Process Innovation

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books:
Business Process Management: The Third Wave and
IT Doesn't Matter: Business Processes Do
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Oliver's Garage

Part 9 in a series on P-TRIZ

This is a story about a boy's imagination, a set of Lego bricks, three garages and an innovation process. I show how, using P-TRIZ, any business process can be improved, yielding an ideal design.

Technological systems evolve in the direction of increasing Ideality. They become less costly to operate, more energy efficient, pollute less, and so on. The first oil tanker was 50% by weight of oil and 50% by weight of vessel. Today's super-tankers have a ratio of 98% oil to 2% vessel. In this respect today's super-tankers are more ideal.

Business processes are also technological systems. They comprise many participants – people, systems, and machines – and they operate much like a complex machine with many concurrently executing parts. Under pressure of competition, they must be continuously improved and occasionally re-invented. Over time, they too tend towards ideality. If your processes are less ideal than your competitors your company is at a disadvantage. All companies are therefore on the look out for ideal processes. If you don't develop them, someone else will. It's inevitable, just like evolution in the natural world.

In previous articles in this series I have shown how P-TRIZ can model a process in terms of its useful and harmful functions. Useful functions are the primary purpose of the process, usually providing some output. Pretty much everything else is a harmful function. Even functions of the process that support or contribute to the output, such as corrective actions, control functions, compliance functions, etc., can be considered harmful. Ideally, we would not wish to include them.

Other harmful functions of any process include the cost to design, implement, and operate the process, the organizational "space" it occupies, the "noise" or "distraction" it creates, the "human energy" it consumes, and the "resources" needed to maintain it, and so on. Understanding these resources allows us to invent more ideal processes. We seek a design that maximizes the useful functions and minimizes the harmful functions. Ideality tends to infinity when useful functions increase and harmful functions decease.

The most ideal process is no process at all. Such a process would provide its outputs, but cost nothing to design, implement and operate. It would use no energy, take up no space, would emit no harmful byproducts and so on. An ideal process, like an ideal system, is one whose functions are performed without the system existing; no "system" at all, just all the benefits. We can say therefore that the objective of reengineering is to get rid of processes altogether!

Wouldn't we all like such ideal processes? Wouldn't it be great if product availability could be achieved without inventory? Wouldn't you like to consume services at zero cost to you? Shouldn't a supply chain operate without a supply chain process?

We never actually need a process; what we really need is a *function*. The objective of reengineering, therefore, is to turn processes into functions, and to remove harmful activity, leaving benefit.

A simple example: We need transportation, rather than a car. Most of the harmful effects of cars are associated with the car-process (the engine, combustion, manufacturing, etc.), rather than with the car's useful function – personal freedom. Do we need, for example, a system called "steering wheel"? No, what we need is a method of controlling the car. Do we need a system called "computer keyboard"? No, we need a means by which information can be input to a computer.

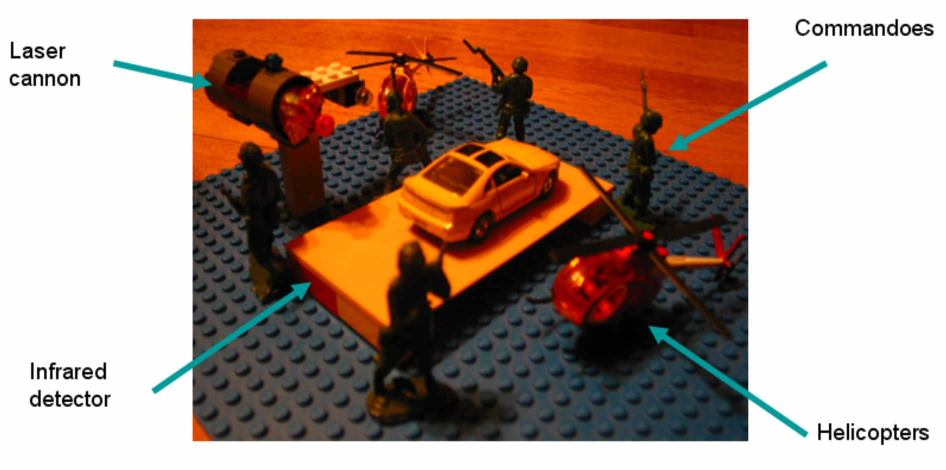
The process of improving and transforming systems to provide greater benefits and fewer harmful functions is called idealization. It applies in all fields of human endeavor, across engineering to process change to organizational design and many others.

To illustrate how idealization works I am going to tell a story.

Oliver's Garage

Inventing the next generation of a popular consumer product is probably beyond the abilities of most adolescents, yet every child can follow rules.

We recently had our car vandalized while it was parked outside of our home. Our kids were upset, so we tried to turn a negative experience into positive learning. I asked my son Oliver, then eleven years old, to design a system that would help to protect the car from future attack. Being a boy of a certain age, he dreamt up a rather sophisticated solution, and, of course, went on to build a model of it using his extensive collection of Lego bricks. His solution consisted of a variety of deadly weapons and other military grade equipment, including laser cannons, infrared detectors commandoes, and helicopters. It was a very exciting design.



Oliver's Garage Version 1

His "idea" was instinctive. He figured that the infrared detectors would spot anyone attempting to come near the car, at which point the helicopters could parachute in a troop of commandoes who would quickly detain the evil robbers. He pointed out that if things got really bad, his laser cannons could quickly take out the aggressors.

Oliver was pleased with his solution, but I felt he could do better if he used the theories of innovation. So I asked him a simple question.

"Oliver," I asked, "What are the useful and harmful features of your solution?"

Oliver had no trouble listing the top three useful features. First, it protected the car. Second, it would catch the criminals. And third, it made him feel safer. He was doing well. So I asked him to list the harmful aspects of the system. At first he thought I was asking him to list things like the guns and lasers. No, I did not mean that. I meant the problems in his system, things that could go wrong, or that could be done better.

I explained to him that every solution always has a downside.[1] Oh yes, he said, "I suppose the laser cannons could kill innocent bystanders." We agreed that this was, indeed, a significant defect. But I felt there were more. Pressing him, I asked him to think hard about other problems in the design of his car-protection invention. It wasn't easy, but he finally got into the swing of the "game."

Oliver realized that the system would be quite expensive to build and to maintain. He also suggested that it could generate a lot of irritating noise that our neighbors would not like. He felt he could live with these defects, but he found one fatal flaw. Criminals could damage the car before they were caught by the commandoes.

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[1] In previous articles we learnt that every useful TRIZ function is also harmful, that is, it can be decomposed into one or more useful and harmful functions.

So I asked Oliver to design a better system

He agreed to try.

I explained that any design he put forward would need to preserve all of the useful functions he had identified in his original design and exclude as many of the harmful functions he had previously listed. Ideally, no new harmful functions should be added. What he came up with did not surprise me, but it did surprise him. He invented a lock-up garage!

Oliver's Garage Version 2

Now garages are not as interesting to boys as are lasers and helicopters. So I needed a device to keep Oliver engaged on this "garage" project if I were to test my innovation theory. So I asked him to list all of the useful functions of a garage.

