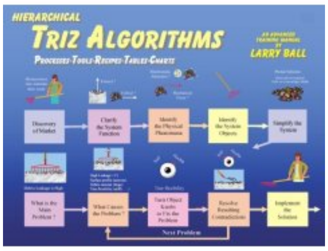
Hierarchal

# TRIZ Algorithms

Larry Ball
Aug 31 2007

TRIZ シンポジウム 2007
The Third TRIZ Symposium in Japan





Translated by Toshio Takahara and Toru Nakagawa for the TRIZ Home Page

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I am honored to be here in Japan at this symposium. I have been requested to talk about the contents of my book "Hierarchal TRIZ Algorithms". A special thanks goes to Toru Nakagawa and Toshio Takahara for translating my book.

# Agenda

- Clarifying or Modifying TRIZ Theory
- A Hierarchy of Tools
- Solution Directed Causal Analysis
  - Different Forms of Causal Analysis
  - Function / Attribute Centric
- How the Causal Analysis is used in Solving
  - Functional Ideal Final Result
  - Discovering Contradictions
- Additional Separation Principles
  - Beyond Separation in Time, Space and the Parts and the Whole
  - How to Know When Each is Possible to Use
- Summary
- Invitation?

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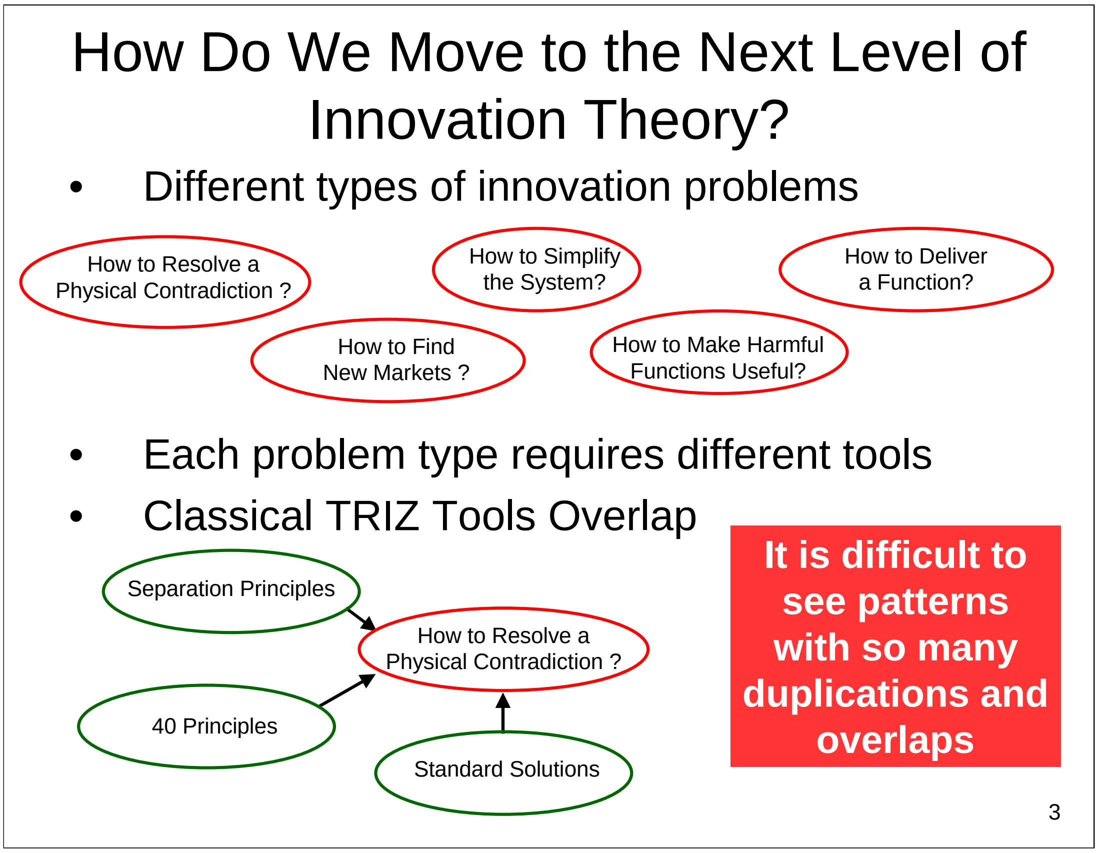
Following is the agenda for my talk. I was first introduced to TRIZ in 1992. Since that time, I have been very engaged in studying, applying and teaching TRIZ. As a result of my studies and applications, I have noticed some inconsistencies in the theories of classical TRIZ. Much of my talk will be around explaining these inconsistencies. The agenda puts this into a format for discussion.




If we are going to modify innovation theory, we can follow a well-known method of gathering information and then classifying it.  But, we must first discover a way to organize it.  One way that helps very much in the organization of TRIZ tools is to ask:  What different  types of innovation problems are there?   There are very many different types of problems.  Each problem requires different tools to resolve.  The problem with classical TRIZ tools is that the tools often overlap. Many people have told me that this is a good thing that the tools overlap because we make sure that we overwhelm the problem.  This may be true, but from the viewpoint of modifying innovation theory, this is a very bad thing.  The tools must be teased apart and separated in order to classify them and see what is missing.

# Clarifying Theory

1. Gather data

15 4 8 27 16 12 21 17 10 20 2 18 23

2. Group into "like" groups

18 4 8 10 12 2 20 16

17 23 21 15 27

3. Identify patterns and exceptions

2 4 8 10 12 16 18 20

15 17 21 23 27

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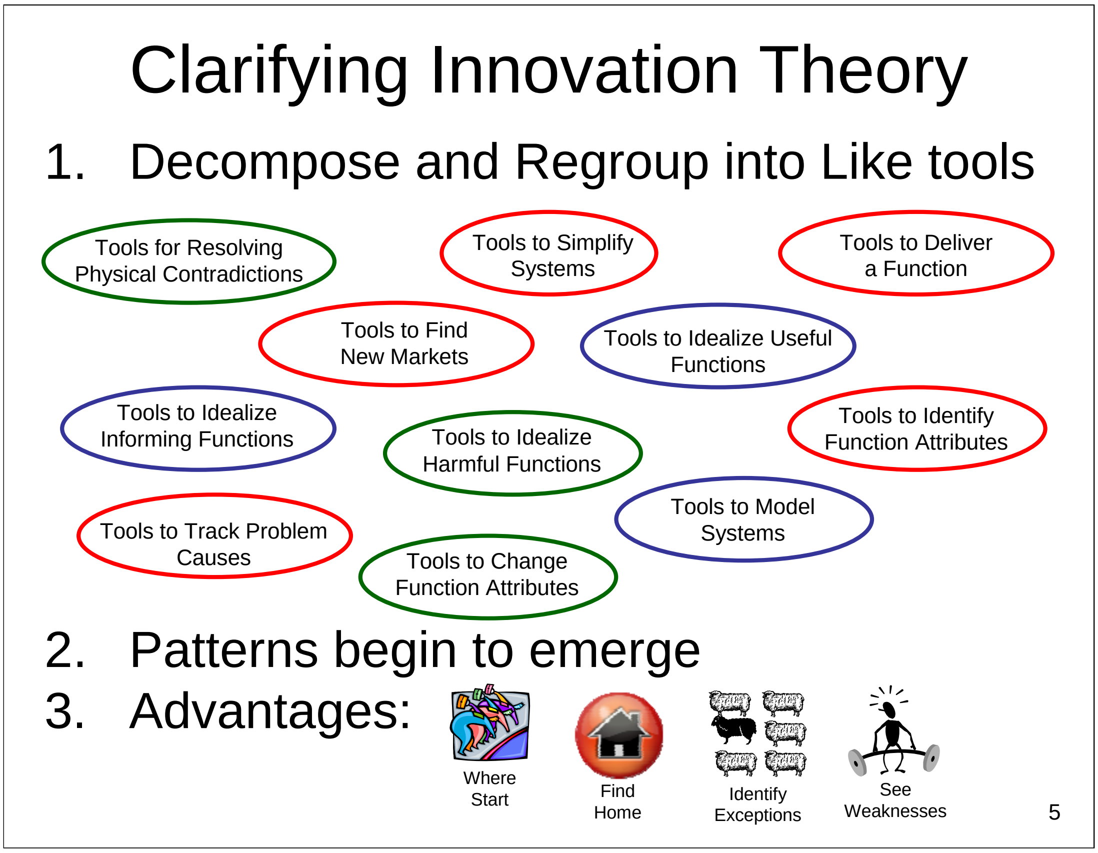
Let us take for example the analogy of discovering order to a group of numbers. First, we gather the data. Notice that there is no pattern. Next we can group the numbers into like groups and finally line them up in order of magnitude. When we do this, we discover that there is a pattern and we also notice the gaps in the sequences.




This is likewise true with innovation theory.  If we gather the tools around the types of problems that they solve, we can then order them in the sequence that they are used.

