Updating TRIZ

1985-2002 Patent Research Findings

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Abstract

A large part of the strength and power of TRIZ exists because the methodology was constructed on the substantial foundations provided by the analysis of a very large number of patents. Around 1985, however, this analysis was for the most part halted and the research focus was shifted to other important areas. In using some of the TRIZ tools on today's problems – in a world, for example, that has become much more electrical and software based in its outlook – it is evident that they are not providing users with as much assistance as they could. With this in mind, a large programme of patent analysis was instigated in 2000 with the aim of extending TRIZ to accommodate the changes brought about by the advances that have taken place in business and technology since 1985. To date, around 150,000 patents from this period have been analysed and added to the TRIZ knowledge-base. The paper describes the form, focus and findings of some of the research.

Introduction

There is growing evidence to suggest that while the high level philosophical elements of TRIZ remain valid, many of the detailed level tools are beginning to exhibit signs of strain in light of the changes that have taken place in the world during the last 15 or so years. Put simply, the world is much less 'mechanical' and much more 'electronic' or 'field-based', and there is much greater awareness of environmental issues – both in terms of designing systems that avoid generating further damage to the environment and using knowledge contained in the environment (most notably nature) to help us to design better systems. On too many occasions, the tools of classical TRIZ can be seen to direct users in directions that are considerably sub-optimal compared to the 'best practices' of latterday inventors. This is not to say that research in the TRIZ domain has stagnated since the emergence of the classical tools; it quite clearly has not. But, it does seem clear that the bulk of research in recent times has made the assumption that sufficient data has been collected and that the research requirement involves re-arrangement and re-organisation of this data. It is the belief of the authors, and the theme of the paper that this type of research – while valuable – is nevertheless built on an assumption that is incorrect.

The paper records some of the ongoing findings of a large-scale programme of research aimed at acquiring substantial quantities of new data to feed into the TRIZ database. The full scope of the research involves acquisition of data from the patent database, management sciences, natural sciences and arts. In order to provide a degree of focus,

this paper concentrates its attention on the first of those four areas. The paper includes the following sections:

- Level of Invention. All of the patents included in the research programme analysis have been assessed in relation to the five levels of invention specified during the original TRIZ research. The paper reports the shifting dynamics of invention level that has taken place over the last 15 years, and, in recording some of the Level 4 and 5 inventions, highlights an emerging dynamic regarding their connection to the subsequent emergence of lower level inventions.
- Trends of Evolution. In addition to uncovering a number of technology and business trends that have not previously been observed, the paper reports on the work done to develop the concepts of evolutionary limits and evolutionary potential (respectively the maximum furthest point a system can evolve to, and how far away from that point the system is currently), and describes how evolutionary potential radar plots have been constructed for all of the patents analysed. The radar plots are shown to offer means of not only comparing similar patents, but also to present means of benchmarking technologies against a set of global datum points. The paper demonstrates how the resultant 'global bench-marking' capability may be expected to have a pronounced effect on the way companies think about their intellectual property and long term business aims.
- Inventive Standards. A number of previously unseen inventive standards have been uncovered and added to the original list of 76. The paper describes how the new findings have generally come from inventions associated with systems in the early stages of their evolution.

The paper ends with a short section examining the importance of maintaining an active programme of patent analysis, the need for customisation for different companies and industries, and finally a description of planned future work.

Patent Research

The patent research being undertaken has adopted the following basic strategy: Every patent granted between the years 1985 and the present day is given at least a cursory evaluation in order to ascertain its potential contribution to the TRIZ database. Anyone that spends any time at all examining patents will know that there is a considerable proportion that have little of value to contribute to either the well-being of mankind or understanding of the inventive process – Figure 1. Nevertheless, for every patent, we make an assessment of the level of invention – using the classification structure formulated by Altshuller (1) . Then, for those patents we consider worthy of further analysis, we conduct a detailed examination of the invention disclosure looking to acquire data in four main areas of focus:-

