TRIZ AND CASE STUDY ABOUT BUS SEATS

By

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The countries, which are dominant to the technology and science that is source to the technology, will have absolute hegemony on industry and the other economic activities. In a word, technology has become the only key of the nation's competition. Consequently, priority on science and technology will be diagnostic on sharing of world's blessings and promoting social prosperity.

And, today technical progress is changing the face of the earth at an ever accelerating pace. Scientists are finding ways to learn more in les time, to remember more and longer, to do thins faster and so on. This creates an enormous need for a constantly growing supply of new ideas and solutions. Moreover, the body of knowledge and application of this knowledge to solving technical problems is expanding rapidly.

Traditional processes for increasing creativity have a major flaw in that their usefulness decreases as the complexity of the problem increases. At some point, the trial and error method is used in every process, and the number of necessary trials increases with the difficulty of the inventive problem. It was Altshuller's quest to facilitate the resolution of difficult inventive problems and pass the process for this facilitation on to other people. His determination to improve the inventive process led to the creation of TRIZ.

In working toward his goal of developing the "science" of creativity, Altshuller's central questions were:

How can the time required to invent be reduced?

HISTORY

Genrich S. Altshuller, born in the former Soviet Union in 1926, his first invention, for scuba diving, was when he was only 14 years old. His hobby led him to pursue a career as a mechanical engineer. Serving in the Soviet Navy as a patent expert in the 1940s, his job was to help inventors apply for patents. He found, however, that often he was asked to assist in solving problems as well. His curiosity about problem solving led him to search for standard methods. At a minimum, Altshuller felt a theory of invention should satisfy the following conditions:

1. be a systematic, step-by-step procedure
2. be a guide through a broad solution space to direct to the ideal solution
3. be repeatable and reliable and not dependent on psychological tools
4. be able to access the body of inventive knowledge
5. be able to add to the body of inventive knowledge
6. be familiar enough to inventors by following the general approach to problem solving [1]

In the next few years, Altshuller screened over 200,000 patents looking for inventive problems and how they were solved. These patterns identified in the development of a design contain two major components: regularities in design evolution, and principles used in innovative solutions. Altshuller's observations led to an additional breakthrough; since the evolution of engineering design is a process governed by definable laws, it can be taught.

Patents representing a simple modification to a design were assigned to the lowest level. Patents that changed the system in some way were considered more

inventive, while patents introducing a new science were considered the most innovative. These innovative patents provided solutions to contradictions, and these solutions often represented identifiable points along repeatable lines of evolution.

In the 1960s and 1970s, he categorized the solutions into five levels.

- Level one. Routine design problems solved by methods well known within the specialty. No invention needed. About 32% of the solutions fell into this level.
- Level two. Minor improvements to an existing system, by methods known within the industry. Usually with some compromise. About 45% of the solutions fell into this level.
- Level three. Fundamental improvement to an existing system, by methods known outside the industry. Contradictions resolved. About 18% of the solutions fell into this category.
- Level four. A new generation that uses a new principle to perform the primary functions of the system. Solution found more in science than in technology. About 4% of the solutions fell into this category.
- Level five. A rare scientific discovery or pioneering invention of essentially a new system. About 1% of the solutions fell into this category. [2]

Inventions involving Levels 1, 2 and 3 are usually transferable from one discipline to another. This means that 95% of the inventive problems in any particular field have already been solved in some other field.

Altshuller extracted from over 1,500,000 world-wide patents these 39 standard technical characteristics that cause conflict [2]. These are called the 39 Engineering Parameters; you can see details in TRIZ Journal [3]. Find the contradicting engineering principles. First find the principle that needs to be changed. Then find the principle that is an undesirable secondary effect. State the standard technical conflict.

TRIZ, on the other hand, recognizes the situation described above as "Technical Contradiction", and tries to find breakthrough solutions by "eliminating"

the contradiction. As a matter of fact, good patents are historical records of such breakthrough solutions that eliminated contradictions. Thus, learning such solutions must give us a lot of hints for eliminating contradictions in our own problems.

Altshuller first selected 39 aspects (Table 1) to standardize the way of describing the systems, and then made a 39 x 39 [4] matrix of improving aspects vs. worsening aspects (Figure 1).

From the analysis of a large number of good patents, Altshuller extracted the essence of ideas which achieved breakthroughs of conventional technology, and condensed them into "40 Principles of Invention" [5], [7].

Then he analyzed good patents one by one to find which contradiction problem in this matrix the patent handled and how the contradiction was solved in terms of the 40 Principles of Invention. [4], [5].

