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Process Innovation

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Thinking Visually in TRIZ and Six Sigma

Part 5 in a series on P-TRIZ

In the previous article I showed how TRIZ can be used to create a "5 Whys on Steroids" methodology. One of the strengths of TRIZ is that it can extend existing business methods. In this article I'll illustrate the principle further by applying TRIZ to another type of commonly used business tool, the Barriers & Aids chart, sometimes called a Force-Field diagram. These visual tools are popular organizational change and Six Sigma specialists.

In today's business world, Six Sigma is an umbrella brand that pulls together disparate business techniques around a core of statistical methods that reveal discrepancies in products, services, and processes. Where does TRIZ fit in Six Sigma? It would be all too easy to throw TRIZ into the Six Sigma hat and forget about it. There are two reasons why this is a bad idea.

First, TRIZ contains content and techniques that have nothing to do with Six Sigma objectives. For example, modern TRIZ describes how products, services, and their dependent technologies can evolve to the next generation.

Second, TRIZ is a meta-method. It can describe and extend other methods. I think about TRIZ as a viable and credible body of knowledge in its own right, not as a technique added to Six Sigma. On the other hand, Six Sigma communities have successfully established a brand in many corporations, even if, in reality, "Six Sigma" is a tag to refer to a bucket of related, but largely un-integrated, techniques.

Where Six Sigma is well known, TRIZ is virtually unknown. Why is this? One reason lies in how the two methodologies were developed. The success of Six Sigma in corporations was achieved in no small part by supplying a well-defined *process* for the conduct of Six Sigma projects. Experience has shown that following this process will deliver results. Despite the success of talented TRIZ masters, the TRIZ community have no equivalent process. At Computer Sciences Corporation I call these processes "TRIZ applications." The applications extend TRIZ and specialize it for various business purposes. P-TRIZ for business process management is one such application. Keep this in mind as you consider adding TRIZ to Six Sigma. It may be tempting to add TRIZ to Six Sigma in order to give it respectability. Yet without thinking about how it should be implemented and integrated, you may not achieve the results you are looking for.

It is easy to be simplistic when considering how to add TRIZ to Six Sigma. For example, TRIZ is mostly known and associated with the field of innovation. This has led some to add a mention of TRIZ in chapters of manuals and books that describe Design for Six Sigma (DfSS), that variant of Six Sigma which applies to the design phase of a project – the phase in which a lot of creativity

occurs. To add TRIZ in this limited way, however, would miss opportunities to use TRIZ in other Six Sigma activities, such as cause-effect, project definition, cost/benefit analysis, business and technology problem solving, brainstorming, mistake proofing, process mapping, selection, and many other aspects. Not only can TRIZ be used to support and strengthen all these aspects of Six Sigma, it can be used to provide an overarching and reliable process of problem-solving and re-design. I expect to describe the end-to-end innovation process in a future article of this series.

Beefing up Barriers & Aids using TRIZ

A Barriers & Aids chart is a simple visual tool. It can help all members of an important project to focus on perceived or actual drivers and inhibitors of a needed business change or remedy. The chart is used in many process and organizational change initiatives. Like the "5 Whys" method I described in part four of this series, Barriers & Aids is also described in Six Sigma training materials such as those supplied by Six Sigma specialists such as the Juran Institute and the Quality Assurance Institute.

Barriers to change pop up in every project and come in many different forms. For example, Six Sigma practitioners refer to cultural barriers. There could be a psychological or organizational reluctance to taking up the changes to a business process recommended by a Six Sigma DMAIC Improve Phase. Significant change will always throw up many barriers. Other types of barriers include the required finance, management support, or deeper technical problems preventing adoption of "the solution."

It is all too easy to forget that implementing a solution to a problem is just another problem in its own right. Only by solving problems is progress made in process change or innovation. Problems must be solved that remove, eliminate, or counter-act barriers that would otherwise prevent implementation of the solution. And we must also never forget that Six Sigma itself has no answers. The statistical tools can identify the source of discrepancy, but a solution must be found through creativity and problem solving. That process is called innovation. In other words, problems must be revealed, solutions must be found, and then the solutions must be implemented, in a continuing process of removing barriers by problem solving.

In a Six Sigma project, the Barrier & Aids chart is used to document the result of the Six Sigma team's proposed solution. The practitioner asks whether all of the important barriers have been identified, whether the existing aids overcome the barriers and, where needed, whether the countermeasures will be adequate. Formal or ad-hoc brainstorming is used to list potential barriers. Brainstorming is also used to list potential aids. Countermeasures are invented to counteract those barriers that have inadequate aids. In this way it is hoped that the solution will be successfully implemented.

TRIZ Models Can Act As A Barriers & Aids Chart With Advantages

TRIZ models visualize functions that are either useful or harmful and define the causes and effects between them. In TRIZ, aids would be considered useful functions and barriers would be harmful functions. In TRIZ, functions that are useful or harmful can produce or counteract other functions. For example, a TRIZ model can show a useful aid – such as new finance – producing a harmful result – less budget for next year.

The general TRIZ model for a Barriers & Aids chart is shown in Figure 1.