1) Contradictions – we look to see whether the inventor has identified and solved a contradiction, and, if so, what Inventive Principles they have used. The results of this work are being turned into a new Contradiction Matrix – something which is the subject of a separate paper (2), and hence will not be considered further here.
2) Trends of evolution. For each patent we are constructing a single composite evolutionary potential radar plot illustrating where the particular invention resides on the known trends of evolution, and what trend jumps have been made (if any) in making the invention. We are also examining each patent for evidence of new emerging trends.
3) Knowledge/Effects. Each patent is examined to determine whether any new or emerging physical, chemical or biological effects are being employed. This data is used to populate our on-line knowledge and effects database (3).

4) Inventive Standards. Each patent is examined from the perspective of determining whether any of the current (or indeed new) Inventive Standards are being utilised in the invention. We recognise here, of course, that there is a deal of overlap between the Standards, Principles and Trends, but nevertheless have endeavoured to maintain a capability to segment the different tools as not every TRIZ user is or intends to be familiar with every part of the whole.

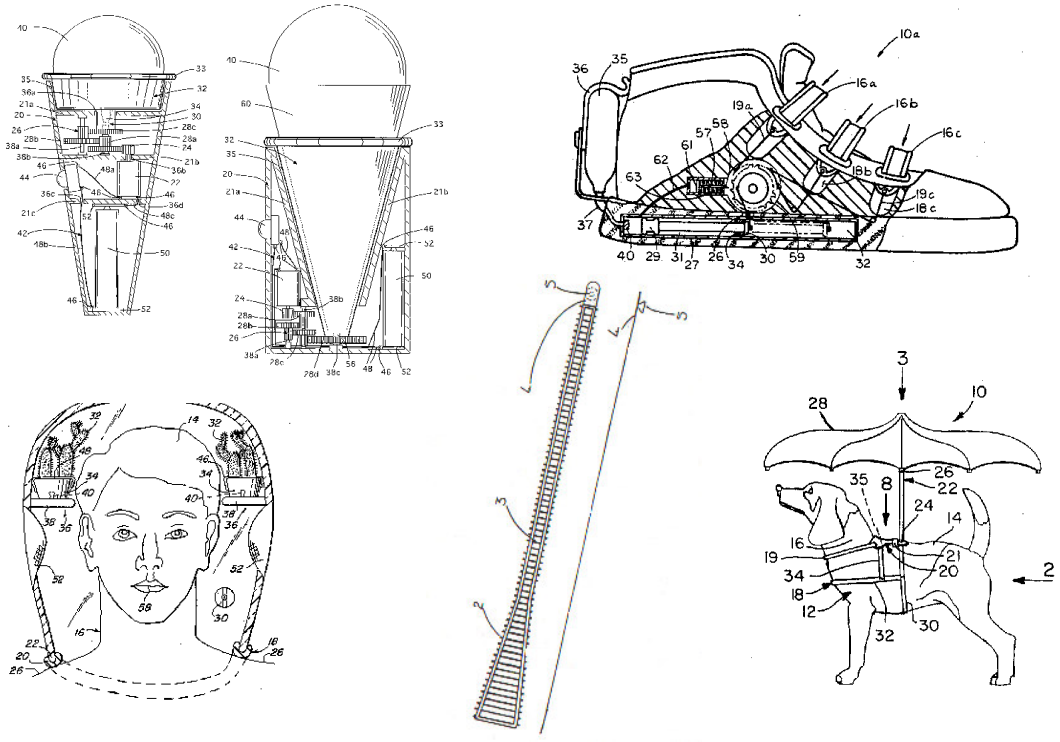

Figure 1: Some Inventions Excluded From Detailed Analysis

Thus far, the analyses conducted have focused on the US patent database. The final section at the end of the paper outlines how we plan to extend our analysis to look at other patent sources in due course. In the meantime, the following sections describe some of our current findings:

Level of Invention

The classification of patents into the five levels defined by Altshuller (1) and the associated distribution of patents between the five categories is well known. We have been interested in establishing any changes to this distribution that might have occurred during the period between 1985 and the present day. The current results of the research are presented in Figure 2.

