A Simple Theory Underlying Structured, Problem-Solving Methodologies – ASIT, TRIZ, USIT and others

Ed. Sickafus (President, Ntelleck, LLC, Grosse Ile, MI, USA)

Abstract:

Structured problem-solving methodologies, such as ASIT, TRIZ, USIT and others, are made easier to learn and practice through a simple theory. Such methods have a common basis in creative thinking but engage various forms of structure to achieve their goals. They have a common starting point – an unsolved problem. And they have a common end point – innovative solution concepts. Furthermore, they use the same machinery to advance from one end point to the other – our two cognitive engines (our brain hemispheres). This talk is not about variations in methodology. It is a theoretical discussion of how we think as we progress along the path from problem definition to innovative solution concepts. It will be seen that our two brain hemispheres provide near instantaneous insights that are both logical and intuitive. By understanding their fortes we can best use our cognitive resources. Some surprising insights are presented. The theory is relevant to understanding and practicing all problem-solving methodologies.

We are not logical thinkers

To be effective in applying structured problem-solving methodologies (SPSM) we need to understand our natural mode of thinking and to recognize that it is not logical. This makes the application (and therefore the experience) of SPSMs complex.

By understanding our natural means of thinking we discover resources for problem solving that may go overlooked. We will examine natural thinking, thinking resources, innovation, and their relation to how we mentally execute structured problem solving.

Complexity in structured problem solving methodologies

SPSMs have varying degrees of complexity relevant to their learning, practicing, and teaching. Complexity of older methodologies has been addressed by newer methodologies. This will continue. The usual tactic is to find ways to simplify former structure. However, root causes of complexity in structured methodologies have not been addressed.

It is assumed herein that one plausible root cause of complexity is the mismatch between idealization of SPSMs and our natural way of thinking. The former are logical and organized, as expressed in their structural heuristics and their teaching, the latter is not.

Mental problem-solving resources

Our mental problem-solving resources lie in our two brain hemispheres. Both perform reasoning, remembering, communication, and problem solving. But they do them differently and share their results. For example, one is better at logic and the other is better at intuition.

The left- and right-brain hemispheres (LH and RH) receive the same sensory information simultaneously but process it according to different protocols. Each is aware of the other through their adjoining corpus callosum. How they think is unknown.

LH controls language and logic in most individuals. Technologists are influenced more by their LHs and artisans more by their RHs. RH is better at visualization of spatial relationships and the use of metaphors. Having no language, RH is at a disadvantage to LH. LH may veto RH ideas. (Note, LH and RH traits are reversed in some individuals.)

History has many tales of technologists being stymied by a problem for long periods, then discovering the answer metaphorically in a dream. Is this RH finally being heard?

RH analyzes spatial information but can't verbalize its results.

> Try describing a spiral staircase while sitting on your hands. (David Galin)

Natural thinking

We often ascribe the "gift" of problem solving to creative people. But what is a creative person? "[It is] someone who can process in new ways information directly at hand – ordinary sensory data available to all of us". (Betty Edwards) This equates to "a person having a new point of view."

Herein, thinking refers to the conscious and subconscious processes used in problem solving. We are aware of the conscious but we cannot know the subconscious. However, we can, through introspection, make useful deductions about thinking and use them to engage best practices for innovation. This requires language, an LH trait.

Introspection reveals that our natural thinking is unorganized and uncontrolled. It is at times logical, at other times illogical. It can be rational and whimsical. It jumps

uncontrollably between different topics interrupting concentration. It pulls together unusual objects and functions creating wholly new concepts.

