

## What Happens When We Have Improved the Crap Out of the System?

*“We can seek to do better and better at what we are doing now – or we can change the way we do something. As a student, Fosbury did not seek to get better and better at the Western-roll method of high jump. Instead he invented the Fosbury flop, which is a different approach. He won the Olympic high jump and changed the method forever.”*

Edward De Bono<sup>(1)</sup>

This article is about two things; firstly the application of TRIZ tools to help solve contradiction chains, and secondly the idea of limiting contradictions and how there comes a point in every system where further improvement can only emerge by changing the system. Our lead for both is the Olympic high-jump event. As described in the quote at the start of the article, the Fosbury flop fundamentally changed the sport of high-jump when it emerged to challenge the ‘normal’ Western-roll jumping style (Figure 1).



Western Roll



Fosbury Flop

**Figure 1: Fosbury Flop versus Western-roll High Jump Styles**

This event represented a significant shift in the prevailing system. Nearly all jumping coaches up until Fosbury’s revolutionary appearance at the 1968 Olympics were stuck in the Western-roll paradigm and before that the straddle; every coach was trying to obtain the last millimetre of benefit from styles that were rapidly approaching their fundamental limits.

In this sense, it is quite interesting to note how the Contradictions part of TRIZ would have dealt with the Western-roll problem. The thing trying to be improved in this instance was quite clearly the height achievable by the jumper. This maps reasonably directly into the 39 parameters of the Contradiction Matrix as ‘Length of Moving Object’ (‘moving’ because there is relative motion between the jumper and the pole being jumped over). The thing preventing the improvement in the case of the Western-roll was speed – in that it was not possible for the jumper to increase their speed any more. Thus the Western-roll was limited by a height versus speed contradiction. In this situation, the Matrix recommends Inventive Principles –

- 13 – The Other Way Around
- 4 – Asymmetry

## 8 – Counter-weight

It is hopefully interesting to record that Dick Fosbury applied both Principles 4 and especially 13 with his revolutionary jumping style.

This provides an interesting (if trivial) validation of the Matrix. What is perhaps more interesting is whether we can use the Matrix again to help us break-out of the limitations of the Fosbury flop – which after nearly three decades has now also been seen to be reaching the fundamental limits of its capability – as shown below, the world record has now stood at 2.45m for almost 10 years.

Year	World Record (m)
1912	2
1914	2.01
1924	2.03
1933	2.04
1937	2.09
1941	2.11
1953	2.12
1957	2.16
1960	2.22
1961	2.25
1963	2.28
1971	2.29
1973	2.3
1976	2.32
1977	2.33
1978	2.34
1980	2.36
1983	2.38
1984	2.39
1985	2.41
1987	2.42
1989	2.44
1993	2.45

The first thing to note concerns an obvious first thought that the contradiction we wish to solve this time around is the same as the previous one – i.e. height versus speed. The interesting fact here that says we can't do anything here lies with the Other Way Around Inventive Principle. Perhaps not surprisingly, this case serves to demonstrate the fact that it is likely that we can deploy this Principle only once to solve a given contradiction – i.e. if we try to deploy it a second time, we are likely to take ourselves back to the original system. Actually this is not quite true. More accurate would be to say that we cannot apply it the same way two times – we could deploy it another way for example if we think about the staggering heights obtained by circus tumblers and imagine that instead of the jumper launching themselves over the bar using their feet, they should instead launch themselves using their hands.

In actual fact, although the latter idea is good (albeit possibly illegal), we don't have to think about this contradiction because, as anyone who has watched a Fosbury flop jumper in action will know, at the end of the run-up, the jumper is almost running backwards, and so increased speed is not the dominant issue.

None of the CREAM staff is an Olympic athlete (understatement of the year!). If we were, however, or if we were in the business of advising coaches how to break out of the Fosbury-flop paradigm and into a new and better one, we would be looking to solve the current limiting contradiction between the desire to jump higher ('length of moving object' again) and the fact that either the stresses and pressures on the human knee are preventing us, or the way we are able to use the available energy are the limiting factors.

