TRIZ POWER TOOLS

Skill #7: Discovering Why Targeted Objects are Required

April 2012 Edition

Know Why They Exist So You Can Remove Them

TRIZ Power Tools

Skill #7 Discovering Why Objects are Required

April 2012 Edition

ISBN Not yet applied for

TRIZ Power Tools by Collaborative Coauthors

16 Pages

Acknowledgements

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The Algorithm

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Introduction

(If you are reading the PDF format—navigate the algorithms with the "Bookmarks" to the left. L1, L2, L3 correspond to levels of the algorithm. The levels are hierarchical; you can go as deeply as required to resolve your problem. Lower levels (L1, L2) have consolidated methods. If you are using the book then use the Table of Contents for the Algorithm)

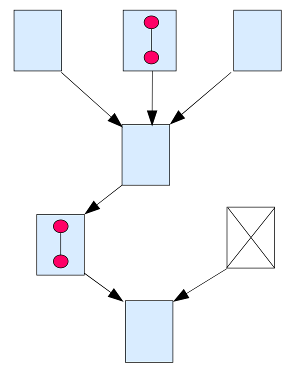
Each of the books in the TRIZ Power Tools book series are designed to be used as algorithms. Each algorithm can be as detailed or simple as required. This is done by going up or down in the hierarchy of the process steps. The top level (L1) of the bookmarks is the highest level. If more detail is required, the user can go to deeper levels (L2 and L3). .

Where the Book Materials Come From

Much of the material for this book was inspired by the thought leaders referenced. The original intent was to codify the insights of these thought leaders, but the exercise of codification ultimately led to the synthesis of other experimental processes. This is because codification required recognizing patterns of similarity of tools. Once this was achieved, the various tools were grouped with key decisions. Decisions require and create information which flows to the next decisions. Patterns and gaps became visible during this formative process. Experimental methods were inserted into the gaps. The proof of these experimental methods is whether they actually help the reader to identify product or process characteristics that will delight the market.

L1-Discover Why Targeted Elements are Required

Note: The main explanation of causal analysis can be found in the book TRIZ Power Tools Skill #6 Discovering Cause. Please read this book and then come back to this one.



All useful elements exist to provide functions that other elements in the system or super-system require. Often elements exist because they are required to solve a problem that other elements introduce. Something in the system is not doing its job and an element is introduced to fix the problem. Almost any useful function can be cast in this light. If we can discover these deeper problems and resolve them without adding elements then the system becomes simpler.

Harmful elements exist because they cannot be avoided or because they are not yet recognized and removed. Most harmful elements also provide a useful function which makes them difficult to eliminate.

Understanding and removing the need for (or cause of) the target element allows us to potentially remove large groups of elements from the system. Many elements or sub-systems are required to compensate for other elements that are not doing their job. There is a function that is flawed or harmful and this fact has become obscure to us. The element that is not doing its job is being *hidden* by compensating elements. If we can discover this weakness and correct it, then the elements that compensate can be removed. That makes this particular method of simplifying systems very powerful. Most useful functions can be framed as compensating functions. For instance, the grass must be mowed because it is not doing its job. If it were, it would grow to the perfect length like eyebrows or eyelashes and then fall out. We can thus view mowing the lawn as a compensating function.

L1-Method

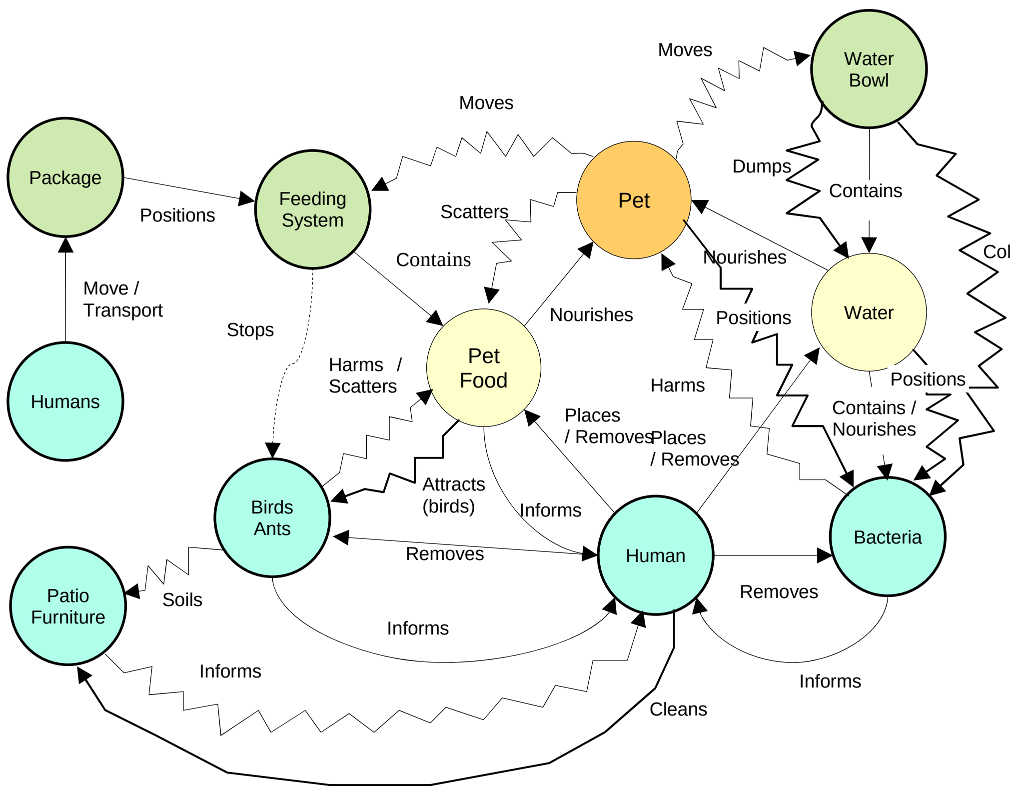
Step 1: Look at the function diagram and see if it is obvious which functions need to be idealized in order to remove elements from the system.

