

To invent is to foresee: How to improve car safety

by Gennady Kizevich

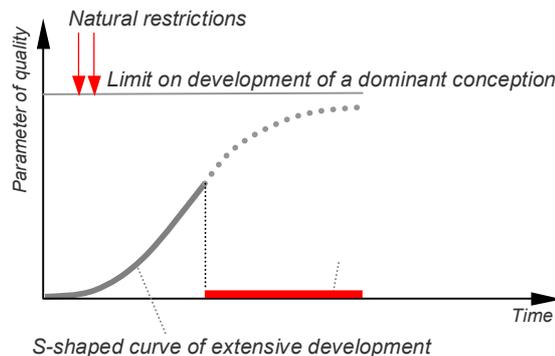
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1. The ideal prognosis

The long-term forecast is wonderful. It is forgotten before it is found inconsistent.

Prognosticators are serious people. They avoid long-term forecasting and fantastical dreams. Their predictions are based on real facts and stable tendencies. If there are no pioneer inventions and no new ideas that radically change traditional views on the technical systems or their parts, it means that there is no reason for sweeping changes.

The usual prognosis is a description of an S-shaped curve which smoothly rises in an attempt to merge with a ceiling of the natural restrictions intrinsic to every technical system and to its design conception:

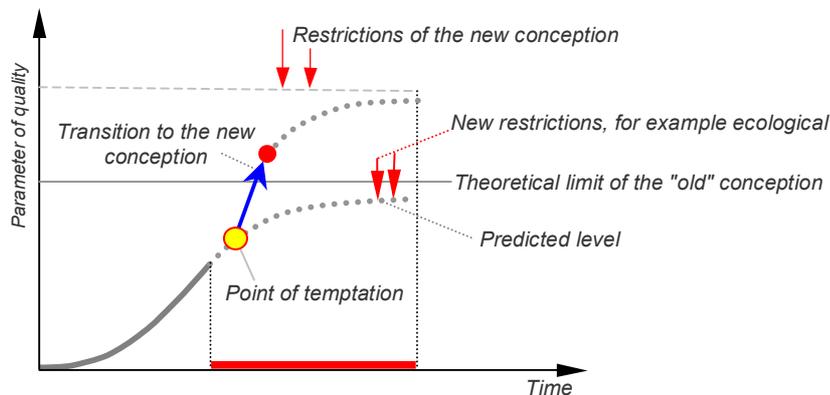


Many systems have already confirmed an S-shaped principle [1] of their development and have convinced us that in conditions of mass production of *similar* products by *similar* way the tendencies of development forms a general stable channel which can be easily predicted.

As for TRIZ the situation looks like a familiar one but too conservative. If there are no obvious reasons for changes, it doesn't mean that the system is free from internal problems and contradictions.

In a competitive environment (or solidarity of manufacturers of some kinds of potentially dangerous products) such contradictions are carefully concealed. Nobody wants to expose problems and thus to weaken market positions.

The acute prognosticator with keen inventing inclinations understands it and is able to find out the latent contradictions and to propose ways of their elimination. Concepts of scientific discovery and quality leap are still alive for him! He has the right to break S-shaped "idyll" by intervention of a new fruitful idea:



Every day the organizers of business should choose whether to follow old well-known conception or to take risks, to give in to temptation and to invest in a new idea which promises additional profit and competitive advantages, but not immediately, and only in indefinite period of time or several years later. It is not a simple task to take into account interests of investors and that every new idea is far from being awarded with commercial success. Therefore more often inventors receive refusal. To hear "Yes" is a fantastic luck even from the people who know invention price very well. Reasons for refusal should not be attributed to "short-sightedness of bureaucrats", but to "sensible conservatism". Small improvements of components of "old" machines making in huge quantity give fast and reliable income. Therefore radical innovations are born more often in small university laboratories and family garages. They are developed and ripen on short rations. It is easy to sell mature inventions, which are ready for immediate use. They are in demand.

Is there a way to overcome a long and burdensome stage of ripening of idea? Is it possible to learn to generate tempting ideas and present them, and have them accepted without delay? Can inventions be easily acceptable and radical at the same time?

