

Enhancing TRIZ' Mapping of the Structure of Problem-Solving by Incorporating Neuro-Semantic Approaches: How to Think Better Outside & Inside the Box

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Abstract

Thanks to its eclectic approach, open to incorporating inputs from similarly-focused disciplines, TRIZ is continuing to evolve and improve, to the benefit of its practitioners and their clients. Comparing TRIZ' approaches with those of NLP/Neuro-Semantics has already born significant fruit. In this paper we present a cutting edge Neuro-Semantic model for mapping the structure of problem-solving and demonstrate how it complements the one which TRIZ offers. We show how it significantly enriches the TRIZ model, all the while enabling it to retain its simplicity and elegance. We demonstrate its use by applying it to specific case studies to see how it contributes to approaching ideality.

Synopsis

In our previous paper (1) we showed how incorporating NLP/Neuro-semantic approaches into TRIZ had enriched the model and gave us a more synthetic perspective on Altshuller's 40 Principles

We introduce the Mind-Lines Neuro-Semantic model (2), initially designed to identify, clarify and resolve contradictions in human intra- and interpersonal relationships, and show how dovetailing it with TRIZ further enhances TRIZ' effectiveness by opening out many unexplored avenues where contradictions may not exist.

Many people have already applied the TRIZ model to resolve human contradictions. We here reverse the process by showing how the Mind-Lines model can also be used to solve physical contradictions by enabling human operators to identify and redress the limitations and filters that they apply, and thereby to think differently about a given issue from a range of perspectives, potentially resolving contradictions perhaps perceived as insurmountable before. We also show how to apply the Mind-Lines model "as if it was part of TRIZ."

We conclude by examining the benefits that TRIZ might draw from incorporating this model into its structure to make it even more versatile.

TRIZ ongoingly demonstrates its effectiveness at enhancing ideality by resolving contradiction identified in specific problems. The reasons why it can do so is that, most of the time, these contradictions are apparent and relate to differing “levels” in the system.

A useful question to ask before carrying out any intervention is: “Where does the contradiction lie? Is it in the product or is it in my mind?” The very fact that so many contradictions have been resolved by applying TRIZ indeed shows the remarkable self-consistency of the physical world. It is only our comparative ignorance of the physical world, even today, which makes us consider that contradictions lie “out there”. Most of the time, what we actually deal with are *perceptions of contradictions* resulting from our limited perspective on an issue, and not actual ones. These reside in our mind and not in the world. Indeed, it was an engineer, Count Alfred Korzybski who, in his epoch-making book *Science & Sanity* (1933) identified and highlighted this fact.

To resolve these *Perceptions of Contradiction* requires that we change perspective in some way. This allows us to consider whatever problem from a different angle or even a range or combination of different angles, until we find one where, either the contradiction is altogether resolved, or it is reduced to a manageable level whereby the benefits of the solution outweigh the costs involved in implementing it and the harms that such implementation will cause, following the well known ratio shown right. (Figure 1)

$$\frac{\text{Benefits}}{\text{Costs + Harm}} \geq 0$$

Figure 1

Ideality, of course, is approached when **Benefits** approach ∞ and **Costs + Harm** near **0**. As it is an absolute, it will be subject to situational constraints in terms of Location, Time, Interrelationships and available technologies.

To do so, we already employ a range of approaches, most commonly, the 40 TRIZ principles (and their corollaries). To make a sweeping generalization, these for the most part, effect a change of scale, whereby we can identify sub-components and change one or more of the sub-components, by removing one or more, adding another or more, change its nature or a combination thereof, as per

	Space	Time	Interface	
Segment	1	18, 19	2	Number
Magnify		20, 21	5, 6, 7, 33 38	Size
Re-shape	3, 4, 14, 17	15	12, 16 39	External Shape
Modify	30, 31, 32, 36, 40	9, 10, 11	8, 37	Internal Structure
Substitute	26, 28 29, 35a	27, 34	23, 24	Content

Figure 2

the matrix presented in a previous paper, (Figure 2) (Ref. 1).

In Neuro-Semantics we have developed a synthetic approach which offer a wide range of permutations and combinations which we can apply whenever we work with clients' issues. You may say that, since these contradictions in the main occur in the mind of our clients, the possibilities to work with them are de facto wider, but I invite you to wonder "What's the difference?", considering that, as demonstrated above, even physical contradictions are consequential to our perception of them. We suggest that, by openly acknowledging the subjectivity of our perceptions of contradictions, TRIZ incorporates this extended range of choices to resolve an even wider range of issues.