Example—Pet Feeding System

A pet feeding system is composed of multiple functions, including harmful functions that make it more complex. These harmful functions require care and maintenance on the part of humans.

Step 1: Look at the function diagram and see if it is obvious which functions need to be idealized in order to remove elements from the system. Identify the functions that need to be idealized.

We note from the diagram below that many of the harmful functions are associated with the bacteria. We can hypothesize that the pet contaminates or places the bacteria in the water. The pet cannot perform this function by itself. The water removes the bacteria from the pet's muzzle and tongue and then continues to nourish it, especially if the climate is warm. We conclude that the harmful function of positioning and nourishing the bacteria is the one that we want to idealize.



L2-Discover Why Targeted Elements Are Required

We begin the process of determining why targeted elements are required (or where they come from if they serve no useful function) by considering their existence. The problem exists because an element exists. If a useful element does not exist, a new problem arises. This is an alternative problem path similar to those we have seen before. This path will show us why the element is required in the system. This will be important when we consider solutions. Most elements are required because something else in the system is not doing its job or because useful elements also create harm.

Practically, we determine why elements are required in the system by removing them and then asking “what gets worse? This is a new and powerful trick that we add to the causal analysis diagram. The process of identifying elements and then removing them to see what happens continues until we can see the chain of causes for why elements are required. Along the way, we discover that some elements exist to prevent or remediate harm or because something performs a function, but does it too weakly to be useful. If we could only solve this problem, we would no longer need the element in question.

When we finally understand the key functions that need to be fixed, we will idealize them or their attributes. We want to idealize functions in such a way that the base problem is completely resolved and we can *remove the most elements from the system*.

Shortcutting the Causal Analysis

In most cases, it is not necessary to understand the full cause before solving the problem. We can understand why targeted elements are required before gaining a full understanding of the problem causes. For many years, it was the author’s practice to perform a full causal analysis. This can be very illuminating, but it is also very time consuming. Under the pressure of time that exists in competitive commercial settings, it is not always possible to do a full causal analysis. If the system is primarily a physics based system, it is often possible to remove elements without understanding the full cause of the problem.

There are exceptions to this rule, especially where the system is very complex or when humans are required in the system, it may be necessary to do a full causal analysis first.

L2-Method

Step 1: Start with the burdensome function and show the existence of elements as inputs:

Step 2: Show what causes the objects to exist if they are not required by the system.

Step 3: If the element is required then turn the existence knob for all elements and then show “??” in the resulting functions to indicate that no element performs these required functions.

Step 4: Show the resulting problems that occur if the functions are not performed because the elements do not exist.

Step 5: Show object attributes that lead to the harmful or missing effects of the missing functions.

Step 6: Continue building the causal diagram in this manner, remembering to use existence as an attribute for each function.

Step 7: Using the causal diagram, identify functions that, if idealized, will allow for the removal of the most system elements. If these are useful functions then they are usually closer to the system product on the function diagram. Fixing these functions allows for removal of auxiliary elements which are further from the system product.

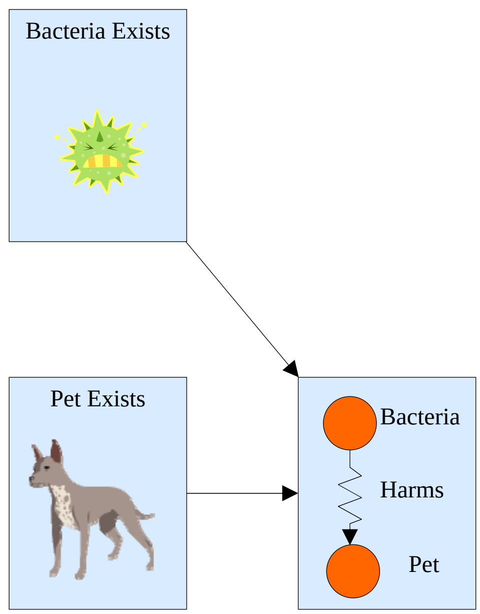
Step 8: Summarize the key functions that should be idealized and the key parameters that need to be changed to improve the situation.

Example—Pet Feeding System

We previously decided that the birds, bacteria and insects were likely targets for removal. Let's look at the bacteria first.