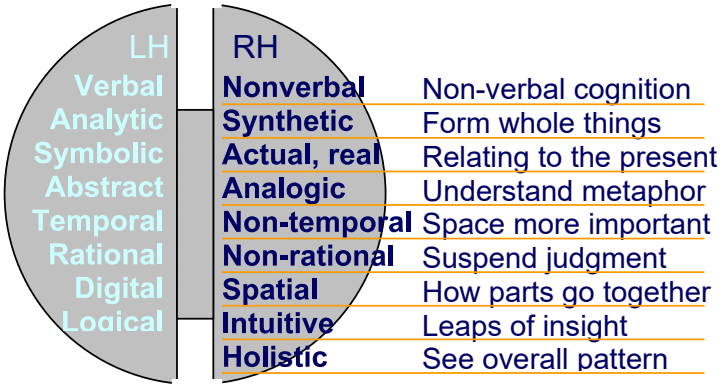
Our communication of problem solving is orderly; like this, Definition – Analysis – Solution. However, thinking while problem solving is not orderly but jumps in random ways between these three phases of problem solving. Typically, we begin with an instantaneous, intuitive, solution concept. It is tested and modified iteratively as necessary for acceptance or rejection. From this observation we deduce that in our natural mode of thinking, while problem solving, the **content** of structure is important not its **order**. Consequently, flowcharts can be avoided.

Effective communication

By comparison with our natural thinking, our communication must be organized and logical to be effective. Organization is a heuristic for communication not for thinking.

Thinking traits

Several types of thinking traits have been identified with tendencies for LH and RH preferences. RH-traits are emphasized here since, as technologists, we already have well-developed LH-traits.



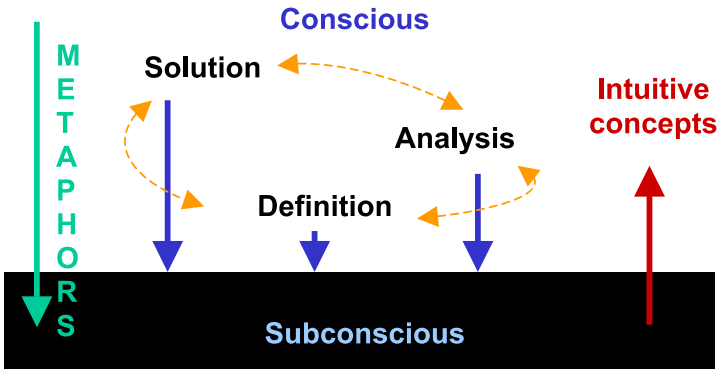
Effecting innovation

To maximize our creative thinking (not communication of our thoughts) we need to subdue LH's logical reasoning while encouraging RH's metaphorical thinking. Structure and language are the tools of logical communication. Image and metaphor are the tools of creative thinking.

Structure can work against effective innovation. A flowchart, for example, is not needed to innovate, it is too organized and works against unregulated random thinking – our natural mode of innovation. A simple model of consciously seeding the subconscious can be used instead.

A model for innovative thinking

A simple model of consciously seeding the subconscious in an iterative fashion can be used instead of structure. One focuses on the generation and regeneration of metaphors during solution, definition, and analysis phases of mental problem solving (without concern for their order). Regeneration of metaphors means their gradual generification to allow multiple versions an opportunity to seed the subconscious. Seeding causes intuitive concepts to rise to the conscious.



Intuitive concepts in innovative thinking are of two types: instant recall of past experience – known problems, and recall of experience that approximates the given problem or contains similarities. Innovation requires new and unusual assembly of parts with leaps of insight.

Let us turn now to opportunities for metaphors in problem definition, analysis, and solution strategies. These will be couched in terms of the USIT proforma model of a well-defined problem.

Problem definition

Problem situations arise as collections of objects, attributes, functions, unwanted effects, causes, and extraneous information, which we must identify, sort, cull, and minimize – logical thinking. The first step is simplification, which leads to identification and elimination of extraneous information. The goal of definition is to reduce a problem situation consisting of objects, attributes, functions, unwanted effects, extraneous information, and images to a well-defined problem. Two heuristics aid this process, simplify and generify. The next heuristic is to construct the well-defined problem into a graphic metaphor based on sharp focus at the interaction of two objects (a single point of contact).

