The journey so far and the way forward for TRIZ.

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Abstract:

Increasing global emphasis on innovation as an agent of change and recovery from the economic crises,places new demands on the development of advanced tools for technical innovation. Four contributing causes for the apparent lack of success of TRIZ in mainstream usage are identified and examined. Consequently, eleven aspects are presented to highlight a way forward for TRIZ and for the overall field of innovation sciences.

Introduction:

The need for practical and efficient technologies for innovation has never been as great as it is at present. Paradoxically the state of TRIZ, as seen through the articles appearing in the TRIZ Journal, appears listless and devoid of energy.

It is widely acknowledged that in a free market situation an increase in the demand for a product or service induces an increase in its supply; or else alternate products or services are quickly developed to meet the shortfall. In innovation we find an anomalous situation.

On the one hand, innovation is being widely championed as a vehicle for economic and corporate revival and the need for developing efficient, applicable technologies for innovation has never been greater. At the same time we observe that TRIZ, which was expected to provide some of the answers, has generally failed to gain any significant traction in mainstream usage.

There can be no doubt about the standard response of most of the classic TRIZ specialists, who would consistently maintain that there is nothing wrong with TRIZ itself, and the fault lies entirely with the limitations of the learners and its users. Their prescribed remedy is to attend more seminars and workshops, and to hire more TRIZ consultants.

I believe a more objective analysis is required at this time, not only to indicate the source of any underlying problems, but also to discover useful directions for further work in innovation science.

Possible causes for lack of mainstream success:

The main theme of this article is that there are four possible causes for this apparent lack of success of TRIZ in the mainstream, which once identified and addressed, can help to highlight a way forward.

These four contributing factors are:

A. A tendency to claim industrial success through inference.
B. Steady reuse of time expired examples.
C. Preference towards generalities over details in articles and presentations.
D. An incomplete body of knowledge.

A. Claiming success through inference:

Many authors and specialists tend to consider the retro-active association of a TRIZ principle, tool or heuristic to any emerging innovation as a justifiable success. This trend may have started quite inadvertently after the release of Darrell Mann's popular book "Hands On Systematic Innovation" [CREAX pub., (2002)] which used external patents to illustrate and explain the real life applications of some of the inventive principles contained in TRIZ.

In the entirety of TRIZ Journal articles and authored books by specialists on the subject, it is rare to find examples where an original concept, not already in the public domain, has been proposed and developed through the innovation cycle. Even with borrowed examples, the analysis is not carried to fruition, but is left unconcluded at the very point where the reader is most interested in the outcome. Many authors regard it as sufficient to link the essence of any and all inventions to some of TRIZ thinking principles, and hence avoid the need to demonstrate any original inventive effort of their own.

It may be useful to consider the motto of IBM in its formative years in the 1930's, when the brilliant T. J. Watson extolled his employees to "Think". From an idealistic and abstract perspective, this single heuristic or tool is sufficient to solve every single problem of humanity, past, present, and future. However, we can no more assign credit for unrelated innovations to TRIZ than we can to IBM.

Let us consider a current example:

Wu Yulu, a Chinese farmer from the village of Mawu on the outskirts of Beijing, has acquired world fame by creating primitive robots, from scrap components, that perform very interesting functions. The important thing for us is to appreciate the process underlying this ingenuity, and to try to capture this capability of synthesis in some formal construct. It would be easy to analyze each robot as utilizing the TRIZ principles of dynamicity (P15), copying (P26), segmentation (P1), periodic action (P19), continuity of a useful action (P20), asymmetry (P4), mechanical vibration (P18), partial or excessive action (P16), cushion in advance (P11), universality (P6), prior counteraction (P9), and nesting (P7), to name but a few.

However, this analysis alone is of little use unless the aim is to find an immediate fit with TRIZ thinking. What is of far greater importance to capture the capability for syntheses of new forms starting with the primitive components, and to devise means of sustaining the innovative momentum.

B. Reuse of time-expired examples:

G. S. Altshuller mentioned simple examples of innovation form the 1950's and 1960's in his books, and to this day these examples are repeated, unchanged, in almost every presentation and book on TRIZ. Most of these examples were past their use by date even then and by now they are completely outdated. I refer to examples of freezing, hydraulics, and actuation through the selective control of magnetic properties with the Curie point (at above 768ºC, no less), etc.

For instance, I do not know how many times the example of the corrosive acid (HF?) and making the container from the material being tested, has been quoted in TRIZ Journal articles. It appears to be included in almost every book on TRIZ. The surprising thing is that none of the TRIZ authors has taken that example and tried to develop it even slightly further using the very knowledge they are espousing. For instance, to apply the STC size operator and reduce the amount of reactant to the smallest feasible drop on the surface, where its surface tension would eliminate the need for making a container. Or to determine the nature of the reaction being studied and to achieve it through other active yet better controlled physical phenomena. Spectroscopic analysis in its many manifestations has been around for over a century. Mathematical models can accurately predict chemical reactivity and rates with ease. Most TRIZ experts are still trading with the old gems, however.