He agreed that, as before, a garage would protect the car. It even improved on his original design, with no chance of damage if the car were locked away. Indeed, the car being out of sight, criminals had no need to visit our house. We were safer than ever! Oliver then realized that all of the functions he had introduced in the original design were no longer necessary. So I kept pushing him for more and more useful functions of his new "design." He only found one. Unlike the version 1 garage, this version 2 garage would even protect the car from the rain and snow. He checked his logic carefully. Could weather protection have been built-in to his original vision? He decided it could not. A roof would prevent the helicopters from carrying out valuable surveillance exercise prior to engaging the commandoes.

All in all, Oliver agreed that a garage was a better design, albeit far less exciting. He was surprised that such a simple thing could do everything it needed to. He quickly realized that this was probably why garages were popular and why he had not seen too many laser cannons and helicopters flying about in his neighborhood. Good designs get used, but even they must eventually be improved to ward off competition from companies with better ideas.

So I asked Oliver to be an inventor

The question was, could Oliver invent something better than the garage version two?

His immediate reaction was “No way.” So to help him move forward I asked him to list the harmful functions of a lock-up garage. He found this task very hard, stating, “There’s nothing harmful about a garage, Dad.” So I asked him to think about why we had not used a garage before. This gave him the clue that enabled him to innovate.

He listed three harmful functions right away:

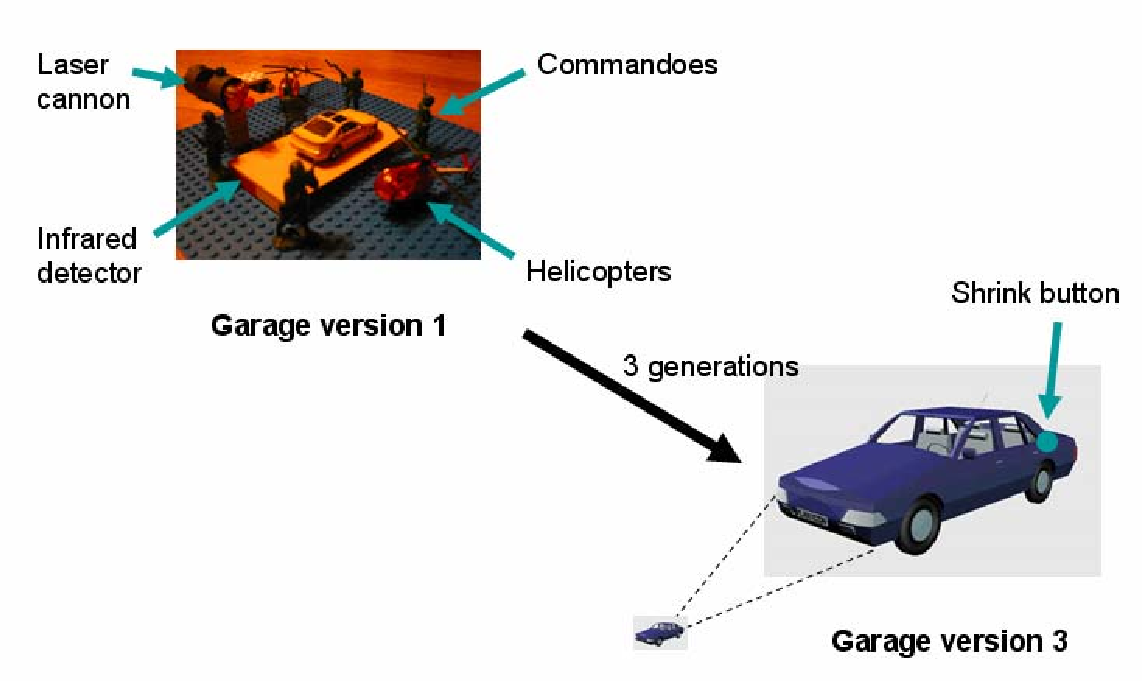
1. Firstly, the current garage was not big enough to take our brand new estate style car. That would mean knocking down the smaller existing garage and rebuilding it. This he agreed would take up a lot more space in the garden, space that Oliver used to play ball. Taking away his space would be a very serious harmful function indeed.

2. Secondly, we would need to spend money on the proposed garage extension, and this would mean cancelling the summer holiday. Oliver agreed that was harmful too.

3. Thirdly, it would be inconvenient to have to put the car away every night just because we were afraid it might be vandalized again. Oliver could relate to that problem as well. Like most boys, his room is a tip. He never puts his own toys away, ever. So I asked Oliver to keep thinking about possible ways out of our dilemma.

Oliver’s version one garage consisted of lasers, helicopters, and commandoes. It was over-complex and dangerous. Garage version two, the lock-up, was better, but required investment and was inconvenient in use. Could Oliver’s innate creativity lead him to an all singing, all dancing, version three garage, providing all of the benefits, and none of the downside? It took him many hours and much frustration. At one point, he broke off for play, exhausted from his innovation project. I’m sure that’s how many companies respond to hard work. Yet all my training told me that a better solution existed, if only we could find it. After some persuasion, he agreed to try. And he did eventually find one, but only with the help of some models, and an automated innovation process.

His solution was surprising, but it wasn’t surprising that it had been invented by an eleven year old boy. He had invented a button on the side of the car which, when pressed, would shrink the vehicle, and everything inside it, to an inch cube. In this way, he felt, his Dad could simply pick up the car, pop it in his pocket and take it away with him.

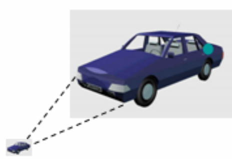


Oliver's Garage version 3

The moral of the story is that not all creative solutions are realizable today. Yet we know that new technologies and new business models are appearing all the time. The world is awash with ideas and inventions. Who knows what the future holds? Do you ever wonder what your competitors are working towards?

Oliver and I reflected on the reality of competition. He felt that something not being possible should not be a reason to stop inventing it! I couldn't disagree. So we played the game one last time. It would be a stretch, but could Oliver identify any harmful functions inherent to the design of his version three garage, the magical shrinking car? Frankly, I could not, but, as is the case so often with children, Oliver surprised us all. In an instant he shot back with, "Of course there is, Dad. When you shrink the car, and you put it in your pocket, you might lose the car, like you lose your car keys." We laughed out loud together.

Let's summarize Oliver's achievement:

	Useful	Harmful
	Protects the car Catches the criminals Makes us feel safe	Could kill innocent bystanders Expensive to build and maintain Creates noise for our neighbours Criminals may damage the car before they caught
	Useful	**Harmful**
	Protects the car Makes us feel safe No need to catch criminals - the garage is locked Preserves life of car – away from pollution/rain/snow	Current garage not big enough Need to spend money on garage extension Takes up play space in the garden Chore to put the car away every night
	Useful	**Harmful**
	Protects the car Makes us feel safe No need to catch criminals - we take the car with us! Preserves life of car – away from pollution/rain/snow Portability/convenience	We might lose the car - like Dad loses his car keys!

Three generations of Oliver's "Garage"

And we might have left it there, had it not been for my stubborn nature and a desire not to let Oliver off the hook so lightly. So I tentatively asked, "Well Oliver, if your new design contains such an obvious flaw that the car might get lost, do you think there might be an improved solution?"