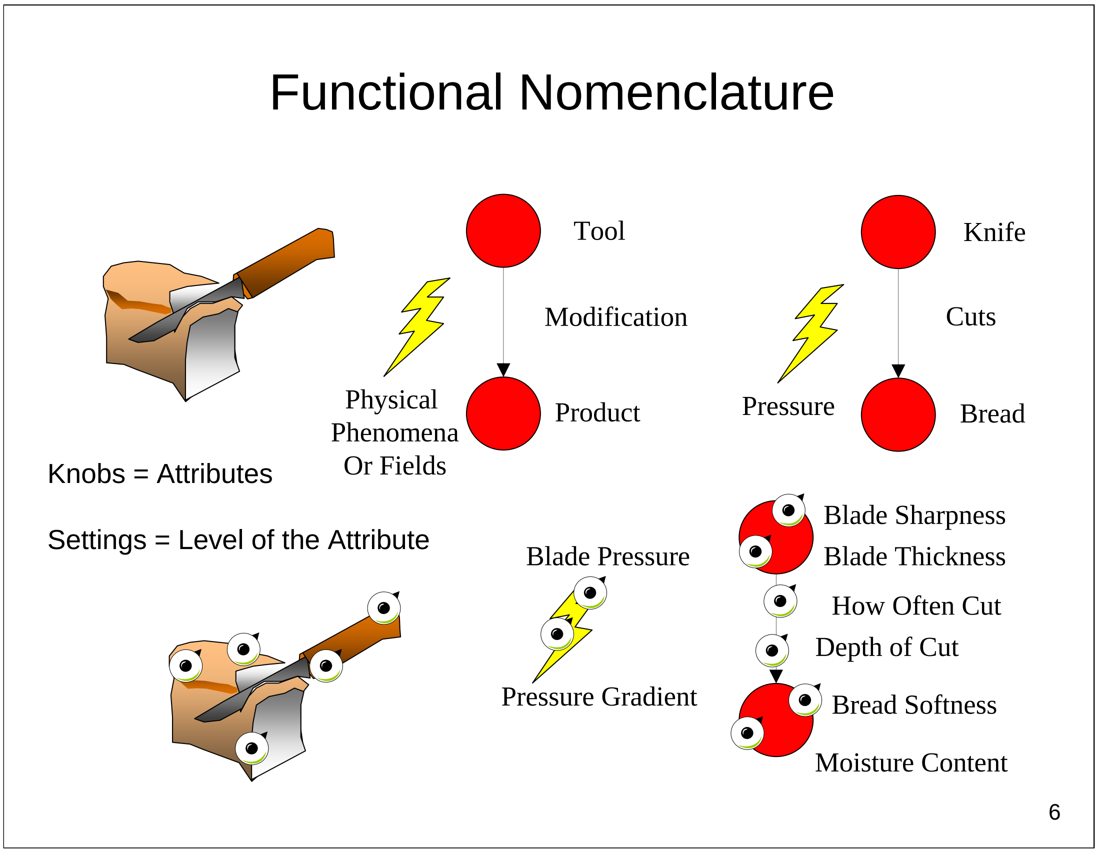
If we will do this, then we will begin to see the patterns that emerge.  There are also a number of other advantages.

1.  Perhaps a pattern will emerge that will answer the age old question of “Where do I start?”

2.  Whenever a new tool is discovered, it has a home.  It can be categorized and compared with like tools.

3.  When someone solves a problem in a way that does not look like the emerging pattern, we have an “exception”.  Such exceptions are important to the development of innovation theory.  Exceptions are not enemies, but food for thought.  “What is the theory missing?

4.  When the theory is laid out, we can see the weaknesses of the theory.  Some problem types may not be addressed by the tools.




Before I go on, it will be necessary to discuss some functional nomenclature. This nomenclature is not new, but will be helpful in further discussion for those that are not familiar with it.

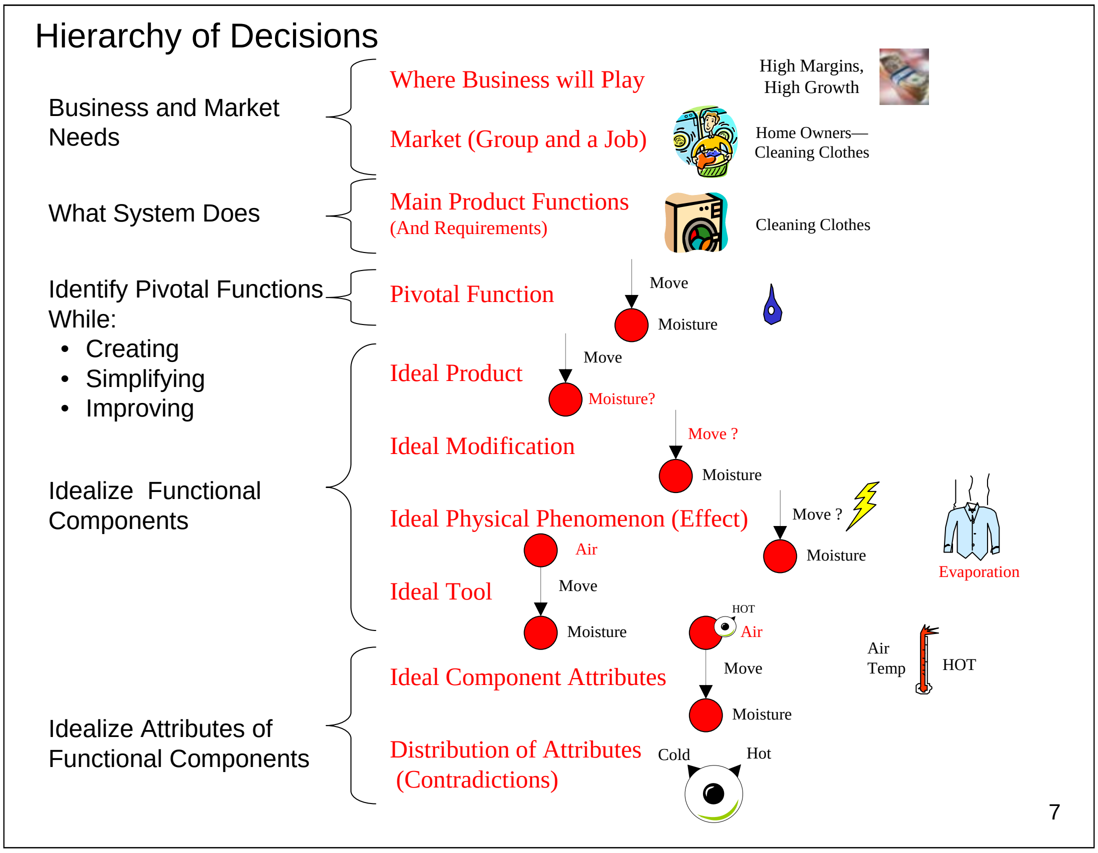
First is the concept of a function. There are three basic parts to every function. The thing that is acted upon or the product. The modification that occurs to the product and the thing that performs the modification, or the Tool.

In this example, the bread is the product, Cuts is the modification and the Knife is the Tool.

The modification is performed using a physical phenomena which is a special combination of fields and substances that allow an interaction to occur. In this case, the physical phenomena which is used to cut the bread is extreme pressure which occurs at the tip of the blade.

The term “knob” will be introduced as this is a common Six-Sigma term. It denotes properties or attributes of substances and fields that can be adjusted to change what happens in the function. Some people may call these “levers”. At any rate, they are measurable properties of substances and fields.

Each element of the function has “knobs”. The product (bread) has softness and moisture content as properties or attributes. The modification (cut) can be measured by depth or frequency. The Tool (Blade) has the attributes of sharpness and blade thickness.

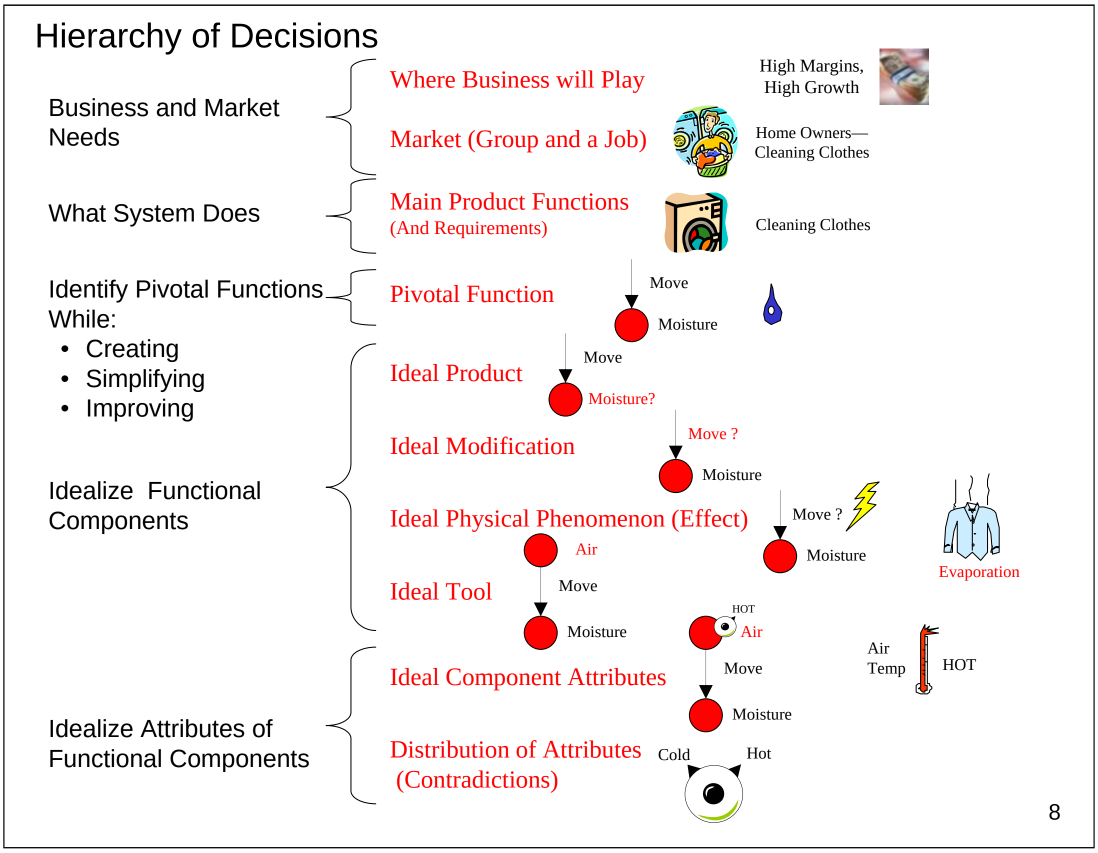



Now we are ready to talk about modifying theory. We need a way to organize all of the tools once they have been separated out. In general, we will organize them in the order of the decisions must be made. We note that certain decisions must unavoidable proceed others. For instance, before we create a system, we should know what the system must do. Before we can talk about the attributes of objects, we must first decide what the objects are. Lets take these decisions in order.

1. We must decide what the business or market needs. An essential part of this is determining who is the market (A group of people trying to perform a job according to Clayton Christensen).

2.What must the system do? And to what degree will the function be performed?

3.Are we Creating, Simplifying or Improving a System? For each of these activities, we will be concerned with pivotal functions. If we are creating a system, the pivotal functions are taken one at a time as we create the system by adding one object at a time. If we are simplifying the system, we are concerned with functions that are holding the system back. If we are improving the system, we are concerned with functions that are causing problems. Depending on the activity, I need tools to focus me in on these functions and the knobs (attributes, properties)that control them.



