" 5W's and an H " of TRIZ Innovation

Prakash R. Apte
Tata Institute of Fundamental Research, Mumbai, India
apte@tifr.res.in

Harish Shah
Neilsoft Ltd., Pune, India
Harish.shah@neilsoft.com

Darrell Mann
Systematic Innovation, Clevedon, UK
Darrell.Mann@systematic-innovation.com

Abstract

It is a commonly held view that '*90% of the problem is defining what the problem is*'. In actual fact, every time the statement or a derivative of it appears, the importance of problem definition seems to tend ever higher as a proportion of the total problem. The " 5W's and an H " and related techniques to be discussed in this article are aimed at helping problem (or indeed, looking at the opposite side of the coin, 'opportunity') owners to help in the definition process. Used in conjunction with TRIZ, the techniques are shown to be effective in helping to find the contradictions and harmful effects crucial to successful application of the TRIZ solving tools. This paper describes the basic TRIZ philosophy underlying various TRIZ tools and techniques, and the way they integrate most effectively with systematic problem definition tools.

Problem Definition using TRIZ tools:

TRIZ consists of many problem solving tools and several different ways of classifying them. The first and the main task in inventive problem solving by TRIZ, however, still remains to be the toughest one - to identify and formulate the problem. The purpose of this article is to concentrate on this aspect and to show how our awareness of the TRIZ solving tools should influence our search strategies during the definition stage. In the very broadest terms, TRIZ can be divided into four main stages as shown in Figure 1.

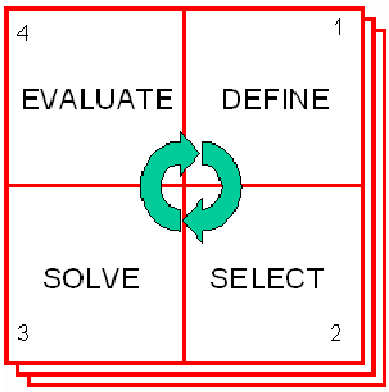

Figure 1: 4 Stage TRIZ Process

We will be concentrating here on the ‘definition stage’, but using the ‘select’ and ‘solve’ stages to help us in our quest for the ‘right’ problem. By ‘select’, we mean the rules and guidelines which influence which of the TRIZ solve tools is most relevant to a given problem situation. The principal problem definition methodology adopted in this article is based on a very simple premise - ask relevant questions until we get the answer. Like W.E. Deming has once said "Ask why 5 times", below is a compiled list of questions one ought to ask to get the ‘right’ answer. Questions we usually ask begin with 5 W's "Who?", "What?", Where?”, "When?" and "Why?". The last one, "Why?" is asked repeatedly till we get the answer! To complete the sequence of questions we need to add one more question starting with "How?" in an effort to find a possible answer or solution to the problem. We will therefore use the phrase "5W's and an H" first to identify the problem and then to provide a possible solution to it. Below we offer a compilation of "5W's and an H" as used for each of the TRIZ stages given above.

Why-What’s Stopping Analysis

First, however, as an aid to assist in our attempts to think about problem definition hierarchy, it is useful to introduce here a modified version of the ‘Why-What’s-Stopping?’ analysis tool first developed by Basadur (1). The tool provides users with a structure through which to visualise an initial problem statement in the context of its broader and narrower context. The tool is aimed at overcoming the highly common situation which starts with statements like ‘the problem is…’ and continues a few seconds later with a headlong plunge into problem solving mode. This phenomenon is one of the most important manifestations of psychological inertia. Countless situations point to the fact that the initial problem definition turns out to be anything but the ‘right’ one. So, the tool takes the initial ‘the problem is…’ statement and forces the user to think about the broader and narrower problem. A typical schema is reproduced in Figure 2. Basically, the user uses the ‘Why?’ question to broaden the problem and uses the question ‘What’s Stopping?’ to narrow the question. In keeping with the ‘ask why 5 times’ philosophy, the schema can be broadened or narrowed multiple times. (In line with Deming’s statement, it would be very unlikely that we would have to repeat the why cycle more than five times to get to the root cause - in practice it will usually take less.) At the end of the process, the user has obtained a vertical stack of hierarchical problem definitions, from which a much clearer picture of what the ‘right’ problem is should emerge in conjunction with some of the strategies described below.

We will see an example of this schema and its ‘5Ws and an H’ relatives in action in a future article.

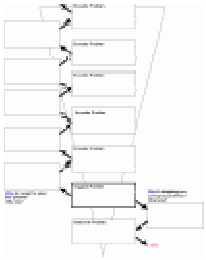

Figure 2: Modified Why-What’s Stopping Analysis Problem Definition Schema

In this next section, we explore how the different TRIZ problem solving tools should influence the following ‘5Ws and an H’ questions we ask while trying to define the ‘right’ problem:

W1. Who has the problem?

W2. What does the problem seem to be?

W3. When does the problem occur?

W4. Where does the problem occur?

W5. Why does the problem occur? What is root cause?

And

H1. How does the problem occur? How can the problem be solved?