O – A
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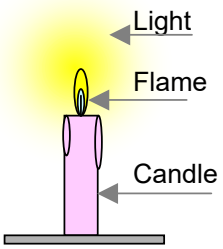
U – A_m – O
/
O – A

Metaphorically, emphasis is placed on two casual attributes (A) of an unwanted effect (U) and the affected attribute (A_m). Now the goal is to identify root causes of the unwanted effect through its underlying phenomenology. In this process we find new and effective insights.

Problem analysis

A heuristic for analysis is the plausible root-causes tool that forces our thinking to the cause-effect links from a causal attribute to the unwanted effect. For example, consider the following problem situation: Our Company makes candles. It is loosing market share and needs a better product in order to compete.



In order to invent, we can either improve an existing function or add a new function. In either case we couch the problem in terms of an unwanted effect: for example, “insufficient light”. This choice reduces objects to two: flame and candle. Now we are focused on the point of contact of two objects: molten fuel and flame (a high temperature plasma) – both new metaphors.

Flame – **Temperature**
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Insufficient light – Visibility – Table
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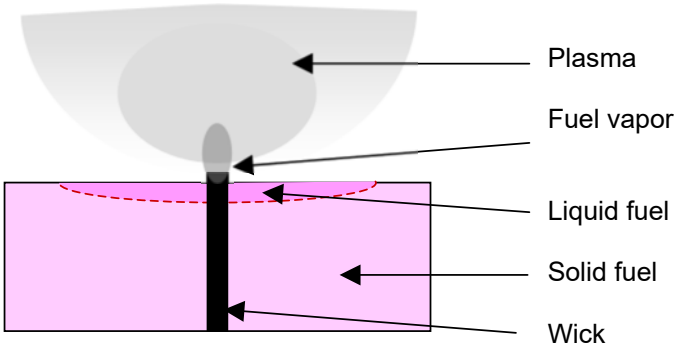
Fuel – **Rate of combustion**

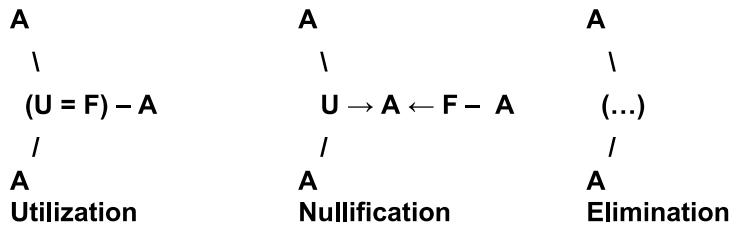
As we probe phenomenology the obvious question to ask is what determines light intensity? Rate of combustion seems an obvious answer. This raises new images of our point of focus.

In this manner, problem analysis takes us through stages of metaphor formation and the generation of new seeds for sparking intuitive concepts.



Solution strategies

Solution strategies need to be simple, graphic, and metaphorical with minimum structure and expressed generically. There are three strategies for resolving an unwanted effect: utilization, nullification, and elimination.



In utilization, U becomes a useful function, F. In nullification, U is countered by a new function. In elimination, U disappears.

Mental attitudes for simplifying problem solving

- Recognize that order and logic can encourage LH-logic versus RH-intuitive thinking.
- Use structure as a heuristic not as a necessity.
- Components, not order of structure, are important.
- Use simple sketches to engage RH metaphorical thinking.
- Match verbal descriptions with graphic expressions.
- Suspend judgment of ideas in order to encourage intuitive leaps of insight.
- Simplify a problem to a single unwanted effect and minimize the number of objects in order to enable a holistic view of a problem.
- Seed the subconscious with verbal metaphors.
- Start with solutions.
- Iterate between solution, analysis, and definition in steps rather than complete one before moving on.
- Search concepts at every step.
- Follow your inspiration.

The goal of a methodology is to spark new concepts from new viewpoints.

Conclusion

By understanding how we think, and by motivating metaphorical participation of both brain hemispheres in problem solving, we can learn, practice, and teach problem solving with innovative effectiveness.

With language we search the depths of our rational thinking.
With metaphor we search the depths of our imagination.
Together they inspire insight and innovation.