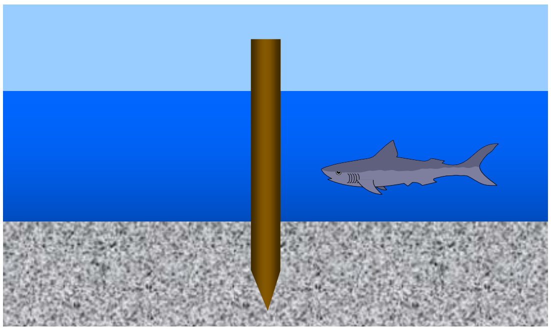

4. How can I idealize the pivotal function? I first consider how I might obtain the ideal product—one which does not need a modification. Next (if I must have a product) what is the ideal modification which will simplify the requirements on the rest of the system. Next, What is the ideal physical phenomena to use to deliver the modification? The ideal physical phenomena will come from abundant resources and will allow for the delivering of multiple functions. Finally, what is the ideal tool to deliver the physical phenomena. This order of consideration is used for useful, harmful and measurement or detection type functions.
5. How can I idealize the attributes of the objects and fields. Idealizing WHICH objects that we use (step 4) does not necessarily create the perfect system. On the contrary, there will usually be problems when we add, subtract or replace objects. We now need to find a way to “turn the knobs” to resolve problems, without causing further problems. In order to resolve problems, we need to learn how to distribute the attributes. (This is normally known as resolving the contradictions).

An important characteristic of this hierarchy is that it is unavoidable. If you start at any point other than the top, you are taking something for granted. Decisions at any level have profound impact on the decisions that follow, whereas the inverse is not necessarily true. Decisions that follow *may* impact previous decisions.

If we must unavoidably follow this hierarchy, then it makes sense manage the innovation process along these lines rather than taking things for granted. This hierarchy provides a framework for organizing the classical TRIZ tools.

## Causal Analysis
## Pile Driving

The driving speed of piles is very slow. Often expensive equipment and personnel wait while driving progresses. How can the driving speed be improved?



Simple Causal Analysis: $Y = f(X_1, X_2, X_3 \ldots)$

Y = Driving Speed
What are the Knobs?

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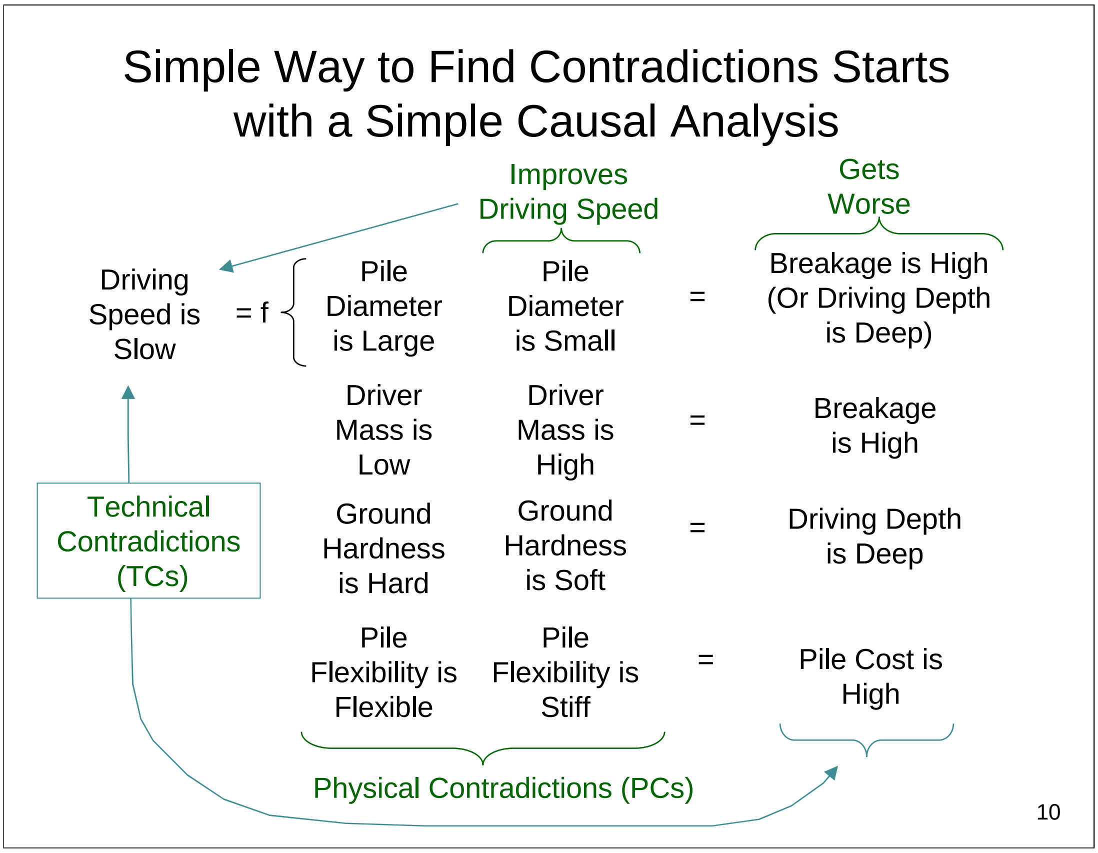
Now I am going to switch ideas and talk about an important tool that is often overlooked in the TRIZ world. That is the subject of Causal Analysis. I am going to present a challenge to the TRIZ community. We must become the masters of causal analysis in order to solve problems!

In order to introduce this subject, let us take an example. I am trying to drive piles in water just off of the coast. Driving the piles is expensive. I need to rent a pile driver, and a crane and I need to employ a lot of people. All of these costs build up while the pile is being driven. What can be done to reduce the high costs which result from the long driving time?

Let us first ask, What are the knobs (attributes of the pile, driver, ground, etc.) that cause the pile to drive slowly?




I am now going to show you a format that can be used for a simple causal analysis that will help us to find the contradictions at the same time. Do not confuse this with deep causal analysis, but it is sufficient to make some good points.

First, I write the problem as a knob and a setting. Driving speed is the knob and the setting is slow.

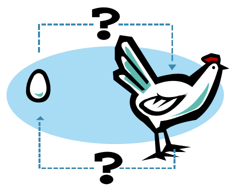
Next, I ask, what is this a function of? What knobs and knob settings cause this problem? Now, I make a column of knobs and settings that I brainstorm. The pile diameter is large. The driver mass is low. Etc.

Next, I ask, what knobs and settings will improve the driving speed. Well, certainly the opposite or very different settings will help. I fill in the next column. The pile diameter must be small to speed up driving, the driver mass must be high. The ground must be soft. Etc.

Next, I ask, what gets worse? Well, if the pile driver diameter is small, I have a couple of problems. The breakage becomes high or the driving depth must be even deeper in order to give me the vertical support that I will need when the structure is placed on top and during an earthquake load. I continue answering this same question for all of the attributes.

Now I see that I have a number of contradictions that cause my problem. For instance, the pile diameter must be small in order to drive fast and it must be large in order to not break. Notice that we now have a list of physical contradictions and technical contradictions. This is a simple approach to finding both technical and physical contradictions. (I would like to point out, however, that the whole contradiction is what we want to resolve. More on this later.)

## Which do You Discover First : the Technical or Physical Contradiction?




| 1 | | 2 | 3 | | 4 |
|---|---|---|---|---|---|
| Driving Speed is Slow | = f { | Pile Diameter is Large | Pile Diameter is Small | = | Breakage is High (Or Driving Depth is Deep) |

## What about ARIZ ?

**ARIZ Starts by identifying a TC and THEN tries to discover the PCs—The Causal Logic is Incorrect**

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Now, let’s notice something from what we have talked about. Which came first, the technical or physical contradiction? Lets follow through what we did with the first attribute, the pile diameter.

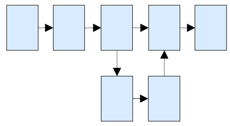
First we asked “what is the problem?” The driving speed is slow. Next we asked “what knobs control this?” The pile diameter is large. Next: “How can we make the driving speed fast?” We can make the pile diameter small. Next: “what gets worse?” Breakage gets worse.

Notice that we discovered the full technical contradiction at the same time that we discovered the physical contradiction!

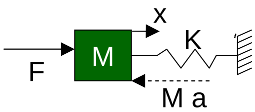
ARIZ starts by identifying a technical contradiction and then tries to discover physical contradictions from this. This causal logic is incorrect and has held back the development of ARIZ for some time. It is not possible to know a technical contradiction without knowing or assuming what causes it! You will notice that when working with experienced ARIZ users that they compensate for this lack and perform the above steps anyway. This is nothing new to them, but they somehow find it difficult to describe this to new ARIZ users as they have not consciously identified this way of thinking within the steps of ARIZ.

## Different Types of Causal Analysis

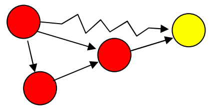
- Process Centric (Products are also Processes)
  - Break down interactions finer and finer in time



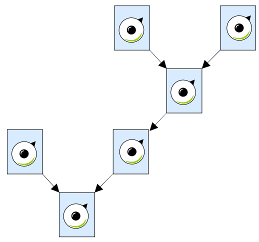
- Model Centric
  - Models and Equations
  - Understand relationship of attributes to results




- Function Centric
  - Shows Why Objects are required
  - Shows How they Interact



- Attribute Centric
  - What causes attributes to be what they are
  - Break down finer and finer showing causes



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Now, back to causal analysis.

