Comparing The Classical and New Contradiction Matrix
Part 1- Zooming Out

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Introduction

This article represents the first of a pair examining the differences between the original Contradiction Matrix of Classical TRIZ (Reference 1) and the new version based on the analysis of 150,000 patents issued between 1985-2003 published in 'Matrix 2003' (Reference 2). In this first article, we examine the differences from a system-level perspective, while in the second part, the focus shifts to a more detailed examination of how the two matrices compare when we analyze patents published since the Matrix 2003 book was completed. The aims of that second article are to explore the stability of the new Matrix and to provide quantified data on how well the two matrices predict the Inventive Principles being used by recent inventors. The aim of this article is primarily to explore the differences between the two matrices in terms of the overall prioritized sequence of Inventive Principles recommended by the Matrix.

Frequency Sequence Of The Inventive Principles

There are many different ways of using the Inventive Principles. At the two ends of the spectrum of possibilities are users that like to use all 40 Principles versus those that use tools like the Contradiction Matrix in order to focus onto a smaller number of 'most likely' Principle recommendations. This flexibility of use is one of the great strengths of the Principles.

One of the points along the spectrum of possibilities is to use a list of Principles based on their frequency of use. Reference 3 for example contains a list of Inventive Principles ordered by their frequency of occurrence in the original Contradiction Matrix. Such a list allows users to focus their problem solution generation activities on a globally averaged level. There are dangers in adopting this kind of approach of course, but nevertheless it can be a valid way of approaching problems under some circumstances.

This article reports an equivalent prioritized list of Inventive Principles based on the content of the 2003 version of the Matrix. Based on the frequency of occurrence in the new Matrix, then, the sequence of Principles is (most likely first):-

35, 3, 13, 28, 2, 24, 1, 10, 17, 4, 19, 5, 25, 15, 31, 7, 40, 12, 37
32, 30, 26, 9, 18, 29, 6, 16, 39, 36, 34, 21, 23, 38, 27, 22, 8, 33, 11, 20

The list is reproduced in the third column of Table 1 below.

Inventive Principle	Classical TRIZ Ranking	Matrix 2003 Ranking	Change
1	3	7	-4
2	5	5	-
3	12	2	+10
4	24	10	+14
5	33	12	+21
6	20	27	-7
7	34	17	+17
8	32	37	-5
9	39	24	+15
10	2	8	-6
11	29	39	-10
12	37	19	+18
13	10	3	+7
14	21	15	+6
15	6	14	-8
16	16	28	-12
17	19	9	+10
18	8	25	-17
19	7	11	-4
20	40	40	-
21	35	32	+3
22	22	36	-14
23	36	33	+3
24	18	6	+12
25	28	13	+15
26	11	23	-12
27	13	35	-22
28	4	4	-
29	14	26	-12
30	25	22	+3
31	30	16	+14
32	9	21	-12
33	38	38	-
34	15	31	-16
35	1	1	-
36	27	30	-3
37	26	20	+6
38	31	34	-3
39	23	29	-6
40	17	18	-1

Figure 1: Comparison Of Classical and New Matrix

The numbers in the table represent the prioritized sequence of Principles based on frequency of occurrence in the Matrix. Thus we can see that Principle 1 is the 7th most frequently occurring, Principle 2 is the 5th most frequent, and so on. The second column of the table records the equivalent prioritized sequence based on Reference 3. Column 4 then records the differences between the two sequences. This column indicates that there

have been some quite significant shifts that have taken place between the two matrices. It is these differences that are the subject of the remainder of the article.

Biggest Risers

The basis upon which patent information was interpreted into the original Matrix has not been published in any detail (in English at least) and hence direct comparison between what was done in the 1950s, 1960s and early 1970s and what was done during the preparation of Matrix 2003 has not been possible. Consequently, any interpretation of the differences between the two is inevitably going to contain a degree of uncertainty.