He looked at me as if to say, "You must be kidding?" "No," I replied, "I'm deadly serious." And we went on to list all of the requirements:

The magical shrinking button had been a surprise. What could be next? The design requirements were formidable. Whatever our version four garage would turn out to be it had to protect the car, make us feel safe, not depend on an ability to catch criminals, involve no expensive surveillance paraphernalia, should be easy to build and maintain, pose no threats to innocent bystanders, create zero disruption for neighbors, keep the car out of the weather, need no upfront investment, take up as little space in the garden as possible, not require a special procedure to put the car away each evening, be failsafe in operation, offer portability, and pose little risk of losing the car.

Unfortunately, Oliver never did come up with anything better than his magical car shrinking button. He gave up thinking about it. Yet this does not mean no such solution exists. We'll never know for sure unless he, or you, can be persuaded to repeat the process.

Many innovators falter when faced with seemingly insurmountable problems blocking their path. Oliver did get bored with my little game, but he learned a lot about being an inventor, and he still talks about it today, and recognizes the method when he sees it. Companies and their shareholders, however, cannot afford to get bored and give up on innovation. They have to learn how to innovate. And they have to learn how to do it more often, and more frequently, than their competitors.

Creativity can be a reliable process

Exactly how did Oliver come up with his crazy ideas for improved garages?

He might not have known it at the time, but much of what he did is mirrored in a well-known process for innovation used by leading firms today. This procedure can be readily codified and put into daily practice. It can be applied to products, services, organizational design and, business processes.

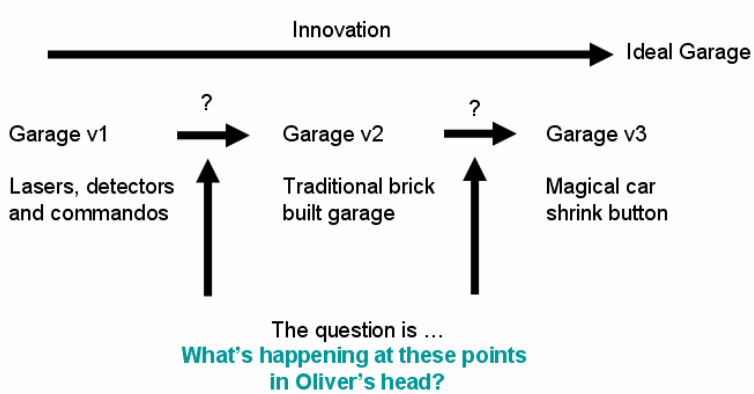
Oliver's version one garage consisted of lasers, detectors, and commandoes. It quickly gave way to version two, a traditional brick building with a lockable front entrance wide enough to drive a car right in. Version three was a device on the car itself, a button to shrink it small enough so that a trouser pocket could act as the garage. In each case, Oliver was moving closer to an *idealized* garage that provides all of the benefits, and none of the associated problems and costs.

How did he do it?

Innovation and a belief in God have a lot in common. If you believe in a deity you don't need to explain how your God works. The same is true of innovation. If you believe that creativity and invention are mystical forces that some fortunate souls have and others do not, then you cannot ask how innovation works. And if you do not know how innovation works you have no means of increasing innovation (value) other than to persuade all of the ultra-creative and knowledgeable people on the planet to join your organization, something that is unlikely to happen. Whereas, if you don't believe in a God, you are forced to investigate the reality behind reported miracles. Creative acts are miracles, but, as many companies are finding out, part of the process can be codified, repeated, and improved.

No company wants innovation to be unreliable, a hit and miss affair, overly dependent on a few talented lateral thinkers. To improve innovation means discovering and putting into practice a repeatable set of activities – a process. Yes, creativity can be taught.

Can we use Oliver's experience with garage innovations to understand the process? How did he step from version to version? If one places innovation on a pedestal, as we typically do with Gods, we will never know. Let's knock down the God of creativity. We then stand a chance of finding out how creativity works.



The first baby step toward innovation is easy. Think hard enough, and ask enough customers, and you will identify the primary and secondary useful and harmful functions within your products and services. The next step is harder.

Oliver asked a lot of questions. He performed thought experiments. Each was designed to test how his system could be improved. Should he throw out the current design (and all of its functions) and start over? Could he introduce a new element to counteract a harmful effect of another function? Would it be possible to enhance a primary function so that its role outweighs the disadvantages of the harmful side effects of other functions in the system, effects that would otherwise be difficult to eradicate.

Of course, he did not know he was doing this, but he was. By making the process explicit, it can be taught to others. We can build a process, and require it to be done. We can make innovation more reliable.

Oliver's "creative" mind

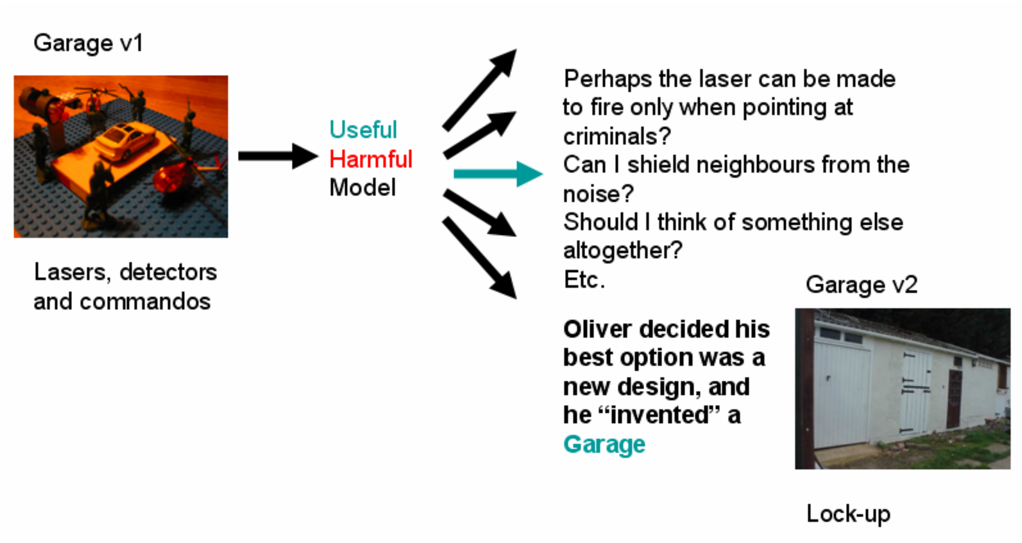
During his analysis of garage one, Oliver become concerned that his laser cannon might inadvertently kill a passer by. Unconsciously he asked, "Perhaps the laser can be made to fire only when pointing at criminals." He was thinking of adding a criminal detector to make safe what must be considered a harmful function from the point of view of the innocent, the danger inherent in the roadside laser cannon. From the point of view of the overall system, the laser is no doubt useful, but, as with every system element, it is also harmful. It can kill criminals. It can kill neighbors. The addition of a criminal detector would help, but system complexity and cost would rise. Everything has a price and therefore everything is both useful and harmful.