It seems TRIZ has answers on these tricky questions. Such inventions should offer "ideal" solutions "forever". Both an inventor and those whom the inventions are presented to, should see them in better quality. It is the most natural and reliable way to show TRIZ value and inventors who own this art.

Three examples of radical changes that **have a chance** dramatically improve car safety are presented, to show these concepts.

2. Prediction Tree and its products

Painter needs paintbrush and knowledge where to direct it.

Julia K. (5 years old)

If you are interested in the solution to a concrete problem, you start with an exact definition of the target and a choice of means to achieve it. If you are interested in new knowledge, you will engage in studying of structure and properties of object. But if you want to make the invention *forever*, you need all!

Step by step you collect all available ideas and means, including collection of invention methods. The fuller the "basket" the more opportunities you get. If you know everything you have chances to make best inventions.

And now the main sacrament: to extract an ideal solution from a multi-dimensions space of opportunities (elements, links and principles)!

I may disappoint you. Even if a "*miracle*" is worked, it's a **difficult** problem to understand itself and to prove that the miracle has taken place, to associates and critics. To evaluate an invention it should be compared with "a scale", i.e. a row similar ideas and inventions. And the best variant is to find the image of the ideal solution.

«*The basket of opportunities*» is necessary not only for combining millions of variants, but to order knowledge and forecast. Old ideas and inventions form a trunk of a tree and skeletal branches of the basic tendencies on which grow new fruit branches decorated with colors of perspective ideas. It is a predicting tree in blossom.

In an initial stage such a tree only accumulates knowledge in a given area and presents them in convenient kind for perception and forecasting. At this stage it is not surprising that 100 % of the skeletal branches and 90 % of the fruits are known ideas. However the first crop from such tree can be collected during its construction. Combinations of the neighboring ideas give such an opportunity.

Two examples:

- *seat belt + airbag = inflatable seat belt;*
- *airbag + upholstery = inflatable upholstery.*

However, if from the beginning we did not suppose an opportunity for changing "fundamental" principles, we would get only the strategy of adaptation supposing introduction of innovations in the conservative environment without rights to radical changes. It means to find *the*

"ideal" solution should be sought in a labyrinth of rigid restrictions and the settled rules, which substantially reduce productivity of a prediction tree.

Patent funds confirm it quite well: 99 out of 100 new inventions in the field of passive safety are stacked in traditional frameworks and put the problem to improve details, practically not mentioning the basic problems of airbag based safety: the false operation, inadequate and superfluous action.

{“99 out of 100 new inventions” - is my expert assessment of approximately 500 recent invention (concerning airbags) registered by US PTO}

It is strange, but the airbag is rather dangerous equipment. The key element of the airbag is the gas generator. It is similar to a mine with an electric detonator. Energy of the built-in charge of low-energy explosive is necessary for fast filling the airbag. Because of malfunction of the sensors or the processor finding the fact of collision is possible, the "mine" blows up. Adults receive traumas, children perish [2]. Airbag was born as a mass product with such congenital defect and continued to be multiplied in millions, filling up statistics in hundreds fatal cases per year. Small malfunction in electroposting, the mistake of a computer, corrosion of the sensor or innocent sliding impact result in misfortunes. The protection device has turned into the cause of serious risk. It's amazing paradox!

Following the principle opened of 30 years ago, inventors of airbags actually develop only one direction. It can be submitted by a scheme chain as follows:



Superfluous action of airbag speaks about functional excess of gas generator and the system in the whole. Therefore a new generation of expensive cars is supplied multi-step gas generators which will fill airbags with portion of gas proportional to force of impact. This adjusting methodology improves situation, but does not solve a problem. The danger of false "undermining" of charges still remains.

Construction of a tree of predicting is a reliable innovational strategy. To the majority of researchers it remains unique on all life. However there is a different strategy. It is based on searching for an image of the ideal solution.

What for such image if the ideal is achievable? Everything is very simple. A new image of ideal stimulates the birth of new concepts and forms a basis for creation of pioneer inventions. As a matter of fact, such a strategy represents a way to the required solution from the top. A predicting tree represents way to ideal from the bottom.