The main shift we observe relative to the data from 'classical' TRIZ findings is one away from Level 1 towards a greater proportion of Level 2 and Level 3 inventions. While we cannot be certain, the evidence from the citation indexes within the invention disclosures suggests that inventors are progressively more likely to look outside the horizons of their organisations. This is probably due in no small part to the massive increase in the availability and accessibility of patent data in recent times, and the growing awareness that intellectual property represents an important competitor discriminator as far as potential investors is concerned. The increase in the number of Level 3 inventions – where we are seeing an increasing number of ideas transferring from one industry to another –

can also be expected to be due to the increasing availability of data, but also due to the fact that organisations are becoming increasingly aware of the possibilities of exploiting their intellectual capital in other sectors – the so called 'Rembrandts in the Attic' phenomenon (4).

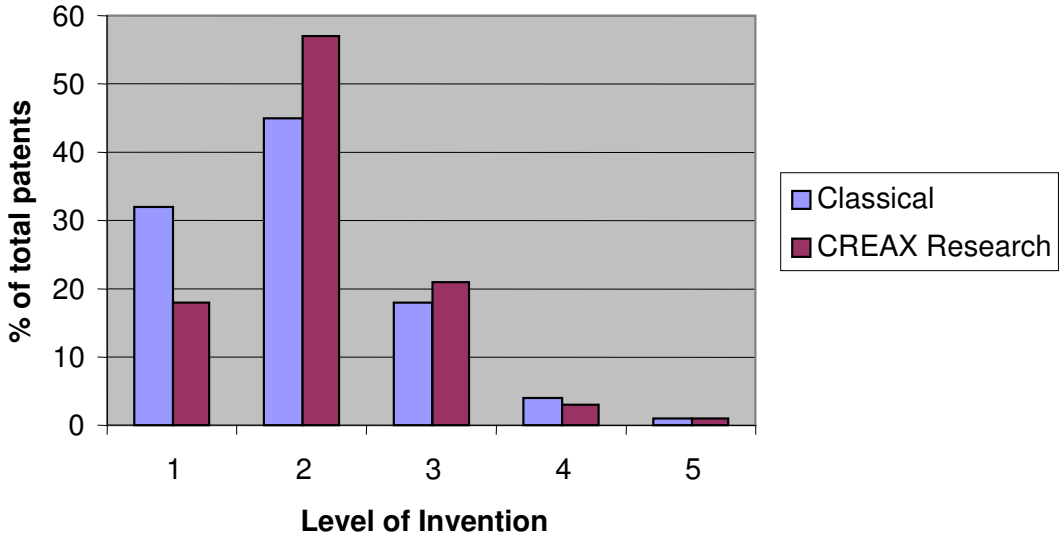

Figure 2: Comparison Between Classical and Updated Data on Level of Invention

The small reduction in the number of Level 4 inventions relative to classical TRIZ findings is difficult to explain, and we thus present the data as we find it without seeking to justify it in any way.

(Awaiting data on the link between Level 4/5 inventions and the subsequent creation of many Level 3, 2 and 1 inventions.)

Trends of Evolution

During our research, we have made no distinction between 'patterns' or 'lines' of evolution, choosing instead to focus on distilling out of the patent database individual trends of evolution that can be used to determine the evolutionary state of a particular system. We realise that there are many possible interactions that can and do take place between trends (see reference 5 for example) and the fact that these 'lines' can become quite complicated, but have decided that in order to make best use of the trends in either a problem solving or strategic sense, it is best to allow the interactions to be mapped on an individual case basis. Our 'trends' then have been segmented in a way that we believe best illustrate key evolutionary phenomena.