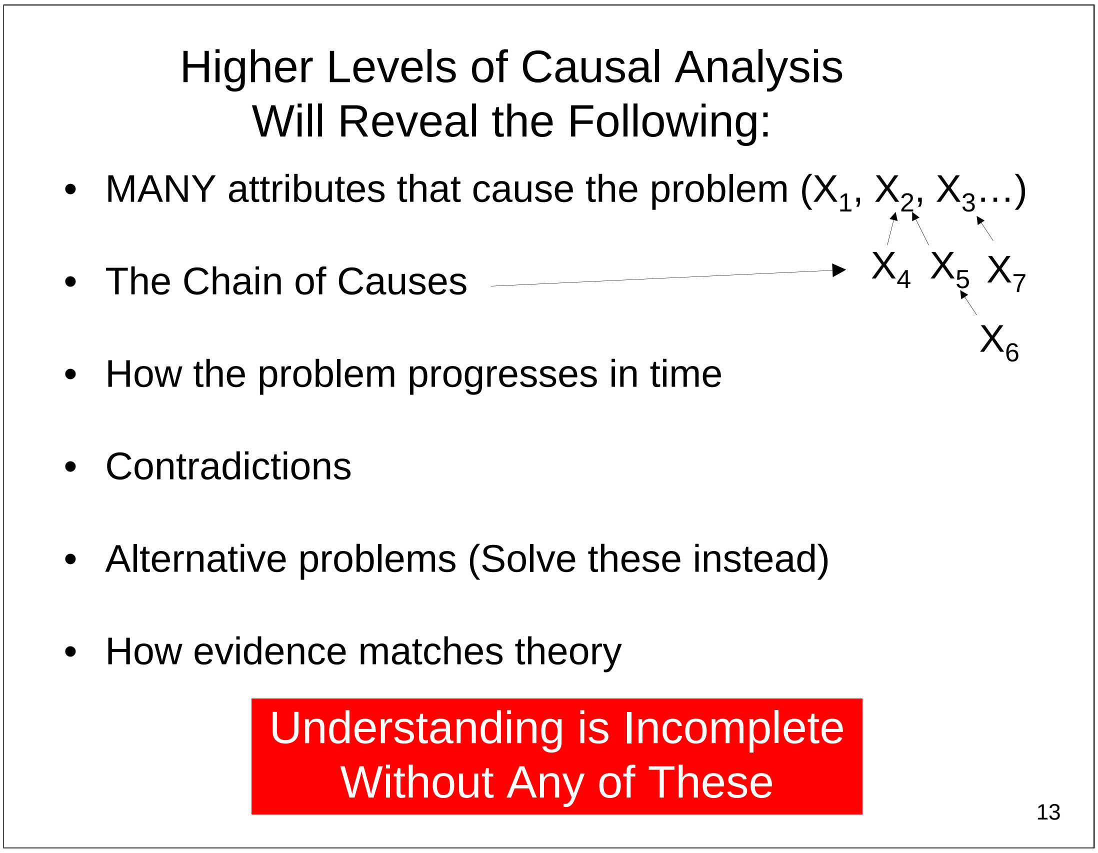
In order to become masters of causal analysis, we must understand the different types of causal analysis and learn to use each well. There are several forms of causal analysis which focus on different things.

“Process Centric” focuses on how interactions progress in time. It’s strength is in being able to break down events into finer and finer detail in time.

“Model Centric” focuses on the physics of what is happening and the equations and models that describe the interactions. It’s strength is in quantifying and verifying the interactions.

“Function Centric” focuses on what is happening and the <u>objects</u> that are engaged. It’s strength is helping the problem solver to include everything and avoiding a blind spot.

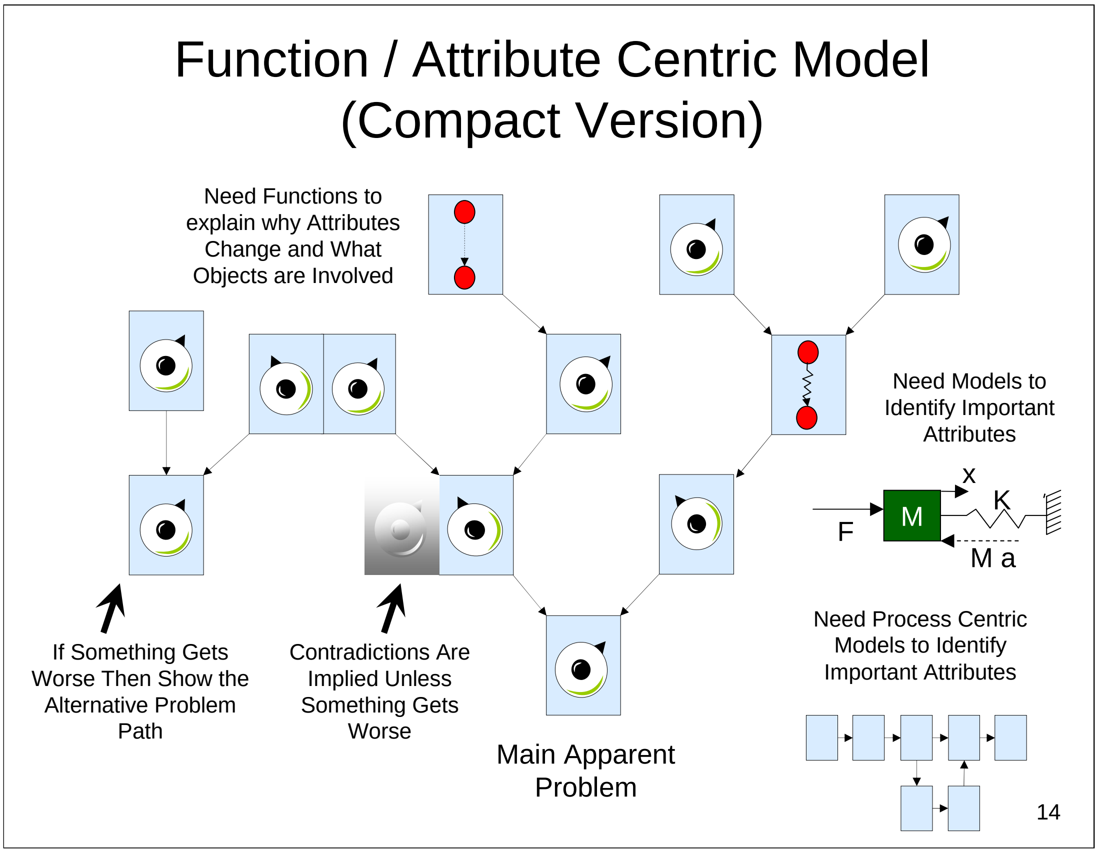
“Attribute Centric” focuses on the attributes (knobs or properties) of objects and fields and how they effect each other in finer and finer detail.




It turns out that we need all of these forms of causal analysis. Each plays a part in its turn. Before we go on, let's talk about what a really good causal analysis will tell us. By the end of a good causal analysis we will know:

- The many attributes that cause the problem. This includes shapes, sizes, surface finishes, etc.; any knob or lever that controls the outcome.
- The chain of causes. What causes what causes what…
- How the problem progresses in time
- Contradictions that result when we try to change something
- The alternative problems that we may solve so that solving the primary problem is not required.
- How the evidence matches the models, equations and theories of what is happening.

It is important to understand each of these things in order to have done a good causal analysis. Those who perform causal analysis regularly know how easy it is to trick ourselves into thinking we understand a problem when we really don't.




What I would like to show you is a way that combines the different forms of causal analysis into one document. We sometimes call this “Solution Oriented Causal Analysis”. This is because it positions the problem solver to resolve the problem.

“Attribute centric” causal analysis forms the basic structure. As this form of causal analysis directly presents the problems, at all levels, that must be solved.

We begin with the main apparent problem and then proceed to describe the attributes of objects and fields that cause each attribute to occur. Each box contains an object or field attribute and the level of that attribute.

In some cases the level of an attribute changes to a new level because of a function, so the function must be included as a cause.

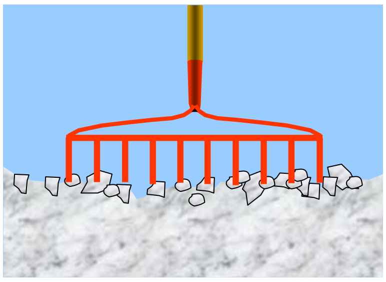
Contradictions are usually implied: A knob must and must not be at a certain setting. In some cases, we can create the alternative problem if a setting is required for some purpose.

Notice that models and equations are also included as well as detailed process maps that help break down interactions in time.

# Causal Analysis

Rake problem:  Formal Causal Analysis can be Downloaded from the TRIZ Home Page in Japan

How to reduce the amount of debris that escapes under and through the tines as raking occurs