The Neuro-Semantics model we apply to explore such alternatives in thinking, feeling, speaking and behaving is called the **MIND-LINES MODEL**, in that it draws the mind to consider different lines of tack to take in order to explore what they offer.(Ref. 2)

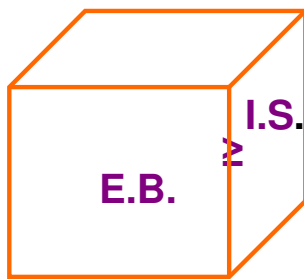


Figure 3

In the ML model as applied to human issues, contradictions most commonly arise between a perception of a given External Behaviour and an awareness of Internal State either equated with this behaviour or consequential to it. (Figure 3)

In a physical system however, contradictions can occur between differing perceptions of External (physical) Manifestations, and differing interpretations of Internal (in our mind) Perceptions, or a combination of the Physical and the Perceptual. All these permutations and combinations thereof form only a fraction of the potential choices and alternatives available to us at any moment in time. Another typical one follows beside right. (Figure 4)

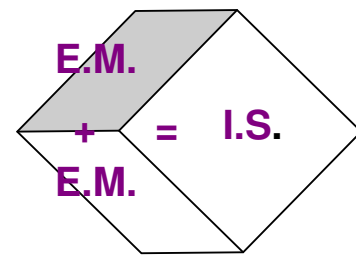


Figure 4

There are broadly eight categories of Mind Lines, which themselves fall into 4 super categories:

DEFRAMING	INFRAMING	OUTFRAMING	PARAFRAMING
	Content Reframing Counter-framing	Pre-framing Post-framing Meta-Framing Outerframing	

The first 3 Super-categories correspond but are not identical with the Sub-System, System and Super-System approach of TRIZ. The last category does not officially exist in TRIZ as such, although many TRIZ masters use it regularly.

I will now introduce each category and its sub-components in a highly simplified fashion. Each can be used in combination with any other or recurrently, with itself.

DEFRAMING:

Going down into particulars of the nature of the experience, its sensory constituents and the parameters of each constituent.

Identifying the constituents of the experience and their order as it evolves over time to identify what causes the problem: it may be that it has too many constituents, too few of them, the wrong constituents, a wrong order of these, extraneous loops between constituents, too few of these, etc..

INFRAMING:

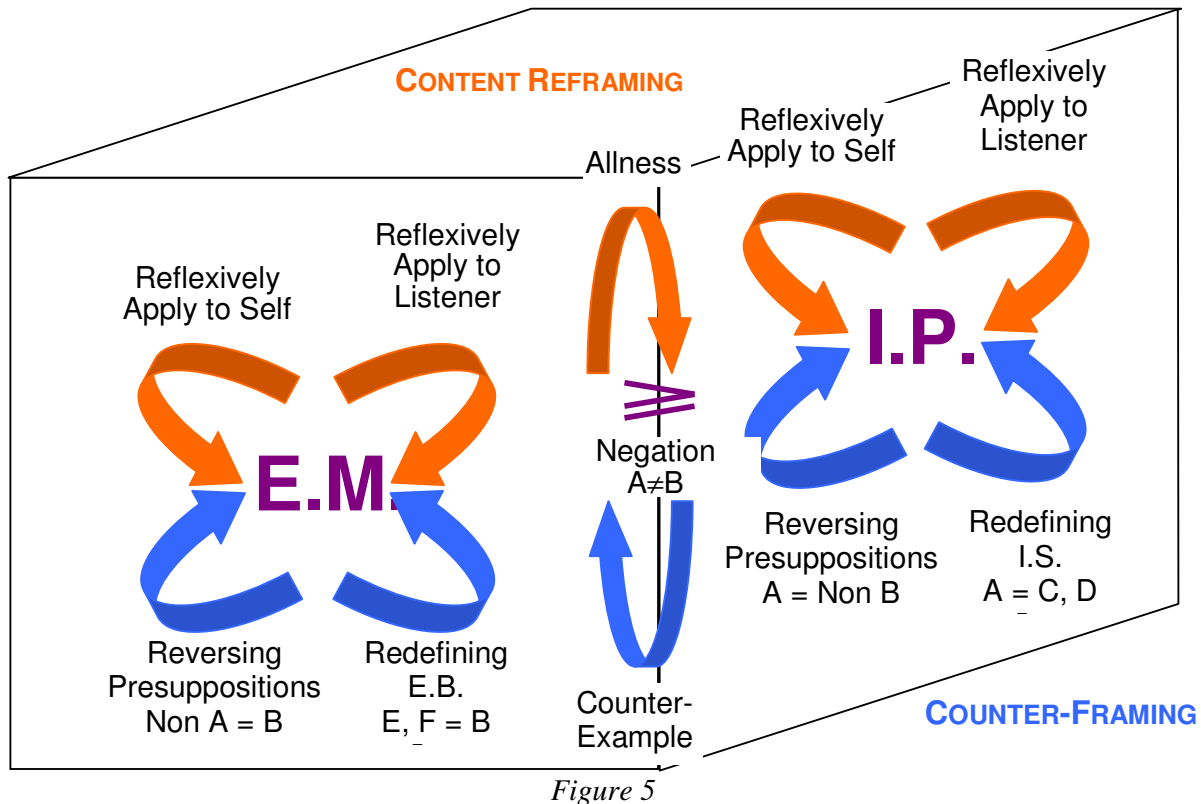


Figure 5

CONTENT REFRAMING

The structure of the contradiction itself, usually expressed in terms of $A=B$ or $A \neq B$. What actually happens is that each of these equations is perceived as bad or toxic.

Working with these involves **changing the terms of the equation**.

- ❖ From $A=B$ to $A=C, A=D$, etc. or
- ❖ From $A=B$ to $C=B, D=B$, etc

[Another set of Content Reframes involves reflexively applying A upon A, B upon B, A upon B and B upon A from the perspective of the speaker or the listener. I leave it to TRIZ Masters to identify how this would fit into TRIZ as applied to physical issues, but it is very effective at addressing human issues.]

COUNTERFRAMING:

This involves **ascertaining the accuracy of the equation in a range of contexts by reversing it or deliberately adding extraneous contradictions**.

- ❖ Does $A=B$ everywhere, all the time, with everybody? Might there be times/places when $A \neq B$? Might there be people for whom $A \neq B$?
- ❖ It's not that $A = B$ or $A \Rightarrow B$, but that $B = A$ or $B \Rightarrow A$.
- ❖ If $A=B$, then the more A=the more B. Does that mean that the less A=the less B?
- ❖ What about: if the less A=the more B, or the less B=the more A?
- ❖ What if in fact $Non-A=B$? What if in fact $A=Non-B$?

Even a cursory presentation of the patterns referred to so far will have rung a bell in any TRIZ practitioner. Indeed, you may have recognized them already as frames of mind that you regularly apply. You may, however, be less familiar with some of the following ones.

OUTFRAMING

PREFRAMING AND POST-FRAMING

These will be presented together, as they form a mirror image of each other.

PREFRAMING looks at the world of origins, causes, and intentions. It also looks at how and when a model of the world, or mode of practice began to manifest.

We are very aware of *causality* from an early age. A favourite question of children is the question: *Why?* But we are not often aware of the structure of causal linkages. What caused this and what caused this? And what was the original cause behind all this? An fascinating example of this is how the size of Space Shuttle tanks may actually owe their diameter to the width of war chariots in the Roman Empire!

Tracking back a chain of causes can enable us to resolve issues far upstream. Indeed, in one of Zola's novels, one of his characters says: "I spend my life rescuing people drowning in the river. I wish I had time to go upstream to find out what make them fall in the first place. If I did something then, they might not fall in anymore." So the best place to resolve a contradiction is not necessarily where you notice it, but somewhere up the line, where changes may be much easier to manifest. In addition, the contradiction may only be a symptom of something underlying it. Going for its underlying causes may not only resolve this contradiction, but many others along the way.

Also, we tend to be very aware of some causal linkages but not of others. One event tends to have many causes and one cause many different consequences. As you run the system backwards in time, does it take you directly up the expected causal chain or somewhere else?

In the same way that we can go up the causal chain, we can also **ascend the chain of intentions**: "What did you have in mind in doing this? What was the intention behind that? And what was the intention behind that?" Going up the chain of intentions can allow identification of an intention which got lost on the way. Going back to this may resolve the perceived contradiction. In Neuro-semantic , we say that "There is something positive for us behind everything we do." The external manifestation of this may be perceived as a contradiction, but recovering the initial intention commonly often different choices and avenues.

What usually occurs is that we commonly start with an honorable intention, which at the time, worked well enough for us. It was adaptive, ideal enough for the time and circumstance. However we have moved on and the world has changed and this adaptive behaviour has now become maladaptive. Many of the ills of pollution and environmental damage arose from a perception of abundance of raw material. Moreover, although evidence amply demonstrates that such resources are finite, we still behave as if they're infinite, hence 'gas-guzzlers', deep sea fish-trawlers, etc. By refreshing the initial intention, we can ask how to manifest this in a world of finite resources.