Thus far we have identified a total of 35 trends of evolution. These trends are described in detail in Reference 6. Reference 6 also describes the concept of evolutionary potential – the plotting of the evolutionary state of a system or invention along the trends. As far as our patent research is concerned, we are producing composite evolutionary potential radar plots for every patent we analyse. (We additionally plot radar plots for constituent parts of a system in addition to the composite plot if so requested by clients who wish to obtain a more detailed evolutionary picture.) During the patent research, in addition to plotting a composite evolutionary potential radar plot for an invention, we are also plotting the jumps made during the invention. Figure 3 illustrates a plot showing the current and pre-invention evolutionary state of a typical invention.

For every patent analysed, the process of constructing the radar plots involves examining each of the 35 trends to establish whether or not they are relevant to the invention. For

those trends that are deemed to be relevant, the researcher establishes where the invention is along each trend (for trends with discrete stages this is done simply by recording stage number, while for continuously variable trends (like 'reducing density' for example), a qualitative assessment is made of position along the trend scale), and also where was it prior to the invention.

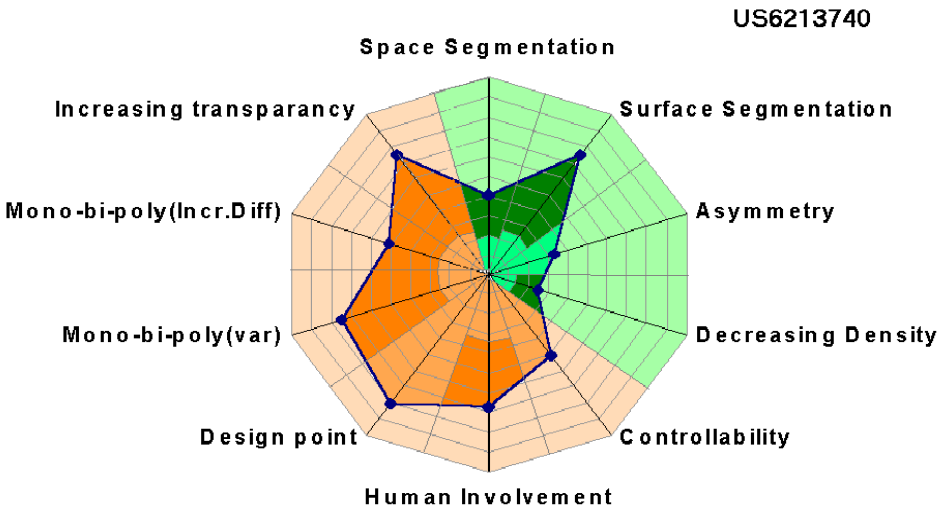

Figure 3: Example Evolutionary Potential Radar Plot Showing Jumps

Figure 4 illustrates a typical group of evolutionary potential plots in an attempt to give an impression of the amount of work that is being conducted during the research.

