# Updating the Contradiction Matrix

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# Updating the Contradiction Matrix

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## Abstract

Although the classical Contradiction Matrix remains a conceptually very important element of the TRIZ toolkit, its age often means that users have difficulty using it successfully across a wide range of modern-day problem settings. The paper discusses a systematic programme of patent and science based research that has culminated in the production of a range of new Matrices.

In particular, the paper discusses the creation of a new generic Matrix aimed at technical applications. This new Matrix updates both the form and content of the original Matrix by updating and expanding the list of parameters it contains, updating and increasing the Inventive Principle recommendations for each contradiction, and also making it easier for users to connect their specific problem to the generic framework. In the first area, the paper describes how the original list of 39 parameters has now been increased to 50 following extensive discussions with the user community.

The paper also discusses the creation of a number of company and industry-specific Matrix tools based on the mass of research data collected. In keeping with the rapidly growing interest in applying TRIZ principles in the software industry, the paper describes a Matrix specifically aimed at this application area.

The paper concludes with a description of a number of real case study examples showing how the new Matrix forms compares relative to the performance of the classic Matrix in terms of quality of generated solution directions.

## Introduction

The classical TRIZ Contradiction Matrix is in need of some attention in order to make it usable my modern day users. The paper describes some of the output of a programme of systematic research to update and refine the Matrix. A parallel paper (Reference 1) details the form and content of that research programme, while a complete book (Reference 2) will detail the full

output of the research and in particular present the full new Matrix in all of its detail. The aim of this paper is to describe some of the underlying philosophy behind the structuring of the new Matrix, and also to describe how the tool fits into a longer-term strategy headed in the direction of the 'Ideal Contradiction Matrix'. The paper is segmented into four main sections. The first section examines a Matrix Explorer – the framework by which we have been assembling and classifying data acquired from the patent database. The second section then discusses the definition of the revised list of parameters that will make up the sides of the new Matrix. Section three provides details of a few key examples extracted from the new Matrix. The point here is to highlight some of the changes in the content of individual boxes in the Matrix that have taken place in the period since the classical Matrix was constructed. The final section of the paper then goes on to describe the expected evolution of the new Matrix (and its bespoke tailored derivatives – including a Matrix aimed specifically at conflict situations within the software development sector) towards its Ideal Final Result.

**Matrix Explorer**

The Matrix Explorer is a software framework we have been using to help file the patents we have been analyzing. Although it has been primarily been developed as an internal facilitation tool, it seems that there is a value in making un-interpreted, raw TRIZ data available to users. Specifically, there has been a desire to relate a given pair of conflict parameters not just to a series of Inventive Principle solution suggestions, but also to the specific patents that feature that particular conflict pair.

Figure 1 illustrates the basic configuration of the Matrix Explorer. It has been written in the Java language, and as such is intended to be usable in an on-line form.
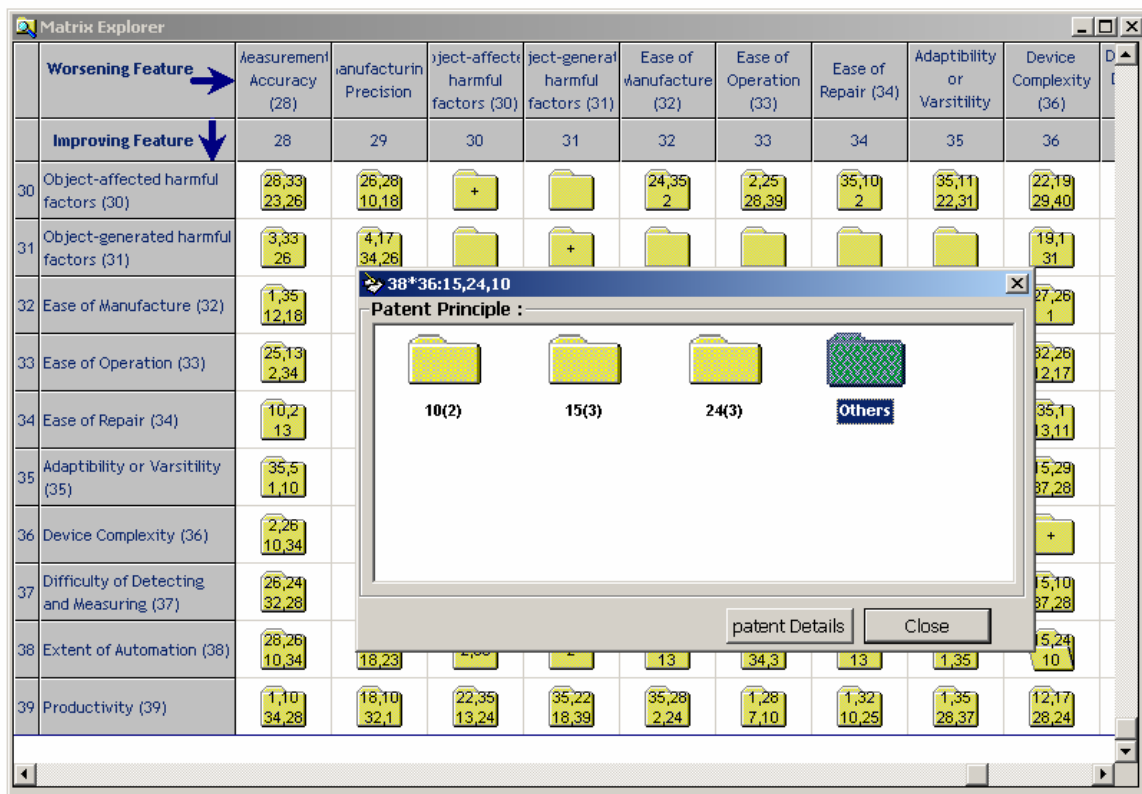