W1. Who has the problem? : This clearly identifies the person connected with the problem. He could be one who is using the final product or anyone in the line-up of concept-to-market or a person at any of the product Life-stages from design through manufacture, transport, use, repair and disposal.

W2. What does the problem seem to be? : This is the type of question we ask in order to narrow the problem and focus in on key issues - as seen in the 'why-what's-stopping' analysis. It is a good idea to keep the TRIZ solve tools in mind when asking the 'what?' question:

1. Try to specify conflict/contradictions -- as a technical contradiction or as a physical contradiction

2. Try to specify harmful action/interaction/effects

3. Try to specify inefficient useful action/interaction/effects

W3. When does the problem occur? : Clearly identifying the time related aspects of the problem. When does the conflict occur? Is the key question here. In line with ARIZ thinking, if we can identify a time of the conflict, the time just before and the time just after, we have a strong basis for identifying physical contradictions which may be amenable to separation in time. If there is a physical contradiction amenable to separation in time, the 'when' question is the key to identifying it.

W4. Where does the problem occur? : Again the key is relating to the ARIZ concept of 'zones of conflict'. Determine what is the zone of conflict looking at the super-system, system and sub-system. The aim again is to keep in mind the TRIZ physical contradiction solution strategies - and in particular to be looking for places/spaces where the problem does and doesn't occur. If there is a physical contradiction amenable to separation in space, the 'where' question is the key to identifying it.

W5. Why does the problem occur? {"Ask WHY 5 times " - W. E. Deming} : In the 'why-what's stopping?' parallel, the 'why?' question is all about broadening the problem and specifically heading back towards root causes. The process is often helped by thinking about the 'function' that creates/leads to the problem and the presence and interactions between substances ("tool"

and “object”) and fields (energy, enabling, acting force) present - is “tool”, “object” or “field” causing the problem?

H1. How does the problem occur? : The how question is present to encourage us to think about the underlying causes and effects of the problem. How does the conflict arise? The how question and its relation to cause and effect plays a significant part of the Theory of Constraints problem definition methodology (2).

Other Times During Problem Definition When 5Ws and an H are used:

5 W’s and an H for Harmful Effects :

1. Who is affected by the harmful action?

2. What is the result of the harmful action?

3. When does the harmful action occur? (time of problem)

4. Where does the harmful action or effects appear? (zone of problem)

5. Why does the harmful action occur? (root-cause of the problem)

6. How does the harmful action arise?

Trends of Evolution:

The 4 Stages of Technical System Evolution are;

I. Synthesis,

II. Selection and improvement of parts,

III. Dynamization of parts,

IV. Self-development of parts

Using 5W’s and an H to identify the Stage of Evolution :

1. What is main function of the system? - What parts are needed to synthesize the required function?

2. How to improve the parts? - Or How have the parts improved (in the past)?

3. How to dynamize the parts? - Or How have the parts been dynamized (in the past)?

4. How to control and hence automate the function?

These questions have much in common with the concept of 'evolutionary potential' - a topic discussed at length in Reference 3.

Evolution timing is another critical issue in problem definition. The key question here is 'When will the evolution occur?' There are no definitive answers to this question. Good pointers come from Reference 4, which describes the emergence of the administrative contradiction for a sufficiently valuable sector of the existing and prospective future customer base becomes dissatisfied with the current offering - Figure 3.