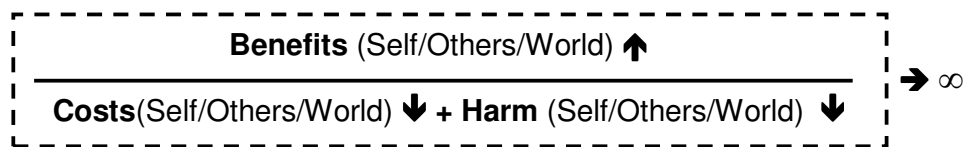
Many practices in science, technology or anywhere else arise because somebody did it once and it set a trend, a paradigm, a '*Model of the World*' in motion and too often we play in a frame set well before our time without being aware that we can do something else. A contradiction may arise because of such a frame. **Questioning where the "Model of the World" frame originates** from and its validity can allow us to step out of it and identify better alternatives. We call this "Thinking Out of the Box".

POSTFRAMING looks at the world of outcomes, consequences, implications and finality. Consequently, it naturally explores the issue of ecology.

Sometimes we have an **outcome**: Ideally **we need to know what we want**. If not, anywhere will do. We want something but we don't know what it will do for us to have this or do that, at least not much beyond 2nd order outcome. **Structuring a chain of outcomes** can serve us to differentiate between means outcomes and end outcomes. A greater awareness of this can enable us to take shortcuts: "If we really want that, do we need to do this, this and this to begin with?" By **identifying an end outcome** we can also find out about the necessary intervening steps to get there. Those of you who play the game "Civilization" undoubtedly realize this.

"Knowing that whatever we do has consequences is the beginning of wisdom", goes a Chinese saying. **Identifying such consequences** can allow us to prepare for them. Our previous paper (*Ref. 1*) showed how to map with much greater precision the positive and negative **consequences** of an action or inaction but did not go beyond that. We tend to be aware of the immediate consequences of an action, but less often so of the consequences of the consequences of such. So, in the same way that we looked for 2nd, 3rd, nth order cause earlier, we can look at the 2nd, 3rd, nth order consequence of an action. Chess players are very familiar with this concept and they can track in their mind the implications of an amazing range of combinations and permutations which informs every move they are going to make.

By **looking at the consequences of an action** (or of an inaction for that matter) and the implications of that for ourselves and other people we can plan ahead, get the benefit of hindsight beforehand, plan for contingencies. Very often we are so concerned by the here and now that we neglect to identify potential contradictions lying ahead of us which, if we considered them and altered our course accordingly, need not arise in the first place. Being mindful of the consequences before we start can enable us to factor them into the equation so that they need not arise in the first place. The worthwhileness equation now reads:



Timeframe:

- ✧ *at this moment in time*
- ✧ *within a given period of time*
- ✧ *from now on*
- ✧ *for the foreseeable future*
- ✧ *forever*

Figure 6

Ecology is the systemic science which explores the ultimate consequences and implications of behaviour. These can often be very far removed in space, time or inter-relational chain terms. The 16th c. French author Rabelais said: "Science without conscience is only ruin of the soul", and many decisions made within a narrow perception of ideality often make things worse for somebody or something, ourselves or others, either later or elsewhere or both.

Again a perception of ideality without awareness of consequences down the line is less than ideal itself. Every day, we are reminded of what is happening to the planet, most probably as a

consequence of our search for greater ideality of comfort and means for our ancestors and ourselves. More ideality in terms of comfort for us may be stoking up a much decreased ideality of conditions for our children (in the widest sense of future generations round the world) and grandchildren, “Yeah, unto the 7th generation”, a much deeper contradiction which involves the whole world.

Is that what we want? What should we do instead? How could we ensure that the optimal physical, mental and spiritual well-being for us here and now benefits them, there and then?