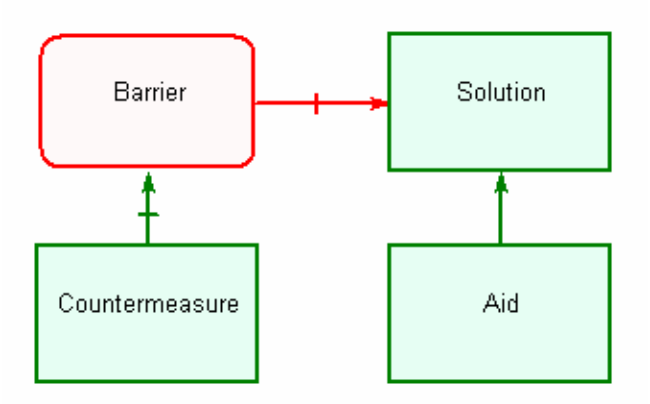

Figure 1. TRIZ model for generic Barriers & Aids chart

The simple diagram says: Barriers (Harmful) counteract Solutions (Useful). Countermeasures (Useful) counteract Barriers (Harmful). Aids (Useful) help facilitate (produce) Solutions. All Barriers & Aids follow this pattern.

Listed below are the primary directions generated from the model. These are all of the fundamental strategies that can be used when analyzing any Barriers & Aids situation:

1. Find an alternative way to obtain [the] (Solution) that offers the following: does not require [the] (Aid), is not influenced by [the] (Barrier).

2. Find a way to protect [the] (Solution) from the harmful influence of [the] (Barrier).

3. Consider replacing the entire system with an alternative one that will provide [the] (Solution).

4. Find a way to eliminate, reduce, or prevent [the] (Barrier).

5. Find an alternative way to obtain [the] (Countermeasure) that eliminates, reduces, or prevents [the] (Barrier).

6. Find an alternative way to obtain [the] (Aid) that provides or enhances [the] (Solution).

TRIZ models are more general purpose than Six Sigma Barriers & Aids charts. As we saw in part four, they can also be used for root causes analysis.

Despite their formality, TRIZ models remain very simple for business people to understand. In TRIZ there are only two types of boxes (Useful and Harmful) and two types of lines (Produce or Counteract). This simple semantic device can be used to model a wide variety of situations, including Barriers & Aids relationships and many other aspects of the work of a Six Sigma Green or Black Belt.

From the model above, the following set of additional solutions can also be generated:

1.1. Find a way to increase the effectiveness of [the] (Solution).
1.2. Find additional benefits from [the] (Solution).

2.1. Try to compensate for the harmful influence of [the] (Barrier) towards [the] (Solution).
2.2. Try to reduce the sensitivity of [the] (Solution) to the harmful influence of [the] (Barrier).

3.2. Consider enhancing the current means by which the primary useful function is achieved, to the extent that the benefits will override the primary problem.
3.3. Consider giving up the primary useful function to avoid the primary problem.

4.1. Find a way to benefit from [the] (Barrier).

5.1. Find a way to increase the effectiveness of [the] (Countermeasure).
5.2. Find additional benefits from [the] (Countermeasure).
5.3.Try to increase the effectiveness of the action of [the] (Countermeasure) toward reducing the harmful nature of [the] (Barrier).
5.4. Consider modifying or influencing [the] (Barrier) to improve its being eliminated, reduced, or prevented by [the] (Countermeasure)

6.1. Find a way to increase the effectiveness of [the] (Aid).
6.2. Find additional benefits from [the] (Aid).
6.3. Find a way to obtain [the] (Solution) without the use of [the] (Aid).

TRIZ is exhaustive. A software tool is often used. TRIZ will find all of the possible ways to improve any situation documented in a Barriers & Aids chart.

From The Abstract To The Concrete

As can be seen from the example above, TRIZ is very effective at modeling abstract diagramming concepts, for it automatically creates a set of generic strategies. This is an effective form of knowledge management. Best practices can be modeled in TRIZ, and the output represents guidance that can be shared among staff. I expect this form of knowledge management to increase in use over the years. At this stage of the development of TRIZ, however, it is much more usual to model unique realistic situations. Here is such an example of a Barriers & Aids chart taken from Six Sigma training collateral:

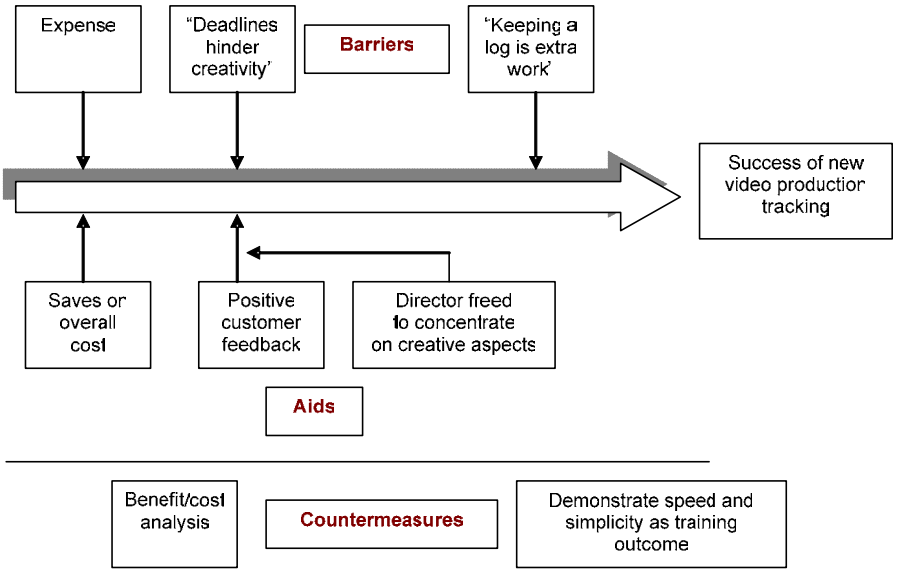

Figure 2. Example of Six Sigma Barriers & Aids Chart
Source: Juran Institute Black Belt Training manual Toolkit