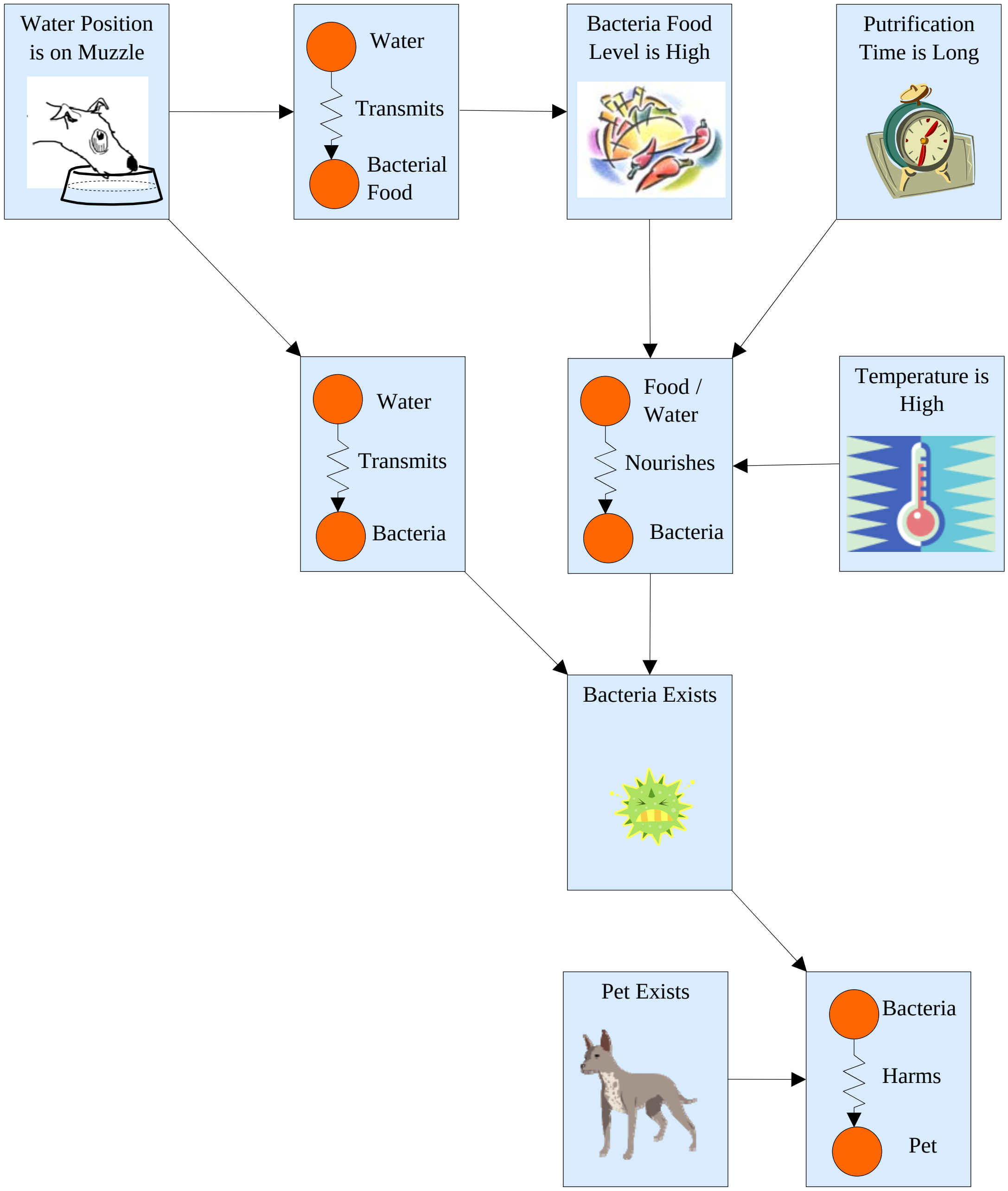
Step 1: Start with the burdensome function and show the existence of elements as inputs:

The burdensome function that we are considering is the harmful effect of the bacteria on the pet.



Step 2: Show what causes the objects to exist if they are not required by the system.

We could follow the existence of the pet in the system for novel solutions, but instead, let's look more carefully at the bacteria since it is not required in the system. Where does it come from and what allows it to continue to exist in the system? We note that the bacteria come mostly from the muzzle and tongue of the pet. The bacterial food also comes from the same source. The pet puts its muzzle into the pet food and particles of this food are then transferred to the water to become food for the bacteria.



Step 3: If the element is required then turn the existence knob for all elements and then show "??" in the resulting functions to indicate that no element performs these required functions.

In this case, the pet is required but the bacteria are not. We will not go into why the pet is required for this example.

Step 4: Show the resulting problems that occur if the functions are not performed because the elements do not exist.

Since we are not going into the requirement for the pet, this is not required yet.