Thus height versus Stress/pressure and height versus use of energy contradictions suggest that the jumping style that will supersede the Fosbury flop may come from one of the following Principles:-

1, 8, 35, or 24.

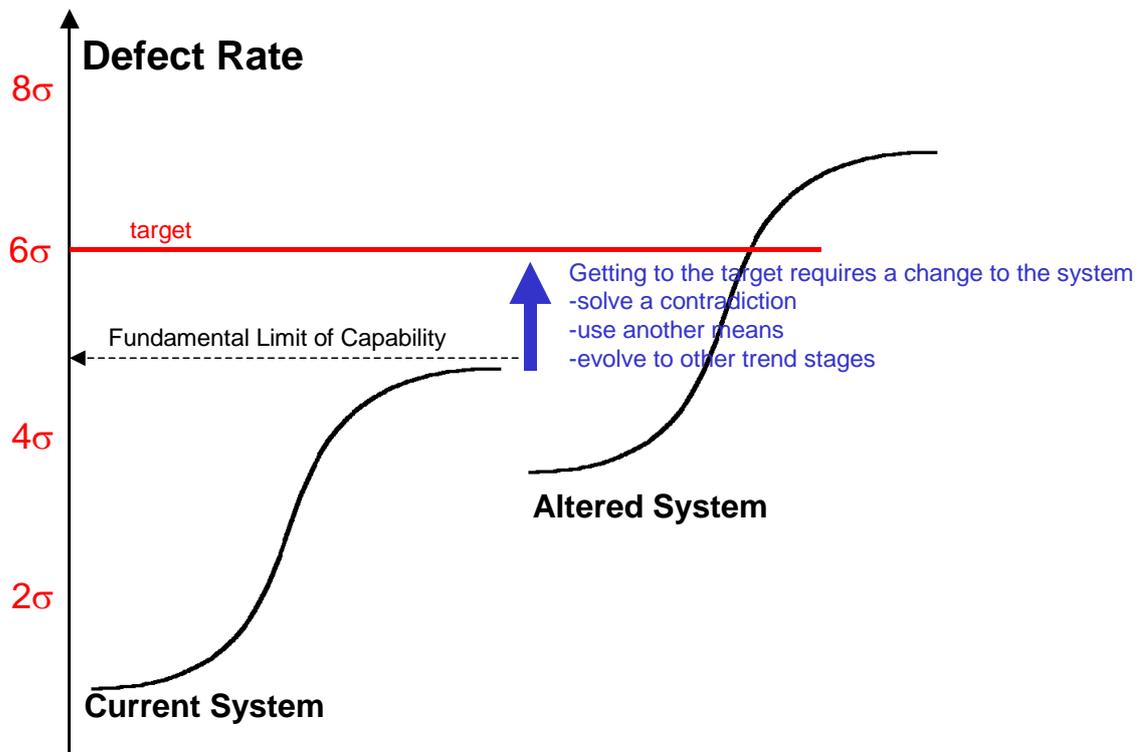
Principle 24 ('Intermediary') sounds somewhat less than legal in an Olympic context, but Principle 8 (again!) and Principle 35 (particularly 'increase the degree of flexibility') sound like they could be promising. A counter-weight in the strictest sense, of course, would also be against the Olympic rules, but the related ideas of stored energy and pre-tensioning also seem to point towards the strategies used by circus tumblers.

### **Systems Hit Limits**

The main point to be noted from the Fosbury flop story is that systems hit fundamental limits. Just about the whole of the mathematics we use to improve systems is based on optimisation. This is great, of course, when the system has not hit any fundamental limits. But after it has, as we discussed last month, no amount of additional optimisation is going to deliver any better performance.