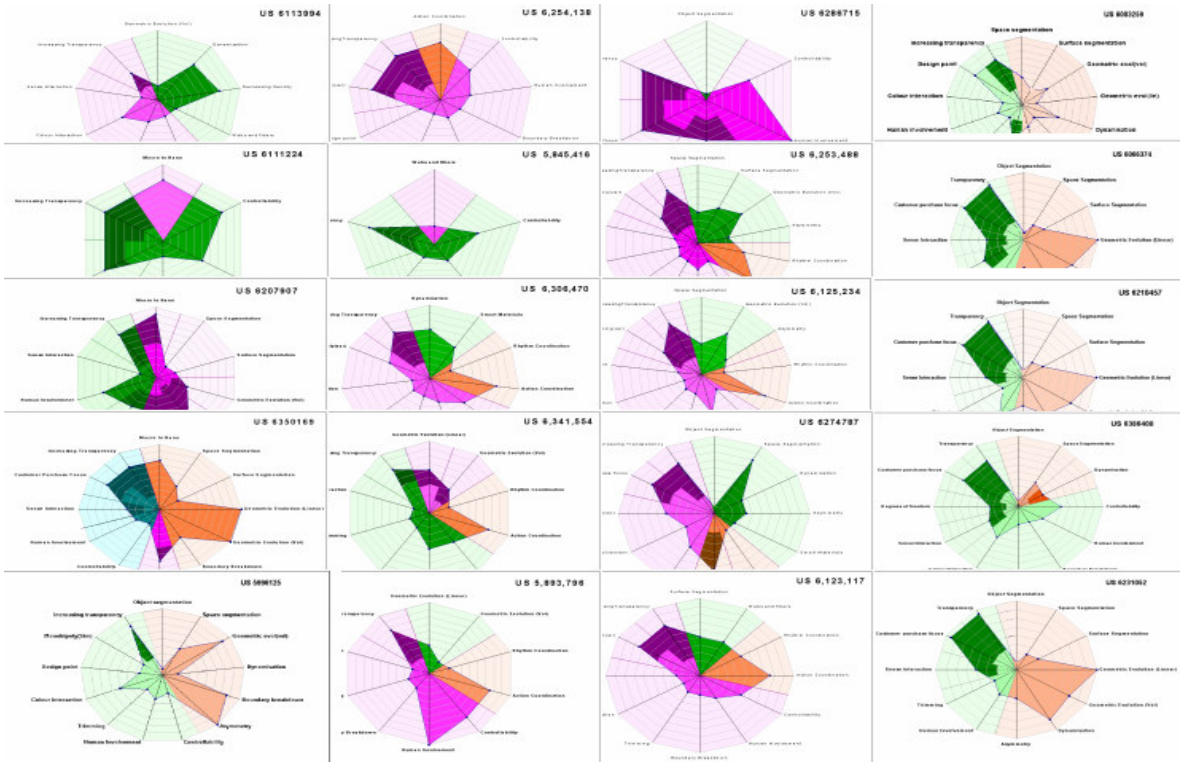

Figure 4: Typical Evolutionary Potential Radar Plots – Patents Involving Transparency Trend Jumps

All of the patents featured in the Figure are connected by the fact that they feature inventions that have made jumps along the 'increasing transparency' trend uncovered during the research. The basic discrete steps of this trend are illustrated in Figure 5.

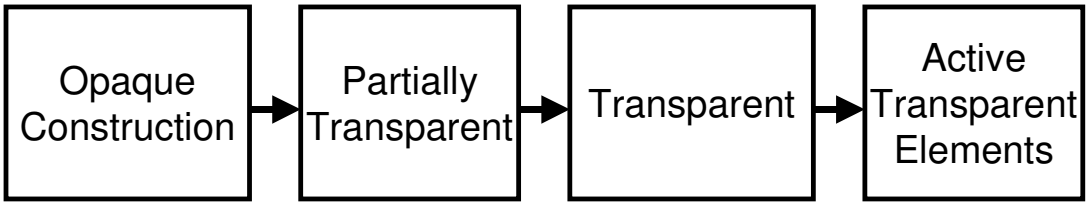

Figure 5: Increasing Transparency Trend of Evolution

Reference 6 refers to the trend in more detail – specifically identifying examples of the trend in action, and also some of the reasons why systems have made jumps from left to right along the trend. By way of further illustrating the breadth and depth of the patent research being undertaken, Figure 6 illustrates the types of technical contradiction that increasing transparency has been used to solve.