**Figure 1: Matrix Explorer Software Tool Screen-Shot**

The basic structure contains a number of hyper-links that first enable a user to click onto a particular box within the Matrix to determine what Principles have been used to solve that conflict. This is the view shown in Figure 1 – where we see the Extent of Automation versus Device Complexity conflict pair being opened to illustrate the fact that in addition to finding examples of patents using the Inventive Principles suggested by the Classical Matrix (10, 15 and 24), there are a variety of other patents that have successfully challenged this conflict pair using other Principles. Figure 2 illustrates the consequence of hyper-linking from this 'other' folder. It may be observed that a new screen opens up. This screen contains further hyperlinks to the specific patents that involve the conflict pair under consideration. Not shown on the screen due to lack of space, the screen containing the hyper-links to the patent database, also describe the Inventive Principles used by each of the patents listed.
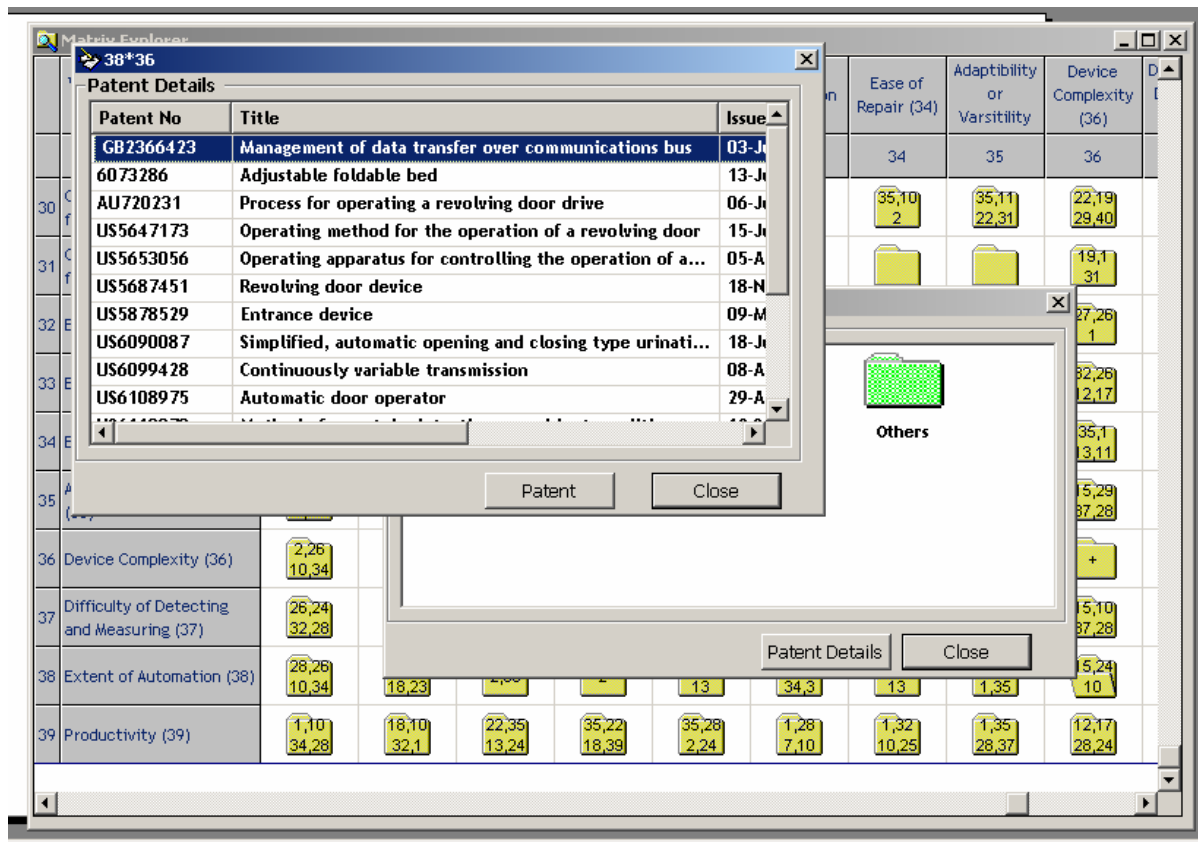