Nevertheless, it is worth discussing some of the changes that have taken place with respect to, first, the Inventive Principles that feature more frequently in the new Matrix than they did in the original version.

The top ten biggest rising Inventive Principles in decreasing order of change are:-

5, 12, 7, 25, 9, 31, 24, 3, 17, 13

It is worth highlighting some of the differences that this list describes:

Principle 5, Merging, is the biggest single riser in the new list. It has climbed from 33rd place in the original list to 12th place in the new Matrix; a rise of 21 places. One implication of this shift that emerges from consideration of the system complexity trend – Figure 2 – is that inventors are increasingly deploying strategies consistent with the reducing complexity half of the characteristic. This may mean that the world in general has shifted towards more integration of systems, but it may also be a reflection that the influence of established tools like Design for Manufacture and Assembly are having an impact on the way in which designers think about the systems they are configuring.

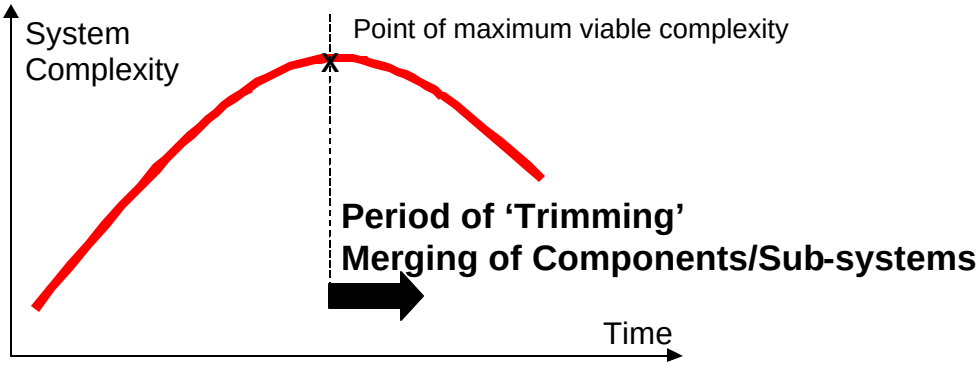

Figure 2: System Complexity Characteristic and Connection To Principle 5

While it is probably too soon to imply that the TRIZ Trimming tools are also having an impact on the shift towards inventions that are using Merging as a source of invention, it is worth noting that the rising frequency of Principle 5 is highly consistent with this part of the TRIZ toolkit.

Another rising Principle is 25, Self-Service. This one again is highly consistent with the TRIZ trend direction towards better use of existing resources and trying to get systems to deliver useful functions 'by themselves'. The rise of this Principle is consistent with the self-x theme discussed in Reference 4.

Closer examination of the 1985-2003 patents analyzed for the Matrix 2003 research reveals large numbers of patents resulting from improvements made possible by design

drafting and manufacturing technologies. Most notably the shift towards multi-axis machine tools, rapid prototyping and casting technology means that designers can increasingly take advantage of increases in use of all of the dimensions of the artifacts they specify. This characteristic appears to be particularly significant in the aerospace sector in general and the design of aerodynamic components in particular. Increased manufacturing capability and the consequent shift towards highly three-dimensional forms is consistent with the rises of Principles 3, Local Quality and 17, Another Dimension as inventive strategies.

Biggest Fallers

By definition, the number of Principles rising up the frequency of occurrence list must be matched by an equivalent number of Principles dropping down the list. Examination of Figure 1 reveals the top ten biggest fallers to be Inventive Principles:-

27, 18, 34, 22, 16, 26, 29, 32, 11, 15

Again, the list is presented in descending order of change. Thus Principle 27, Cheap Disposable is the inventive strategy that has dropped furthest – going from 13th place in the original Matrix to 35th in the new version. Again also, it is difficult to definitively explain how and why such a shift might have occurred due to the lack of data on how the original Matrix was compiled. Nevertheless, there is perhaps likely to be a correlation with the increased emphasis on sustainable solutions on the one hand and the marked rise of manufacture of disposable goods in the Far East, and the reduced emphasis on patenting of design solutions in the countries in that part of the world. In other words, Principle 27 may still be being used as frequently as ever, but that designers using it as a strategy are patenting such solutions far less frequently.