As Oliver tried to improve garage version one to take account of its harmful functions, he was adding more harmful functions, and the system Ideality was decreasing. This is a sure fire signal that a jump to a new generation of system is required.

By asking questions, Oliver was decomposing the system. He was not decomposing by physical parts, but along functional lines and through causes and effects, both within the system and in terms of the interaction of the system with its environment and purposes. It was this that allowed him to consider the design alternatives.

For example, he identified that the surveillance helicopters, something he originally considered extremely useful during his early work on the project, nevertheless generated harmful noise. As he reached for a version two design concept he wondered whether he could somehow shield the neighbors from that noise. He realized he could not, but by considering that factor the idea of a shield came into his mind. A garage door is a shield. He jumped out of one design into another. His best option was a new design, and so he "invented" a lock up garage! In reality, he connected his world knowledge to the problem situation which he faced.

Whether he knew it or not, Oliver was drawing useful-harmful models in his head, and morphing those models to find ways to replace the harmful elements, while retaining the useful elements.



Oliver considered questions for improvement of his design based on his mental model of the design – When we later formally modelled the design using P-TRIZ the software generated many options he had not previously considered.

His head must have been spinning with all of the permutations to consider. To make matter worse, he was initially muddling system design and system function. He needed to protect the car, not to supply commandoes. Every system function is only useful in terms of its causes and effects, not its presence. As we saw earlier, the most ideal system does not exist, just provides the needed output. Consider this: Commandoes were only added to the system at the outset to counteract the lack of protection afforded in street parking. Street parking was, in reality, garage version zero. Had he started with an analysis of parking, he may have skipped the unrealistic commando-based design altogether.

Street parking may not protect cars, but it is convenient. Oliver returned to that point later in the design process, noting that if a car could be miniaturized, convenience would be enhanced. Not only could the car be parked at a moment's notice, parking spaces were no longer required! In addition, the car was portable. The driver need not return to the original parking bay. Just step onto the sidewalk, take the car out of your pocket, expand it to normal size, and drive away. Oliver and I discussed this point in some depth. He noted that his design was not only more convenient, but also more robust. Parking systems inevitably depend on parking zone restrictions and parking meters. Useful to residents and local councils, these functions are generally harmful to those who need to park urgently. Oliver's magical-shrinking-car "garage" design was independent of such artificially added devices.

The elements of the innovation process

The inventive problem-solving process that Oliver unconsciously followed during his leaps of imagination can be codified and used by any innovator. It comprises four ingredients.

The first ingredient is a cause-effect model of how the system provides its purpose. This defines the "problem" facing the innovator. The innovator's task is to replace this model with the next generation – improved version – of the system. Such models are very helpful in achieving this step. Because the causes and effects in the model are stated explicitly, algorithms can be designed to analyse the links.

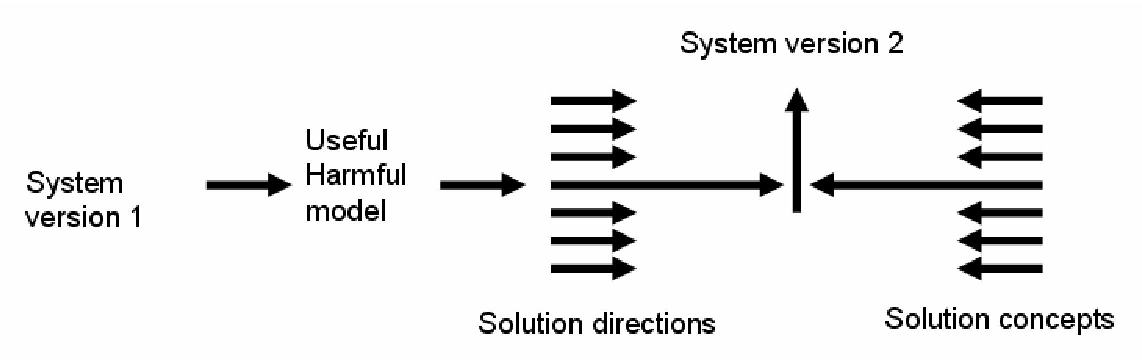
The second ingredient in the recipe for innovation is formulation. It exhaustively lists all of the possible ways in which improvements to the system can be made. There is no magic here. The procedure is trivial, and can be written down by any child. When Oliver asked, “Should I throw away this system and replace it with another,” he was following one specific path – system replacement. When he asked, “Can I make a garage more convenient,” he was using another path: to eradicate or limit the harm associated with the locked door. Remember, these are not solutions, just directions for finding solutions.

The third ingredient is a database of world solution knowledge. These are the principles that have been shown to have worked well in the past in other contexts, and which can be reused in problem solving. Had Oliver had easy access to such a library he may have reached his conclusion more easily, with less effort and in less time. If he had been “stuck” on garage version two, examples would have helped him to see a way forward.

These three ingredients – models, formulation of options, and illustrative solutions – would, no doubt, be very powerful. The fourth ingredient meshes them together. With such a power tool for innovation Oliver may even have found a solution to the last challenge I had set him, that of eradicating any possibility of losing a miniaturized car as one might lose a set of car keys.

Here’s how the innovation process works:

Innovators model the current generation of the system they wish to improve. From these models, solution directions are generated. Selected directions are used to conceptualize a new vision for the system. This is realized in practice by incorporating solution elements drawn from previous innovations, past or present business practice, and available technologies.



Even with tool support, this is hard work. Inventing imaginary garages is one thing. Deciding which products and services your customers will demand next is quite another. So, naturally, people don’t believe tools can help. But who would dream of writing a book without a word processor. That would just be stupid.

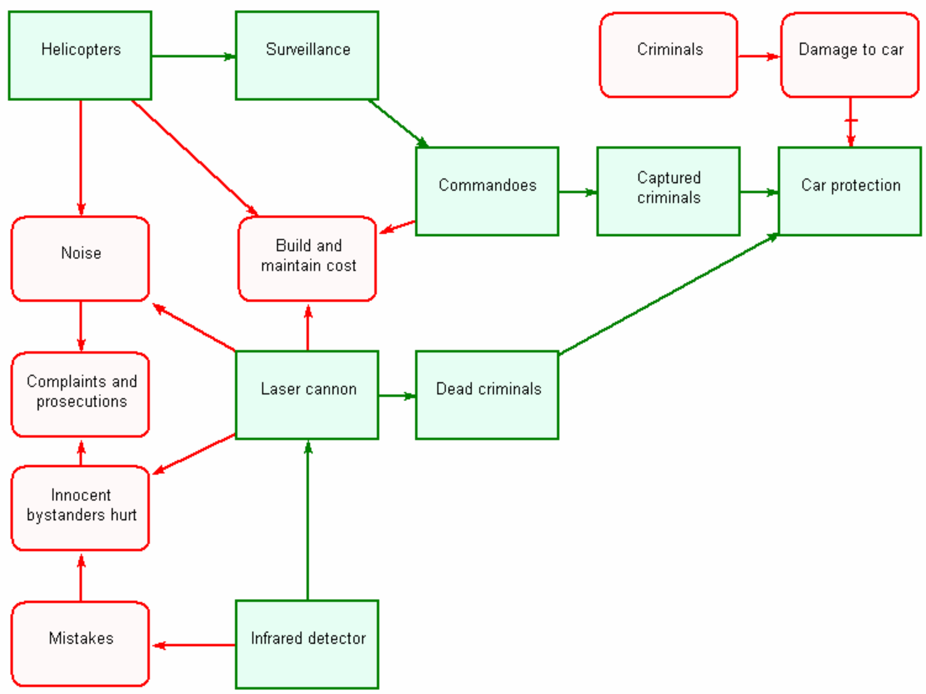
Today, innovation software is becoming available to speed results from creative energy. Far from replacing human creativity, it amplifies it and accelerates it, providing an operating system for innovation within which teams can work together effectively, combine their efforts, and contribute key problem solving or solution knowledge.