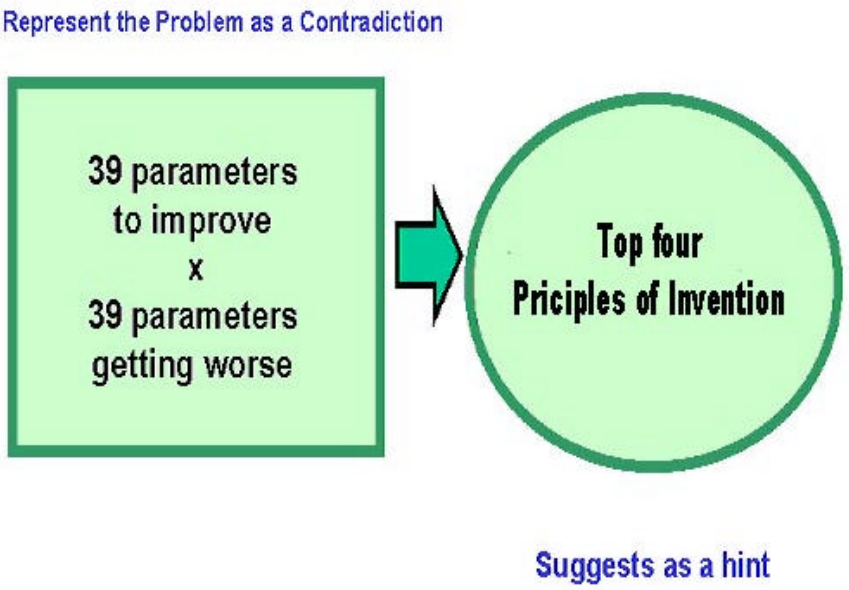

Figure 1: Eliminating "Technical Contradictions" with Altshuller's "Contradiction Matrix" [6]

Trends of evolution of technical systems

One of the insights by Altshuller is that all technical systems have a number of trends of evolution which are common across the fields and eras. [6]

One of such trends is that one part, such as a functional part, in a system evolves into two parts, then into multiple parts, into many parts, and finally into one part at a higher level. An example of this type of evolution can be seen in the speaker system of a radio; a single speaker equipment evolved into a stereo system of two speakers, then a surrounding sound system of multiple speakers, and finally into a 3D sound system.

CASE STUDY

In the world that time is very important we all don't want to lose time especially when we are throughout the journey. So we all prefer journeys at nights but there are disadvantages of this situation: sleeplessness and discomfort.

This is because of the shape of armpits of the buses (Figure 2)

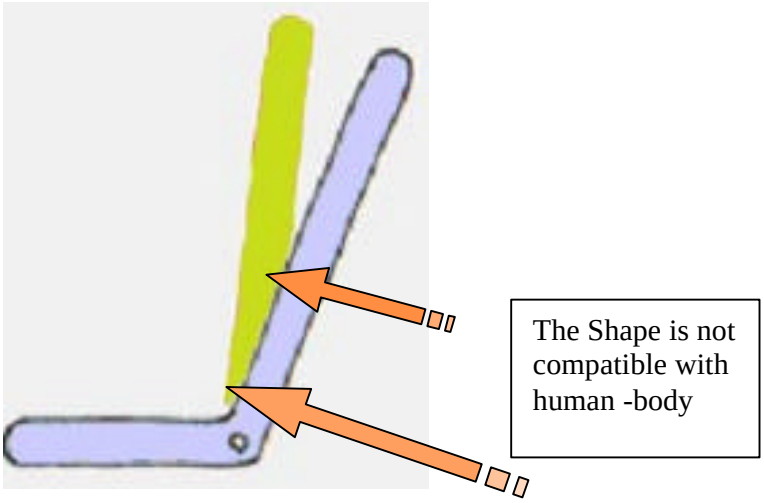

Figure 2

Because the human body is not straight the back bone has a curve shape (Figure 3)

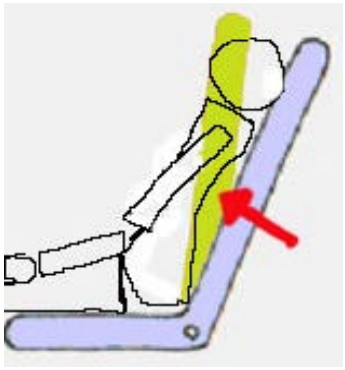

Figure 3

You see, no matter how the back of the armpit can lay we couldn't have comfortably position for sleeping then a rough journey waits us. Let's look at to TRIZ tools if we can solve this problem.

For identifying the convenient Engineering Parameters the main contradiction to all improving efforts is the space of which the armpit covers because there is no enough space for the passengers sitting back and front when you lay the back of the armpit. If we want to lay the back of the armpit then the space must be enlarge between the armpits by lessening the armpits or there must be alteration done in the length of the bus. Either alternative is contrary to the Ideal Final Result and to economic principles. If so we should decrease the space of armpit when laid and lay down the armpit and when this done there is a contradiction occurs: we have not have enough space but when armpit is laid the space covered is not enough.