Both strategies supplement each other; they are not opposing values. The way from the top enables the inventor to find a solution, going down from ideal to a level of realizable prototype. The

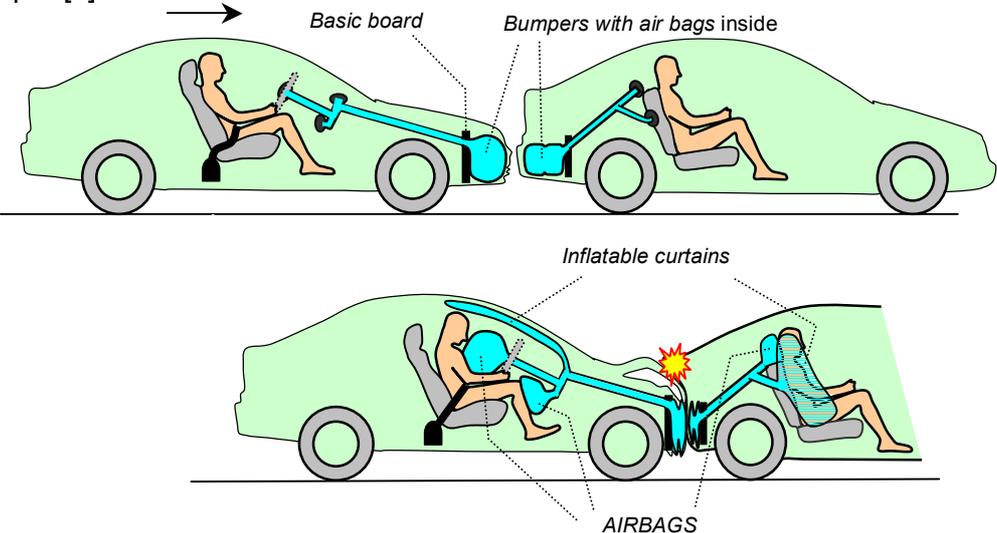
way from bottom is founded on experience of the past, however, it quite often leads up in blind alley. The image of an ideal is a reference point indicating an exit from the impasse and that shows a true direction.

The beauty of the ideal technical system consists of successful composition of two properties: *completeness and minimalism*. We shall try to build the strategy of the solution on the basis of principles of *minimization* and *combining functions*. Our formulation of *ideal airbag* takes following classical kind:

Ideal airbag itself finds out the fact of collision and fills by itself!

Such *ideal* assumes giving away any external control system (sensors and processor). Moreover, it demands removing the gas generator, which is a "heart" of the system. It is unprecedented! The system will lose ability to work! How can it be possible?

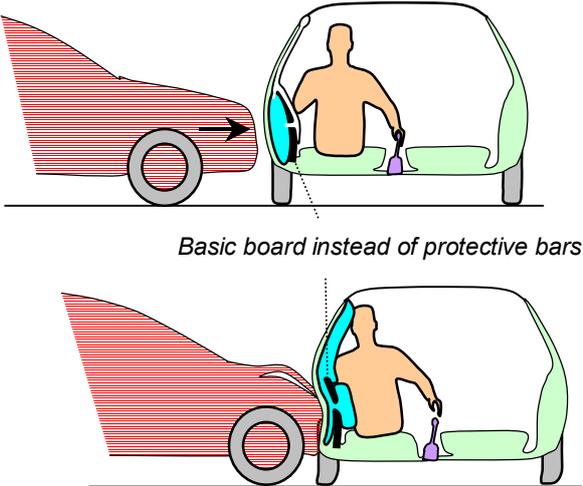
It is possible if a part of the airbag is filled with gas and placed inside bumpers or instead of the bumper [4]:



At the time of the collision there is more than enough energy for activating the system. We use it for actuating system of safety. Thus the crumpled air bags will swallow up a significant part of the impact energy, which is spent for filling of airbags and protection of people.

It is strange, but energy of impact can be used as a useful resource. It is a good example an action of paradoxical method to use *harm for benefit*.

It seems we have coped with frontal impact and impact in back. How to withstand a side impact?



Strong air container {which may be crumpled without rips} we shall place inside of a door and we shall leave a little place for a lowered glass. Protective bars inside a door we shall replace with a basic board, which will be displaced to the internal side of door. In case of collision firstly it helps to oust out gas from flexible container inside a door in lateral airbags of safety and, secondly it protect the space of the occupants' section.