**Figure 2: Matrix Explorer Software Tool – Hyperlinks to Patent Database**

The screen-shots shown in these two figures illustrate the form of the Matrix when using the 39 parameters as described in classical TRIZ. The next section describes the alternative structuring of these and other new parameters in the new Matrix structure.


**New Matrix Parameters**

The principle guiding features we used when determining the form of any new Matrix structure were a) to include parameters that were not adequately addressed in the original Matrix (specifically those parameters were not considered to be important when that matrix was devised), and b) to re-sequence the parameters into a more logical and informative

sequence. With regard to the first issue, it is evident from the original Matrix – and specifically the 'Amount of Information' parameter (for which the Matrix contains many blank entries) – that the growth of Matrix is a story of a gradually unfolding world of innovation in which new parameters become important in the design process. Issues like safety, noise and environmental factors, for example, are considered to be much more important today than they were during the 1970s.

With regard to the second issue, we have tried to re-sequence the matrix parameters in line with a general progression and shift of focus as systems evolve from their conception and infancy through to maturity and retirement – Figure 3.
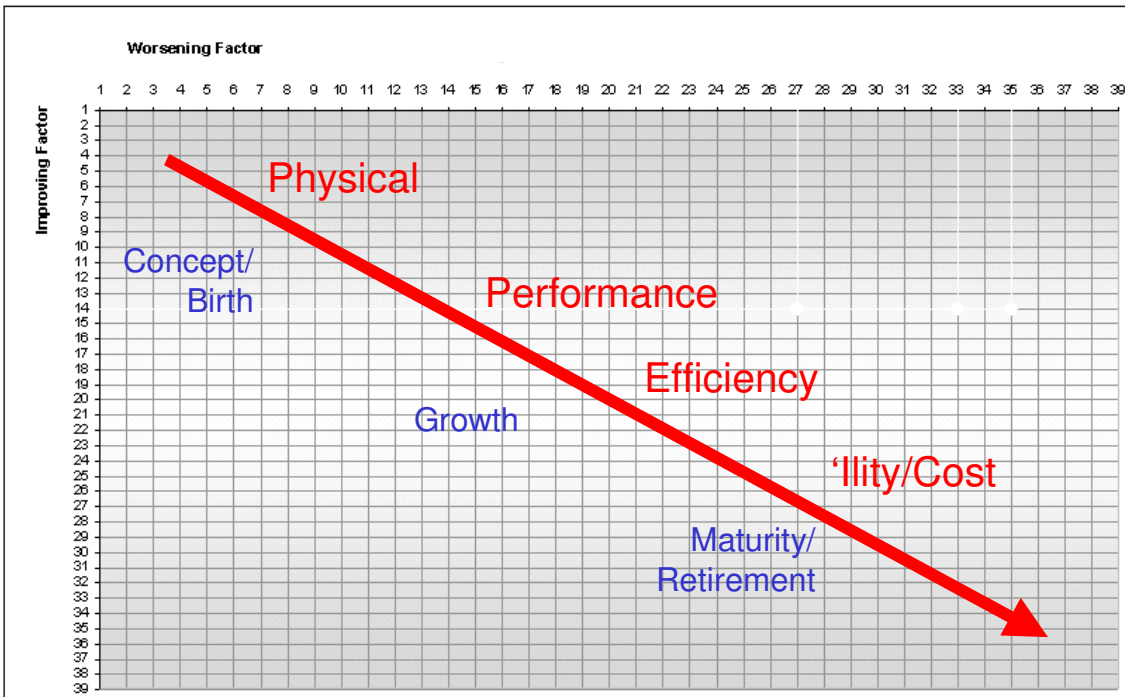