First of all I tried to determine the Engineering Parameters relevant to the problem. These are:

- 6: Area of nonmoving object
- 13: Stability of object
- 33: Convenience of use
- 36: Complexity of device

The next step is to put these parameters in the form of matrix and then finding the Invention Principles in the intersecting points (Table 1)

Table 3

CONTRADICTION MATRIX	13 Stability of object	33 Convenience of use	36 Complexity of device
6: Area of nonmoving object	**2, 38**	**16, 4**	**-**
13: Stability of object	**-**	**32, 35 , 30**	**-**
33: Convenience of use	**-**	**-**	**32, 26 , 12, 17**

Now look at the results. First:

1. From matrix Area of nonmoving object (6) ×(13) Stability of object:

   2. Taking out

   38. Strong oxidants

2. Then Stability of object 13 ×33 Convenience of use again from matrix:

   32. Color changes

   35. Parameter changes

   30. Flexible shells and thin films

3. Again from matrix I compare Area of nonmoving object (6) ×(33) Convenience of use:

   16. Partial or excessive actions

   4. Asymmetry

4. And last I compare Convenience of use (33) ×(36) Complexity of device

32. Color changes
26. Copying
12. Equipotentiality
17. Another dimension

Afterwards, I interpreted the results. The result 17 Another Dimension gave me a hint: we can't lay down the armpit to back because there is not enough space for the rear passenger. As well we can't extent our legs to front because of insufficient space, and then could we make the armpit steep upwards? In other words could we upwards the bottom part of the armpit (Figure 3)

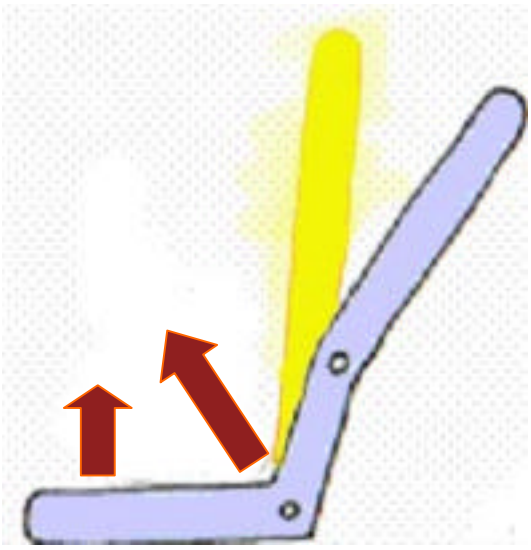

Figure 4

In this way, the armpit becomes more vertical instead of becoming more horizontal. It is a kind of straight sleeping position but you can lean to armpit. A kind of belts can be added to this system then it can be safer.

For adjusting the armpit easily we can use 15 Dynamism then we have (Figure 5) [8]

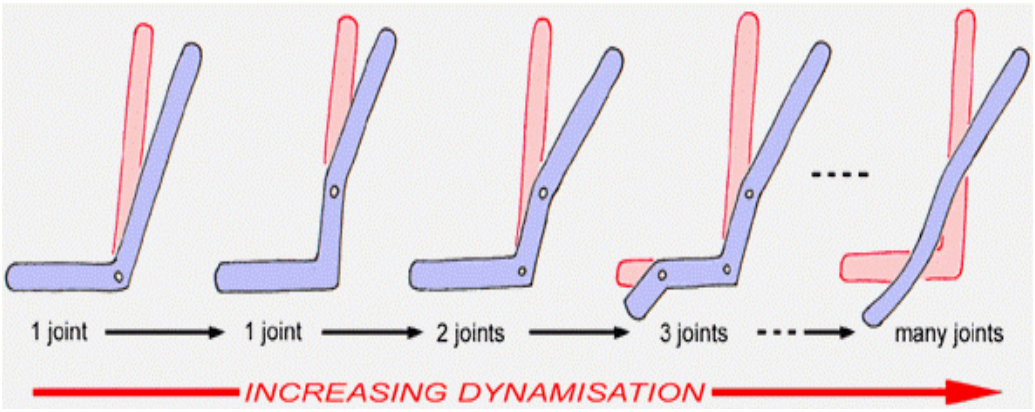

Figure 5 [8]

This work is a prototype and we hope it can be used in the future.

References

1. http://www.mazur.net/triz/index.html (02,001,2003)

2. Terninko John; Alla Zusman and Boris Zlotin, 1998. Systematic Innovation, an Introduction to TRIZ, St Lucie Press, Boca Raton, FL.

3. Domb, E., The 39 Features of Altshuller's Contradiction Matrix, TRIZ-Journal, November, 1998

4. Contradiction Matrix, TRIZ-Journal, July, 1997

5. Mann D., Domb E., 40 Inventive (Business) Principles With Examples, TRIZ-Journal, September, 1998

6. http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/eTRIZ/eIntroduction980517.html (15,08,2002)

7. Tate K. and Domb E., 40 Inventive Principles With Examples, TRIZ-Journal, July, 1997

8. Carter, S., Case study: The application of TRIZ to economy class aircraft cabin design, TRIZ-Journal, December, 2001

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