It is easy to see how the chart can be converted into a TRIZ model. As a first step, let's do a literal model. It's probably the best we can do without interviewing the people involved:

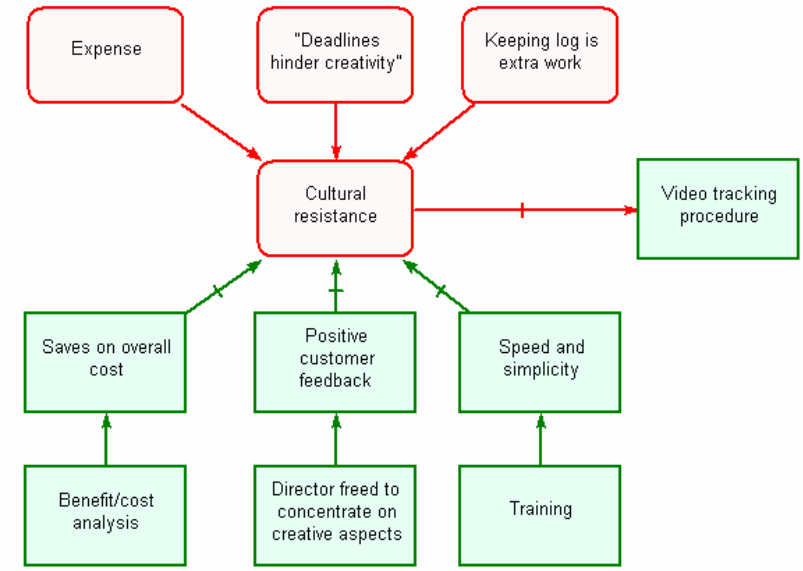

Figure 3. TRIZ model corresponding to Barriers & Aids chart

Directions generated by this model include

1. Find an alternative way to obtain [the] (Video tracking procedure) that is not influenced by [the] (Cultural resistance).

This is prompting the team to look for other solutions that may not be so sensitive to cultural factors.

2. Find a way to protect [the] (Video tracking procedure) from the harmful influence of [the] (Cultural resistance).

This prompts the team to examine the root cause of why the Six Sigma solution, a Logging System, is creating such cultural resistance.

3. Consider replacing the entire system with an alternative one that will provide [the] (Video tracking procedure).

This says: If the solution throws up barriers, perhaps there is a more ideal solution. A more "ideal" solution in TRIZ is defined as one that continues to provide its primary useful function (Tracking), but is not accompanied by as many harmful functions – for example, the extra cost of tracking. Perhaps *automation* of the business process is required?

4. Find a way to eliminate, reduce, or prevent [the] (Cultural resistance) under the conditions of [the] (Expense), ("Deadlines hinder creativity") and (Keeping log is extra work).

This is prompting us to find other aids or countermeasures.

5. Find a way to eliminate, reduce, or prevent [the] (Expense) in order to avoid [the] (Cultural resistance).

The diagram includes one countermeasures suggestion, a Benefit/Costs Analysis. Perhaps there are others?

6. Find a way to eliminate, reduce, or prevent [the] ("Deadlines hinder creativity") in order to avoid [the] (Cultural resistance).

7. Find a way to eliminate, reduce, or prevent [the] (Keeping log is extra work) in order to avoid [the] (Cultural resistance).

Automation of the business process is once again suggested.

8. Find an alternative way to obtain [the] (Saves on overall cost) that offers the following: eliminates, reduces, or prevents [the] (Cultural resistance), does not require [the] (Benefit/cost analysis).

Perhaps there is a way to make the cost benefits more obvious as part of the process?

9. Find an alternative way to obtain [the] (Positive customer feedback) that offers the following: eliminates, reduces, or prevents [the] (Cultural resistance), does not require [the] (Director freed to concentrate on creative aspects).

This is probably not a viable solution path to follow. However, we should not dismiss it too easily. All directions generated by TRIZ are valid semantically, even if, at first, it is hard to see how to follow that path. TRIZ practitioners report that the most unlikely paths can often yield the most inventive solutions. On the other hand, selecting paths to follow and rejecting dead ends is an important team activity in any project that uses TRIZ.

10. Find an alternative way to obtain [the] (Director freed to concentrate on creative aspects) that provides or enhances [the] (Positive customer feedback).

11. Find an alternative way to obtain [the] (Benefit/cost analysis) that provides or enhances [the] (Saves on overall cost).

Perhaps the system can, if automated, generate a weekly report of ongoing savings. This would provide positive reinforcement of the benefits of the new business practice solution suggested by the Six Sigma team.

12. Find an alternative way to obtain [the] (Speed and simplicity) that offers the following: eliminates, reduces, or prevents [the] (Cultural resistance), does not require [the] (Training).

Perhaps if the solution is automated, its speed and simplicity would be apparent to all?

13. Find an alternative way to obtain [the] (Training) that provides or enhances [the] (Speed and simplicity).

TRIZ Models Are Extensible

The statements scattered among the TRIZ outputs listed above are, of course, little more than illustrations. Nevertheless, the brainstorming suggested here shows how TRIZ leads into the solution space. The output generated from the literal model is far from ideal, but, even so, useful ideas have emerged.