**Figure 3: Re-Sequencing of Matrix Parameters**

The full list of parameters in the new Matrix and some of the detailed definition underlying how we placed different solutions into the different classifications is illustrated in Figure 4 below.

The new colour-coded categories are:-

|        |   |                                                     |
|--------|---|-----------------------------------------------------|
| Green  | - | Physical Parameters                                 |
| Purple | - | Performance Related Parameters                      |
| Yellow | - | Efficiency Related Parameters                       |
| Blue   | - | 'ility (reliability, durability, etc) Related Parameters |
| Grey   | - | Manufacture/Cost Reduction Parameters               |
| Pink   | - | Measurement Parameters (Special Category)           |

|  | New | Old | Comments |
|---|---|---|---|
| green | Weight of Moving Object | Weight of moving object | Understand the grouping for geometrical properties. |
|  | Weight of Stationary Object | Weight of stationary object |  |
|  | Length/Angle of Moving Object | Length of moving object |  |
|  | Length/Angle of Stationary Object | Length of stationary object |  |
|  | Area of Moving Object | Area of moving object |  |
|  | Area of Stationary Object | Area of stationary object |  |
|  | Volume of Moving Object | Volume of moving object |  |
|  | Volume of Stationary Object | Volume of stationary object |  |
|  | Shape | Shape |  |
|  | Amount of Substance | Quantity of substance/ matter |  |
| green | Amount of Information | Information |  |
| purple | Duration of Action of Moving Object | Duration of action of moving object | Here definitely a 'time' related parameter - no 'durability' as in some translations of the classical Matrix |
|  | Duration of Action of Stationary Object | Duration of action by stationary object | same |
|  | Speed | Speed | Includes velocity and process time |
|  | Force/Torque | Force (Intensity) |  |
|  | Energy Used by Moving Object | Use of energy by moving object | Relates to performance and 'amount' and specifically not efficiency or 'loss' |
|  | Energy Used by Stationary Object | Use of energy by stationary object | same |
|  | Power | Power |  |
|  | Stress/Pressure | Stress or pressure |  |
|  | Strength | Strength |  |
|  | Stability | Stability of the object's composition | Intended to be more general than 'composition' - which implies chemistry |
|  | Temperature | Temperature |  |
| purple | Illumination Intensity | Illumination Intensity | Includes 'brightness' |
| yellow | Function Efficiency |  | Intended to help focus on function of whatever form |
|  | Loss of Substance | Loss of substance |  |
|  | Loss of Time | Loss of Time |  |
|  | Loss of Energy | Loss of Energy |  |
|  | Loss of Information | Loss of Information |  |
|  | Noise |  |  |
|  | Harmful Emissions |  |  |
| yellow | Other Harmful Effects Generated by System | Object-generated harmful factors | Anything harmful not specifically covered in the preceding parameters |
| blue | Adaptability/Versatility | Adaptability or versatility |  |
|  | Compatibility/Connectability |  |  |
|  | Transportability |  |  |
|  | Trainability/Operability/Controllability | Ease of operation |  |
|  | Reliability/Robustness | Reliability |  |
|  | Repairability | Ease of repair |  |
|  | Security |  | Anything to do with security |
|  | Safety/Vulnerability |  |  |
|  | Aesthetics/Appearance |  | An emerging parameter - still not too many examples |
| blue | Other Harmful Effects Acting on System | Object-affected harmful factors | Anything harmful not specifically covered in the preceding parameters in this category |
| grey | Manufacturability | Ease of manufacture |  |
|  | Manufacture Precision/Consistency | Manufacturing precision |  |
|  | Automation | Extent of automation |  |
|  | Productivity | Productivity |  |
|  | System Complexity | Device complexity |  |
| grey | Control Complexity |  |  |
| pink | Ability to Detect/Measure | Difficulty of detecting and measuring |  |
| pink | Measurement Precision | Measurement accuracy | new title includes 'accuracy' |

**Figure 4: Revised List of Matrix Parameters**

## Examples of Changes to Matrix Content

By way of illustrating some of the changes that have taken place in the time between the production of the original Matrix and this one, we present below two specific cases from the Matrix. In the first case, we examine one of the most commonly used conflict situations – the perennial fight between strength and weight – in order to illustrate the potential significance of the findings that have populated the new Matrix. In the second case, we describe one of the more extreme changes that we see having taken place between original and the new Matrix.

