

# Evolving the Inventive Principles

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## Abstract

The 40 Inventive Principles of classical TRIZ are useful creativity tools in a variety of problem solving situations. On the other hand, they are often criticised for being too abstract, for their often illogical sequencing, their level of overlap, for the gaps that they contain and, most of all, for the difficulty most people experience trying to remember them all.

The article describes an ongoing piece of research aimed at not only overcoming these issues, but also trying to improve the richness of the Principles. In defining a revised Inventive Principle structure that is both richer and easier to remember, a contradiction has had to be solved. The article describes the resolution of this contradiction. It describes how the richness of the Principles has been increased through the integration of contradiction-breaking strategies from outside TRIZ (namely the Osborn 'SCAMPERR' and WOIS models), and how the ability to remember the Principles has been influenced by psychological work on the mechanics of the human mind - namely that we have a short term memory capable of remembering no more than nine things at a time.

Applying TRIZ trends to the Inventive Principles strongly suggests the benefits of using Principles in combination. Looking further forward, the article shows how the re-structured Principles facilitate greater ease of use during problem solving situations in which it is helpful to utilise more than one Principle at a time.

## Some Principles Are Stronger Than Others

Any regular user of the Inventive Principles will have experienced the fact that some Principles tend to give results that are more powerful than others. In this sense, it appears that some of the Principles work at a higher level than others. Based on the experience of this author, the higher level Principles are closely related to the philosophical pillars of TRIZ described in Reference 1 and reproduced in Figure 1.



**Figure 1: Five Pillars of 'Systematic Creativity'**

In particular, it was noted that two Principles - 25 Self-Service and 22 Blessing in Disguise very specifically related to the Ideality and Resources pillars respectively. The connection between 'self' and the Ideal Final Result element of the ideality concept has previously been made in

Reference 2 alongside the recognition that the Self-Service Principle does not feature very often in the classic Contradiction Matrix. Similarly, the Blessing in Disguise Principle is featured only infrequently in the Matrix. This despite the fact that the definition of a resource within TRIZ very definitely encourages users to consider that even the things that are currently thought of as 'bad' can be transformed into something useful. One of the things meant by 'higher level' here in fact is that they are Principles that should be considered all the time, and not just when the Matrix suggests they be used.

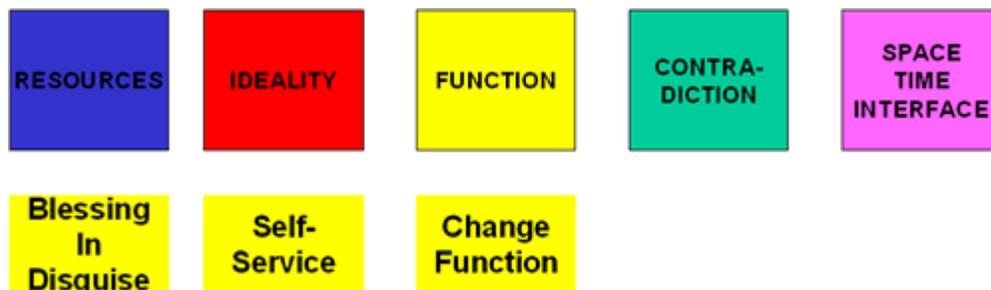
As described in Reference 3, when examining the SCAMMPERR model in more detail (for those that don't know, the letters that make up the acronym are **S**ubstitute, **C**ombine, **A**dapt, **M**agnify, **M**odify, **P**ut-to-another-use, **E**liminate, **R**e-arrange and **R**everse), we found that while 8 of the 9 strategies in the model were covered by the Inventive Principles and by the 5x3 matrix framework above, the 'P' - 'put to another use' was not. In SCAMMPERR, this trigger encourages users to solve problems by changing function. This is not normal TRIZ practice, but, again, when we asked the question 'would it be possible to challenge a contradiction by changing function, the answer was an unqualified 'yes'. For example, here is a quote from Reference 4:

*"Not long ago, Pfizer invested considerable energy and resources in a drug for treating hypertension. Tests indicated that its effects in hypertension were not all we had anticipated. This disappointment was offset by tests indicating that it would prove a much better treatment for arrhythmia - irregular heartbeat - than any other available medication. Another medicine, which was slated to treat anxiety, seems to be a very effective headache remedy."*

*"On another occasion, our researchers were dissatisfied with the performance of a new medication we had developed to treat angina; it failed to alleviate angina's paroxysmal chest pains. Serendipity intervened, however, and defeat emerged as opportunity. By chance we discovered the medication's extraordinary side effect: It restores sexual vigor to the impotent. The US market for such a drug is significant. Impotence afflicts some 20 million men in this country alone."*

It is also noted that the 'change function' means of resolving a contradiction is also a feature of some of the 'additional' Inventive Principles included in the WOIS methodology (Reference 5).

Taken together with the above Principles 22 and 25, we believe this 'change function' Principle forms a useful third entry in a trio of special Principles linked directly to the five philosophical strands of TRIZ - as illustrated in Figure 2.