Literal translation of one business diagram to a TRIZ model may not be the most appropriate strategy. Using TRIZ in a Six Sigma project is not just about writing TRIZ models for existing Six Sigma charts. TRIZ should ideally be used as a Primary Analysis Technique to document problem situations in depth, leading to novel solutions.

Root Causes analysis or "5 Whys" repeated questioning can be used to look at the causes and effects between barriers, aids, and countermeasures. In fact, all of the techniques the Six Sigma practitioner uses to develop cause-effect diagrams and to suggest theories of root causes and "Vital Xs" can be used during the refinement of a TRIZ model. Many techniques from the field of "creativity" can also be used. For example, De Bono suggests assigning "Hats" to workshop members in order to open up the topic from different perspectives.

Here are four techniques, illustrated using TRIZ, that prove useful in expanding any TRIZ model. Every connection in a TRIZ model is a possible question. Answering that question reveals more domain knowledge – the more knowledge, the more chance of finding a solution.

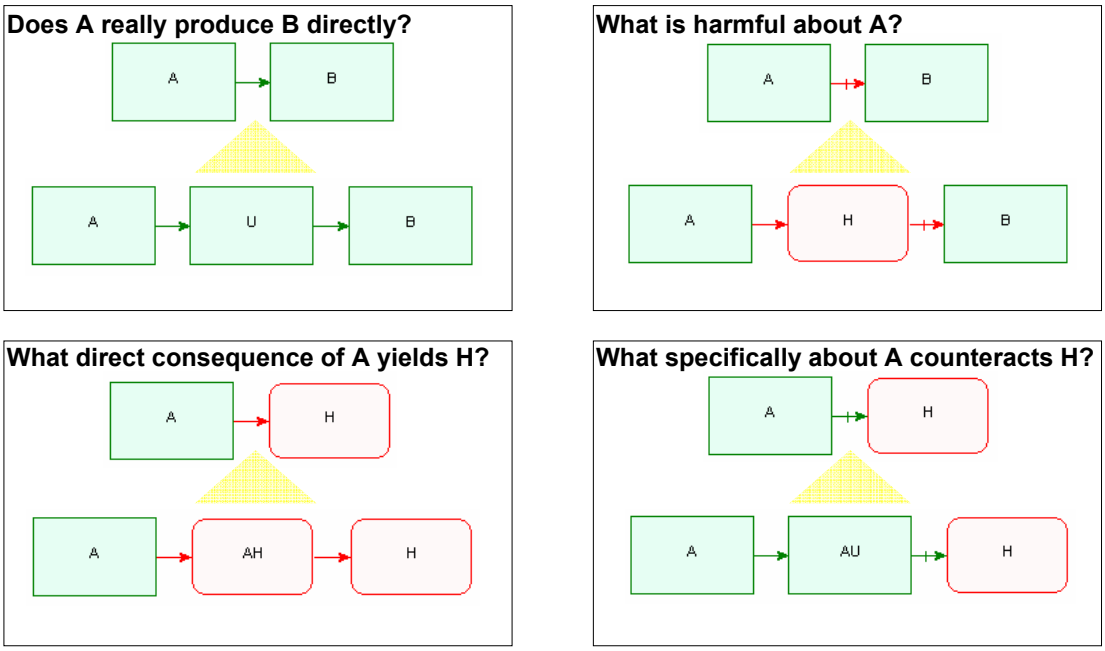

Figure 4. Four ways to elaborate and extend a TRIZ model

The advantage of using TRIZ to capture problem-solving knowledge is that it opens more and more pathways as the work progresses. TRIZ provides a process for problem-solving. Models are elaborated and refined and reviewed. This is often a group activity. Since teams work on a model together, independently of their individual theories about possible solutions, TRIZ can engender a powerful sense of building towards a consensus. Usually, when the solution is found, everyone agrees on the approach since they have been part of a rigorous process of exploring alternatives.

Thinking Visually

TRIZ is a visual technique, coupled to automated analysis. Some people make use of diagrams quite naturally, without prompting. Others would rather use a thousand words than a simple, quickly drawn diagram. The great advantage of TRIZ models lies in their simplicity. They can be drawn by all, and are often sketched on the "back of napkins." Yet they contain just enough

semantics to generate useful output. The value of the output is sufficient to foster the continued development of the visual model.

In Malcolm Craig's book, *Thinking Visually – Business Application of Fourteen Core Diagrams*[1], he describes a Force-Field diagram (Figure 5 below). The idea is nearly identical to the Barriers & Aids chart, in that it describes "driving" and "restraining" forces to a proposed change or to a new idea (opportunity).