**Strength versus Weight**

Figure 5 illustrates a before and after comparison of the Classical Matrix entry for the strength versus weight (of stationary object) versus the findings of the research into more recent patents.

| | |
|---|---|
| **40** | **26** |
| **27** | **1** |

OLD

| | |
|---|---|
| **40** | **31** |
| **2** | **1** |

NEW

**Figure 5: Revised Strength versus Weight Entry in Matrix**

The continuing use of Composite Materials (Principle 40) as a means of challenging the conflict is apparent in many patents, and in fact the number of patents using this Principle is around double those of the nearest other Principle. This phenomenon is probably self-re-enforcing in that there is now a broad awareness of the benefits of these materials and an industry of manufacturers intent on selling them into new applications.

Principle 31 – Porous Materials – on the other hand did not feature in the classical Matrix, but finds itself as the second most commonly deployed strategy for improving strength/weight ratio. Although the resolution of conflicts by adding holes is very TRIZ-like in its philosophy – 'doing more with less' – we are more inclined to attribute the increase in use of this strategy in inventions to the increasing awareness of how nature uses the 'add holes' strategy to solve similar conflicts. See also the TRIZ and Biology project at the University of Bath for other examples of the use of holes to improve strength/weight ratio at Reference 3.

By way of an example of Principle 31 in action to solve a strength/weight conflict, Figure 6 illustrates an elegant solution used in US6,162,962

The invention relates to a medical device, an areal implant used in operations to assist abdominal wall closure. As is the convention during the cataloguing of research we read the invention disclosure text in order to highlight the contradictions being challenged by the invention for ease of reference:-

*During an operation in the abdominal region, it is often necessary to* **strengthen** *the abdominal wall using an inserted areal implant. It is known to use nets made from the non-resorbable plastics polypropylene or polyester or from the slowly resorbable polyglactin 910 (a copolymer of glycolide and lactide in the ratio 9:1) for such implants. Metallic implants are also used.* **The known implant nets have some disadvantages**. *For example, they are relatively* **heavy***, i.e. the areal weight is as a rule more than 50 g/m.sup.2 and predominantly even ca. 100 g/m.sup.2. If the implants are not resorbable, a relatively large quantity of foreign substance thus remains permanently in the body.*

In this case it was also apparent that the words 'porous' or 'holes' were not mentioned in the context of the actual resolution to the strength/weight conflict used by the inventors. The

recognition that holes formed an integral part of the solution had to be gleaned from the figures contained within the disclosure – Figure 6.
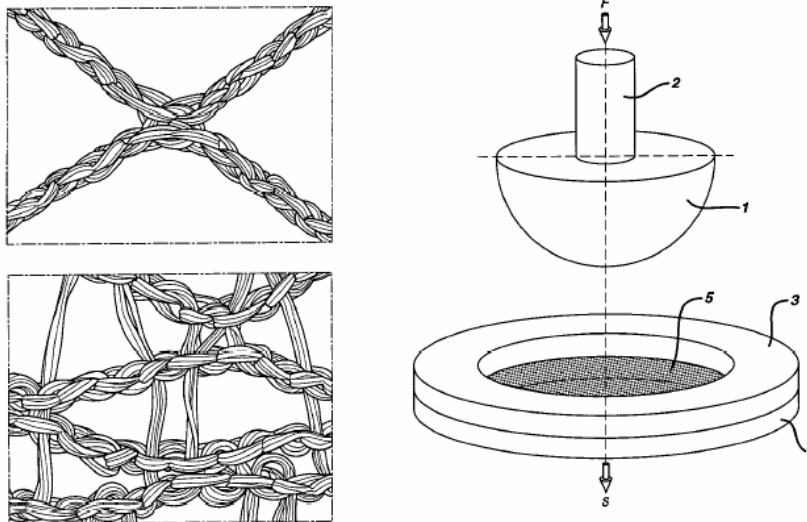


**Figure 6: Example of System Using Principle 31 To Improve Strength/Weight Ratio**
**US Patent 6,162,962**

This fact – by no means uncommon – represents a case against the use of computer analysis of text. A semantic processor, for example, would not have identified this patent as one using Inventive Principle 31.