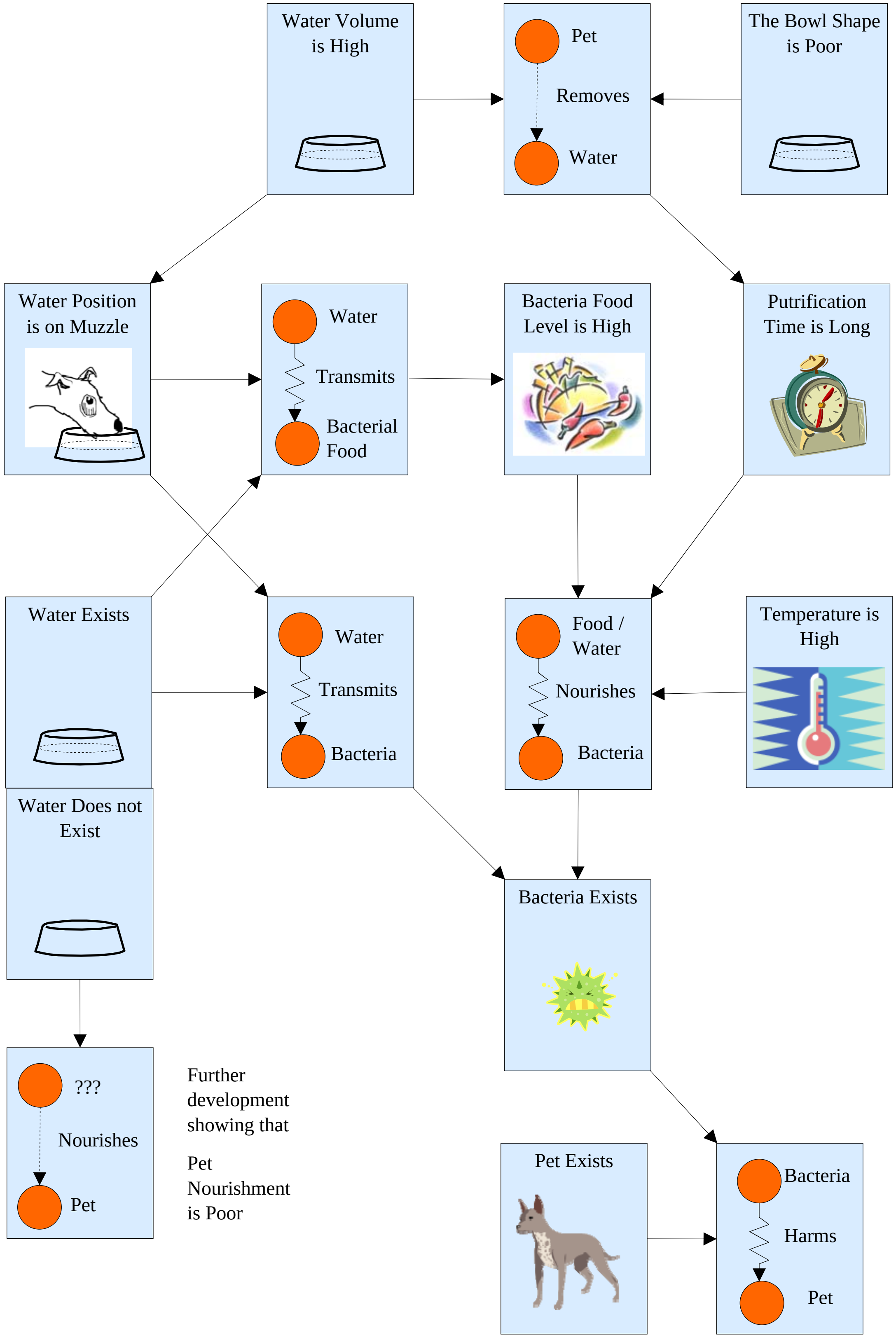
Step 5: Show object attributes that lead to the harmful or missing effects of the missing functions.

So far, this is not required

Step 6: Continue building the causal diagram in this manner, remembering to use existence as an attribute for each function.

We continue the diagram showing the requirement for the water. Since this is a useful element, steps 3-5 now have applicability.

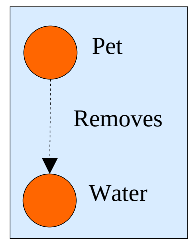
The existence of the bacteria is developed further. Space does not permit to show all of the attributes of the water and the watering bowl that controls this, but one that is noted on the diagram is the volume of water in the bowl and the shape of the bowl. The volume of the water controls the length of time that the bacteria are allowed to feed on the food and the water and the shape allows the bacterial food to collect in corners. We can imagine that if the volume were buckets worth that the bacteria might never be removed. If the volume amounted to the water consumed each time then the bacteria would be removed each time that the pet took a drink. We also note that if the volume of water is smaller than the amount of food washed off of the muzzle is much smaller.


Water Volume is High
Pet
Removes
Water
The Bowl Shape is Poor
Water Position is on Muzzle
Water
Transmits
Bacterial Food
Bacteria Food Level is High
Putrification Time is Long
Water Exists
Water
Transmits
Bacteria
Food / Water
Nourishes
Bacteria
Temperature is High
Water Does not Exist
Bacteria Exists
???
Nourishes
Pet
Further development showing that
Pet Nourishment is Poor
Pet Exists
Bacteria
Harms
Pet

We have developed the diagram as far as necessary to demonstrate the value of this method. Remember that we are trying to discover key elements which if removed allow us to remove other system elements at the same time. At this point, the bacteria in the water are a part of the system. They cause added burden to the system, both to the pet and to its owner. What we would like to do is to remove the bacteria from the system if possible.