The opportunity for innovation software arises because of developments in the understanding of how systems can be improved through idealization. The techniques can be applied in any field, including business process design. They are not complex, but applying them can be complex.

A notation for innovation

I didn't tell you this before, but Oliver didn't just do his innovating in his head. He used a notation, and a software tool. He used TRIZ. We have notations for business processes. Why not a notation for innovation? As Oliver has proved, TRIZ notation can be learned by a child.

In TRIZ, it's a common convention that useful functions are green and harmful functions are red. Here is the model of garage version one that Oliver developed. It might not be the best model, and may even contain logical errors, but it was his model. It was the very same model that he used to generate the next version of his garage.



Oliver's TRIZ model for his Version 1 Garage

This diagram is easy to read. For example, helicopters provide surveillance, which guides commandoes to capture criminals providing a level of car projection. At the same time, criminals could reach the car in advance, and cause damage, which counteracts the protection, compromising the entire system. Helicopters are themselves harmful, creating noise. The confluence of noise and misfired laser cannon could lead to complaints and prosecutions. Etc.

Using a software tool, all of the possible ways to improve this system can easily be generated. This is <u>not</u> artificial intelligence, or even very complex. It's simply common sense knowledge, operating over a structured traversal of nodes and links in the model.

It turns out there are twenty-one primary directions in which Oliver could have innovated his way out of the complexity inherent in his original laser-based design. Each was generated by the software.

1. Find an alternative way to obtain [the] (Captured criminals) that offers the following: provides or enhances [the] (Car protection), does not require [the] (Commandoes).

2. Find an alternative way to obtain [the] (Dead criminals) that offers the following: provides or enhances [the] (Car protection), does not require [the] (Laser cannon).

3. Find an alternative way to obtain [the] (Car protection) that offers the following: does not require [the] (Captured criminals) and (Dead criminals), is not influenced by [the] (Damage to car).

4. Find a way to protect [the] (Car protection) from the harmful influence of [the] (Damage to car).

5. Consider replacing the entire system with an alternative one that will provide [the] (Car protection).

6. Find an alternative way to obtain [the] (Laser cannon) that offers the following: provides or enhances [the] (Dead criminals), does not cause [the] (Innocent bystanders hurt), (Noise) and (Build and maintain cost), does not require [the] (Infrared detector).

7. Try to resolve the following contradiction: The useful factor [the] (Laser cannon) should be in place in order to provide or enhance [the] (Dead criminals), and should not exist in order to avoid [the] (Innocent bystanders hurt), (Noise) and (Build and maintain cost).

8. Find a way to eliminate, reduce, or prevent [the] (Innocent bystanders hurt) in order to avoid [the] (Complaints and prosecutions), under the conditions of [the] (Mistakes) and (Laser cannon).

9. Find an alternative way to obtain [the] (Commandoes) that offers the following: provides or enhances [the] (Captured criminals), does not cause [the] (Build and maintain cost), does not require [the] (Surveillance).

10. Try to resolve the following contradiction: The useful factor [the] (Commandoes) should be in place in order to provide or enhance [the] (Captured criminals), and should not exist in order to avoid [the] (Build and maintain cost).

11. Find an alternative way to obtain [the] (Helicopters) that offers the following: provides or enhances [the] (Surveillance), does not cause [the] (Noise) and (Build and maintain cost).

12. Try to resolve the following contradiction: The useful factor [the] (Helicopters) should be in place in order to provide or enhance [the] (Surveillance), and should not exist in order to avoid [the] (Noise) and (Build and maintain cost).

13. Find an alternative way to obtain [the] (Surveillance) that offers the following: provides or enhances [the] (Commandoes), does not require [the] (Helicopters).

14. Find a way to eliminate, reduce, or prevent [the] (Noise) in order to avoid [the] (Complaints and prosecutions), under the conditions of [the] (Helicopters) and (Laser cannon).

15. Find an alternative way to obtain [the] (Infrared detector) that offers the following: provides or enhances [the] (Laser cannon), does not cause [the] (Mistakes).

16. Try to resolve the following contradiction: The useful factor [the] (Infrared detector) should be in place in order to provide or enhance [the] (Laser cannon), and should not exist in order to avoid [the] (Mistakes).

17. Find a way to eliminate, reduce, or prevent [the] (Build and maintain cost) under the

conditions of [the] (Helicopters), (Laser cannon) and (Commandoes).

18. Find a way to eliminate, reduce, or prevent [the] (Criminals) in order to avoid [the] (Damage to car).

19. Find a way to eliminate, reduce, or prevent [the] (Damage to car) under the conditions of [the] (Criminals).

20. Find a way to eliminate, reduce, or prevent [the] (Complaints and prosecutions) under the conditions of [the] (Noise) and (Innocent bystanders hurt).

21. Find a way to eliminate, reduce, or prevent [the] (Mistakes) in order to avoid [the] (Innocent bystanders hurt), under the conditions of [the] (Infrared detector).

More and more solutions

The solution directions above are called primary directions. If solved, system Ideality increases. There are, in fact, a host of other directions. These secondary directions typically involve making a compromise. System Ideality may not increase.

1.1. Find a way to increase the effectiveness of [the] (Captured criminals).

1.2. Find additional benefits from [the] (Captured criminals).

1.3. Find a way to obtain [the] (Car protection) without the use of [the] (Captured criminals).

2.1. Find a way to increase the effectiveness of [the] (Dead criminals).

2.2. Find additional benefits from [the] (Dead criminals).

2.3. Find a way to obtain [the] (Car protection) without the use of [the] (Dead criminals).

3.1. Find a way to increase the effectiveness of [the] (Car protection).

3.2. Find additional benefits from [the] (Car protection).

4.1. Try to compensate for the harmful influence of [the] (Damage to car) towards [the] (Car protection).

4.2. Try to reduce the sensitivity of [the] (Car protection) to the harmful influence of [the] (Damage to car).

5.1. Consider transition to the next generation of the system that provides [the] (Car protection), but which will not have the existing problem.

5.2. Consider enhancing the current means by which the primary useful function is achieved, to the extent that the benefits will override the primary problem.

5.3. Consider giving up the primary useful function to avoid the primary problem.

6.1. Find a way to increase the effectiveness of [the] (Laser cannon).

6.2. Find additional benefits from [the] (Laser cannon).

6.3. Find a way to obtain [the] (Dead criminals) without the use of [the] (Laser cannon).

6.4. Find a way to decrease the ability of [the] (Laser cannon) to cause [the] (Innocent bystanders hurt), (Noise) and (Build and maintain cost).

