fact provide a very good indication that the contents of the patent are of considerable interest.

This happens to be the case in the Minolta patent – which concerns the use of shape memory alloys – a technology of considerable interest in the resolution of a large number of problem situations involving physical contradictions.

The abstract of the invention disclosure outlines the basis of the patent:-

**United States Patent** **6,459,855**
**Kosaka , et al.** **October 1, 2002**

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Actuator

**Abstract**

An actuator applied with shape memory alloy which can be operated in a wide operating temperature range and has a long life time. At a normal ambient temperature, when the first wire of the acting member made of shape memory alloy in which predetermined shape is memorized in advance, is heated, it is transformed to the memorized shape to enable the acting member to be moved. A relative low stress is generated at the first wire and its life-time is not shortened. In the case that the ambient temperature is increased to exceed a transformation starting temperature of the shape memory alloy, the second wire of shape memory alloy is transformed to the memorized shape to generate a high stress at the first wire and to increase the transformation starting temperature of the first wire. With such an arrangement as above, it is possible to operate the actuator applied with the shape memory alloy in a wide operating temperature range.

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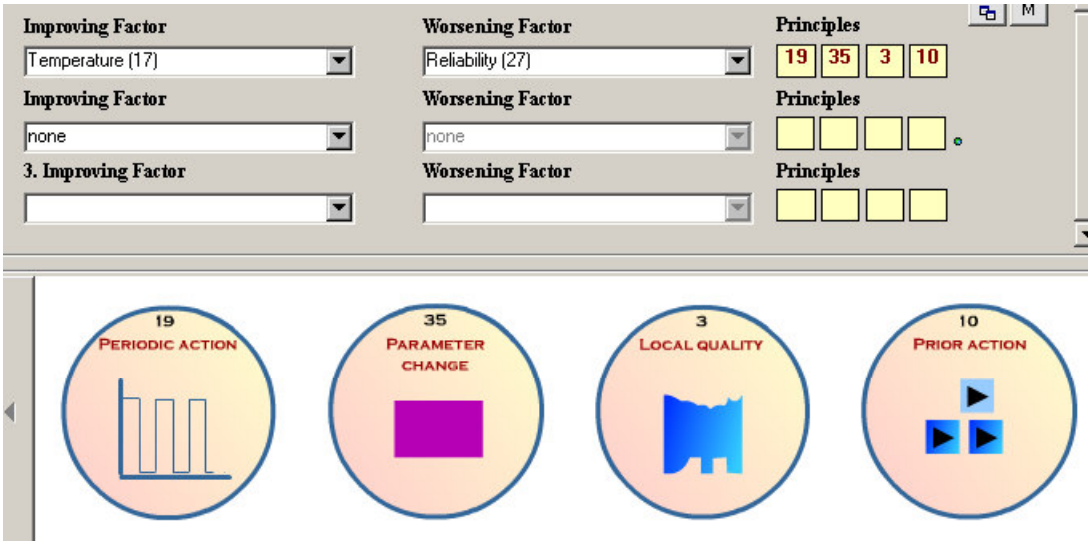
Inventors: **Kosaka; Akira** (Yao, JP); **Tanii; Junichi** (Izumi, JP); **Tanaka; Yoshiharu** (Kawachinagano, JP); **Minato; Shoichi** (Sakai, JP)

Assignee: **Minolta Co., Ltd.** (Osaka, JP)

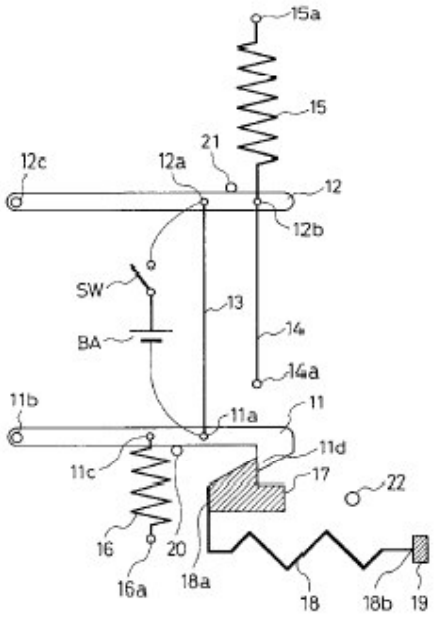
Consistent with the large majority of patents, the invention seeks to challenge a contradiction. In this particular case, the contradiction being tackled is one concerned with

the alloy itself – specifically, reading from the abstract a '*shape memory alloy which can be operated in a wide operating temperature range and has a long life time*'

Which, in TRIZ technical contradiction terms is a conflict as follows:-




The actual solution used in the invention manages to use two of the suggested Principles from the Classic TRIZ Matrix, although the main inventive step actually involves Principle 1, Segmentation. The figure below illustrates the main features of the invention.