A good example of this in practice comes with the so-called 'Six-Sigma' 'method'. Six Sigma is about reducing defect-rates during (predominantly) manufacture operations. A six-sigma defect rate (about one reject per million depending on how strictly you apply the mathematical smokescreen) can be a useful goal (it can also be excessive – think of placing cherries on the top of cakes – or inadequate – think of a pacemaker battery, which helps to demonstrate the arbitrariness of the concept).

A 'useful goal' is unfortunately not the same thing as an 'achievable' goal. This is because of our friend 'fundamental limits' again; quite simply, if the fundamental limits of the manufacture process under evaluation are less than six-sigma, we will never reach six-sigma defect rates. At least we won't until we change the system. The overall message is illustrated in Figure 3.



**Figure 3: Improvement Beyond 'Fundamental' Limits Demands A Change of System**

What the Figure tells us is that sometimes, the only way to achieve a goal is to change the system. The Root Contradiction concept from last month is one way of identifying what the limiting factors of the current system are. There are other ways. What is clear, however, is that changing the system means solving a contradiction. Which in turn means doing like Fosbury did, and applying an Inventive Principle or two.

## References

- 1) De Bono, E., 'New Thinking for the New Millennium', Viking, 1999.

## **New Applications - Lasers**

Any of our readers familiar with the trends of evolution parts of TRIZ will be aware of the importance of field-based solutions. An example of a very effective, but as yet much under-utilised field resource is the laser.

Our new applications section this month emerges as a result of finding the Trumpf Group's bi-ennial Innovation Award to promote and stimulate interest in laser technology. The award targets 'outstanding research work in applied laser physics in production technology or laser medicine'.

Lasers are capable of delivering a number of useful functions. In keeping with our article of last year on 'Opportunities', the key to successful exploitation of opportunities is the identification of problems that can make use of the functions delivered by the laser.

The prize for the Award is quoted to be 35,000Euros. Anyone wishing to take part should contact [sales@uk.trumpf.com](mailto:sales@uk.trumpf.com).

You might like to think about our previous article on 'opportunities' ([hyperlink here](#)) and the trends of evolution pointing to things being done by fields rather than fluid-based or mechanical means. The trick to winning the Trumpf group award, we think, is to identify either a mechanical or a fluid means of delivering a function and then working out why a laser (field) method would do it better.

## Best of the Month

Another pretty thin month as far as published TRIZ literature is concerned. We did forget to mention Jack Hipple's paper in the January issue of TRIZ Journal (our excuse is that we read it in the TRIZ Future conference proceedings last year!). The important point made by Jack is that different people have different ways of thinking and working and, with the best will in the world, no TRIZ or any other kind of creativity session is going to produce effective results if those differences are not taken into account. Link to the article here, or contact the office if you'd like one of the few remaining hard-copies of the conference proceedings.

Beyond that, we were extremely flattered to be featured in the Anti TRIZ-Journal Journal (i.e. it's anti TRIZ-Journal, not anti-TRIZ). Anyone wanting a few moments of amusement might like to check out 'The TRIZ Sins of Darrell Mann' at. If the journal had been put together with more than half an hour's thought, we might find ourselves book-marking it for future reference. That being said, we have promised to publish something in a future issue. The working title is 'The TRIZ Sins of Darrell Mann Part 47: When will he shut up and leave us alone'.

A final thought on the Anti TRIZ-Journal Journal; is that it fits almost exactly into the Mono-Bi-Poly(Increasing Differences) trend of evolution. Congratulations, therefore, to the editors for having the idea first.

Anyway, back to reality, our real recommendation for this month is another not-really-TRIZ-but-nevertheless-very-TRIZ-like 'Disruption: Overturning Conventions and Shaking up the Market-Place' by Jean-Marie Dru. Monsieur Dru's book is about the power of disruption as a strategy in the world of advertising. Disruption in advertising turns out to mean jumping to a new s-curve. The strategies documented in the book for achieving these jumps are not elicited very well. Anyone who reads the book knowing about the use of contradiction elimination and the trends of evolution (particularly the business analogies) will immediately see that these are precisely the strategies underlying the jumps described in the book. In other words, eliminating contradictions and using trend jumps maps directly to successful advertising campaigns. Expect more from us on this subject in the coming months. In the meantime you might like to check out [www.disruption.com](http://www.disruption.com) to see examples of disruptive advertising campaigns.