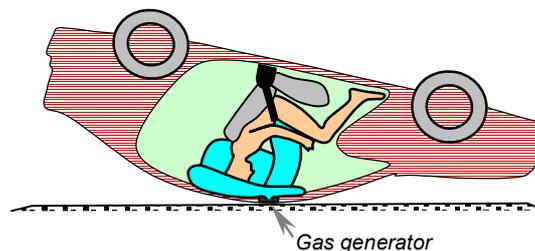
It is easy to guess that the internal upholstery of doors and roof props of the car also can be made inflatable and at the same time (following principle of a minimalism) to cease to hide inflatable devices for plastic shields. Accurately stacked and attached to a ceiling and lateral racks inflatable subjects of safety are capable to replace the upholstery. In case of collision it is not necessary for the airbags to break through plastic shields that have sharp edges representing additional danger.

Now an impact in a wing of the car is not dangerous as well. We lay the container filled with harmless gas. One bag in every wing! They take up impacts and fill those pillows which are necessary in the given corner of automobile occupants' section.

Such a safety system *is really safe*. It instant "switches on" and starts to work there and then, where and when it is completely necessary. It does not require power supplies and strike sensors. Therefore false operation is impossible absolutely!

But what to do in case of overturning? It is a good reason inflates a mattress of safety placed in the ceiling of the occupants' section instead of traditional soft upholstery. Crests on edges and along a mattress protect heads of occupants from lateral impacts and, probably, protect cervical vertebrae of those who forgot to fasten safety belt.

How a mattress can be filled?



Again we need a pulse gas generator. Since a space reserve for air container is not available in a car (if it not the catafalque) we should take a step back and to use traditional gas generator, but without an electric detonator. We shall arrange on the roof of the automobile something similar to an anti-infantry mine. Pressing or strong impact on the roof of the car due to overturning will result in gas generator action. The life-saving "explosion" will fill the inflatable upholstery of ceiling and will preserve lives inside the car.

So, we had the boldness *to define an ideal airbag* and have received motivation for sweeping changes and getting rid of the inertia of dominant concept. We used principles of *minimization* and *combining of functions*. We have looked at automobile buffer and have found a *reserve of space*. We had enough imagination to fancy the collision of the car in full details, and have found a *free-of-charge resource* and a successful opportunity to turn *harm into benefit*. The unique method/principle *on the contrary* again has surprised us with the paradoxical result: again invented “anti-infantry mine” has ceased to kill and has “learned” to protect lives.

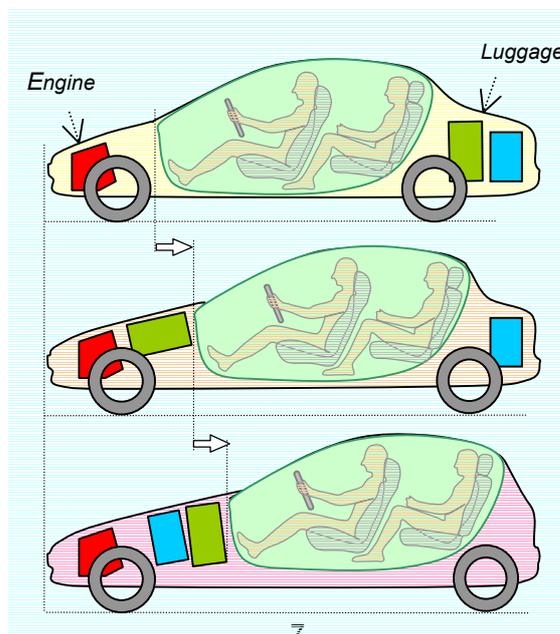
Are there different ways to incise car safety?

To achieve a desirable result it is possible to increase the durability of a body and reduction of harm to people by means of belts and a collection inflatable pillows. It can be done by way of radical reduction of impact force that people are exposed to at the time of the automobile collision. And there are approaches and resources and ways to achieve the task. For example, paradoxical method *on the contrary* can be used to save lives at a head-on collision, not by increasing of a car body’s resistance; but *on the contrary*, by increasing a deformation zone! (Not due to occupants section, certainly).