**Figure 2: Higher Level Pillar-Related Inventive Principles**

Again as reported in Reference 3, the space-time-interface dimensional thinking pillar acted as an important start point for rethinking the structure of the remaining Principles. Many users, for example, will have noticed how some of the Principles can be related to all three dimensions - Segmentation for example can be applied as a contradiction breaking strategy with respect to physical segmentation, segmentation of time (see also 'Periodic Action') and segmentation of the

interfaces between things. It was also noted that some Principles had analogues that reversed the Principle - e.g. 'Segmentation' and 'Merging' are often interpreted as two opposites. On the other hand, some didn't - Asymmetry being one such example. When asking the question 'would it be possible to challenge a contradiction by making something symmetrical instead of asymmetrical, we again answered with a definitive yes. The opposite can also occur, balance and proportion then becoming important factors. The same happened with many other Principles.

Later on while looking at the space-time-and interface entities it was observed that within each category, all of the Principles grouped into just five different strategies for modifying a system :-

1. segment or merge (i.e. change the number of entities)
2. make the entities bigger or smaller
3. change the external geometry
4. change the internal structure
5. substitute the existing structure for something else.

It was then found that the existing Principles fitted very neatly into a 5x3 matrix as illustrated below:-

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

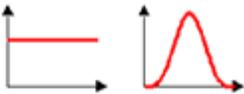
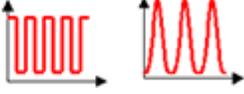
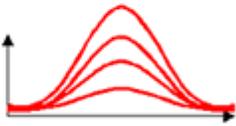
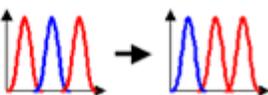
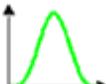
**Figure 3: 5x3 Matrix of Remaining Inventive Principles**

Each box in the Matrix is split into two halves - a yellow triangle representing the usually positive interpretation of a given strategy, and a blue triangle representing the opposite interpretation (for example segmentation in the top left corner has a segment (yellow) interpretation and a merge (blue) interpretation).

In showing how the matrix of Principles can be interpreted in each of the space, time and interface categories, Figure 4 provides a visual representation of basic images and how the five different (number, size, external shape, internal structure, substitute) modification strategies affect those basic images.

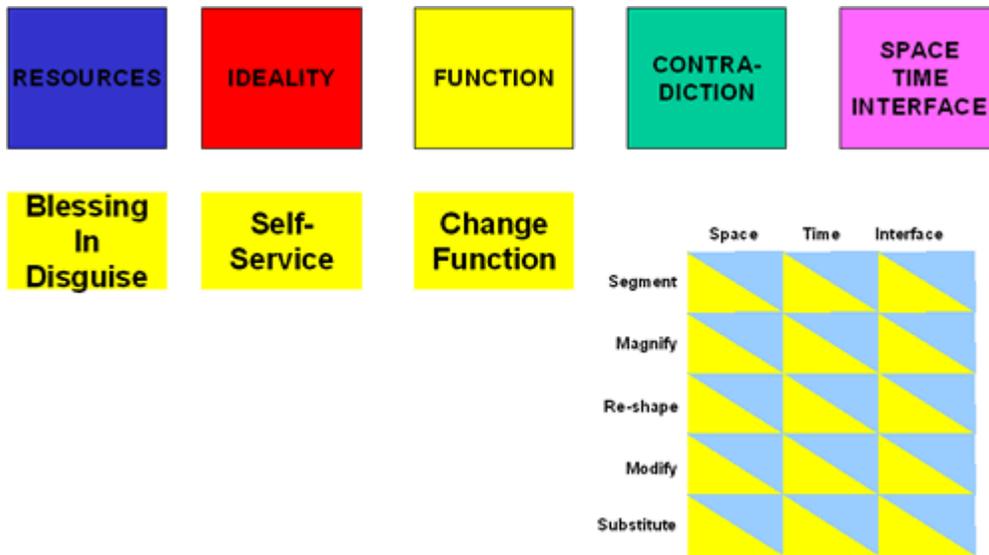
The basic idea behind the revised means of structuring the Principles is that although it is easier to remember (basically just the five modification strategies plus space, time and interface

interpretations at the highest level), it actually contains a degree of richness greater than the original 40 Principles. For example, most users tend to naturally interpret the 'Asymmetry' Principle in the context of a physical entity. What the 're-shape' modification prompt is intended to provide is the image that 'asymmetry' can equally well also be applied in both time and interface contexts - as illustrated in the Figure.

	Space	Time	Interface
			
Segment			
Magnify			
Re-shape			
Modify			
Substitute			

**Figure 4: Visual Interpretation of the 5x3 Matrix Elements for Space, Time and Interface Categories**

Taken together, then, with the previously identified 'higher level' Principles, gives the comprehensive Inventive Principle map illustrated in Figure 5.



**Figure 5: Alternative Inventive Principle Structure Model**

### Future Work

The initial experience of this author is that the revised Principle structure gives a significantly richer structure with which to solve contradiction related problems. Undoubtedly, the revised structure is still in a process of iteration - with, for example, ongoing tasks to show how the Principle sub-categories also fit into the overall structure (Principle 35A through E fitting into several different boxes in the 5x3 matrix) and to more explicitly incorporate some of the WOIS and other 'missing' inventive strategies - e.g. the 'use of reducing agents' analogue to Principle 38 described in Reference 6.

More importantly, it is also emerging that the revised structure can be connected to the Contradiction Matrix of classical TRIZ, the physical contradiction separation strategies and the more effective use of Principles in combination with one another. This work - including a new Contradiction Matrix based on the revised Principle structure - will be published in Reference 7.

Readers are invited to contribute their comments and input to the ideas contained in this article.

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