Step 7: Using the causal diagram, identify functions that, if idealized, will allow for the removal of the most system elements. If these are useful functions then they are usually closer to the system product on the function diagram. Fixing these functions allows for removal of auxiliary elements which are further from the system product.

The removal of the water by the pet is a key weak function. This is the deeper problem that, if resolved, allows the system to become simpler and removes one of the primary constraints on the target market which is the harm that the bacteria does to the pet. If the water were removed more completely, then the bacterial problem would mostly go away. From our analysis we see that this is largely controlled by the volume of water and the shape of the pet bowl. As a side note, we also notice that the removal of the food from the muzzle is also controlled by the volume of the water.

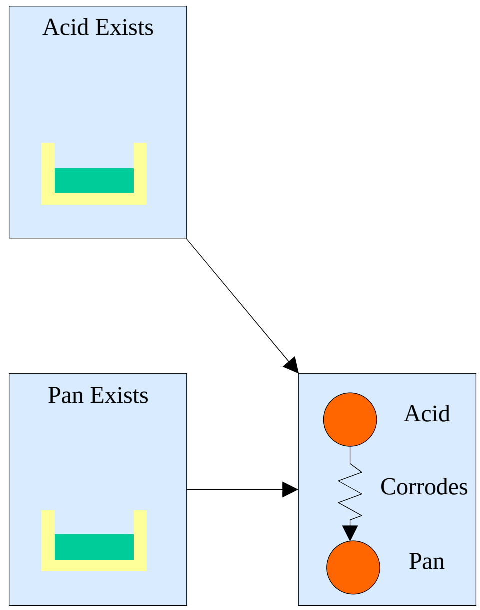


Step 8: Summarize the key functions that should be idealized and the key parameters that need to be changed to improve the situation.

It was found that the removal of the water by the pet is a key weak function for removing the bacteria. The main thing that is wrong with this useful function is that the amount of water removed is not the full amount in the bowl. This is the deeper problem that, if resolved, allows the system to become simpler and removes one of the primary constraints on the target market which is the harm that the bacteria does to the pet. If the water were removed more completely, then the bacterial problem would mostly go away. The volume of the water controls the length of time that the bacteria are allowed to feed on the food and the water. We can imagine that if the volume were buckets worth that the bacteria might never be removed. The requirement then becomes to have only a small amount of water available. Further, if the volume amounted to the water consumed each time by the pet, then the bacteria would be removed each time that the pet took a drink. We also note that if the volume of water is smaller than the amount of food washed off of the muzzle is much smaller. The net result is that the water available should be the same amount that the pet consumes. Further analysis of the removal of the water showed that the shape allows the bacterial food to collect in corners. From our analysis we see that all of these things are largely controlled by the volume of water and the shape of the pet bowl should be such that nothing can hide in corners. There should be no corners in a pet bowl. The pet should drink from a “spoon”. With all of these requirements satisfied, the water bowl becomes “self-cleaning” because the pet automatically removes any food and bacteria each time it drinks. Thus we have a further requirement that the small amount of water be replenished after or during the time that the pet is consuming the water.

Example—Acid Container

In the next section which is a tutorial on causal analysis, an example is given of acid corroding a pan which is used to contain test cubes. The acid corrodes the cubes but also corrodes an expensive pan that contains the cubes and the acid. Most people would start by looking for materials that are less expensive or ways to reduce the acid damage. This is done without considering that the pan may not be necessary. If we do not require the pan, then we can completely side-step compensating for acid damage. By using the following process, we can find the problem that the pan compensates. If this problem is solved (not compensated) then we remove the necessity for the pan, and potentially other elements of the system.



Step 1: Start with the burdensome function and show the existence of elements as inputs:

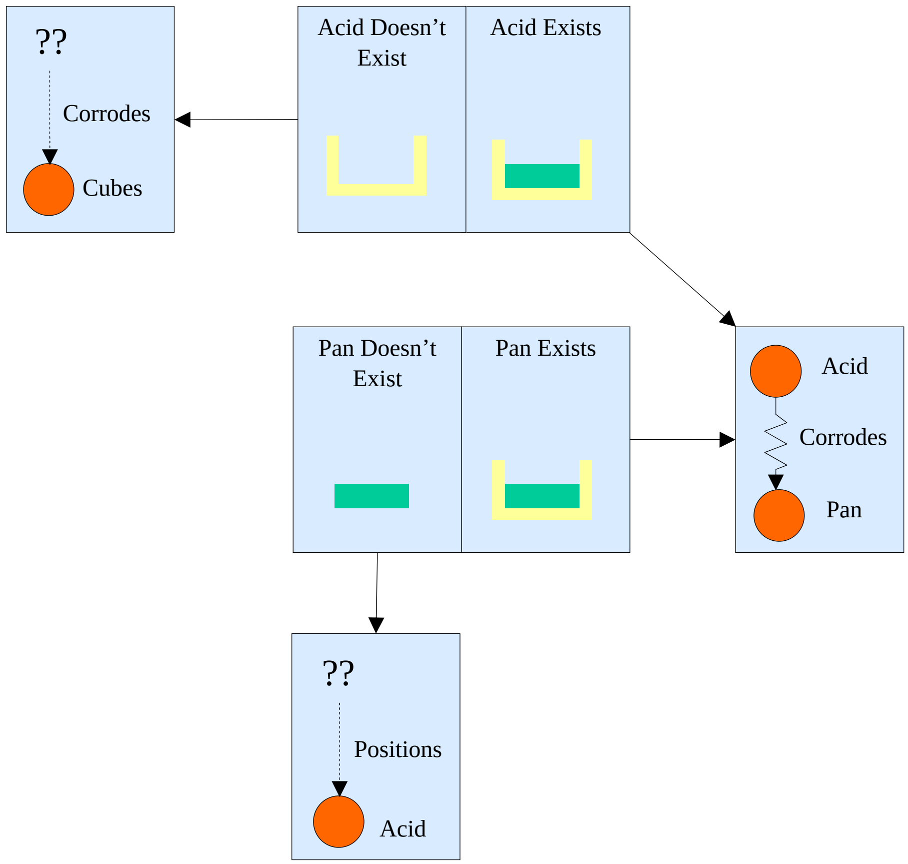
The burdensome function that we are considering is the harmful effect of the acid on the container.