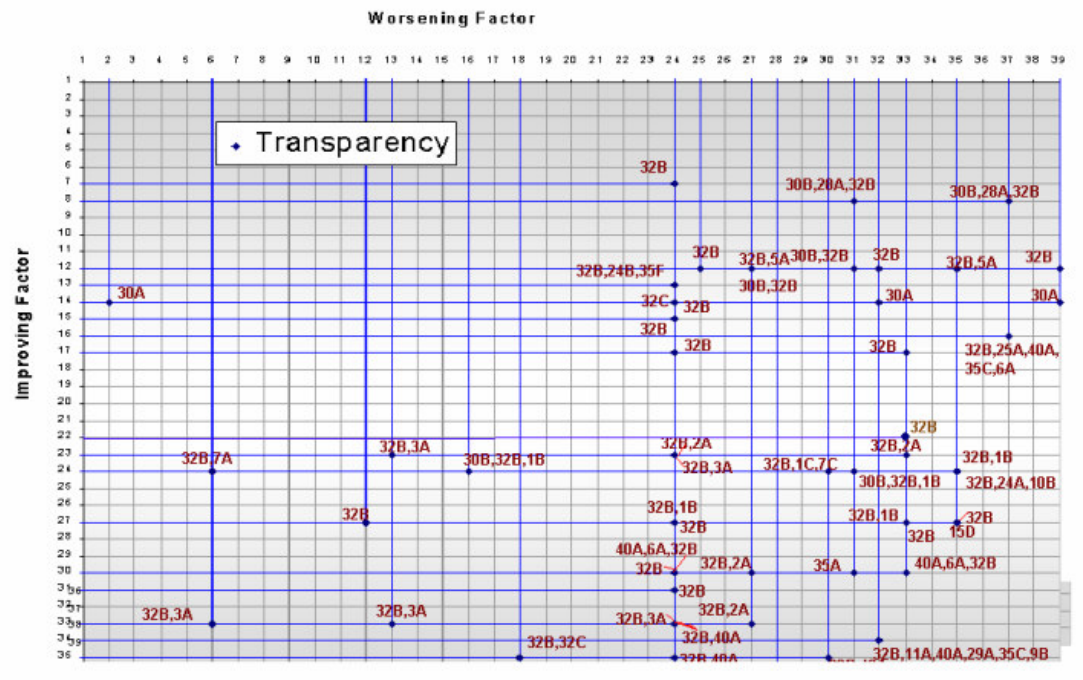

Figure 6: Increasing Transparency Inventions – Contradictions Solved Data

The figure suggests a much broader range of benefits and applications of increasing transparency than might otherwise be imagined.

Future papers and books (7) will record similar data for other trends within the framework we have devised. In the meantime, the main purpose of the description here is to suggest at the size of the patent research we have determined to undertake.

Inventive Standards

(Awaiting data – will be finished in early January)

Conclusions and Future Work

The programme of research to update TRIZ has generated several new trends, new Inventive Standards and has provided significant new data on the evolutionary state of systems relative to a global benchmarking scale. It has also provided, for the first time, detailed information on the frequency and purpose of use of different parts of the TRIZ problem solving toolkit. For these reasons alone, we propose that the research has justified the significant investment we have made. We are continuing the research in the interests of furthering the state of the art of TRIZ methods. In an ideal world, the raw data used in the construction of the tools of classical TRIZ will become available in the public domain. If this proves not to be possible for whatever reason, the value we have obtained through conducting an analysis of patents granted during the period 1985-2000, may well justify extension to examine (or re-examine) some of the patents granted prior to these dates.

In the meantime, we anticipate making more of our findings available to the world at large through other publications.

References

1) Altshuller, G., 'Creativity As An Exact Science', Gordon and Breach, 1984.
2) Mann, D.L., Dewulf, S., 'Updating the Contradiction Matrix', paper to be presented at TRIZCON 2003, Philadelphia, March 2003.
3) www.creax.com
4) Rivette, K., Kline, D., 'Rembrandts in the Attic: Unlocking the Hidden Value of Patents', Harvard Business School Press, 1998.
5) Mann, D.L., Dewulf, S., 'Evolutionary Potential: The Next Stage', paper presented at TRIZ Future Conference, Strasbourg, November 2002.
6) Mann, D.L., 'Hands-On Systematic Innovation', CREAX Press, April 2002.
7) Mann, D.L., Dewulf, S., 'Trends', CREAX Press, to be published Summer 2003.