Essentially, the invention works according to the description contained in Claim 1 of the disclosure:-

*What is claimed is:*

*1. An actuator comprising:*

*a moving member biased in a predetermined direction;*

*an engaging member for engaging with and stopping a movement of said moving member in the predetermined direction;*

*a first acting member connected to said engaging member and starting a shape transformation upon reaching a first temperature to move said engaging member to release an engaged state of the moving member with the engaging member; and*

*a second acting member effecting an operational response upon being heated by ambient temperature to a second temperature, lower than said first temperature, the operational response of said second acting member at the second temperature preventing movement of the engaging member by said first acting member when said first acting member starts said shape transformation.*

The two shape memory alloy components (labels 13 and 14 in the figure) are thus seen to act in such a way that one element (13) is used in 'everyday' low-stress applications, with element 14 only acting in out of the ordinary situations (e.g. in hot weather) to protect the first element.

The invention uses Segmentation in that it has transformed the inadequate functioning of a single piece shape memory alloy by adding a second piece. The most interesting aspect of this use of Segmentation is that it has increased the complexity of the system. As discussed on page 197 of Hands-On Systematic Innovation, there are times in the evolution of systems when it the resolution of contradictions is much more likely to require an increase in complexity rather than a decrease. SMA's – or the applications thereof – being at the relatively immature end of their S-curve, currently fall into this category.

In addition to Principle 1, the 6,459,855 invention also manages to use two of the Principles recommended by the Matrix: The overall method of operation of the actuator (i.e. the over-stress protection features) represent use of Principle 10, Prior Action, with a dash of Periodic Action (one SMA component acts in one set of operating conditions; the other acts in other conditions) and Local Quality (making use of the difference between SMA transition temperature and local ambient temperature to perform a useful action) thrown in for good measure.

**Best of the Month**

Okay, let's hope that everyone is saving their good stuff for the Strasbourg conference next month, because October presented us with a second month with very little of a TRIZ-specific nature for us to recommend to you.

For those with little time to spare, we recommend that you give this month a miss in terms of TRIZ reading (modesty prevents us from recommending our contributions to TRIZ Journal).

For those with a desparate urge to read something new that doesn't have a CREAX label attached to it, we'll opt for Martin Hyatt's article 'An Overview of Synoptics and the Six Challenges of Creativity'. It doesn't add anything new to the subject (except perhaps the uncomfortable word 'synoptics'), but the article is very nicely constructed and written in a style that is very readable.

**Investments – Quantum Tunnelling Composite (QTC) Technology**

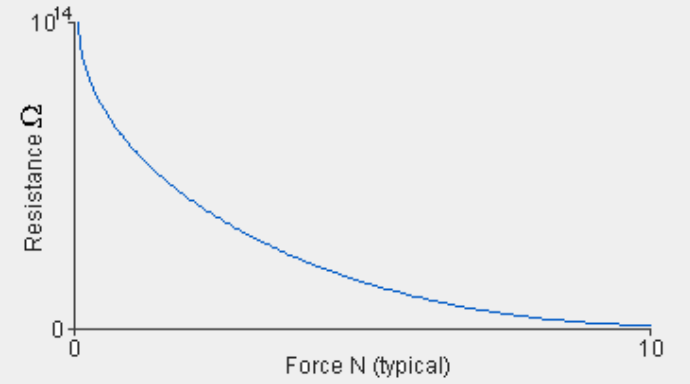
Investment of the month this month comes from a very surprising source; the UK television programme Tomorrow's World and its annual Innovation Awards programme. Whereas the programme normally features inventions that are more laughable than laudable, this year, the organizers had made an obvious move towards gaining a tad more credibility and as a consequence featured one or two ideas with some actual merit. The best of these was the 'Invention in Industry' award, which went to Peratech in the North East of England (http://www.peratech.co.uk/).

Here are a few highlights from their website describing their quantum tunneling composite (QTC) technology:

## Technology

QTCs are a solid state material which change from an insulator to conductor when pressed, stretched or twisted. QTCs can be used to make switches, variable resistance controls and sensors that respond to force, temperature and volatile organic compounds. They also have electromagnetic and radio frequency screening properties.

Operating pressures can be extremely small or large; they can be mechanical or electrical and may be applied directly or can be induced in QTCs.




Peratech's Quantum Tunnelling Composites (QTCs) form a new class of electrically conductive composites that conduct electrically by a process called electron tunnelling. Electron tunnelling is a consequence of Quantum Mechanics allowing current to pass between conductor particles within the composites that are not in physical contact. The dependence of tunnelling current upon conductor particles separation is exponential, therefore an enormous resistance range can be controlled by relatively small changes in separation.

Durham University has assisted Peratech in the understanding of the complex physics behind the behaviour of Peratech's QTCs.

- **Bulk QTC**
  This has the look and feel of 'rubber'. It can be cast, extruded or moulded.
- **Granular QTC**
  This looks like dark grains of powder. Each individual granule has the same properties as a sheet of bulk QTC and if required can be put into and onto other surfaces or materials to impart the novel electrical properties of QTCs to the host surface eg onto foams, plastics etc.

This is one of those inventions where, as soon as you realize that it is possible to produce a material that is both conductor and insulator (a physical contradiction resolved!), you

recognize a whole host of possible applications of the concept. We're already thinking of ours, we invite you to do the same.