Related arguments may also be made regarding the drop in significance of Principles 22, Blessing-in-Disguise and 34, Discard-and-Recover: while it may well be that these strategies are being used as frequently as they ever were, analysis of the patent database from recent years clearly shows that solutions generated through such strategies are not often being patented.

Perhaps the most surprising faller on the top-ten list is Principle 15, Dynamics. Detailed examination of the possible reasons why this Principle has dropped down to 14th on the frequency list reveals two main contributing factors:-

1) The sharply increase in patents relating to software, electronics and bio-sciences compared to mechanical systems means that there are proportionally less mechanical patents. Principle 15 is a strategy used much more frequently as an inventive strategy in mechanical design than it appears to be in software or bioscience applications. In software design, for example, although the concept of dynamization is commonly observed, it is more likely to be something that is automatically assumed rather than being used as an inventive step per se. Certainly, the patent database contains very few software patents in which Principle 15 has been used to make an inventive step.
2) The TRIZ Dynamization trend – Figure 3 – suggests that mechanical means of delivering movement functions will also tend towards increasing use of electrical systems. A sharp rise in ‘control-by-wire’ and ‘control-by-light’ actuation methods in recent years is evident.

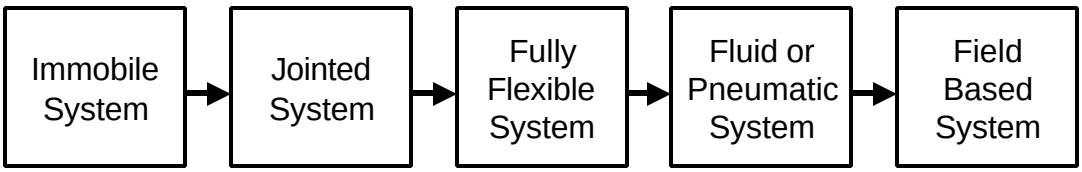

Figure 3: Dynamization Trend

The Dynamization trend may also help to explain the decline in the frequency of Principle 29, Pneumatics and Hydraulics in the new Matrix.

The other interesting faller on the list is Principle 11, Beforehand Cushioning. Coupled with the rise in Principle 9, Prior Counter-Action, the drop in frequency of use of Principle 11 may well be explained by the increased use of FMEA and other risk assessment techniques since the 1970s. Designers, in other words, are more likely to produce designs that do not need potentially expensive back-ups to be included. This is also consistent with the preceding discussion of the increased use of Principle 5, Merging as an inventive strategy. As an alternative suggestion, it may also be the case that inventors are simply not patenting (or the Patent Office is increasingly unlikely to grant) solutions that involve the incorporation of emergency back-ups.

Conclusions

The frequency with which Inventive Principles occur in the new Matrix compared to the original matrix is both similar and different. The main similarity is that 5 of the top 8 most commonly used Principles – 35, 28, 10, 1 and 2 are the same in both matrices. On the other hand, as shown in Figure 1, there have also been some significant shifts.

The main value of having a prioritized list of Inventive Principles is for those people that don't wish to worry about the details of defining contradictions, but simply want to start using the Principles to help generate ideas. To those people, the new Matrix offers a revised list of Principles 'most likely' to help them generate inventive solutions. This article represents the first place in which such a list has been published.

Any attempt to use a globally averaged 'most likely' list is inevitably skipping a lot of relevant information. Hence in the second part of this article, the focus shifts towards a more detailed analysis of the content of the new Matrix. Specifically this means establishing the likelihood that the Inventive Principles suggested for a given pair of conflict parameters are going to be the 'best' ones.

References

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