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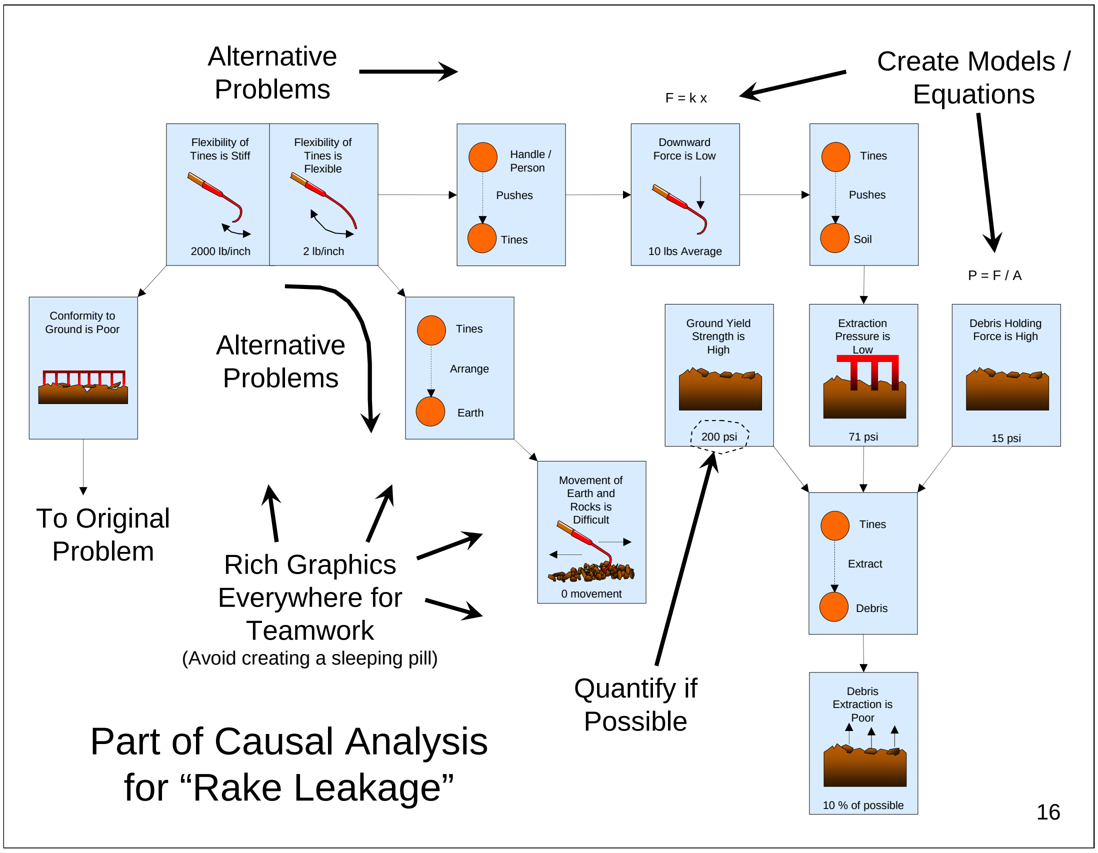
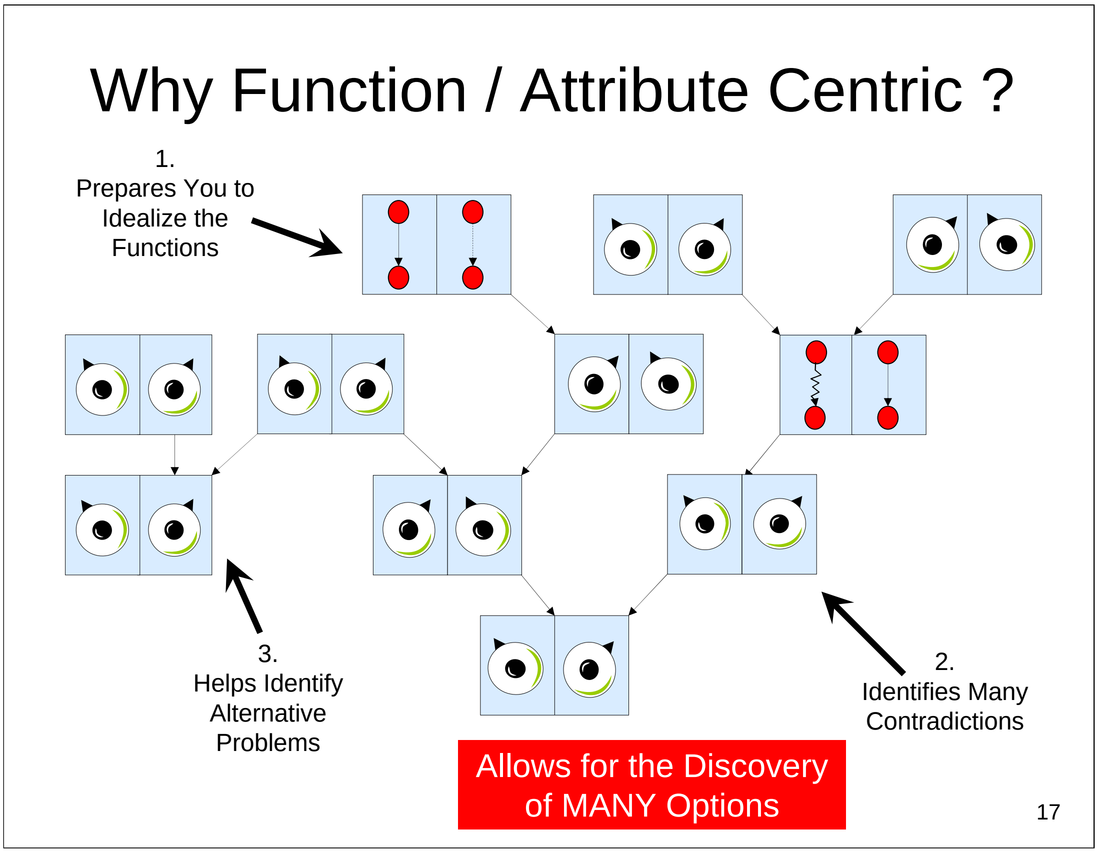
In order to illustrate how this is properly done, I have included a PowerPoint version of a causal analysis of a rake problem.  It can be downloaded from the TRIZ Home Page in Japan.  The base problem starts with debris flowing around and under tines of a rake causing more effort to be required.



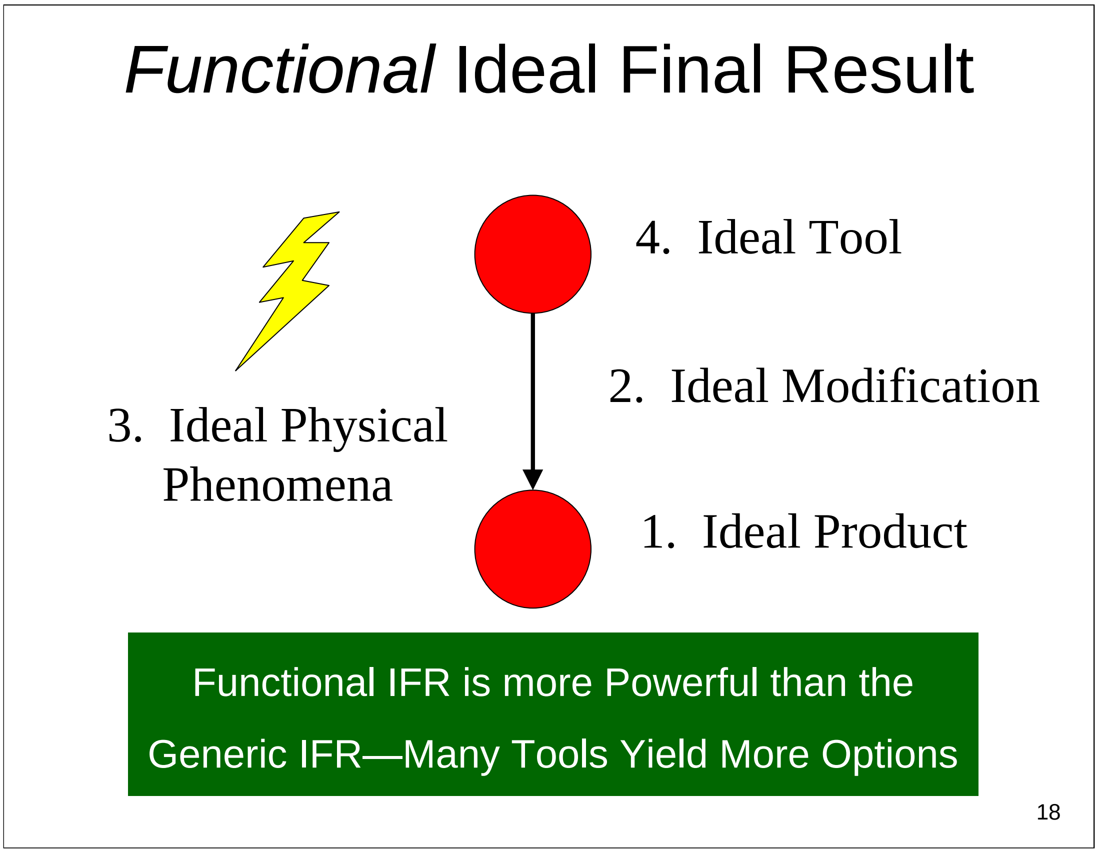

A piece of the full diagram is shown. I have included this section to show some of the features that I include, particularly when I am working with a team.

- Equations and models are used everywhere possible.
- I like to quantify the level of the attribute so that I know how important they are and how much energy should be spent on developing that branch of the diagram.
- Rich graphics are used everywhere. This helps people follow through to understanding. Otherwise, these charts become sleeping pills.
- You can also see how the alternative problem is generated. In this case, the tines are stiff. This is required due to the need to extract embedded debris and also to move soil around. Both alternative problems are shown.



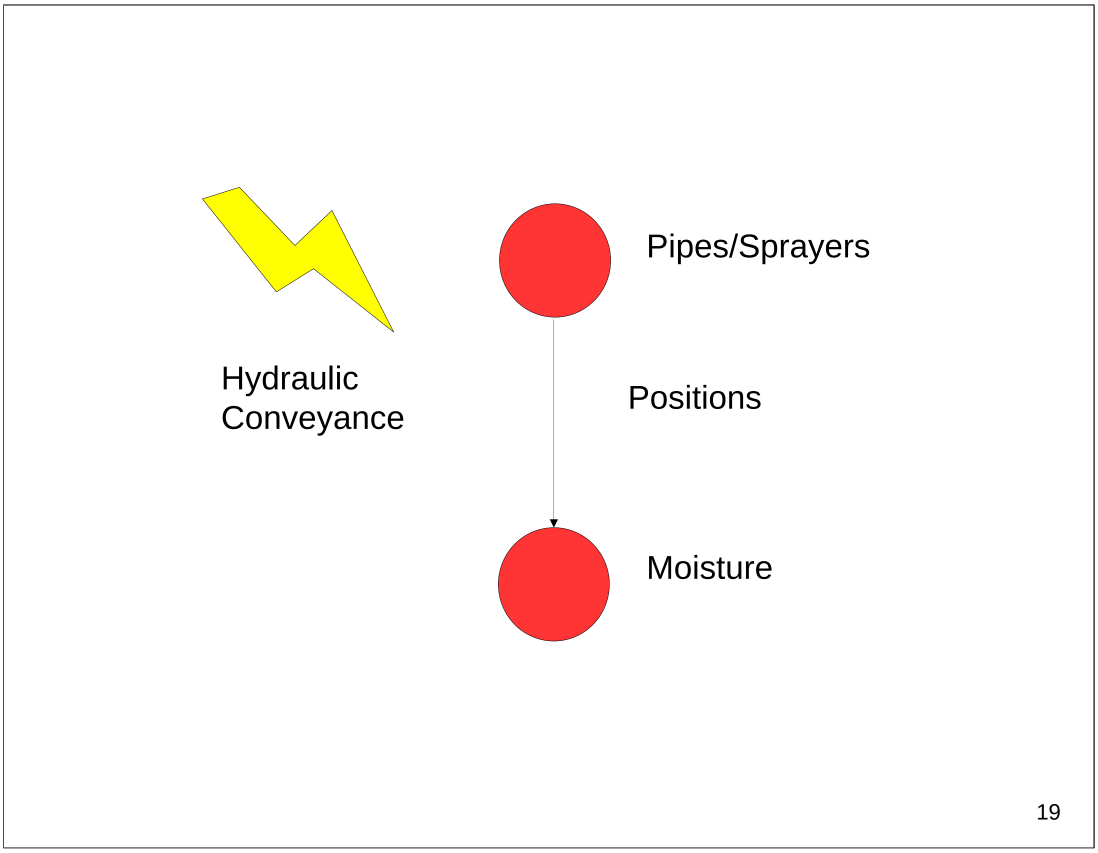

Now, why do we refer to this form of causal analysis as “Solution Oriented”?

- This form allows for the discovery of many solution options.
- If we show the chart in expanded form, we can see that it prepares you to idealize the faulty functions that cause the problem.
- Also, all of the contradictions become visible.
- Finally, the alternative problems are systematically created.
- The problem solver need only look at the chart to find the next step to the solution.