## Shape versus Stability

The shape versus stability entry in the new Matrix is most striking because in terms of the top four most commonly used Inventive Principles used to challenge this conflict in recent times there is no common ground with the recommendations found in the classical Matrix – Figure 7. Lack of data concerning the detailed make-up of the classical Matrix makes it impossible to fully understand whether the new Matrix is 'better' or 'worse' than the original. All that we are able to say with any precision is that during the ranking of Principles our research has taken into account the Level of Invention, and that the quality of Inventions we have observed using the new Principle recommendations is considerably higher than the patents we have observed using the old recommendations.



OLD → NEW

| 33 | 1 |
|----|---|
| 18 | 4 |

| 35 | 40 |
|----|----|
| 24 | 31 |
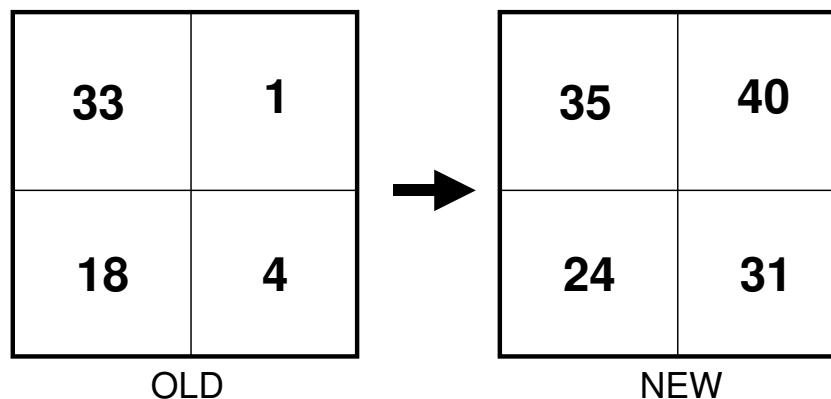
**Figure 7: Revised Strength versus Weight Entry in Matrix**

**Contradiction Matrix For Software Problems**

A lack of relevance of many of the parameters used to make up the axes of either the classical or new Matrix to software problems (weight, length, area, shape, volume, temperature for example) has prompted many users to ask us for a bespoke Matrix specifically for software problems. In researching the possibilities for such a Matrix we have had to conduct an analysis of both patents and (outside the US – where patents on software are not permitted) examples from journals and trade literature to establish whether the concept of conflict elimination was being practiced at all. Very soon into this research in fact, although in the case of patents the level of Invention is generally very low, it became clear that all 40 Inventive Principles are being used to challenge conflicts, and that there were certain emerging patterns of usage that meant construction of a new Matrix was going to be possible. The final public form of the new – currently 22x22 Matrix will be published elsewhere (Reference 4).

**The Ideal Contradiction Matrix**

The recent announcement of our collaboration with Ideation on the production of an expanded and updated version of the technical contradiction matrix, plus the ongoing creation of the above outlined matrix specifically aimed at software applications, plus the expanding use of our matrix for business problems has prompted a number of questions about our longer term strategy.

What we are in fact experiencing with this apparent proliferation of Matrices is one of the fundamental trends described within TRIZ – that of increasing complexity followed by decreasing complexity. Or rather increasing number of components followed by decreasing number of components (see Reference 5 for more details on why the difference between these two is important). The increasing number of Matrices, then, is simply a system in the first half of the trend – Figure 8.
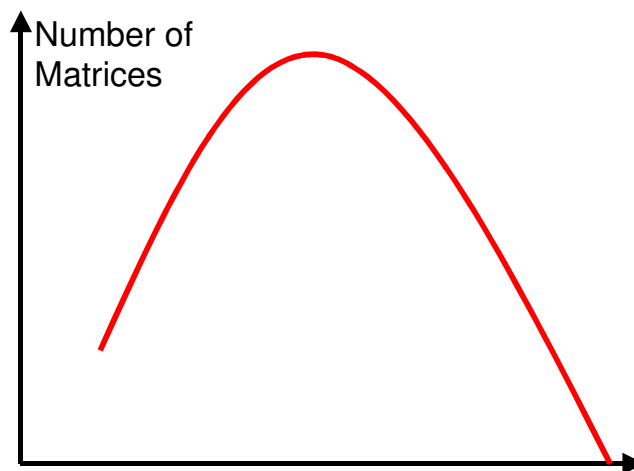


