A METHOD FOR APPLYING TRIZ TO ENHANCE BRAINSTORMING

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Abstract.
Value management is a function-based methodology focused on improving value (defined as function ÷ cost). Its function-based analysis and traditional brainstorming approach to problem solving share a number of characteristics with TRIZ, creating a unique opportunity to apply TRIZ principles into the value methodology. The synergy between these approaches results in enhanced brainstorming output (quantity of high quality ideas). This paper will examine a way to integrate key ingredients of these two approaches, and the benefits that can be realized from the combination of the value methodology and structured innovation.
INTRODUCTION

“Value Methodology (VM) is a systematic process used by a multidisciplinary team to improve the value of a project through the analysis of its functions. The VM process comprises techniques that enable the project team to provide the highest value products, projects, processes, and services to the customer.”¹

“TRIZ (pronounced treez) is the Russian acronym for the "Theory of Inventive Problem Solving." TRIZ is a powerful methodology, based on empirical data, which can provide solution concepts for a wide range of technical and non-technical problems.”²

These two methodologies, were derived around the same time frame in history, with divergent approaches, but a single objective – improvement. Practitioners of each methodology recognize and admit to the shortcomings of their approaches, but to date there has been no agreement on the best approach to address and mitigate those shortcomings. Many practitioners see the methodologies as competing ideologies. A growing number of practitioners, however, see them as complementary tools which can be used in combination to leverage the outcomes from both. It is the aim of this paper to explore one method for accomplishing this task.

VALUE ENGINEERING

The Value Methodology approach can trace its roots back to World War II where it developed out of necessity. Key materials used in manufacturing military and civilian products were in short supply. Alternative materials needed to be found. Ingenuity and creative thinking to find solutions was evident in large scale improvisations, and substitutions, often yielding better and less costly results than the original designs. In 1947, this unstructured process was developed and formalized, into what is now called the Value Methodology, by Lawrence D. Miles, an engineer in the Purchasing Department of General Electric. This methodology focused on the functions which manufactured components had to deliver, and created the process of function analysis. With the constraint of describing each function performed in only two words -- an action verb and measurable noun -- all physicality of the product or process is removed, thus freeing the mind to think more freely about alternatives. This process later evolved into the formal practice called Value Analysis.

With the two-word function description as the backdrop, the creative process of generating ideas and alternatives to deliver the same, or improved, functionality is conducted. To stimulate this idea generation, Miles relied on a technique which was in vogue and gaining widespread use at the time. That technique was called Brainstorming.
Brainstorming was introduced in 1939 by a contemporary of Miles’, an advertising executive by the name of Alex F. Osborn\[R2\]. The brainstorming technique is universally known and practiced in a number of situations, and is often the first and only creativity tool used by many. Its effectiveness in many situations is the main reason for its popularity. However, its major drawback is that it relies on the experiences, skills, talents and backgrounds of the people in the room during the brainstorming activity. This is where the structured aspects of the Miles process breaks down into a free-flowing, unstructured frenzy of rapid fire idea generation where quantity is stressed over quality.

The benefits of the Value Methodology quickly became apparent, and the technique spread rapidly throughout various industries and government agencies in the U.S. during the 1950’s, eventually spreading into many areas of application beyond product design.

In the 1960’s, this function based approach to the analysis of products and processes was enhanced by the contributions of Charles Bytheway\(^3\), who provided a graphical representation and logical structure to the functional analysis step of the Value Methodology. This graphical representation, known as the FAST Diagram (Function Analysis System Technique), organizes the functions that need to be performed by the product, process, or system under study into a How?/Why? relationship.

The Value Methodology has evolved into a structured, 6-Phase, cross-functional team approach to improving value. The discipline defines value as “a fair return or the equivalent in goods, services, or money for something exchanged.”\(^1\) Mathematically, it is the quotient resulting from dividing Functions Delivered by Resources Used to deliver those functions.

Just as in our everyday purchase decisions, value is a judgment, or evaluation that we make based on what we get in return for what we have to give up. When the scale is in balance, our sense of value is minimally satisfied. If the balance is in favor of functions delivered, we are increasingly satisfied. However, anytime we judge the resources given up as greater than the functions delivered, we are dissatisfied.

**TRIZ**

Along about the same time Miles was developing his Value Methodology, on the other side of the world, in the former Soviet Union, Genrich Saulovich Altshuller, a patent agent in the Soviet Navy was developing a theory for structuring
and stimulating creativity. During his time as a patent agent Altshuller reviewed numerous patents, looking for patterns and characteristics that would explain the creation of new patents and methods. What resulted was *Teoriya Resheniya Izobreatatelskich Zadatch* (Theory of Solving Inventive Problems), or TRIZ.

In 1948, Altshuller wrote a letter to Josef Stalin, in which he indicated that the USSR’s approach to innovation was chaotic and ignorant, and that he had discovered a way to make the Soviets the most innovative people in the world. Although Altshuller was a patriot, his actions were viewed as treasonous, and he was arrested and sentenced to 25 years in prison, and sent to the Gulag. Altshuller used his time in prison to further develop and refine his theory. Altshuller was released from prison about 18 months after the death of Stalin, along with many other political prisoners.