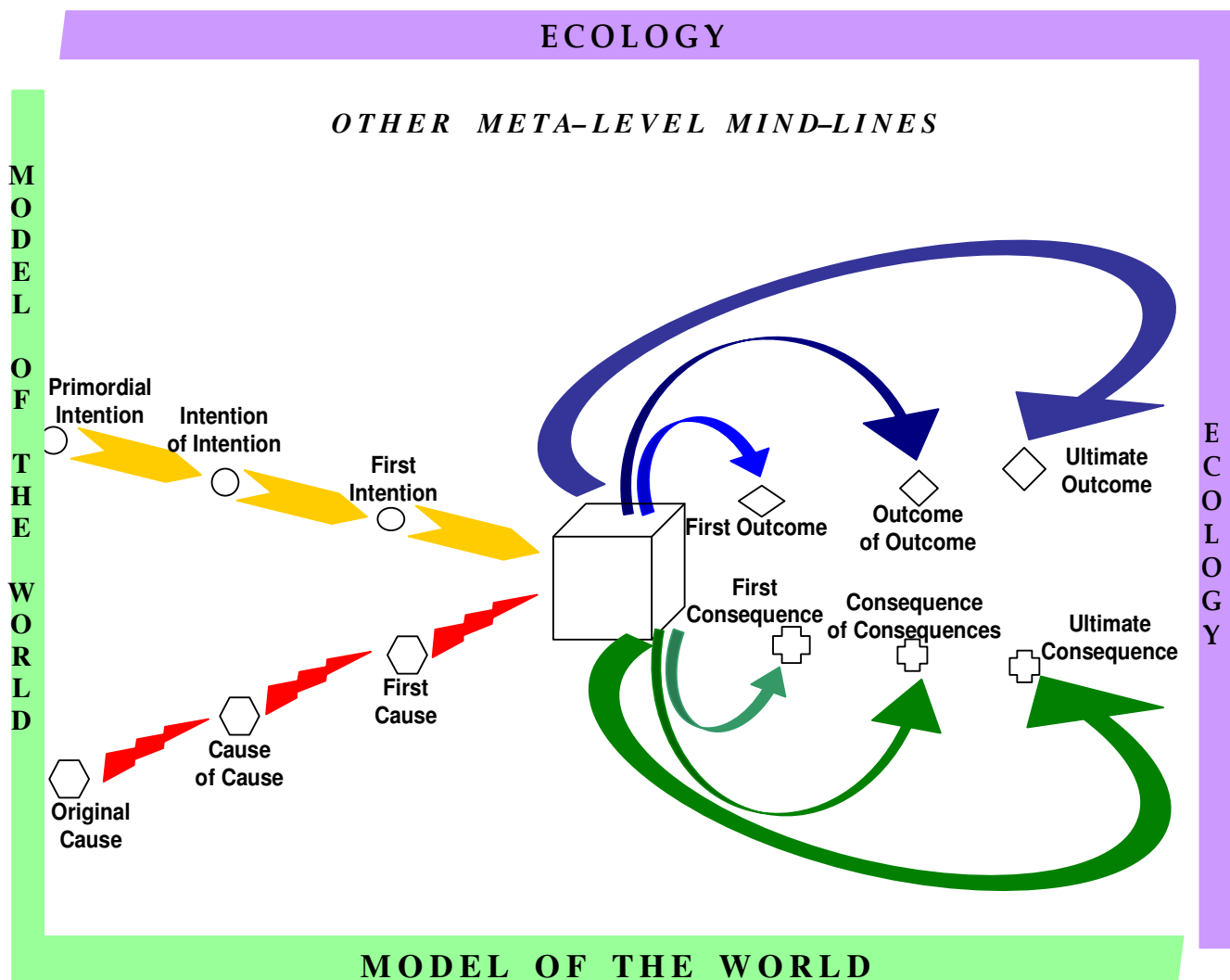


Figure 7

META-FRAMING

Values, & Priorities and Their Opposites

Before we do something or carry out an intervention, it is useful to **know what we value, what’s important** about what we seek to accomplish or to resolve. Many initiatives or interventions fail because people focused on the wrong priorities. These priorities will vary depending on the issue or market. Drawing a list of priorities is not sufficient: how do you prioritise which should go at the top? Therefore you also need to put them in an order of importance in order to be clear about what you are trying to accomplish.

Eliciting and ordering values is a systematic process. Ask the client to list the 7 to 9 things that are important to them in the context that you are dealing with, such as Convenience, Price, Quality, Speed, Sturdiness, etc. Notice how values are abstract concepts which only exist in our mind. To put them in order of importance, oppose them two at a time going down the list, asking:

"If you could have A and not B, B and not A, which would you have". Answer: A

"If you could have A and not C, C and not A, which would you have." Answer: C

"If you could have C and not D, D and not C, which would you have." Answer: C

"If you could have C and not E, E and not C, which would you have?" Answer C
and so on, until all values are sorted by order of importance by a process of elimination.

Notice how not all these can be met equally but, as long as the topmost ones are, the rest may follow. In the 1990s NASA embarked on a series of initiatives identifying a triarchy of values in the mantra of "Better, Faster, Cheaper", without realising that these were mutually incompatible: Faster + Cheaper usually meant worse, such as cutting unnecessary corners, which several times invalidated the whole mission and cost more in the end. Better + Cheaper usually means slower, while Better + Faster usually means more expensive. Many other issues have more than these three dimensions, however, and these introduce additional dimensions which one can explore in a similar fashion. Rarely, however will it be possible to satisfy all equally. An acceptable ratio of all these values needs to be identified to be clear about the outcome you seek to achieve, otherwise you may be surprised by what you get.