C. Preference towards generalities over details:

Many TRIZ specialists tend to avoid discussing details. If the intemperate audience insists, they mention issues with confidentiality clauses. Examples presented from real life are either trivial, or are often not developed to their expected fruition so as to avoid the need to discuss any additional thinking with the audience. They may instead choose to emphasize broad generalities, emerging mega-trends, etc., which are important, if somewhat ancillary issues.

D. Incomplete body of knowledge:

In its present state of evolution, TRIZ can not be classified as a science, nor is it complete.

If TRIZ were a complete scientific system for innovation / technical invention, then it should perform well with inputs from the user side such as their domain knowledge, technical and engineering experience, etc. Thus for simple everyday items, where they were unfettered by issues of commercial confidentiality, TRIZ specialists would be able to routinely produce examples of useful inventions, and explain the process in detail in their articles to the TRIZ Journal, or to any other medium.

If, on the other hand, TRIZ is still an incomplete work in progress, then it is up to the experts to try to identify the gaps and then to develop the missing tools and techniques. This is an even more difficult task than coming up with a simple invention.

In its current state of evolution, TRIZ is mostly a set of heuristics and these tools collectively are not enough to achieve the required critical mass to sustain chain reaction in any organization seeking innovative capability. The provided tools are well suited to the task of analysis of an invention, as can be seen in most TRIZ literature, but they are less well suited to the follow up task of synthesis of the inventive work.

There is the need to develop greater macro level planning and structuring tools in TRIZ to provide synthesis-oriented functionality. Such tools would guide the application of the existing TRIZ tools and to address the issues of what needs to be done and in which order. Systems level considerations should be processed such as the direction in which the innovative effort needs to be steered for the greatest influence over the problem space.

It may be said that there exists a “valley of difficult passage”, between the towering mountains of domain expertise of industrial users on the one side, and the less impressive hills of contemporary innovation tools on the other. Not only do the innovation tools need to grow in stature, but efforts need to be made to bridge this divide from both sides.

An example of bridging this divide would be to develop mechanisms which support the earliest stages of the innovative process from the user-side. One such approach could be CAR Analysis, which the author has been working to develop, to effectively capture constraints, assumptions, and resources (CAR) and to pre-process them for greater compatibility with TRIZ or any other innovation process.

The way forward for TRIZ and innovation sciences:

Whether it falls under the ambit of TRIZ or is called innovation science or innovation engineering, a body of knowledge needs to be developed, tested, revised and refined to assist individuals and firms seeking reliable capabilities for technical innovation.

With the situation as is, how do we proceed forward from this point? I would like to suggest the following eleven aspects for our consideration, and to guide our thinking for the future.

First, we need to acknowledge and accept the fact that TRIZ can neither be classed as a science, nor is it complete at this stage of its evolution. What constitutes TRIZ is mostly a set of heuristics and these tools collectively are not enough to achieve the required critical mass to sustain chain reaction in any organization seeking innovative capability. In its current form, TRIZ is also unlikely to gain exclusive billing in a prestigious engineering curriculum.

Second, is to realize that most intellectual developments involve an analysis cycle followed by a synthesis cycle, and the present toolset of heuristics included in TRIZ is more supportive of analysis than it is of synthesis. Analysis is the resolution of an entity into its constituents, and TRIZ Journal articles demonstrate this frequently by associating an innovation with the heuristics that may have played a contributing role.

TRIZ will approach completeness when tools for exhaustive synthesis of solutions are also developed. Synthesis refers to the process of coming up with an innovation from its basic constituents, and is considerably more difficult. Here the innovation expert cannot get by with a just a superficial association, the innovation must be developed from a concept, and taken to at least a conceptually complete form, ready for engineering / prototyping. During the synthesis stage, innovation authors have to demonstrate considerable knowledge of the details of the task.

Third, is that an innovative mind should be open to all possibilities at all levels. This includes the likely possibility that existing TRIZ tools are not perfect and not well integrated. As an example of an alternate approach to TRIZ, in 1997, Ed Sickafus provided a different and more compact perspective with his Unified Structured Inventive Thinking (USIT) [www.u-sit.net]. This work continues to be developed further in Japan by Toru Nakagawa and his associates.

As one of his several examples of modifying existing TRIZ tools, Yevgeny B. Karasik maintains that using the same broad classes of engineering parameters on both sides of the contradiction matrix is meaningless. He suggests that for this purpose one set of parameters ought to be resolved into their directly and indirectly controllable components to achieve a more logical and accurate analysis. [Anti-TRIZ Journal, July 2008, Vol. 7, No. 6]. All such contributions represent substantial quantum of thinking and need to be actively considered.