Step 2: Show what causes the objects to exist if they are not required by the system.

In this case, the creation or providing of the acid and pan are not considered because both are required to make the current system work. They are not produced products or unwanted waste, for instance. We will bypass this step on this iteration.

Step 3: Turn the existence knob for all elements and then show "??" in the resulting functions to indicate that no element performs these required functions.

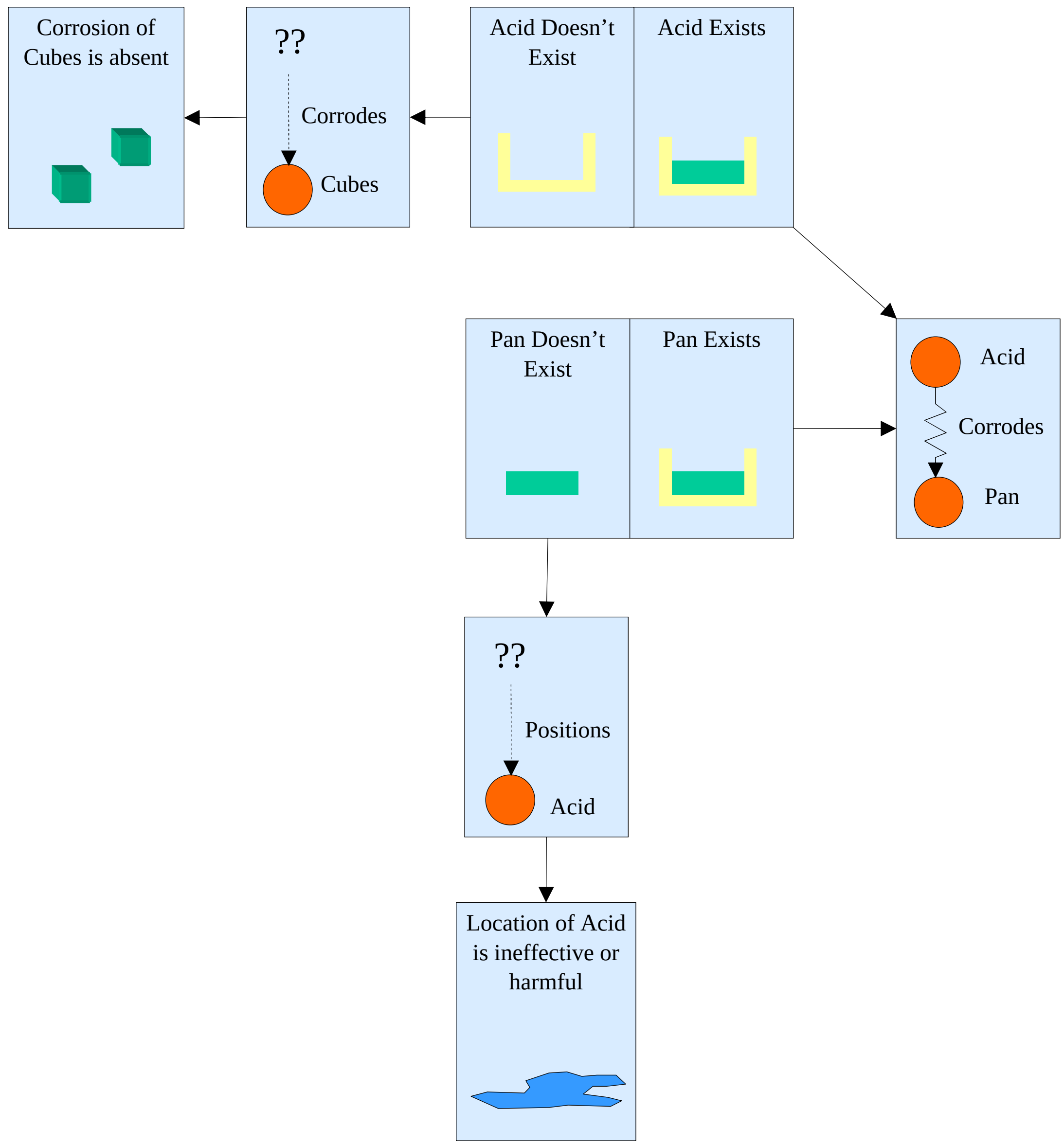
In this case, there is nothing to corrode the cubes and nothing to position the acid. In effect we have said "the acid is required to corrode the cubes" and "the pan is required to position the acid relative to the cubes". It seems like a lot of effort to say it this way, but notice that we have also considered the possibility of solving the problem by turning a



seldom turned knob, existence. This opens the possibility of solving the problem by resolving the contradiction that something must and must not exist. Also, we have remained consistent with a simple set of rules linking functions through the use of attributes.