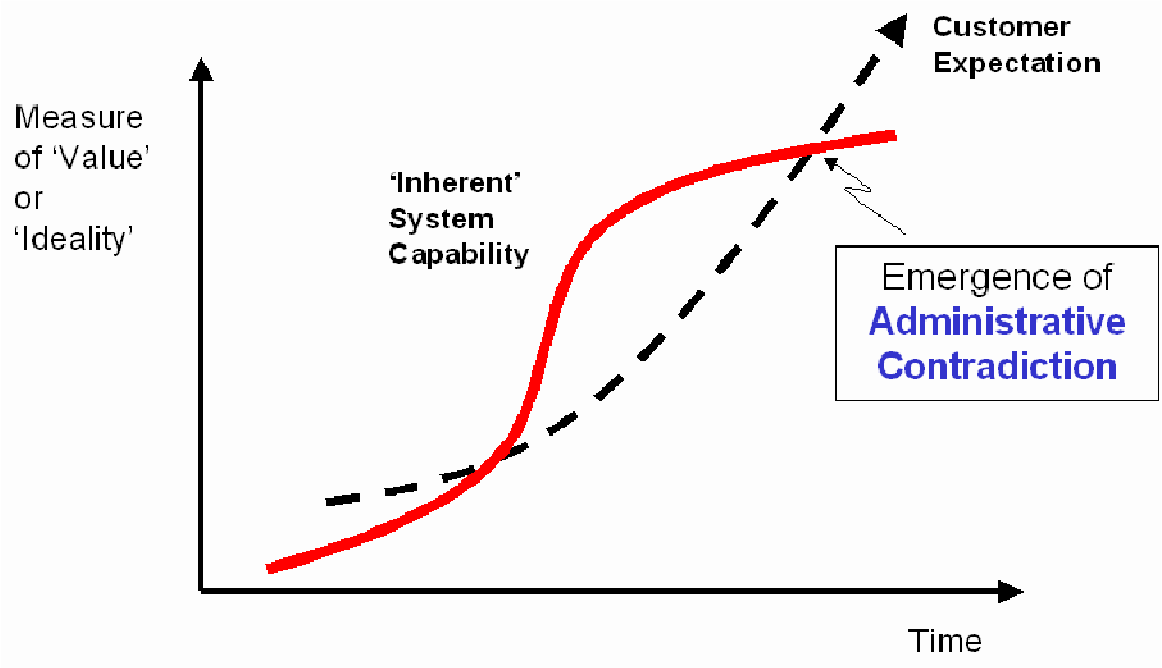

Figure 3: Emergence of Administrative Contradiction defines the 'When' of System Evolution Timing

Ask 5W's to help Identify "Parts of a Technical System" :

1. What is the source of energy? (called "Engine")

2. How is the source connected to the output? (called "transmission")

3. What are the parts that do the "work"? (called "limbs")

4. When/Where to control the limbs? (called "Controls")

5. How to provide consistency / reliability to actions of the limbs? (called "Interface" - Reference 5)

Ideal Final Result (IFR) and Ideality:

Ideal Final Result is very useful concept as it,

1. gives an implementation-free description (after the problem has been solved)

2. focuses on functions needed (and not on the currently used processes and / or equipment)

3. eliminates rework (by solving the 'right' problem the first time itself)

4. leads to breakthrough thinking (about the solution and not inhibited/hindered by intervening problem)

The IFR has the following **characteristics** (as defined in (6)).

Eliminates the deficiencies of the original system

Preserves advantages of the original system

Does not make the original system more complicated (uses free or available resources)

Does not introduce new disadvantages

Ask 5W's and an H to help formulate IFR :

1. Who has the problem? (person connected with a life-stage)

2. What does the customer want? What is the ideal function?

(think of some implementation-free (ideal) solution)

3. When does the problem occur? (time of conflict)

4. Where does the problem occur? (zone of conflict)

5. Why does the problem occur? (root-cause of the problem)

Then use the set of questions to formulate IFR :

1. What is the final aim?

2. What is the ideal final result?

3. What are the obstacles to achieving this?

4. Why do (these) obstacles interfere?

5. How would this interference disappear? Under what conditions?

Remember, of course, that one of the key issues when using the tool is to formulate the IFR from the perspective of the customer. There are frequent (and often seemingly intractable) differences between the customers IFR and that of the supplier and, for that matter, other parts of the supply system. Thus the 'What does the customer want?' question is often paralleled with a 'What can we supply (and still remain in profitable business)?' question in order to help answer the key question here 'Who's Ideal Final Result?'

System Resources:

Ask 6 questions to find Resources

Q1.What are the Substance resources? - any available material within the system or system's surrounding, which can be used. This will include any unused evolutionary potential as defined from the trends of evolution (3).

Q2.What are the Energy Resources? - any sources of energy available within the system or system's surrounding, which are not used fully.

Q3.What are the Space Resources? - any unused space.

Q4.What are the Time Resources? - any time slots in between, before or after technological processes, that have not been used fully.

Q5.What are the System resources? - new useful features of the system, which can be obtained by changing relations between parts of the system.

Q6. What are the Knowledge Resources? - who knows something that might help solve the problem?

Functionality - Knowledge and Scientific Effects:

Ask 5W'sand an H to describe "Scientific Effects":

1. How can one use / or receive the specific effect?

(required conditions that the tools, objects, and fields must satisfy)

2. How can one eliminate /or inhibit the outputs of the specific effect?

(Identify an anti-effect that can "correct" harm in part or full)

3. How can one control the input parameters (and hence the output)

of the specific effect? (Continuous or discrete levels?)

4. How can one join this effect with another effect?

(In tandem, in parallel)

5. How can one measure the input and output parameters of the effect?

(Direct or indirect measurements)

Final Thoughts

In the same way that the TRIZ system operator (9-Windows) concept should be an integral part of the way we use each and every stage of TRIZ, the '5Ws and an H' idea also plays a strong across-the-board part in helping us to define the 'right' problem.

Knowledge of the TRIZ problem solving tools should influence how we use the 5Ws and an H in formulating questions during the problem definition stage - and should help us in making the leap from 'right' problem definition to 'best' solving tool(s) to solve the problem.

References

- Abrader, M., 'The Power Of Innovation', Financial Times Prentice Hall, 1995.
- Mann, D.L., Stratton, R., 'Physical Contradictions and Evaporating Clouds', TRIZ Journal, April 2000.
- Mann, D.L., 'Evolutionary Potential In Complex Systems', paper to be presented at CIRP2002, Hong Kong, April 2002.
- Mann, D.L., Domb, E., 'Business Contradictions - Profitable E-Commerce', TRIZCON2001, Los Angeles, March 2001.
- Mann, D.L., 'Laws Of System Completeness', TRIZ Journal, May 2001.
- Domb, E., 'Ideal Final Result: Tutorial', February 1997.