Fourth, is the need to develop the missing innovation tools which are synthesis oriented. These have to provide a planning and structuring function to guide the application of the TRIZ tools and to address the issues of what needs to be done and in which order

We need to develop synthesis tools for macro planning the scope and configuration of the inventive effort from the available resources. How to systematically achieve this is not fully covered by TRIZ.

The author is developing an approach which seeks to build and sustain the innovative momentum through the processing, in parallel, of separate paths of inquiry about the system of interest. Different assumptions are modeled into macro-level entry vectors leading into the problem space. Each of these can be resolved further to provide micro-level detail. Each of these processed micro-level details is developed into a solution vector which is conceptually closer to the finished form of an innovation.

By entering the solution space from multiple directions, there is less likelihood of the momentum being arrested due to issues with a single direction. The approach seeks to find solutions at the super-system level which will have the greatest influence and cover a larger span, than by focusing on localized, low level solutions.

The approach was partially presented in an article that originally appeared in the TRIZ Home Page in Japan in June 2009, with about 25 innovative concepts developed for an airline safety issue. A further reworked version appeared in November 2009 in the TRIZ Journal, but it suffered from rather unfortunate editing, replacement of key graphics with smaller poor quality artwork, excessive and needless insertion of hyper-links to weak TRIZ Journal articles, etc.

Fifth, is to acknowledge that the dialectic approach is the philosophical essence of TRIZ, by equally considering both sides of an argument. New insights can emerge when the two opposing views are considered in greater contrast, and the conflict, as it were, is intensified. An international journal in this field must allow for even sharply differing views to appear side-by-side, and let the reader gain from the exchange.

As innovation deals with qualitative and not quantitative reasoning, the mode of knowledge creation in TRIZ is through inductive logic. The basis for the inductive inference is observation and empirical data, our confidence levels improve with the size of the data collected and by the removal of any bias. It is due to this reason that we must ensure that constant questioning and inquiry is welcomed as a source of re-generation in such a body of knowledge.

Sixth, is to realize that an inventive process is a visual process, and so there is a need to emphasize the more visual modes of presentation in articles whenever possible. A visual representation often imposes greater demands on clarity than the textual narrative. A reader may also gain additional perspectives by interpreting the visual in their own unique way.

Seventh, is to suggest that TRIZ experts should produce more examples to explain to the reader the usage of tools and especially how gaps around abstract heuristics may be filled as they are developed into more concrete solutions. Contributors from India, China, and elsewhere in the world may consider developing the many original examples of local ingenuity, which range from low tech improvisations to industrial applications of advanced technology at the highest level.

The consumers of innovation tools can also help by demanding from specialists more specifics and details, as to how to actually achieve innovative outcomes in their own specific domain and tasks. They must be less tolerant of the canned presentation and the one size fits all approach.

Eighth, is to ensure that interaction and feedback with industrial practitioners is necessarily included, regardless of any need to wrap or cast their work in TRIZ nomenclature. Their actual experience at the coal-face, both successful and unsuccessful, should be objectively reported and inductive inferences drawn to help develop new tools, particularly in the synthesis area. An example is the TRIZ Home Page in Japan, where its editor, Prof. Toru Nakagawa actively encourages industrial participation, and maintains an exceptional standard for editorial work.

Ninth, efforts must be made to link innovation heuristics with mainstream design and engineering. One way of doing this may be to seek the establishment of a new discipline of innovation sciences within the field of Industrial Engineering. Another way would be to progressively include innovation heuristics as part of engineering design. As advanced software packages for engineering design are developed, it is conceivable that innovation heuristics can play a role in the background to transparently steer the user towards various unanticipated or non-obvious options.

Tenth, is to avoid the belief that in order to gain more impact, TRIZ (or innovation science) should fold into or merge with another semi-technology such as Six Sigma, Theory of Constraints, Lean, etc.

I use the term semi-technology because they each have a limited original knowledge base which seems largely incapable of native evolution and growth with time. They share little in common except a sizable aspect of marketing hype.

Each will have to find, essentially from within, the ways, means, and energy to evolve along their relative strengths. Due to increasing intolerance to hype in industrial users, brought about by economic stress, some semi-technologies may not last for very long, at least in their current forms. It makes little sense to hitch one's cart to a horse which is showing signs of weariness and fatigue.

Eleventh, is to realize that we are still much closer to the beginning of the journey than to its end, and are still evolving towards achieving critical mass in this essential field. However, the direction and pace of this evolutionary process is neither established, nor assured. Perspectives from renowned TRIZ specialists are needed at this time to help establish the overall direction. An international academic style journal on TRIZ and Innovation Sciences is needed as well, which will serve as a forum to archive and disseminate essential contributions from specialists, practitioners, academics, and especially industrial users, and to help direct and channel these energies productively.

References:

Specific references have been provided in-text.

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