8.1. Find a way to benefit from [the] (Innocent bystanders hurt).

8.2. Find a way to decrease the ability of [the] (Innocent bystanders hurt) to cause [the] (Complaints and prosecutions).

9.1. Find a way to increase the effectiveness of [the] (Commandoes).

9.2. Find additional benefits from [the] (Commandoes).

9.3. Find a way to obtain [the] (Captured criminals) without the use of [the] (Commandoes).

9.4. Find a way to decrease the ability of [the] (Commandoes) to cause [the] (Build and maintain cost).

11.1. Find a way to increase the effectiveness of [the] (Helicopters).

11.2. Find additional benefits from [the] (Helicopters).

11.3. Find a way to obtain [the] (Surveillance) without the use of [the] (Helicopters).

11.4. Find a way to decrease the ability of [the] (Helicopters) to cause [the] (Noise) and (Build and maintain cost).

13.1. Find a way to increase the effectiveness of [the] (Surveillance).

13.2. Find additional benefits from [the] (Surveillance).

13.3. Find a way to obtain [the] (Commandoes) without the use of [the] (Surveillance).

14.1. Find a way to benefit from [the] (Noise).

14.2. Find a way to decrease the ability of [the] (Noise) to cause [the] (Complaints and prosecutions).

15.1. Find a way to increase the effectiveness of [the] (Infrared detector).

15.2. Find additional benefits from [the] (Infrared detector).

15.3. Find a way to obtain [the] (Laser cannon) without the use of [the] (Infrared detector).

15.4. Find a way to decrease the ability of [the] (Infrared detector) to cause [the] (Mistakes).

17.1. Find a way to benefit from [the] (Build and maintain cost).

17.2. Try to cope with [the] (Build and maintain cost).

17.3. Consider ways to compensate for the harmful results of [the] (Build and maintain cost).

17.4. Consider creating a situation that makes [the] (Build and maintain cost) insignificant or unimportant.

18.1. Find a way to benefit from [the] (Criminals).

18.2. Find a way to decrease the ability of [the] (Criminals) to cause [the] (Damage to car).

18.3. Consider the conditions that cause [the] (Criminals) and try to change them.

19.1. Find a way to benefit from [the] (Damage to car).

20.1. Find a way to benefit from [the] (Complaints and prosecutions).

20.2. Try to cope with [the] (Complaints and prosecutions).

20.3. Consider ways to compensate for the harmful results of [the] (Complaints and prosecutions).

20.4. Consider creating a situation that makes [the] (Complaints and prosecutions) insignificant or unimportant.

21.1. Find a way to benefit from [the] (Mistakes).

21.2. Find a way to decrease the ability of [the] (Mistakes) to cause [the] (Innocent bystanders hurt).

Intentional innovation

I forced Oliver to read the long list of suggestions. Innovation is hard work. As we now know, his instincts eventually led him to pick direction 5: Consider replacing the entire system with an alternative one that will provide [the] (Car protection). But he also had ideas in other directions.

In response to 11.4, for example, Find a way to decrease the ability of [the] (Helicopters) to cause [the] (Noise) and (Build and maintain cost), he suggested moving to a large house in the country where he wouldn't have to worry about the neighbors and could have his own private army of commandoes free of the fear of upsetting anyone. He also suggested replacing them with tiny airborne micro robots. It is often surprising how the solutions directions generated by the procedure stimulate original thinking.

In response to 17.4, Consider creating a situation that makes [the] (Build and maintain cost) insignificant or unimportant, he suggested trying to win at Lotto!

Very often, innovators are required to explore many such paths, sifting up and down through a complex tree structure pointing to numerous possibilities, before backing up and choosing a strategy. Software tools are a great help. Once a path is selected, the innovator solves the technical or business problems associated with that direction, initiating a project for that purpose. Sometimes they enlist staff in the problem solving via idea management tools that can reach out to the people in the field working in other areas of the business.

One way to guide the work is to repeat the process. At each stage a new model is developed – one describing the problem, then the solution, then the emergent problems, etc. Barriers and aids (useful) are identified, taking account of available solutions and viable technologies. A model is developed, leading to the generation of business or engineering strategies.

Software can help automate the steps, and prompt the innovator's creativity, by providing links into existing databases of known techniques. The best software should offer abstract solutions that can be reused in many different situations. For example, separating two conflicting functions in space or time is one of thousands of such patterns that have been documented by TRIZ scientists. Some firms link the tools to in-house databases and the World Wide Web.

In Oliver's model, direction 5 generated the following suggestion from such a database:

> Usually, when a new function is required, a new system (or subsystem) is introduced. As a result, systems become more and more complicated over time. Sometimes, however, through the appropriate utilization of a special effect (social, psychological, physical, etc.) a cumbersome and/or costly system can be replaced and the same results achieved. For example, an appropriate stimulus that motivates people to take a particular action might be more effective than a complicated system of control.

Oliver probably did not realize, but when he replaced his complex security solution with a simple garage, he was removing unnecessary functions from the system one by one – helicopter, laser etc. – and introducing a special technique, a device that can be in one of two states, a lock, achieving the same effects of protecting the car but with far less external machinery. In innovation lingo, he had trimmed and idealized the solution.

Automating Oliver

Did the software help Oliver in making the leap from a brick Garage, to a magical car shrinking device? The creative process is no doubt mysterious, yet innovation experts are gradually revealing some of its secrets. Are we automating a part of Oliver's creativity?

Yes and no. The software forced Oliver to confront many more lateral thinking paths than he could have achieved just by "thinking."

It used to be the case that "all models come in black." Today, companies innovate in every aspect of their products and services. This includes the design, technology, function, usability, process, business model, organizational strategy, operational delivery models, and brand. The pace of innovation is relentless, and companies often work in parallel on hundreds, in some cases thousands, of problem-solving activities arising from the need to improve, renew, or replace existing products and services. Anything that can save time and effort should be welcomed.

Oliver is a child, and software helped him. You might think that business people are more systematic and don't need software. You'd be wrong. They hardly have time to think at all. They need all the support they can get for their innovation process. It helps amplify their lateral thinking, something, no doubt, of which Edward De Bono would be proud. "Six Thinking Hats" is rarely enough.

Automation is particularly critical to innovators when faced with really tough problems or where large teams are required to work in parallel on many related sub-programs. Automation can also be pivotal in finding a solution when critical domain knowledge must be integrated from diverse fields into a directed problem solving process. Automation is a must in any situation where intuition or hope is not a viable option. We must not expect miracles, but we can expect more reliable innovation if we use process. And, as we know, any process can be more reliable, more thorough, and, in some cases, more efficient, using automation. Once we have a process, we can take a hold on innovation, and improve our ability to create value. Think Six Sigma for innovation!

Bear in mind that results may be incremental, for example, changing this or that aspect, or they may be radical, such as replacing the whole system and replacing it with a new generation based on a new technology. Solutions may be genuinely inventive, for example introducing a new technique or science, or a compromise, for example, improving a specific function even if this causes a less critical function to deteriorate. Output from software is only limited by the extent of the domain knowledge encoded in the associated models. The better the input models, and databases, the better the output.