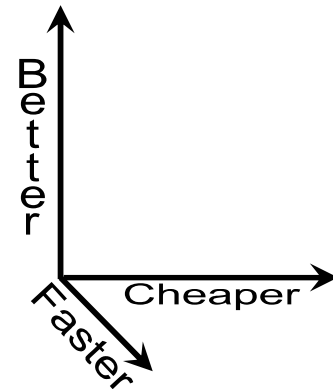


Figure 8

In the same way that we have a set of Values about what is important to us and motivates *towards* having this or doing that, we also have a set of **Countervalues** which define what is equally important for the opposite reasons: they motivate us *away from* what we seek to avoid, providing us with the internal energy to act, if only to avoid problems.

Taken together and used as a duo, values and countervalues concerning a particular issue or product create propulsion systems. If values set us along a particular path to follow, countervalues also identify limiting parameters which keep up on the straight and narrow, dissuading us for taking risks which might put us into unnecessary danger.

Criteria

Often people put **criteria** in a hierarchy of values or countervalues, which introduces logical confusion. Criteria are not values but are instead how these values manifest in life in ways which are tangible and measurable. In the case of Sturdiness, possible criteria might be:

- ❖ How much wear and tear do you expect a product to face before replacement,
- ❖ How much resistance to shock, to weight, to heat, to corrosion, to water, etc. do you expect it to face.
- ❖ Etc.

These **criteria themselves need to be identified and ordered** in a hierarchy which will be nested within the hierarchy of values. Each criteria can be further nested until you obtain precise enough information in terms of see/hear/feel /smell/taste/etc.

Thus, in the case of a car you may have:

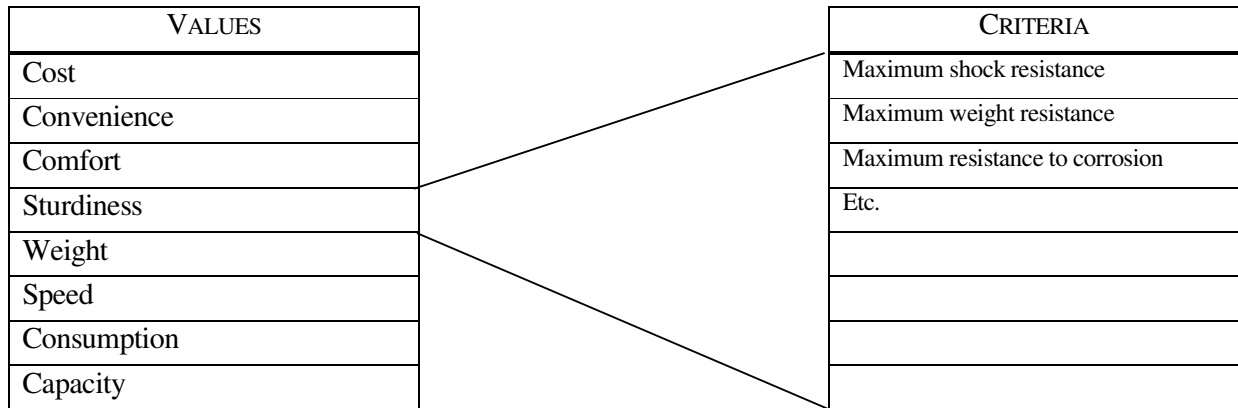


Figure 9

Necessity / Possibility Essential / Desirable

For whatever you seek to produce, obtain, achieve, accomplish or resolve there will be some essential aspects and some desirable ones, things you need to do, things you want to do. Essential ones need to be attended to, while desirable ones are optional. Essentiality and Desirability manifest themselves in degrees. Thus eliminating dust is an essential component of a vacuum cleaner and therefore expresses itself in absolute terms. However, the quality at which it does so is relative and measurable in terms of desirability. The more something is desirable, the more it will be perceived as essential.

Essentiality and desirability are closely connected with the concept of Ideality in TRIZ. **Distinguishing Essentiality and Desirability** is itself essential to prioritise well.

As If

A useful way to resolve things is **operating “As if”** we already had the solution to the issue and worked out the steps backwards. This change of perspective often offers insights not otherwise available and gives us the benefit of hindsight beforehand.