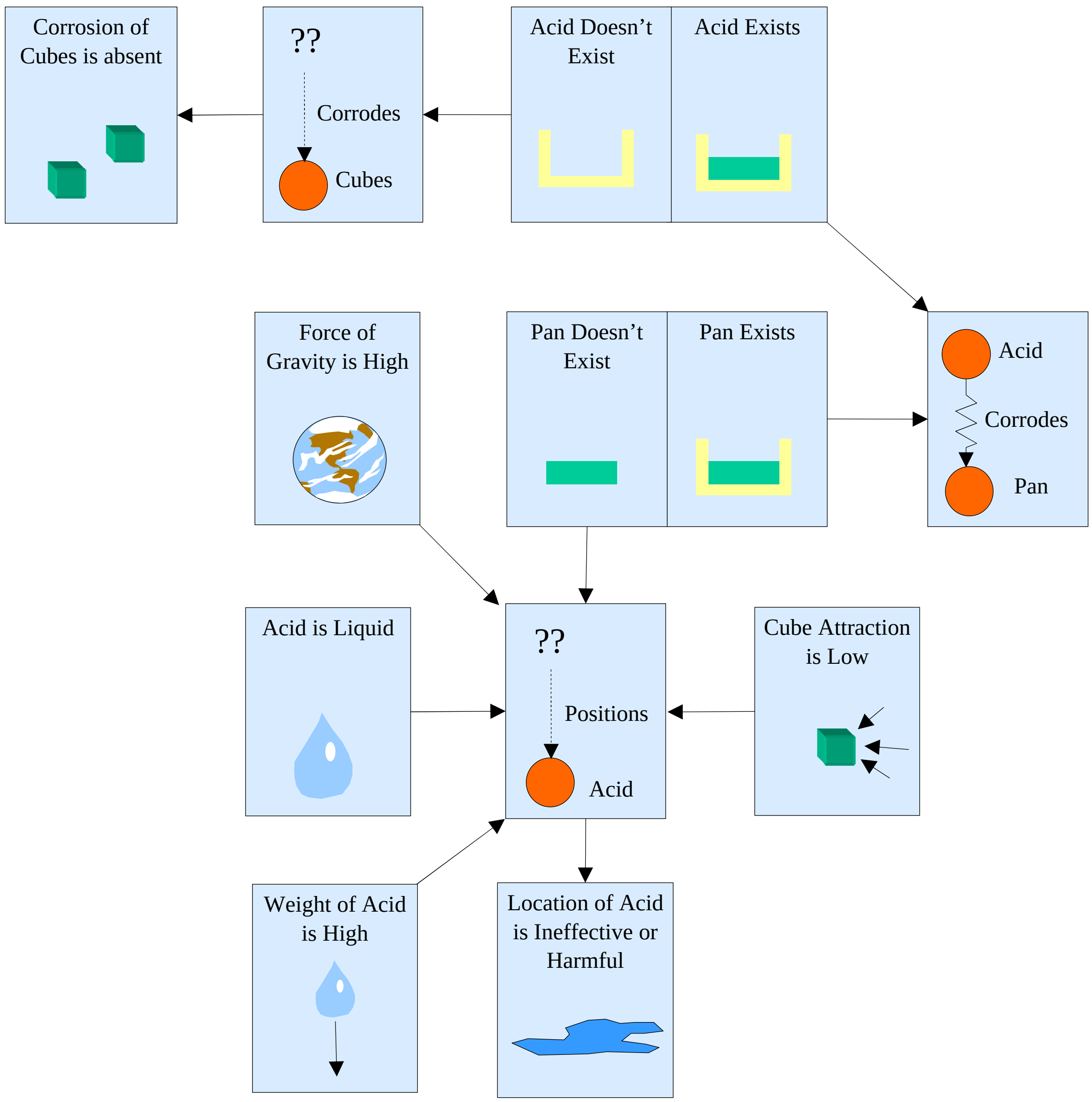
Step 4: Show the resulting problems that occur if the functions are not performed because the elements do not exist.

In this case, there is no corrosion of the cubes, the primary reason that the acid is required, and the acid goes everywhere but where the cubes are. Clearly, the primary function is not performed for both reasons. There is either no acid, or the position of the acid is inadequate to corrode the cubes and goes into the oven. This opens the potential that the problem could be resolved by using other functions.