In the 1970’s, Altshuller trained many Soviet engineers in his methodology, developing quite a following, which grew into a full-fledged movement. Altshuller continued to develop and improve on his theory with a series of improved methodologies (ARIZ) which went unnoticed in the west until the fall of the Soviet Union and the advent of Perestroika. In 1992, Altshuller and many of his TRIZ trained scientists relocated to the U.S., beginning the spread of the methodology in the west.

The TRIZ methodology consists of four basic principles – Contradictions, Ideality, Resources, and a system of Inventive Principles. It is these Inventive Principles, and the use of them that is most applicable to the improvement of the effectiveness of the Value Methodology.

The Inventive Principles are a system of abstract principles that have been derived from the study of over 2 million patents. Each principle captures an abstraction which embodies a creative solution approach to solving real world problems, from diverse situations and industries, as evidenced in the patents. These principles can be used to overcome “functional fixedness,” or psychological inertia as it is referred to in the TRIZ community and stimulate new ways of thinking about the problem situation and functions that need to be performed or delivered.

**METHODOLOGY SIMILARITIES**

As mentioned earlier, there are a number of similarities between Value Management and TRIZ, with respect to problem solving workshop events. As one can see from Figure 1, the steps of each process address: 1) defining the problem/assessing the situation; 2) stimulating creativity/idea generation; and 3) evaluating those ideas against selection criteria to organize the results into implementable solutions.
Figure 1. Process Comparison

VA/VE Workshop Phases

Challenge – Identification of Value Improvement effort
1. Information Phase – Review all information regarding system under study
2. Function Phase – Define and organize the functions that must be delivered
3. Creative Phase – Brainstorm ideas for improvement
4. Evaluation Phase – Categorize ideas as to Impact (savings) and Ease (timing)
5. Development Phase – Analyze most promising ideas based on investment and payback

The Guided Innovation Process

Challenge – Define what should be improved.
1. Define Objectives – Form an Ideal Vision and determine the criteria for evaluation your solution.
2. Formulate Opportunities – Define the functions to be changed.
3. Generate Ideas – use TRIZ Inventive Principles to focus and accelerate brainstorming.
4. Evaluate Ideas – Assess the type of idea, its impact and ease of implementation.

Solution – Prepare an action plan to implement the solution concept
The Guided Innovation, or Structured Innovation, TRIZ methodology has a couple of advantages over the VM Job Plan approach. One advantage is in the inclusion of negative or harmful functions in the function model. This topic was very well addressed by Hanik and Kauffman, in their 2005 paper (VE-TRIZ: A Technology Partnership)\[^{[R1]}\]. They concluded that the addition of harmful functions in FAST diagrams, along with key physical elements, can lead to a better understanding of the problem, and generation of additional solutions.

One example of this is shown in Diagram 1. The function model depicts a subset of a FAST diagram relating to the training of employees. The How-Why logic is present in the depiction of the relationship between “Train Employees” and “Improve Skills”, and provides opportunities for brainstorming improvements. However, the addition of the negative effect produced by the training, that of the employee being away from his/her job to attend the training, opens up an entirely new aspect on the problem and another area for brainstorming. Additionally, the inclusion of this negative function reveals a contradiction (training employees improves their skills, but at the cost of lost productivity during the training). Contradictions\[^{5}\] represent yet another vast opportunity for the generation of solutions.

Another advantage of the TRIZ approach is in the idea generation phase, due to the use of the Inventive Principles. By bringing into the brainstorming session the Inventive Principles, and examples of how they have been successfully used to solve previous problems in various industries, the creative horizon of the participants is measurably improved, and a major shortcoming in the Value Methodology can be resolved. The brainstorming session is no longer limited to the experiences, skills and knowledge of the people in the room.

The challenge, then, is to bring elements of one discipline into the workshop/practice of the other, when many practitioners from both disciplines steadfastly believe that their method is best and superior to all others. The TRIZ principles, and the methodology, although briefly described in the Value Methodology Pocket Guide\[^{1}\], are not considered part of the Value Methodology, but recognized as a potentially helpful adjunct tool, “when there is a specific problem that can’t be solved with traditional brainstorming, or other creativity techniques.”\[^{6}\] TRIZ concepts are believed, by many, to be too complex, too difficult to be applied except in special circumstances, and requires training of participants in the methodology for it to be effective. TRIZ is applicable to a wide range of problems and shouldn’t be reserved just to those cases where the problem can’t be solved through traditional brainstorming.

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Diagram 1.
INCORPORATION
The single-minded focus of the Value Methodology – to improve value – can be viewed as a subset of the broad range applicability that TRIZ or Structured Innovation offers, whose focus is to improve whatever function or feature is under study, from whatever viewpoint (technical, financial, human factors, etc.) that is most appropriate for the task at hand.

A typical Osborn type brainstorming session is focused on a single function (and dependent on the cleverness of the people in the room). When the session starts, there is a flurry of ideas initially, but in a very short time, the participants struggle to “squeeze out” additional ideas. This process is repeated until all of the functions to be reviewed have been brainstormed. Usually, the results are a rather lengthy list of ideas, some of which are potentially workable, but a great many are not and could be characterized as being “crazy”, “wild” or even “silly”.