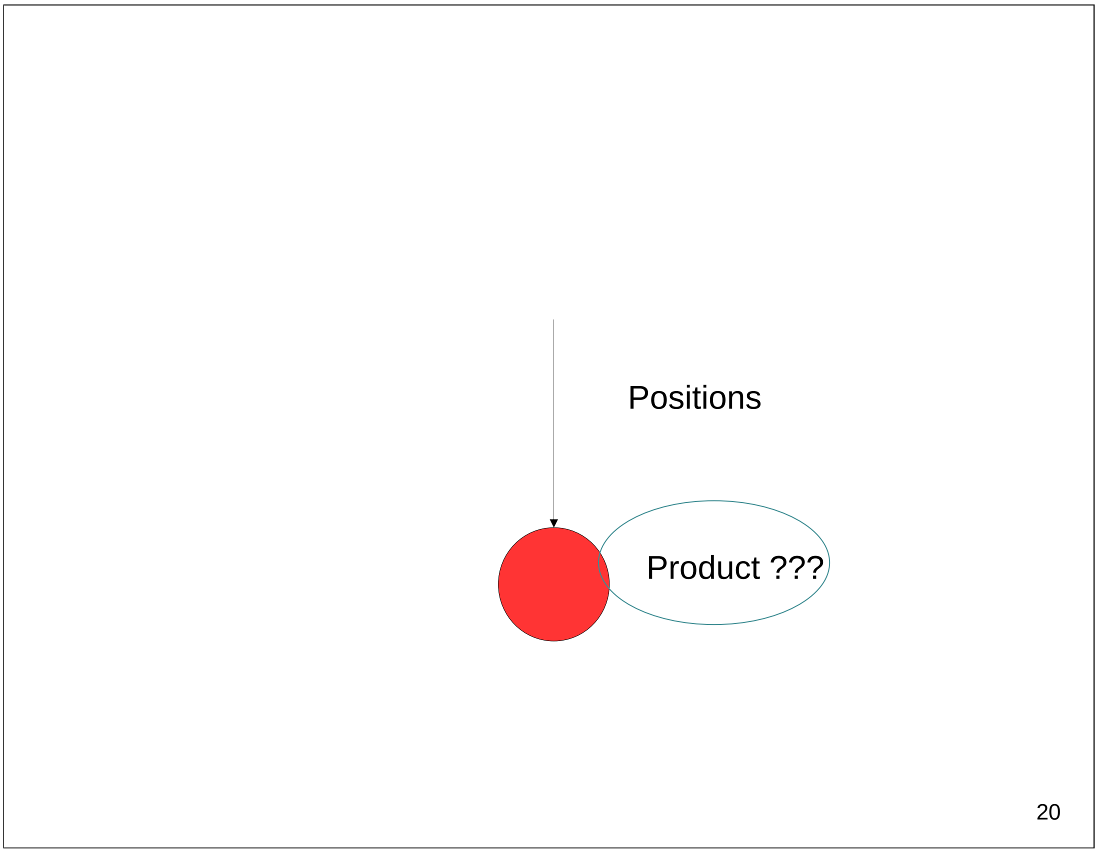

I have mentioned idealizing functions in order to solve them. Many people find this to be a new concept. It is described at the FUNCTIONAL Ideal Final Result. If you think about what a function is, it is a description of "results" and what accomplishes them. The Ideal Final Result (IFR) is usually stated in a way that is very similar to functional language. "The required effect must be obtained without the use of substance or energy. It must happen of its own accord". Functionally this can be stated in a variety of ways, each different from the other. The functional IFR is actually more powerful than the classical IFR because it opens more options. (The following was not included in the symposium presentation but is added to give more understanding).

Let us take an example from one of Altshuller's books. There is a need to spray water across large fields of crops. Normally this is accomplished by a motorized tractor with water storage and long booms that go out over the crops. In order to reach further and further, the booms must become more and more massive. What is to be done? At one point of the discussion Altshuller presents the ideal final result or the ideal situation. All that is required is that the water be present and fall down over the crops. Everything else is extra. The IFR can be stated. "The water is present over the crops of its own accord." Now, it is hard to think of a more ideal way to say this, but actually there are many alternative ways this could have been stated. Each way will branch off to a different line of thinking. All can be thought of as an ideal final result. (Though some will be more ideal than others).




For instance: “The plants have no requirement for water” or, “The water is already present in the soil” or “The plants generate the moisture that is required”. Actually, there are usually MANY ways that we could have stated an ideal final result. Due to this thinking, it is not appropriate to discuss THE ideal final result, but MANY ideal results. Now, you can observe that some of the above examples are more ideal than others. For instance, it is more desirable that the plants have no requirement for water than it is that the water be suddenly present in the air above the field. However, having the option of looking at many IFRs may help bring a number of ideas to mind.

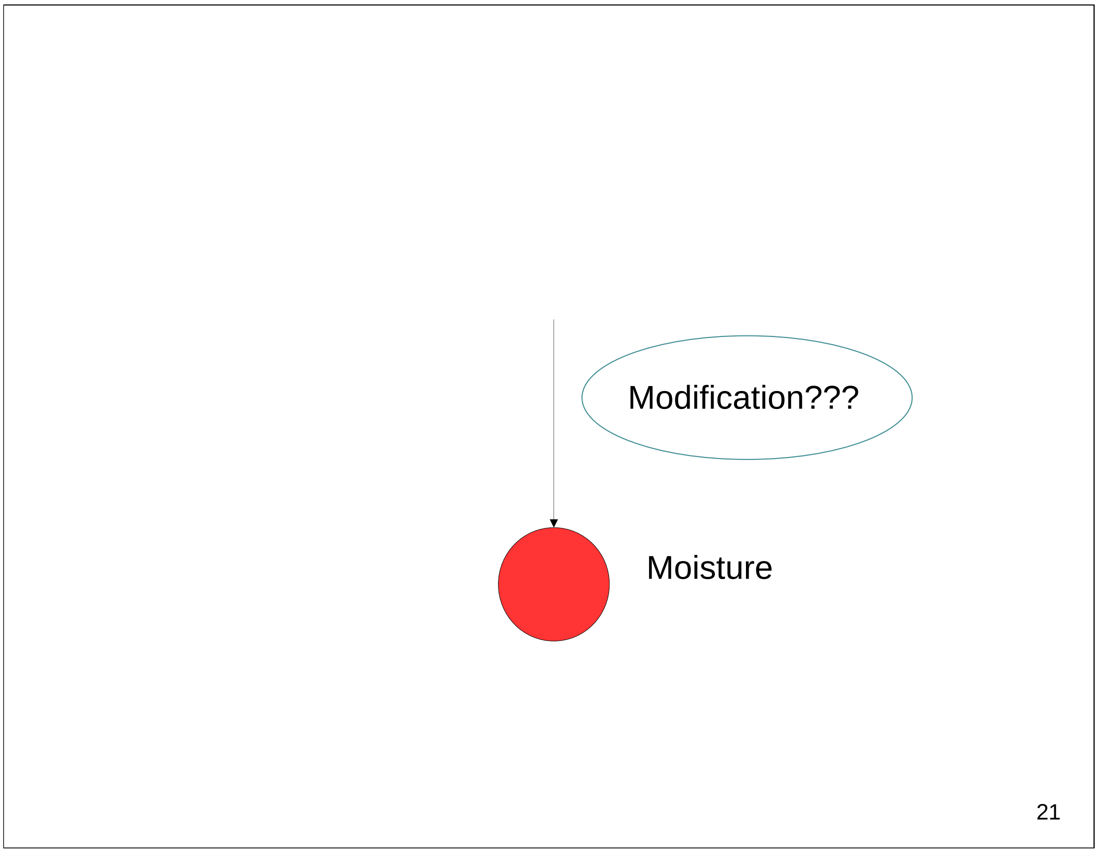
Now, lets look at an organized way to generate these IFRs. This can be done with functional thinking. But first we need to start with a function. There are actually many functions in this problem, but lets start with the one shown above. (Had we chosen another function such as the effect of the moisture on the plants, we would be able to generate another set of ideal results.) The order of consideration is the ideal Product (moisture?), then the ideal modification (Positions?) Then the ideal physical phenomena which delivers the modification (Hydraulic Conveyance?) and finally, the ideal Tool (Pipes/Sprayers?) We consider it in this order, because this allows for the most ideal possibilities first. We shall see this as we move along. Lets start with the ideal product




We start with the requirement to position moisture.  We have to display the modification at the same time that we display the product because otherwise, there is no context to determine whether the product is ideal.  For idealizing the product of a useful function, I know of six considerations.  Some of these will not apply, but let us consider them all.