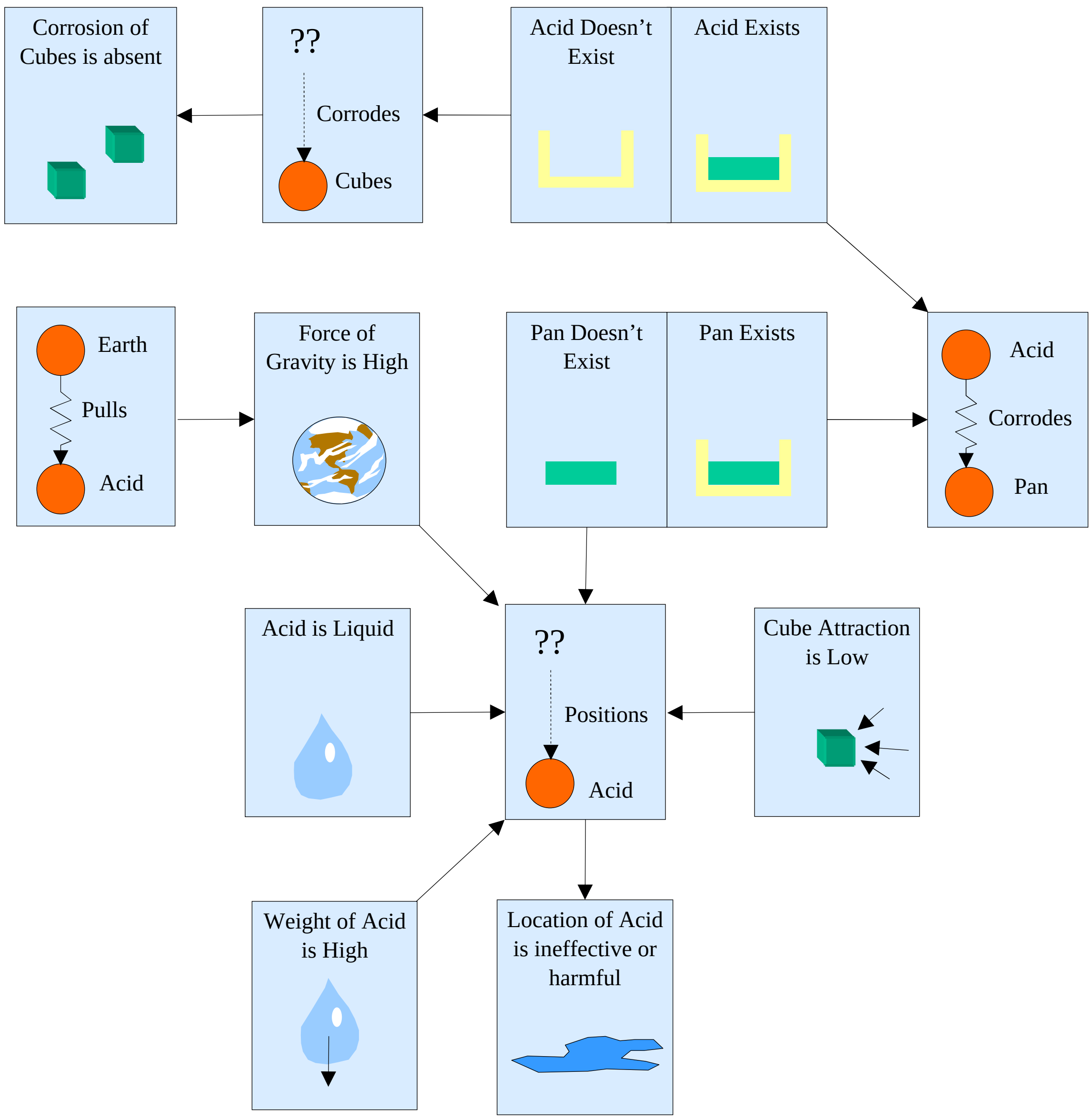
Step 5: Show object attributes that lead to the harmful or missing effects of the missing functions.

To conserve space, we will not address additional attributes that cause corrosion of the cubes to be absent. As for the location of the acid being ineffective or even harmful, there are a number of object attributes that influence this. First, the pull of gravity forces the acid away from the cubes and the acid is in liquid form and flows easily under the force of gravity. The attraction of the acid to the cubes is low. And the weight of the acid is high.



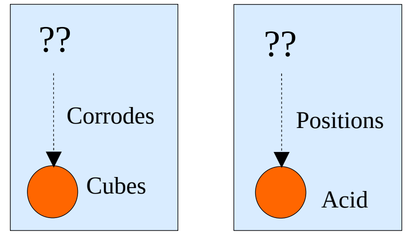
Step 6: Continue building the causal diagram in this manner, remembering to use existence as an attribute for each function.

We will only show one more addition in order to make the next step more concrete and offer up questions that can lead to important insights. We will add the harmful action of the earth on the acid which occurs due to the pull of gravity.



Step 7: Using the causal diagram, identify functions that, if idealized, will allow for the removal of the most system elements. If these are useful functions then they are usually closer to the system product on the function diagram. Fixing these functions allows for removal of auxiliary elements which are further from the system product.

The two key functions that need to be idealized are: The corrosion of the cubes and the positioning of the acid. The corrosion of the cubes is closer to the system product. In other words, if the corrosion of the cubes was performed in a different way than the acid, then the pan would not be required.



Step 8: Summarize the key functions that should be idealized and the key parameters that need to be changed to improve the situation.

Even though the corrosion of the cubes could be done in a different way, the decision is made to identify different ways to position the acid.