**Figure 8: Number of Components Trend in Relation To TRIZ Contradiction Tools**

Why do we expect this characteristic to be relevant to the evolution of the Contradiction Matrix? There are several answers to this question. The first relates to the needs and desires of users of the Matrix: for a long time, the classical Contradiction Matrix has been viewed as a 'good enough' or 'sufficient' tool (albeit some TRIZ researchers have since walked away from

the concept completely). But then when the business community began to become interested in TRIZ, it very quickly became apparent that the conceptual elegance of the Matrix was not matched by its relevance to typical business situations. This phenomenon was the main spur for us to create the Business Matrix. Subsequently, we have seen similar problems in the software development sector; here too, people have been attracted to the conceptual elegance of the concept, and then disappointed when they find it difficult to relate their particular problems to the generic parameters contained in the Matrix. As a consequence, we have also taken it upon ourselves to construct the above outlined matrix tailored specifically to the needs of the software sector.

While not being 'new' in the same terms, we are also expecting the Matrix concept to expand further when other sectors (and in some instances, individual companies) ask us to produce a bespoke Matrix for a particular field. In the majority of cases, these bespoke Matrix tools will be subtle variants on the technical, business and software Matrix tools with parameters reframed in the terminology and jargon of a client. In other cases, we will simply be deleting lines from a Matrix in order to take-out parameters that are considered irrelevant to a given type of situation (the legal sector, for example, has generally speaking very little interest in R&D, at least not in those words).

It is important to recognize, of course, with any of these specialized matrices, that we are not trying to filter out the ability of TRIZ to transfer ideas from one sector to another, but merely to make it easier for users to translate their specific problem into the generic problem – Figure 9. Beyond that, it is the job of the Matrix to identify the best generic solutions from across all fields that may be used to help solve the specific problem at hand.
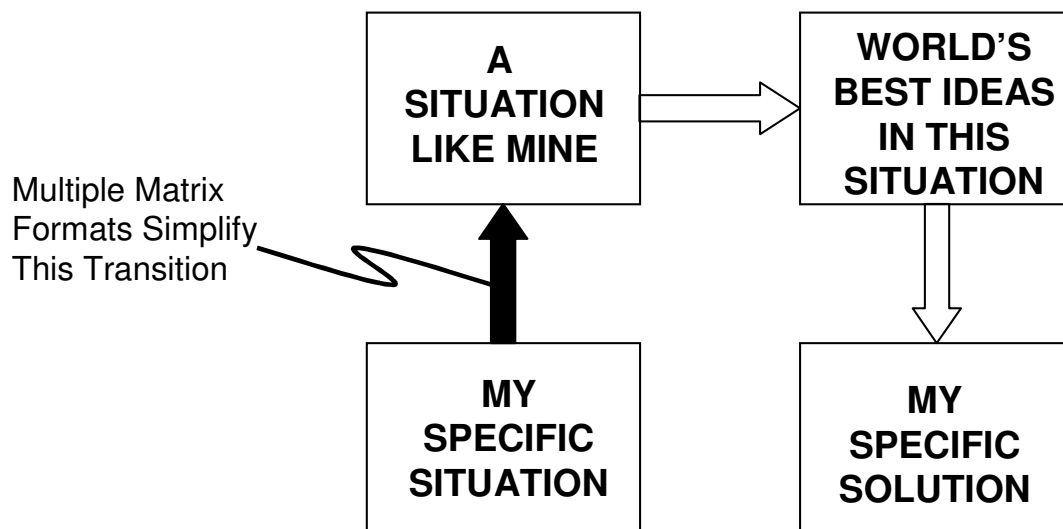