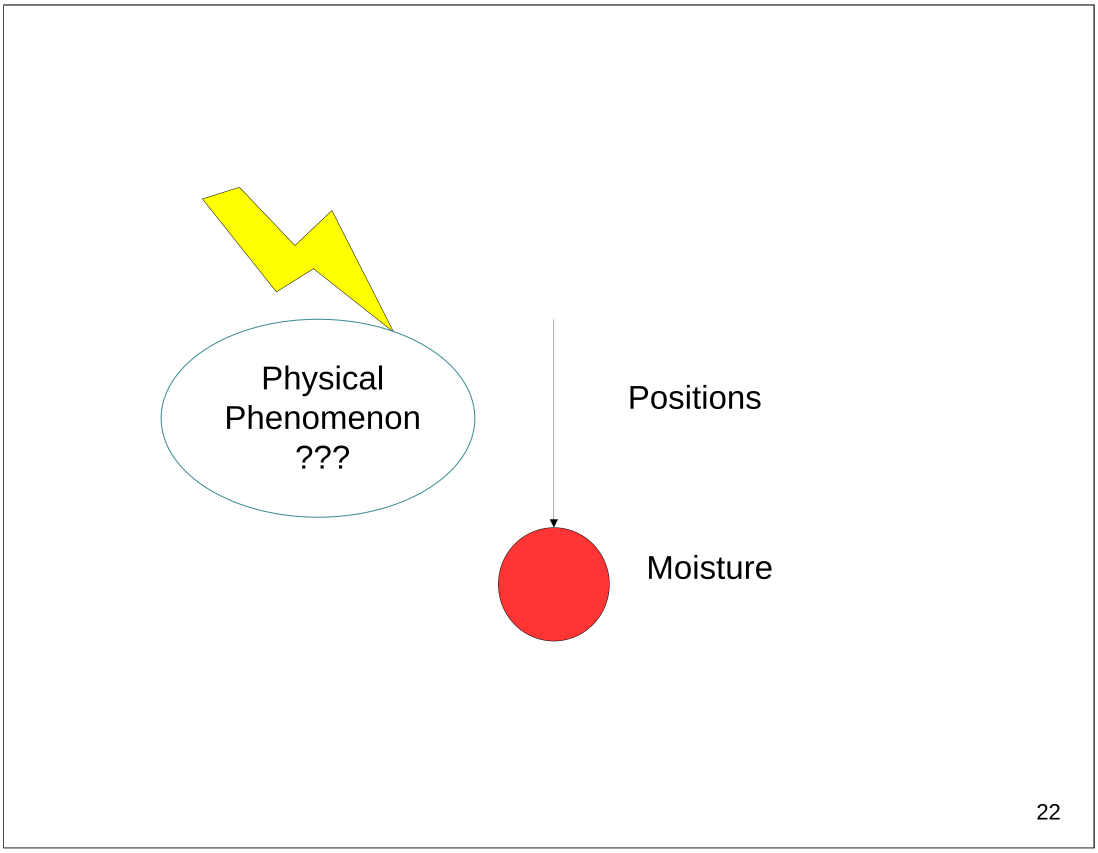
1. Removal of Transmission Elements: In the first case, we consider two types of moisture—one in the tube going out to the sprayers  and the moisture in the sprayers.  IFR #1 is that “the moisture must not be transmitted through tubes, but must magically exist at the plants.”
2. Non-Existent Products:  This usually relates to waste or harmful elements that should not exist in the first place.  This probably does not apply here
3. Modification not Required:  IFR #2:  “The moisture is special.  There is some small change to it that makes it unnecessary to be transmitted—perhaps it is vapor which is constantly in the air anyway.”
4. Comes that Way:  IFR #3:  “The moisture is already where it needs to be—right at the root level of the plants”
5. Self Service:  IFR #4:  “The moisture transports itself to the required location.  Nothing else is required to transport it.”
6. Minimum Part: IFR #5:  “All of the moisture is not required.  Only a fraction is required.  Perhaps only one of the chemical components.”

By now, you should be able to see that there are many ways that an “Ideal Final Result” could be stated.



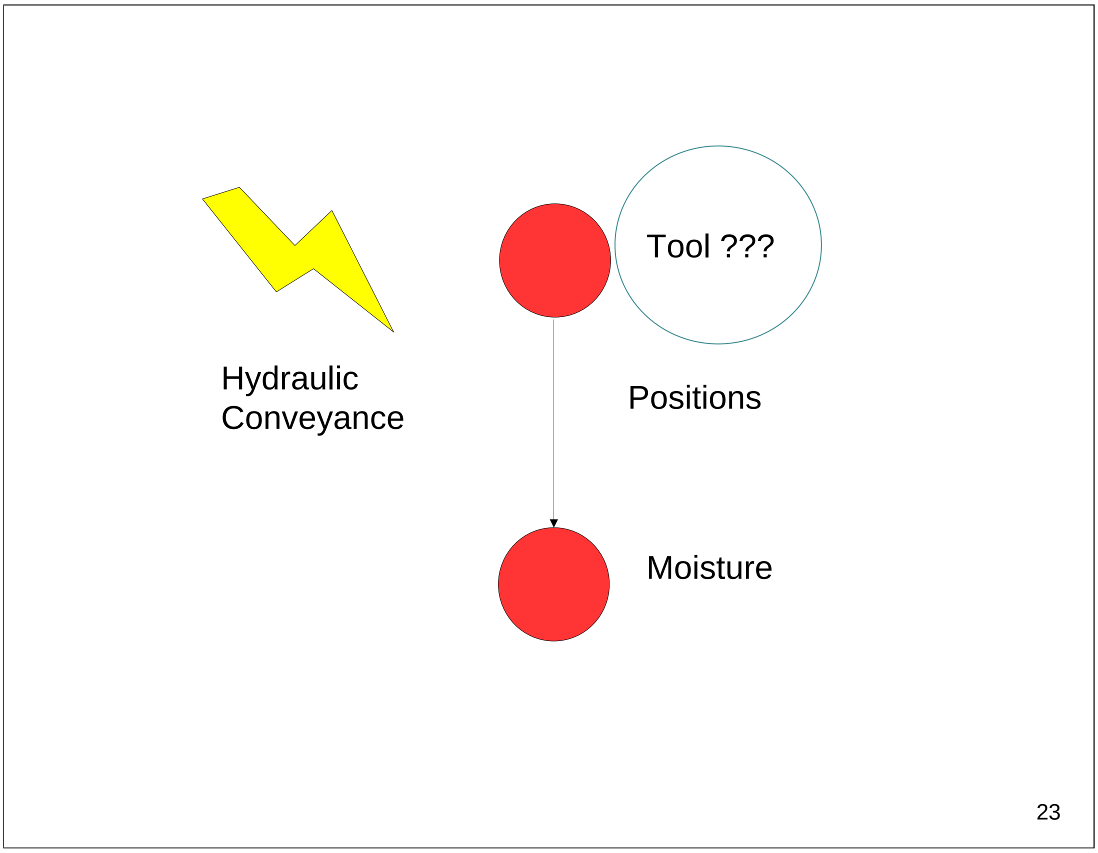

Now, lets move on to the Modification.  Assuming the less ideal situation that the ideal moisture is not achievable, we ask,

1. Are there other ways to describe the modification? IFR #6: “The moisture is “generated” above the plants or in the soil”  IFR #7:  “The moisture Flows to the plants”
2. The reverse modification is considered:  IFR #8: “The plants must move to the moisture”
3. At the micro level– IFR #9:  “The moisture (as vapor) already exists at the plants.  It must magically relocate itself on or in the soil.”




Next, we consider the potential Physical Phenomena that can perform the modifications that we are considering.  We would consider the various abundant fields and look for ways to move moisture; form moisture above the plants and in the ground; create a high density of vapor at the plant to keep the water vapor inside the plant and ways to move the moisture from holding tanks or channels.

All the time we would be looking for physical phenomena that is abundant and can be used to perform other functions required by the system.




Given that we cannot find ways to avoid performing the function, we now consider potential objects that can deliver the modifications. We would like to add nothing to the system.

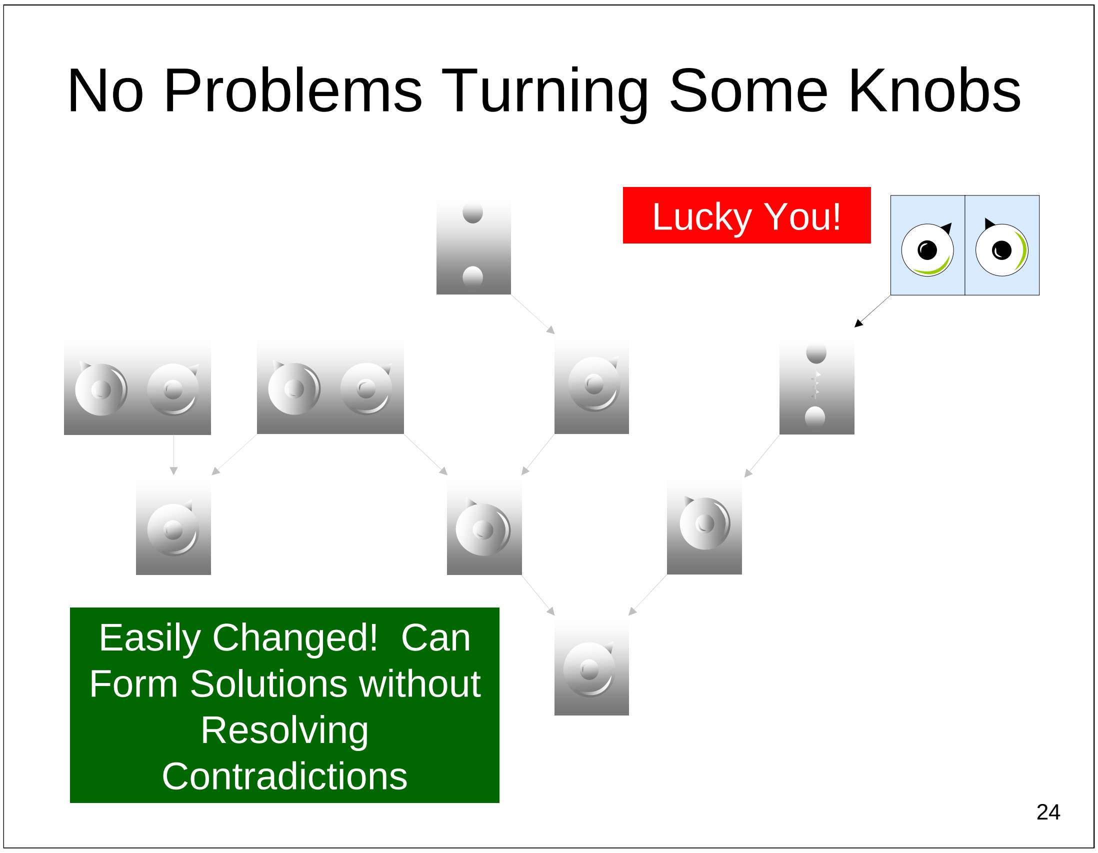
We consider means by which the required functions are performed already but poorly: IFR #10: "The Rain will reliably deliver the moisture". IFR #11: "Ground water will reliably deliver the moisture". IFR#12: The water vapor around the leaves will always be high enough so little moisture is lost from the plants." IFR #12: "The dew will reliably water the plants".

Next, we make a laundry list of abundant or cheap resources and consider how they might be employed. IFR #13: "The ground moves the moisture from a collection point to the plants" IFR #14: "The moisture moves itself to the required locations". IFR #15: "The air moves the moisture from a location to the plants". IFR #16: "The plants generate their own moisture".