Oliver used his model to piece together how the garage "worked." This led him to see the fault, and reveal a solution: The garage provided weather protection. How? It had a roof. The locked door excluded criminals, but was less convenient. The garage occupied space in the garden. Why was that a problem? Fewer flowers meant a less attractive garden. Mom would be upset.

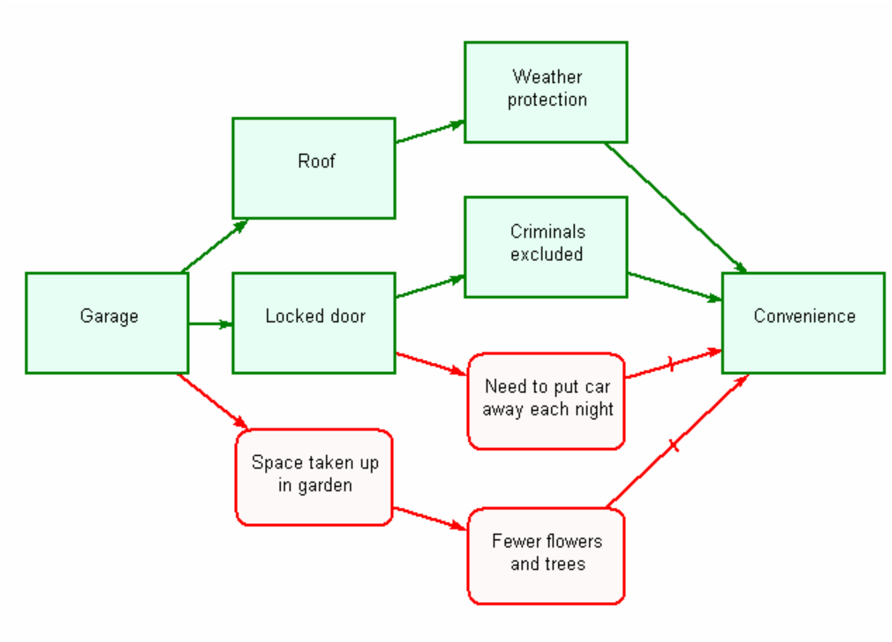
Oliver's model described his "problem" – to improve on a complex system of car protection in the street. His solution was one that required a space no larger than a trouser pocket. The fact that such a solution was not possible in practice, the science of miniaturization not existing at the time, was largely irrelevant to the eleven year old boy. He was open to innovation.

Before anyone misunderstands me, and lest I be accused of harking back to failed attempts in artificial intelligence, I should stress that the *computer-mediated creativity* of which I speak cannot solve scientific problems. Innovation is very different from science. It is not Research. Indeed, it is this that makes management of the innovation process so difficult, especially when new technologies must be developed as part of delivered solutions. The unexpected scientific solution can derail the search for directions. Fortunately, however, this hardly ever happens. We live in a world of parts, whether in physical products or service components. Often, new technology does not depend on fundamental new science, but on a rearrangement of exiting techniques in a new context. And this is how many innovations occur. Rarely is new science required. And when it is, the innovation process can help direct the search.

Towards the next generation garage

Oliver's job became much harder after he had made his first leap from lasers to lock-up. He had then reached the current state of the art of garages. I doubt if Oliver would have "invented" the magical shrinking button and the portable car without the use of TRIZ. He needed something to trip him over the edge. Let's see what happened:

After Oliver had come up with the garage, he developed a model of its useful and harmful functions. Here is the model:



Oliver's TRIZ model for his Version 2 Garage: The Lock Up

Reading this model, we see that a garage provides a locked door which excludes criminals but which also requires the car to be put away each night, thus counter-acting the convenience. Etc. It generated thirteen directions. Oliver read through these directions carefully. And magic happened.

Look at his response to direction 13: Find a way to eliminate, reduce, or prevent [the] (Fewer flowers and trees) under the conditions of [the] (Space taken up in garden). Oliver suggested building a garden on top of the garage. Nice idea.

But it was when he looked at the list of directions in aggregate that, I believe, he was led to his ideas for a car with the ability to change size. Watching him carefully during this process, he appeared to focus on the following directions, those in BOLD text in particular:

1. Find an alternative way to obtain [the] (Locked door) that offers the following: provides or enhances [the] (Criminals excluded), **does not cause [the] (Need to put car away each night),** does not require [the] (Garage).

2. Try to resolve the following contradiction: The useful factor [the] (Locked door) should be in place in order to provide or enhance [the] (Criminals excluded), and should not exist in order to **avoid [the] (Need to put car away each night).**

3. Find an alternative way to obtain [the] (Roof) that offers the following: provides or enhances [the] (Weather protection), **does not require [the] (Garage).**

6. Find an alternative way to obtain [the] (Garage) that offers the following: provides or enhances [the] (Roof) and (Locked door), **does not cause [the] (Space taken up in garden).**

7. Try to resolve the following contradiction: The useful factor [the] (Garage) should be in place in order to provide or enhance [the] (Roof) and (Locked door), **and should not exist in order to avoid [the] (Space taken up in garden).**

9. **Find a way to eliminate, reduce, or prevent [the] (Need to put car away each night)** in order to avoid [the] (Irritation), under the conditions of [the] (Locked door).

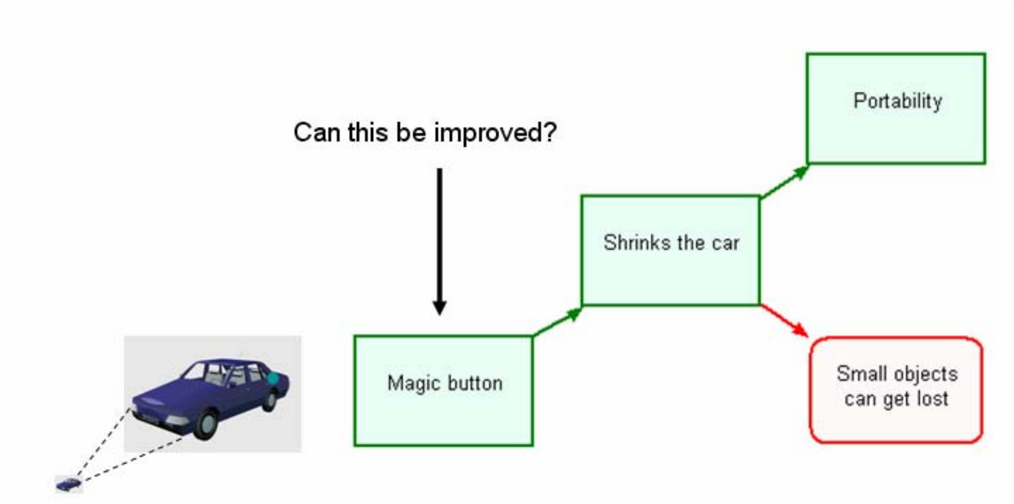
Lodged away somewhere at the back of his mind, the magic shrinking button had always existed. And it "came out" when prompted by these directions. And this is precisely how the best innovation software works, linking models, to formulated directions to pre-existing patterns of invention.