**Figure 9: Multiple Matrices Help Make the Transition From Specific To Generic Problem**

So then, what about the second half of the component count trend curve? What about the ideal Contradiction Matrix? The ideal Matrix is the one that presents the users with the best generic solutions without the Matrix actually having to exist at all. At least it should not exist as far as the user is concerned. In effect, the Ideal Matrix would offer the shortcut illustrated in Figure 10.
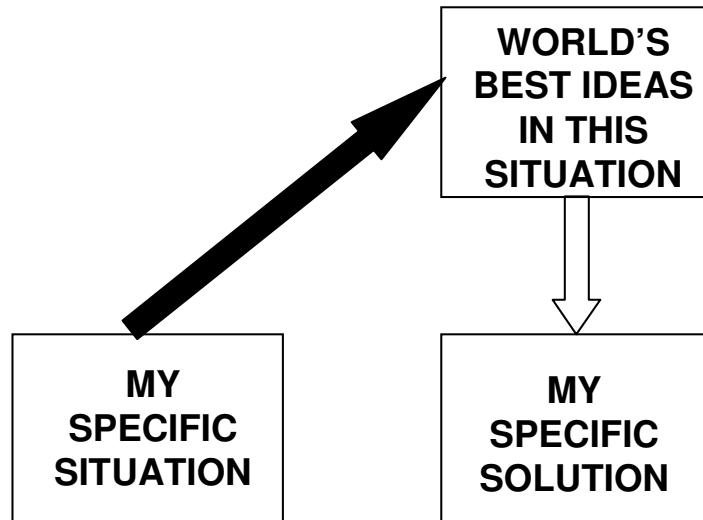
**Figure 10: The Ideal Matrix… Is No Matrix**

We are beginning to see the emergence of this Ideal Matrix in our 'Contradiction Finder' tool. You will find a free version of this tool on the CREAX website as well as inside the latest versions of CreaTRIZ – Figure 11.
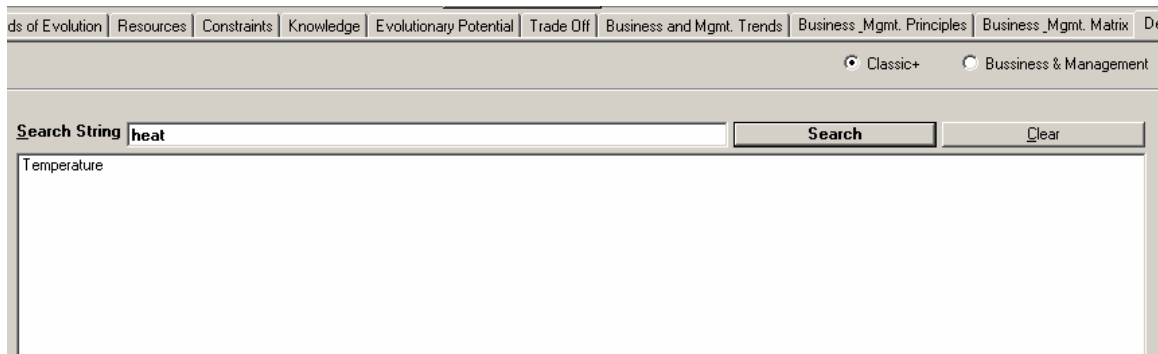


**Figure 11: Contradiction Finder Software**

The basic idea behind the Contradiction Finder is that eventually users of any background will simply be able to enter the description of a problem in their own language and jargon. An appropriate algorithm will then analyse this input and provide the most appropriate generic solutions – whether they be Inventive Principles, Inventive Standards, Trends of Evolution or Knowledge/Effects.

So why not just go straight to this ideal final result you might be asking? The answer lies in the fundamental phenomena underlying the increasing-decreasing complexity trend. It is simply that without working having worked out the 'right' routes from specific problem to right generic solution, it is not possible to eliminate the Matrix. Put another way, it is only by acquiring the data to populate the various different Matrices that we will acquire sufficient data to ensure we are making effective recommendations when a user types in their problem. The proliferation, to put it yet another way, is an essential requirement along the road to a more ideal system.

## References

1) Mann, D.L., Dewulf, S., 'Updating TRIZ – 1985-2002 Patent Research findings', paper presented at TRIZCON'03, Philadelphia, March 2003.
2) Mann, D.L., Dewulf, S., Zlotin, B., Zusman, A., 'Matrix 2003: Updating the TRIZ Contradiction Matrix', CREAX Press, February 2003.
3) Vincent, J.F.V, Mann, D.L., 'TRIZ and Biology – Naturally Smart TRIZ', paper presented at TRIZ Future conference, Bath, November 2001.
4) Mann, D.L., Dewulf, S., Hey, J., 'Conflict and Trade-Off Elimination Tools for Software Developers', paper to be published, destination unknown at this point in time.
5) Mann, D.L., 'Complexity Increases And Then…(Thoughts From Natural System Evolution)', TRIZ Journal, January 2003