Force of impact essentially depends on the time it lasts and on the distance that the dented buffer will move aside in the occupant section. In interests of occupant’s safety this distance and this time were as large as possible.

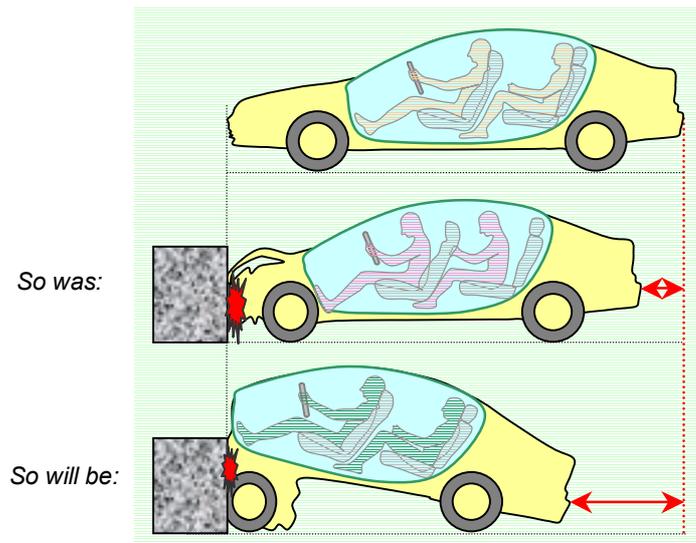
In our disposal there are three ways to achieve the task [3, 4]:

1. To use powerful energy consuming buffer exposed far forward.
2. To remove occupants’ section back and to move a luggage section forward. But not to shock public, this operation can be done in two steps. Thus the car will get an extravagant sports look in early traditions of XX century. The occupants will be finally rid of a motor roar and an increased base (distance between axes of wheels) will give additional stability to the car:



3. To change a movement trajectory of the occupant section and at the same time to evade impact. It seems improbable only at first sight.

Today's car designers consider it obvious that the occupant section should inevitably move aside for obstacles, not changing direction. Is it possible to do this somehow differently?



To ram the engine under the occupants' section is an old and proven method. But it is possible to make on *the contrary*: to lift the occupants' section and to direct it atop of the engine and even atop of an obstacle. This is possible not only in fiction film. The forward part of the car can be used as a mobile support and as a springboard. Not only the engine should be moved under occupants' section. The forward part as a whole, crashing and absorbing energy, should *lift upwards and pass forward* the occupants section. It is also desirable to make it operate smoothly, without separate sharp jerks. I.e. a motor section should be designed so that at a head-on collision it transforms into a flexible absorber able to weaken impact energy and evade a blow.

The new airbag and the idea to change a direction of impact are only two examples how deviations from "general line" can affect a design of the modern car and essentially raise its *safety*.

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1. ***Creativity as an Exact Science: The Theory of the Solution of Inventive Problems***, by Genrich Altshuller, Gordon and Breach Science Publishers, 1984.
 2. Airbag Safety <http://www.kgrs.com/info/airbag.htm> <http://www.nsc.org/partners/safetips.htm>
 3. ***Principles of Survival, a Theory of Every Day Creativity*** by Gennady Kizevich, Washington House, 2004.
 4. Principles of Survival, a Theory of Every Day Creativity (Russian version), Williams, 2004.

About the author:

Gennady KIZEVICH, Ph.D. (attached picture)

Scientific and Business Consultant:



- a.. search of new ideas with high commercial potential;
- b.. examination and organizational support of innovation projects;
- c.. technological and market forecasting;
- d.. TRIZ and patenting;
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In 1986 I got the diploma of PhD degree (Radio and Television Systems).

In 1988 I was appointed Head of the Research Group of the General Physics

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Since 2001 I am in Moscow with private companies in a position of Investment Expert.

I have 35 registered inventions.

My book ***Principles of Survival, a Theory of Every Day Creativity*** (concerning inventing skill) was published in Moscow in 2000. Now the book is issued in English by Washington House. Today it is being sold in the USA, England, Belgium, Italy, New Zealand, Czech Republic and Japan.