## News

'Hand-On Systematic Innovation' will be published by CREAX Press in mid-April, price 65 Euros. Advance orders are already looking very good. Pre-order your copy by phoning the office or purchasing on-line.

We will be featuring the book and the latest versions of the software when we attend TRIZCON in St Louis at the end of April. We are presenting five papers at the conference, either as CREAX or in collaboration with people we like working with.

We are also co-presenting a half-day TRIZ/systematic innovation seminar in Torino, Italy on April 19. More details at....

We are also pleased to announce that CREAX is helping to speed the full launch of the European TRIZ Association (ETRIA), by hosting and managing the web-site and monthly newsletter. The main aim of ETRIA is to try and co-ordinate TRIZ expertise within and beyond Europe. CREAX is proud to be able to play a part in this activity.

Anyone interested in integration of TRIZ with other creativity methods may be interested to learn that we are presenting two papers at conferences in the US in June – one examining TRIZ used in conjunction with Design for Manufacture and Assembly; the other discussing our work to integrate the best of Axiomatic Design practice into a systematic creativity context.

Details of the DFMA conference can be found at [www.dfma.com/forum/](http://www.dfma.com/forum/)

Details of the Axiomatic Design conference are at <http://axiom.mit.edu/icad2002/>

When this letter is issued, Darrell will be in Las Vegas presenting a paper at the International Fluid Power Exhibition ([www.ifpe.com](http://www.ifpe.com)) describing the use of the CreaTRIZ trends and 'evolutionary potential' concept to help design more effective fluid power systems.

## Patent of the Month

We had to look through over 2000 patents this month before we found something we felt was worthy of the 'patent of the month' title. As it turns out though, US patent 6,353,033, 'Method and apparatus for cutting high viscosity liquid material' awarded to Dow Corning on March 5, looks like one of the most elegant we have featured so far in this part of the newsletter.

According to the invention disclosure;

*"A method in which a high viscosity liquid material is cut into blocks for easier handling is frequently employed in fields of technology dealing with rubbers, plastics, adhesives, paints, and foods. For instance, in the manufacture of an organic solvent solution of a high viscosity liquid material such as crude silicone rubber or synthetic rubber, the high viscosity liquid material is taken from its manufacturing apparatus or storage site and cut into blocks, and these blocks are then put into an organic solvent and mixed.*

*"In fields of technology dealing with high viscosity liquid materials such as foods, a high viscosity food material whose main ingredient is a starch or protein is taken from its storage site through a supply pipe, cut into blocks, and these blocks are sealed in a container.*

*"A method employed in the past for putting such high viscosity liquid materials into the form of blocks was to cut the material with a **mechanical means** using a blade or cutting tool similar to a blade. However, when the high viscosity liquid material was a tacky material, the high viscosity liquid material would often adhere to the surface of the cutting tool and decrease its cutting performance. In severe cases it was even impossible to cut the high viscosity liquid material. Also, if a block form of the high viscosity liquid material needed to be discharged in a specific quantity, high viscosity liquid material adhering to the cutting tool had to be scraped off or washed away each time, and this resulted in poor productivity."*

Anyone familiar with either the object segmentation or dynamization trends in TRIZ will make a connection between the prevailing method of cutting high viscosity liquids using mechanical blades ('completely flexible') and the jumps towards either fluid or field based alternatives.