Charles Bytheway recognized the importance of viewing problems/situations from various points of views, and asking probing questions from these different perspectives. Formalizing this process, which Mr. Bytheway naturally performed, lead to the creation of FAST Diagrams. For those of us that are not Charles Bytheway, how can we provide guidance to the brainstorming through the introduction of different viewpoints, or perspectives? How can we inject knowledge from outside the room into brainstorming sessions to improve the results of the session?

It is well known within TRIZ circles that the Inventive Principles are extremely useful for looking at a problem from a number of diverse viewpoints. And, that changing the perspective of the participants in a brainstorming session, every few minutes, can greatly enhance the output of such sessions, both in terms of quantity and quality of ideas generated (Figure 2).
So we are left to resolve a contradiction:

- to improve the effectiveness of VA/VE workshops, Structured Innovation/ TRIZ techniques should be used; but,
- because they are complex and difficult to teach, they should not be used.

Teaching all the participants the basics of TRIZ/Structured Innovation prior to or during a Value Workshop will easily add two days to the effort. Many times this is not practical. And, depending on the level of complexity of the Value Study, may not be a good use of time (there may be insufficient payback on the investment of training and time).

The TRIZ Inventive Principle Exclude (remove a critical element from the system) would suggest one way to resolve this contradiction is to remove the training -- apply the Inventive Principles without teaching the underlying science (TRIZ). How can this possibly be accomplished? The short answer is: by stealth!

Although it would be very helpful, the participants of a Value Study do not necessarily need to have any prior training, or need to know anything about TRIZ, or Inventive Principles, or contradictions, or any TRIZ basic teachings. The Value Methodology/ Brainstorming Session facilitator is the only person in the room that needs to be trained in the Structured Innovation methodology and Inventive Principles. Such a facilitator must be well versed in not only the basics of TRIZ, but must have a commanding knowledge of the various Inventive Principles, be able to provide examples of each principle, and point out the principles in everyday objects.

This, of course, puts tremendous burdens on the facilitator:

- The requirement for more in-depth knowledge of the TRIZ methodology (additional training);
- Guiding the group to identify an ideal final result to focus their thinking;
- The “stealth” construction of a parallel function model which includes harmful or negative functions (to avoid objections from “pure FAST” diagram proponents);
- Tactful introduction of the various Inventive Principles, in the form of probing “what if”, or leading questions;
- An ability to remember all of the Inventive Principles, or use of a “cheat sheet” to help guide the process.

With the proper tools and training, the TRIZ-proficient facilitator can effectively guide workshop participants to generate more, higher quality ideas compared to a traditional Osborn type brainstorming session.
This “stealth” approach has been practiced by a few Value Methodology facilitators over the past several years, who have reported (subjective) improvements in brainstorming results. One empirical study suggests that while actual ideas recorded may in fact have decreased, the ideas were more complete, better formulated and a higher percentage were evaluated as potentially valuable. The result was a significant net positive impact on the ratio of good ideas to the overall number of ideas generated in the brainstorming session. A majority of workshops conducted using the TRIZ Enhanced Brainstorming approach have reported that between 25% and 40% additional ideas were generated as a direct result of the application of the TRIZ methodology.

Facilitators who have tried this approach have abandoned the strict Osborn approach altogether in favor of the guided approach to brainstorming. A training seminar which teaches the basics of Enhanced Brainstorming to Value Practitioners/Facilitators has been successfully conducted at the SAVE International Annual Conference in each of the last three years, with increasing participation and high marks from the attendees relative to the usefulness and applicability of the technique to the Value Methodology workshop.

CONCLUSION

It has been repeatedly demonstrated that applying TRIZ concepts to brainstorming sessions increases the quantity of ideas, improves the quality of ideas, and brings additional outside knowledge into the session by way of the Inventive Principles, and as such should seriously be considered as an integral part of any Value Study.

How well the methodologies are integrated, for now, depends on the skills of the individual facilitator. How well the methodology integration is received by the individual professional societies will likely hinge on these individual results and the increasing use of the Enhanced Brainstorming format in Value Methodology workshops. It is too soon to tell if the encouraging results to date will translate into institutionalization of the combined methods in the future, but for now, the method is gaining in popularity.
Footnotes:
3 – Charles Bytheway, (Mile Value Foundation Fellow) used function analysis and FAST diagrams as stimulators for creative thinking. He asked what he called the “thought-provoking questions” to get the team to think creatively. He played roles, and switched roles, and encouraged role-playing among his team members. http://www.valuefoundation.org/fellows/bytheway.htm
4 – Noted Gestalt Psychologist, Karl Dunker (1903 – 1940), defined “functional fixedness” as a “mental block against using an object in a new way that is required to solve a problem.”
5 – Contradictions are defined as situations where the improvement in one function, aspect or feature of the system is achieved at the detriment of another function, aspect or feature of the system. Contradictions often lead to design compromises.

References:
[R1] -- Hanik & Kaufman, 2005, VE-TRIZ: A Technology Partnership