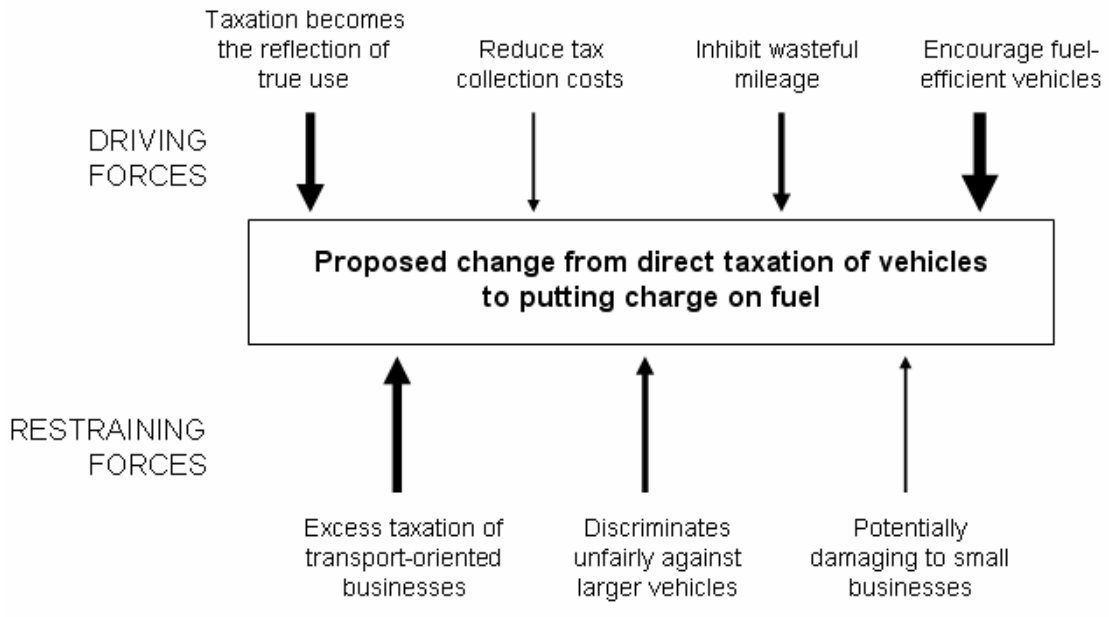

Figure 5. Example of a Force Field Diagram

Craig points out that an issue affecting the understanding of diagrams is the persuasiveness of certain words. The idea of "driving" can easily be seen as positive and therefore as something "good" or certainly better than the rather negative sound of "restraining." He points out that "In any change people may use 'modern' or 'modernize' in a similar way when there is no reason for assuming that 'modern' or 'modernize' are automatically better, or to be preferred to a word such as 'traditional.' There is a danger that the persuasive force of the words blinds people to the real issues involved in the change." TRIZ models, unlike Force Field diagrams and Barriers & Aids charts, provide the semantics that enable the generation of solution pathways, avoiding psychological factors that might sensitize readers to one direction over another. As Craig points out in his book, which was written without knowledge of TRIZ, the Force Field diagram in Figure 5 can be treated in at least five ways:

1. Ignore the restraining forces and concentrate only on the drivers to make the change happen.
2. Take account of the restraining forces, and increase the power of selected drives to make the change happen.
3. Take account of restraining forces and take action to remove people's objections.
4. Increase force of drivers and decrease the force of restrainers together.
5. Take account of restraining forces and abandon the idea.

[1] Craig, M., *Thinking Visually – Business Applications of 14 Core Diagrams,* Continuum, 2000

Without knowing it, Craig has demonstrated a subset of the solution pathways that TRIZ would generate automatically from a TRIZ model of the force field. Here is the model:

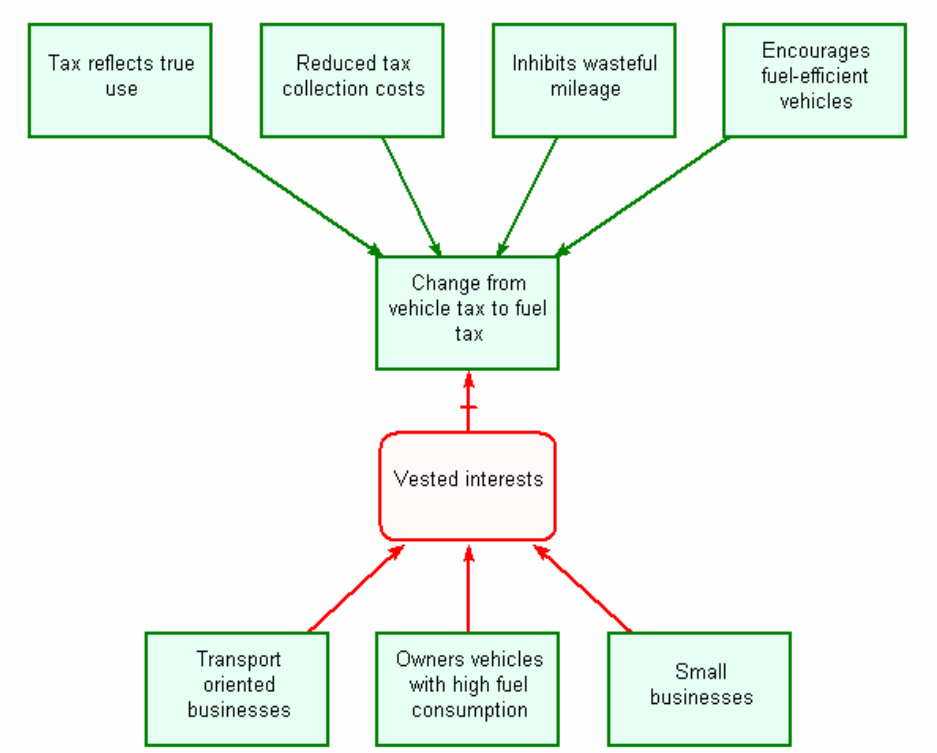

Figure 6. Literal TRIZ model corresponding to Figure 5

In transcribing the Fuel Tax Force-Field model to TRIZ, I have taken the liberty of introducing the box "vested interests." This was not strictly necessary, for the lines from the lower restraining boxes could have been connected directly to the "change of vehicle tax" box. The arrows would then have been "counteracting" (tick across the arrow) instead of "production" (standard arrow). The reason that I introduced the "vested interests" function was to illustrate the point that a model can only generate useful solution directions if the appropriate intellectual property has been included. Without the vested interests, the model could not have generated these directions:

1. Find an alternative way to obtain [the] (Change from vehicle tax to fuel tax) that offers the following: does not require [the] (Tax reflects true use), (Reduced tax collection costs), (Inhibits wasteful mileage) and (Encourages fuel-efficient vehicles), is not influenced by [the] (Vested interests).