Another one is to put ourselves in the shoes of somebody who has the solution, or who, by virtue of their skills, would have resolved that. At the turn of the last century, forensic detection made tremendous progress, thanks to people putting themselves in the shoes of Sherlock Holmes, even going so far as to wear similar clothes, to think things out.

- ❖ If I was Sherlock Holmes, what would I think?
- ❖ If I was Einstein, what idea would come up about this?
- ❖ If someone else knew how to do this how would they go about doing it?

Identity

Surprisingly often, what we call an object or issue affects how we perceive it or what we can do. Giving something, anything, a name tag, label or identification as “A” creates a frame of mind which constrains our thinking, causing us to think about what we are naming in terms of “A” and leaving out anything which is perceived as “Not A”, among which may be the solution to our presenting issue. **Removing the identity tag**, if only temporarily, frees us to explore what else might be there, to redefine the issue, to open hitherto unexplored avenues. Even the idea of redefining a problem as “a solution waiting to happen” opens our mind to possibilities.

OUTERFRAMING

This introduces the awareness of an *external context*, environment, setting, situation or circumstance has on an issue. Whether we like it or not, our external environment constrains our mode of thinking. $A=B$ for us, here and now. We therefore **define a context as a matrix of *Space/Time/Relationships*** (physical or human interfaces) and **change it to where things would be different or where they would work out**. Somebody else may not see it this way. Somewhere else this would not apply. Another time we would think of this differently.

In Neuro-semantic we say that “Whatever we do, there is a context where this would be useful, would have value”. Every home or office these days abounds with great products which started their life as a contradiction in a given context. When the context changed, these became a resource. Fortunes have been built on someone’s mistakes. The French chemist Pierre-Gilles de Gennes wanted to create a new superglue but what he got was something that stuck less strongly: problem. He had the genius of finding contexts where this would be useful. We now are removable stickers, post-it tags and stickers.

Genius doesn’t necessarily manifest itself by making something new but thinking where or when something perceived as negative might be better employed someplace else. So, when we identify a problem or contradiction, instead of banging our head against a brick wall in the futile hope of breaking it down and move towards a narrowly defined direction, what about going somewhere else, another time? How would somebody else tackle this?

Changing perspectives, looking at things from another angle, another time or from someone else shoes, enriches our awareness of choices and options and often suggests alternatives. Einstein knew this, who imagined himself riding a light beam and tested out in his mind how space-time is experienced at relativistic speeds.