Oliver's version one garage consisted of laser cannons, commandoes, infrared detectors, and helicopters. At first, he ignored the harmful functions altogether, and so had no means to improve his design. Only by decomposing the causes and effects among the solution's useful and harmful functions was he able to glimpse potential improvements.

Towards the ideal garage

While Oliver's version three garage design provides many novel advantages, it has that one fatal flaw: it is possible to lose the car, just as car keys can be lost. Remember, it was Oliver, not me, who recognized this harmful function. And so we were prompted to go further and repeat the process. We continued to play the game.

I challenged Oliver to come up with an improved design. He drew this model of his version three design:



Oliver's TRIZ mode for his version 3 Garage

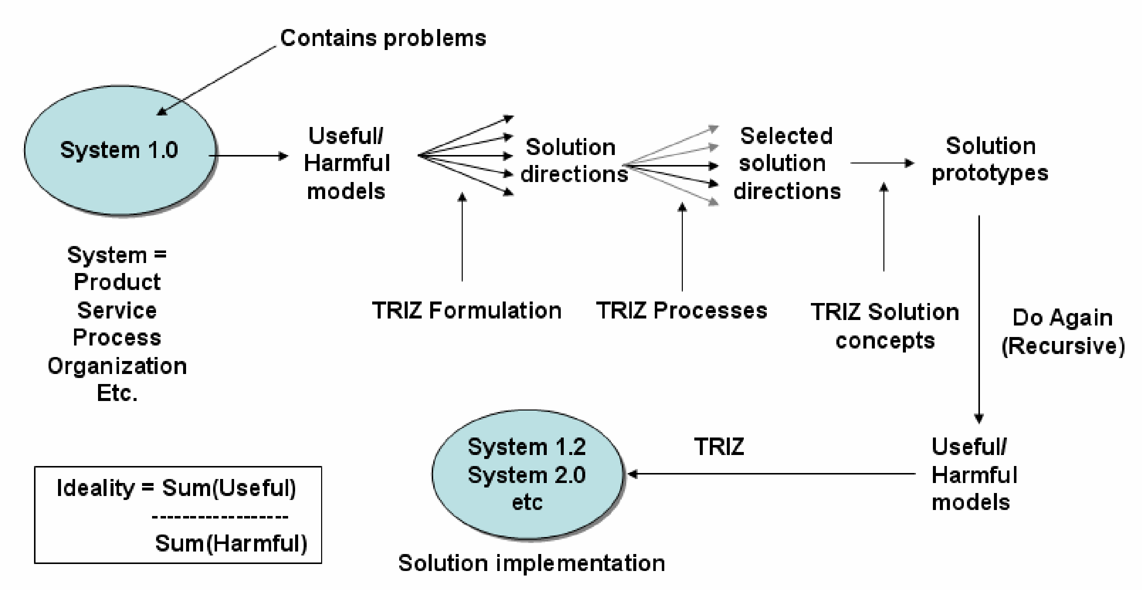
And his innovation process said: 6. Find a way to eliminate, reduce, or prevent [the] (Small objects can get lost) under the conditions of [the] (Shrinks the car). And it started to spew out directions. To find the answer, Oliver is going to have to do what he did before, decompose the model into useful and harmful functions and their interactions. I have no doubt this can be done, and I leave it to the reader as an exercise. How will you choose to decompose "Magic buttons," "Portability," and "Small objects"?

I wonder what Oliver will invent in the future?

The corporate innovation process

Everything that exists, or is yet to exist, is attended by an inseparable companion: an innovation shadow-self. To the untrained eye, such phantoms – in reality models of innovation yet to be performed – are dimly perceived, if perceived at all. To a skilled innovator, however, they become a dominating and pervasive presence in all creative work. The role of the innovator is to bring forth such apparitions from out of the shade and to subject them to a formal analysis, guiding improvement and transformation in products, services, processes, ideas, and strategies.

And that is what I taught Oliver to do.

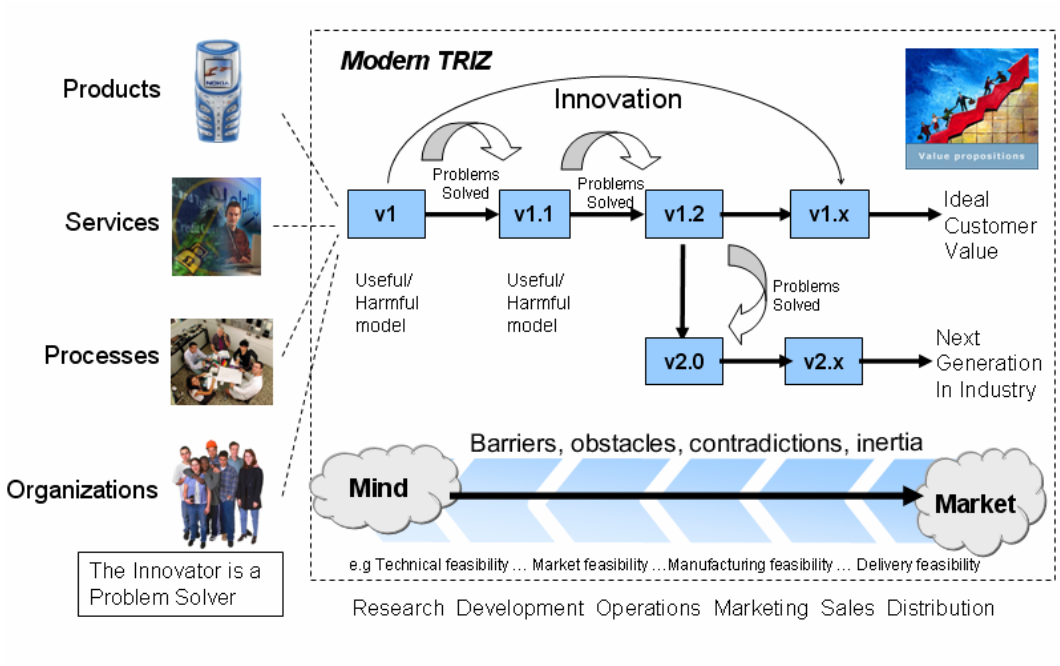


The idealization process

No one is forced to use rigorous innovation methods, but those who do are likely to be more successful. Their innovation will be more rigorous. They will miss less than those who choose not to. They will create more innovations, of greater significance and value in the marketplace, than those who do not. They will become more reliable innovators, creating more relevant ideas in less time and with less resource. So if your company is facing competitive hurdles or impossible customer challenges, why ignore any trick in the book? An innovation process can draw out increased creativity from all members of your team. Rigor has its benefits.

Gradually, TRIZ is showing the world how to encode the innovation process into a set of rules. The best companies are learning these rules, and accelerating and deepening their innovation. Already ideas are being commoditized, and the global World Wide Web makes it hard to keep any idea under wraps. Executing on ideas is the new competitive differentiator. Being innovative from time to time is no longer enough. Companies do need to encode, describe, and improve their innovation process, just as they do with any other business process.

And that's what P-TRIZ can be – a process for innovation. So now go out and "Improve everything always."[2]



The Big Picture of Corporate Innovation

[2] The title of a forthcoming white paper