2. Find a way to protect [the] (Change from vehicle tax to fuel tax) from the harmful influence of [the] (Vested interests).

3. Find an alternative way to obtain [the] (Transport oriented businesses) that does not cause [the] (Vested interests).

4. Try to resolve the following contradiction: The useful factor [the] (Transport oriented businesses) should be in place in order to fulfill useful purpose and should not exist in order to avoid [the] (Vested interests).

5. Find an alternative way to obtain [the] (Owners vehicles with high fuel consumption) that does not cause [the] (Vested interests).

6. Try to resolve the following contradiction: The useful factor [the] (Owners vehicles with high fuel consumption) should be in place in order to fulfill useful purpose and should not exist in order to avoid [the] (Vested interests).

7. Find an alternative way to obtain [the] (Small businesses) that does not cause [the] (Vested interests).

8. Try to resolve the following contradiction: The useful factor [the] (Small businesses) should be in place in order to fulfill useful purpose and should not exist in order to avoid [the] (Vested interests).

14. Find a way to eliminate, reduce, or prevent [the] (Vested interests) under the conditions of [the] (Transport oriented businesses), (Owners vehicles with high fuel consumption) and (Small businesses).

Literal TRIZ Models Are Not Always Useful

It is relatively easy to draw a quick Barriers & Aids chart or a force-field chart, without a lot of thinking about semantics. The chart then may, or may not, be useful in helping the change move ahead. One thing is sure: It won't necessarily provide an optimal solution.

While TRIZ can be used to get increased value out of nearly any business diagram, a literal translation is almost always sub-optimal. To illustrate the point, here is another TRIZ model derived from Figure 5:

As you can see, some of the boxes are similar. Wording has been changed slightly, and new boxes added. Overall, the picture is much clearer.

In the previous literal version, it was the factors hindering or driving the change from vehicle tax to fuel tax that were the focal point for the diagram. In this new version, the solution of fuel tax over vehicle tax is used as the primary perspective. This feels a more natural solution to me. The fuel tax produces useful functions such as take-up of fuel-efficient vehicles and inhibition of wasted mileage. It also produces harmful functions such as excess taxation and discrimination. Everything is useful *and* harmful, not useful *or* harmful. The same is true of vehicle tax. The Barriers & Aids charts and the force-field charts, while useful in communicating the factors limiting change to a chosen solution, cannot express this deeper knowledge about the problem. To illustrate this, the harmful factors of excess taxation and burden on small businesses have been linked to a box about damage to the environment. This elaboration of the model is critical in order to get at the underlying reasons for a change from vehicle tax to fuel tax being considered. At the same time, the useful take-up of fuel-efficient vehicles and fewer wasted miles counteract damage to the environment. The counteraction is considered useful (hence, a green line) and the damage considered harmful (hence, a red box). As a result, we now have, in the same diagram, additional factors associated with the solution. As a result, it is clear that both types of tax are both useful and harmful.

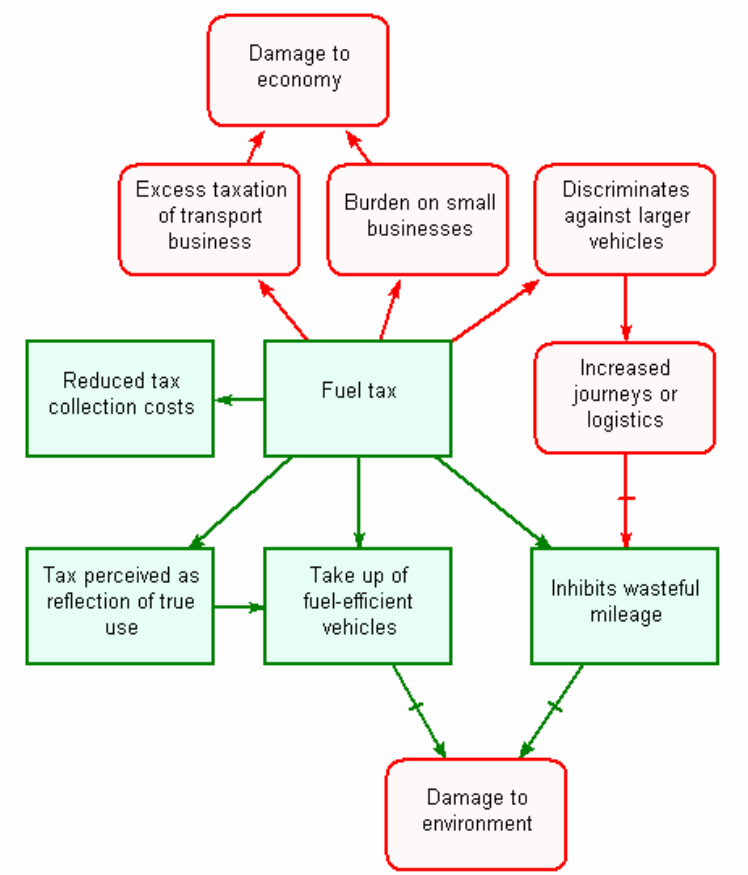

Figure 7. TRIZ model corresponding to Figure 5 from perspective of Solution

The knotty problem of *tax policy development* is emerging. This can best be expressed as follows:

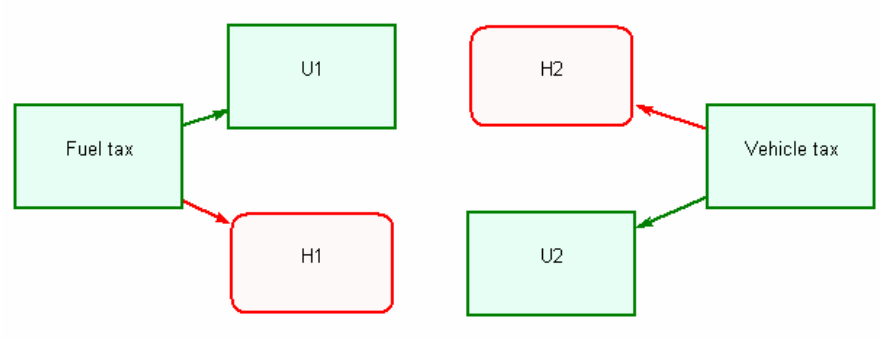

Figure 8. Everything is useful and harmful, including alternatives.

How the interactions between U1, U2, H1, and H2 play out lies at the source of frustration in getting to an appropriate tax systems for transportation. For example, in Figure 7, fuel tax which in the force-field diagram looks like a great solution, actually has the downside of discriminating against larger vehicles, which could add to logistics costs, and, hence, counteract the ability of fuel tax to decrease wasted miles, which is turn limits potential environmental upside. This

additional intellectual property is what allows TRIZ to suggest interesting lines of attack for reaching a breakthrough solution. For example,

> 2. Try to resolve the following contradiction: The useful factor [the] (Fuel tax) should be in place in order to provide or enhance [the] (Tax perceived as reflection of true use), (Reduced tax collection costs), (Inhibits wasteful mileage) and (Take up of fuel-efficient vehicles), and should not exist in order to avoid [the] (Excess taxation of transport business), (Discriminates against larger vehicles) and (Burden on small businesses).
>
> 4. Find a way to eliminate, reduce, or prevent [the] (Discriminates against larger vehicles) in order to avoid [the] (Increased journeys or logistics), under the conditions of [the] (Fuel tax).
>
> 6. Find an alternative way to obtain [the] (Tax perceived as reflection of true use) that offers the following: provides or enhances [the] (Take up of fuel-efficient vehicles), does not require [the] (Fuel tax).
>
> 10. Find a way to protect [the] (Inhibits wasteful mileage) from the harmful influence of [the] (Increased journeys or logistics).

As I illustrated in Figure 4, TRIZ models expand by asking questions. For example, exactly what lies on the line between discrimination against large vehicles and increased logistics? Isn't that important? Replacing that line with a box yields more insight into the problem space.

For these reasons, those who are exposed to TRIZ modeling quickly find it more useful than many other types of common business diagrams.

TRIZ Models Are Integrated Models

TRIZ models can be developed from the perspective of individuals or multiple stakeholders. For example, the model above could be drawn from the perspective of those consumers and businesses advocating fuel tax and from the alternate perspective of those who advocate vehicle tax.

If team members working on problem solving don't agree on the model, their individual perspectives, documented in their own models, can be integrated in a joint-workshop to form and agree on a single diagram. Equally, it is valuable to draw multiple perspectives in the same model, perhaps grouping them together in order to illustrate the roles being played in problem solving. The approach is very flexible.

Team members can play games with TRIZ. A useful function (like price) can be studied from the perspective of someone who regards it as harmful for example (a customer). In this way, they co-create solutions that appeal to all of the stakeholders.

The power of TRIZ is that it is an *integrating* methodology. Diagrams converge towards a single model of a situation which all team members can work on to agree until it is complete in their diverse views. Unlike barriers & Aids charts, TRIZ models can be easily combined into one diagram, which will retain its structural integrity and can continue to evolve and generate solution directions. Where more detail needs to be added, one function can be exploded to a second level in another TRIZ model. For example, if a TRIZ model at the system level contains a harmful function, the function can be pulled out as a separate model, and either de-composed into its sub-system functions (useful and harmful) or studied, in terms of causes and effects, from a perspective relevant to the problem solving activity. Here is an example:

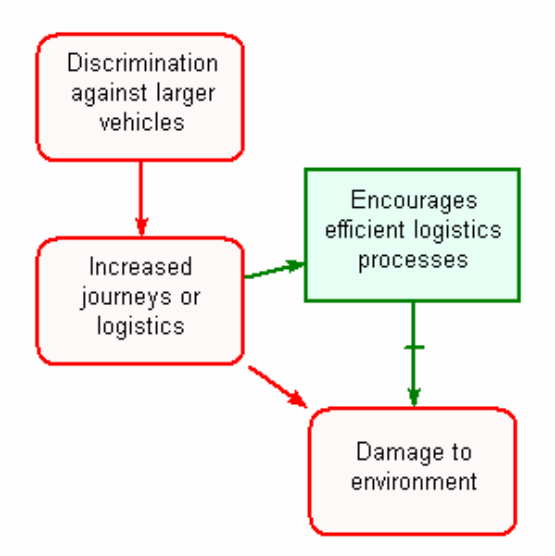

Figure 9. Second level diagram to investigate logistics implications

Triz Works As A Powerful Tool For Brainstorming And Communication

Without something like TRIZ, it's hard to get everyone on the same page. A set of diverse diagrams will not develop a clear picture of a problem.