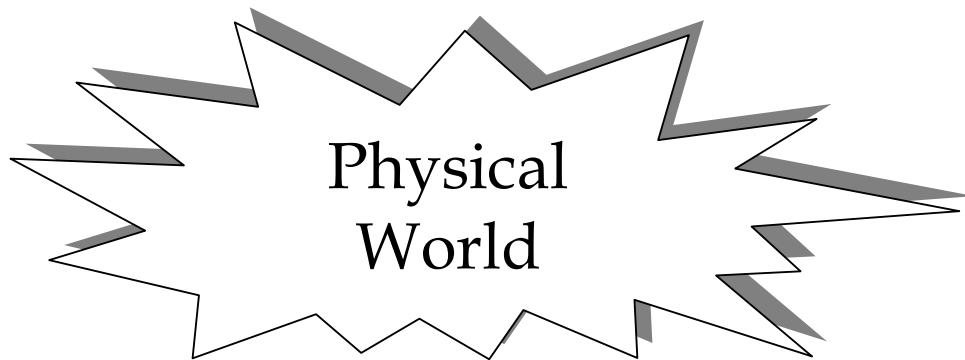
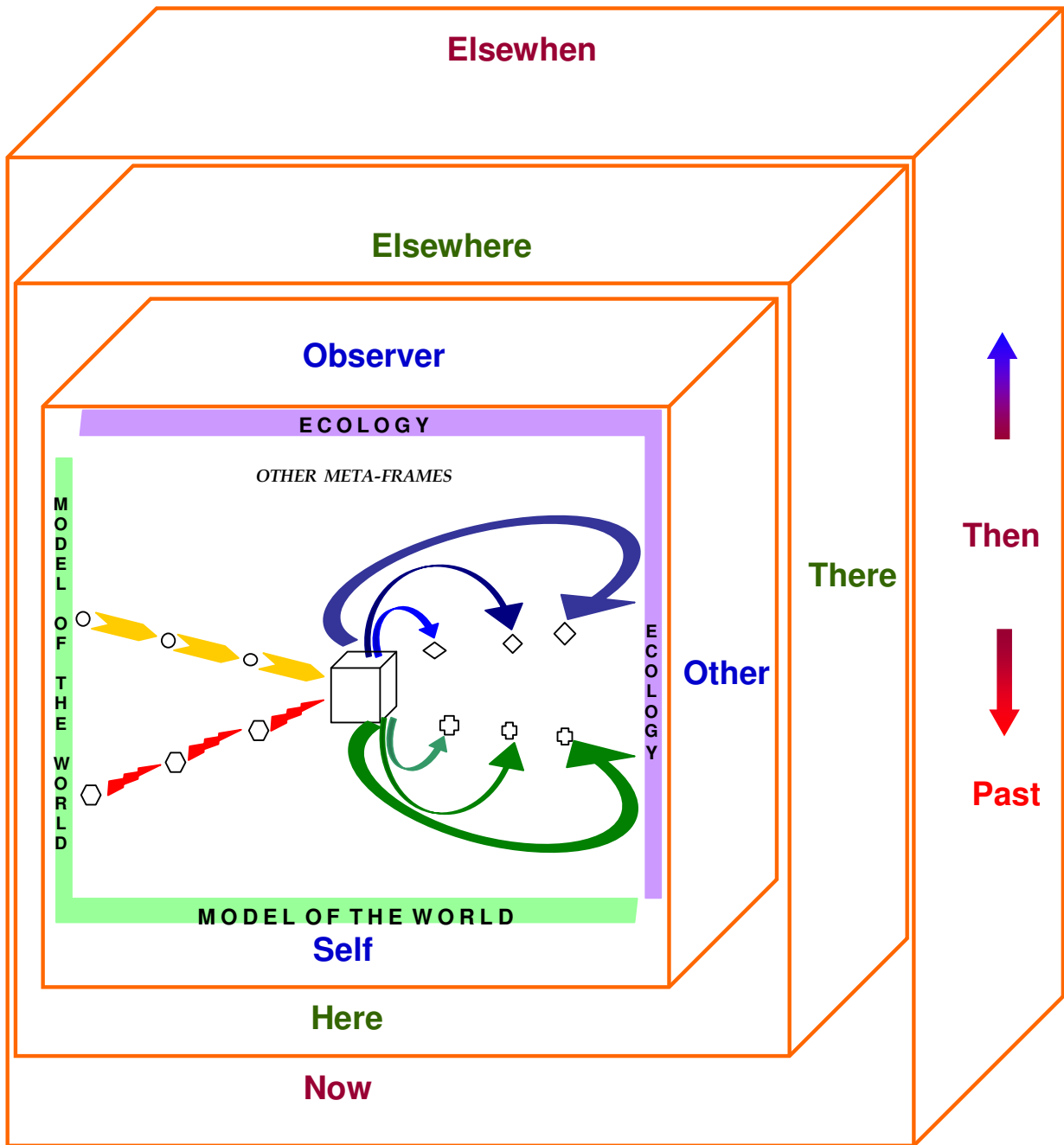


Figure 10

PARAFRAMING

When working with people, a useful way of getting people to think out of the box is to **use metaphorical alternatives**. “If this was like that, how would that be?” Thinking on one thing in terms of another often has ways of freeing the mind from the constraints of a given situation and benefiting from the change, provided the metaphorical is “isomorphic” to the original, i.e. has the similar internal structure to the issue at hand but works. It is an extreme form of Outer-framing: Way-out there, Way-back, somebody or even *something* completely different.

A version of this in the engineering domains is the **modelling the natural world around us**. Nature has been at it well before we came on the scene and has grappled with similar contradictions. Finding an animal of plant or physical structure, which either has resolved this, or for whom this was not a problem and modelling how they do it, is one of the fastest growing areas of engineering development. Many noteworthy inventions are derived this way, such as Velcro from burrs, or zips from birds feathers, etc. In many ways, you could say that it’s all been done before: therefore, all that we need is eyes to see. However, in a world where many species go extinct every year, this knowledge may be lost forever. Oh dear, ecology again.

Case Studies to be included in the finished paper.

CONCLUSION

By becoming more aware of the subjective nature of our contradictions, we can more easily step out of the box where they held us and identify creative alternatives which are a hallmark of TRIZ.

References

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Darrell first started using TRIZ in 1992, and has been teaching, developing products and solving technical and non-technical problems using TRIZ and related methods for a range of blue-chip companies since 1995. He is the author of over 80 patents, patent applications, and conference papers, and is a regular contributor to the on-line TRIZ Journal. With colleagues in Europe and the US he is pioneering the effective application of TRIZ to non-technical situations. He is the author of **Hands-on Systematic Innovation**, 2002 CREAX Press

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