The invention, in fact, makes one such jump – describing how the cutting operation can now be performed by a 'low viscosity fluid'. In this case that fluid includes:-

*"...water; aqueous solutions of inorganic salts such as brine; ethanol, acetic acid, ethylene glycol, and other such hydrophilic organic compounds and aqueous solutions thereof; low viscosity diorganopolysiloxanes; organic solvents such as toluene, xylene, and hexane; and edible oils."*

While this makes a good example of the trend in action, it is by no means the whole story behind this invention:

*"Method and apparatus for cutting high viscosity liquid material, said apparatus comprising a cylinder divided into upper and lower tanks by a partition with a central discharge opening, a moveable and elevatable liquid supply pipe with a distal end positioned opposite the discharge opening, the liquid supply pipe being mounted so that it can be*

*raised until its distal end contacts the partition around the discharge opening, and then lowered until there is no contact, means for raising and lowering the liquid supply pipe, the upper tank having peripheral injection ports for injecting a low viscosity liquid into the upper tank, means for feeding high viscosity liquid material into the lower tank and flowing it into the upper tank, means for feeding low viscosity liquid into the liquid supply pipe and for feeding low viscosity liquid into the peripheral injection ports, the high viscosity liquid material flowing from the lower tank into the upper tank when the liquid supply pipe is lowered, the high viscosity liquid material being pushed upwardly into the upper tank by the low viscosity liquid when the liquid supply pipe is raised, whereby the high viscosity liquid material being pushed upwardly in the upper tank is cut into blocks by the low viscosity liquid being injected into the upper tank.”*

In other words, by making a bath of the low viscosity fluid, where the density of that fluid is greater than that of the higher viscosity fluid, it becomes possible to achieve two things:-

- 1) the high viscosity fluid floats – and so is easy to move,
- 2) once it has been used to cut the high viscosity fluid, the low viscosity fluid is automatically returned to where it started as the high viscosity fluid is already floating in a bath of the low viscosity fluid – and so there is no need to set up special recovery systems.

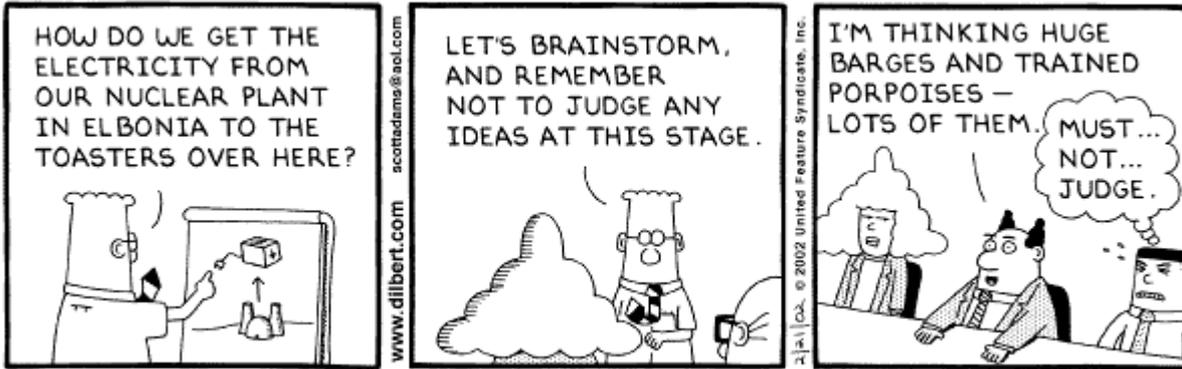
The low viscosity fluid is thus used as a resource three times – it achieves a cutting function, it achieves a transport function, and it achieves a self-cleaning function.

It is also likely (although not explicitly mentioned in the invention disclosure) that the low viscosity fluid can be made to achieve a fourth useful function – by making its constitution have some form of useful interaction with the material being cut – for example, the low viscosity fluid could contain flavourings or preservatives.

All in all, we like this patent – it provides a good example of the trends in action, and an even better example of using resources to their maximum advantage.

## Humour

Damn!



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One of the things we missed when we were compiling the 'move field' part of the CreaTRIZ knowledge/effects database.

Catch more great Dilbert cartoons at [www.dilbert.com](http://www.dilbert.com).