TRIZ models can be used to integrate different Six Sigma charts – for example, a Barriers & Aids chart with a causes-effect Fishbone diagram. In workshops, brainstorming is facilitated by the directions generated by such multi-faceted models.

While a variety of techniques are used by Six Sigma practitioners during workshops, nothing beats TRIZ at generating options to consider. One creativity expert stated that TRIZ can be considered a super-set of De Bono's "Six Hats" technique. De Bono considers problems from only six perspectives. TRIZ provides an infinitely extensible 360 degrees view.

The directions generated by TRIZ, together with the abstract solution descriptions (not covered in this paper) build on standard brainstorming techniques. So effective is the technique that TRIZ can make up for a certain lack of creativity among the workshop participants. Something about the directed form of problem-solving moves people to the next step and removes any psychological barriers. I appreciate that this is a large and bold claim. Can TRIZ really make people who are not so creative emulate their more creative colleagues? The evidence is there for those who have been trained in and tried the technique in practice. In one case, a team working on an important make-or-break proposal to a client could not see the factors limiting their success until TRIZ was introduced into the project. Over a two day period, fifty diagrams were developed, views aligned, and, based on the directions generated, a clear path to a winning solution was found. The TRIZ output initially overwhelmed the participants. Once they understood it served them, rather than they serving the process, the combination of visual thinking and rigorous analytics helped them to work through the solution. Working through the solution was half the battle in demonstrating to the customer that the supplier was serious in its bid for new work.

TRIZ is also useful if the solution is known, but not understood. A TRIZ process for retroactively justifying a decision can be developed.

Solutions To Be Implemented Are Also Problems

The inclusion of the Barriers & Aids chart in Six Sigma is an acknowledgement that any solution developed via Six Sigma analysis may not be adopted in practice. In TRIZ, that means that the solution itself has a harmful output – change:

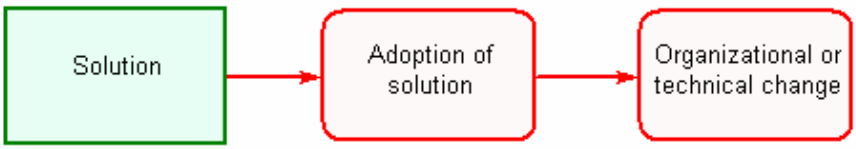

Figure 10. Every solution is also a problem.

The example illustrates that it is impossible to think of any function that does not have a downside. Getting rid of harmful side-effects is a key part of problem solving. TRIZ provides a powerful procedure for working towards such ideal solutions – solutions which can be immediately implemented.

The Hydrogen Combustion Engine is a more ideal solution than the petrol engine because it not only generates lower emissions; it can actually clean the air. Thus, it solves the problem of adoption by providing an incentive. Air coming out of the tailpipe can be cleaner than air going into the engine. In TRIZ, this is called surmounting a contradiction.

Petrol-engine cars create a harmful contradiction. We all love our cars, but we also worry about the number of cars and the effect on the environment. The hydrogen car by contrast does not have this inherent fault. In TRIZ, “Ideality” is defined as the sum of the useful functions divided by the sum of harmful functions. Ideality is an abstract concept, but one to keep in mind in any Six Sigma project. The barriers on the barriers and aid charts are an example. A barrier is a non-ideal aspect of the solution. The presence of a barrier implies a contradiction – that is, an underlying function with both useful and harmful side effects. Finding that function lying at the intersection of the contradiction is the task of the analyst. It’s not easy work, and it’s all too easy to ignore it and compromise by allowing harmful functions to remain in the system.

In Six Sigma, change is often pushed through with counter-measures. To a TRIZ specialist, that’s a poor solution indeed. If a solution throws up barriers, the solution is surely sub-optimal. Why should such a solution be implemented?

The most ideal system is a system that does exist. The most ideal solution is a solution that is readily adopted without barriers.

To illustrate the principle of Ideality think about a car. What is the purpose of a car? Surely it is to create a fluid economy, not to cause lots of travel, burn fossil fuels and damage the environment. A more “ideal” car would provide its primary function without the need to travel. You may never have thought of the World Wide Web as a car, but that is precisely what it appears to be! Tele-working allows a fluid economy with less damage to the environment.

Conclusion

TRIZ is a powerful problem-solving method that lies at the heart of innovation. TRIZ can extend and deepen a Six Sigma Belt’s ability to find practical real-world solutions to business or technical challenges.

This article has touched on only a small part of the TRIZ methodology. It has not described TRIZ solution patterns. Nor has it covered any of the TRIZ procedures and applications that can be used to systematically drive towards ideal solutions.

The use of TRIZ is often shaped in practice. The method is non-prescriptive and, once understood, can be used in a myriad of ways – in everyday work, or as part of a formalized Six Sigma project. TRIZ will help any Six Sigma Black and Green belt to meet their objectives.

TRIZ does not replace the statistical techniques within Six Sigma such as ANOVA. However, some TRIZ applications, such as TRIZ Anticipatory Failure Determination (AFD), can extend or enrich methods with which the Six Sigma practitioner will already be familiar, such as Failure Modes Analysis (FMEA).

Future articles will describe how TRIZ can be applied to something as simple as a SWOT diagram and to something as complex as the innovation theories of Clayton Christensen.