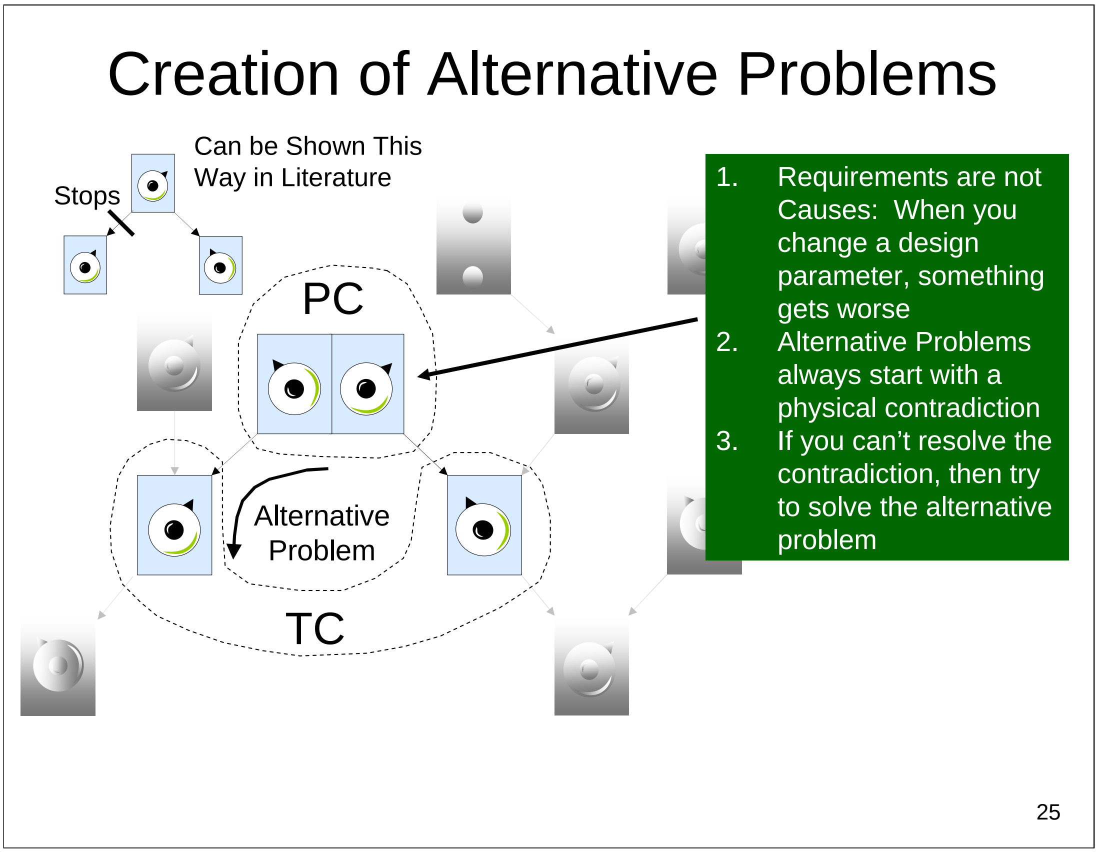
Next, we consider means that are nearby that already perform this function but for different reasons: IFR #17 "The channels that deliver the water to the fields will also deliver the moisture to the plants."

Next, we consider self service: IFR #18 "The moisture will move itself to the plants".

Note that we have created 18 ways to state an ideal result. Each of these ways will challenge us to think down different paths. Each will have their unique set of problems to be solved at a later step. (Now back to the presentation.)

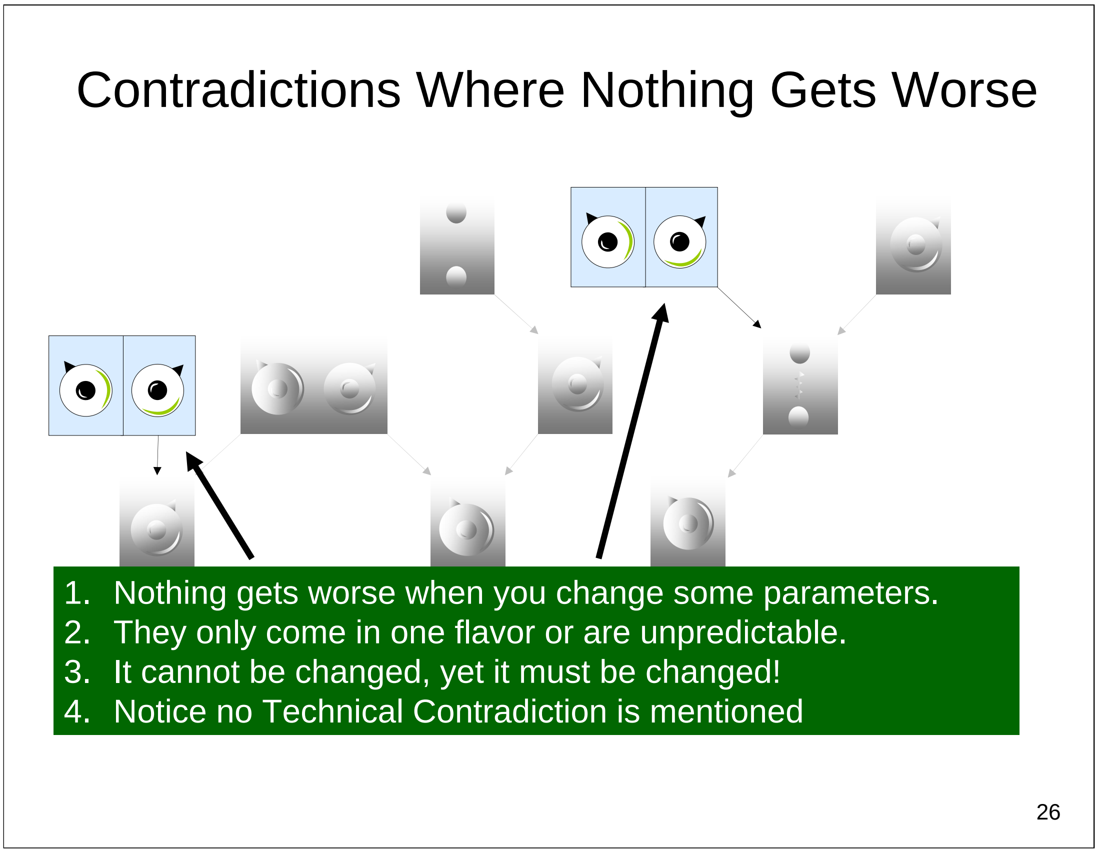



Now that we have considered ways that we can idealize flawed functions, we continue to look for more options by considering the attributes or knobs that cause the problem. The first set of knobs that we try to turn are the ones that we think will have no drawback. It is possible to find such attributes if we delve deeply into the physics of the problem. Legacy problems are often not understood at a deep level. When we take the time to really understand the physics of the problem, we can often turn up object or field attributes (knobs) that were overlooked before.




If we cannot solve the problem, perhaps we can solve an alternative problem. Alternative problem come as a natural step when we consider new attribute states for attributes that we have control over. These knob settings are ones that we specify in our design documents. It may be a length or a surface texture, for instance. We specify them for a reason. We specify these attributes because if the attribute or property was greatly different, a new problem would arise. This new problem is the alternative problem path. The alternative problem always starts as a contradiction with an associated physical and technical contradiction. Sometimes it is not necessary to resolve the physical contradiction in order to solve the alternative problem. There are other knobs that can be turned to solve the alternative problem.

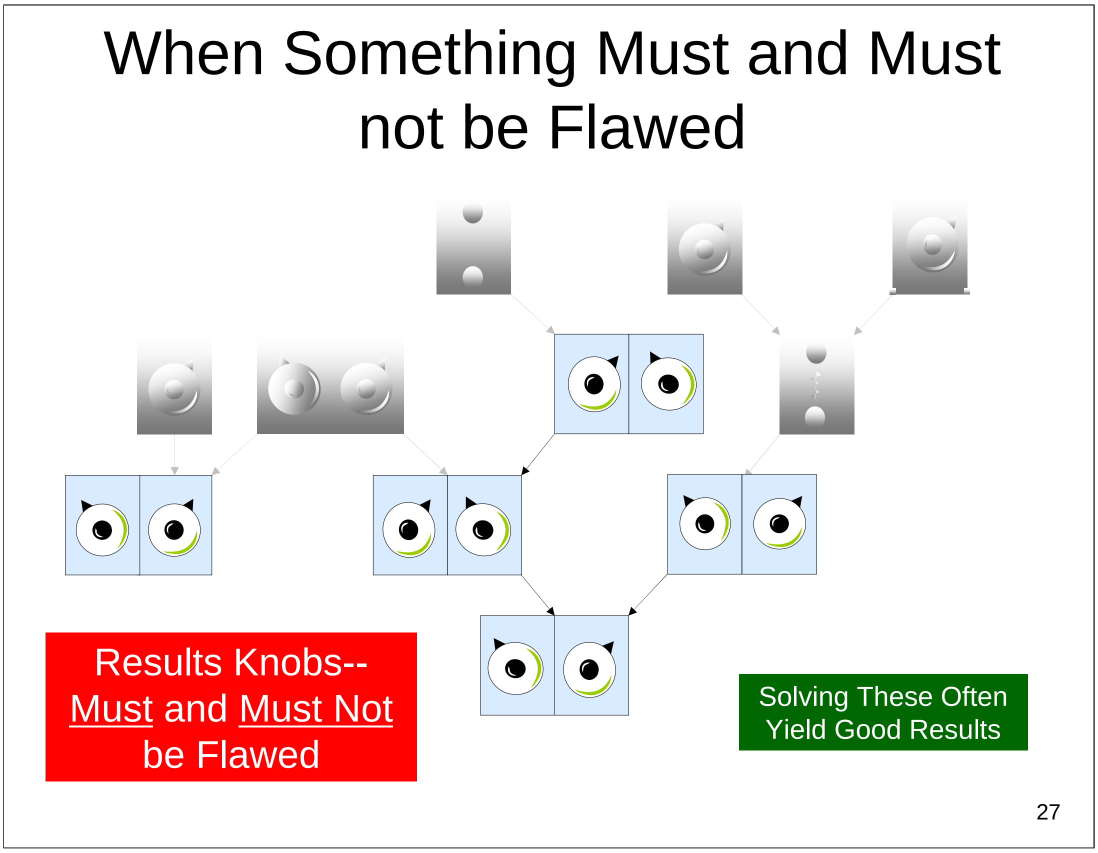
Sometimes, these contradictions are shown in an alternative fashion. As shown in the inset picture.




Next, we consider contradictions in which nothing gets worse when we try to change the knob setting (attribute level). It is not allowed that the knob setting be changed. There are many situations where this happens. Perhaps objects only come one way. They only come in one flavor, so to speak. Perhaps they are so variable that we cannot control how they are presented to us. Yet, the knob must be turned to solve the problem. I have found that most people shy away from these contradictions.

A famous example of this type of problem is found in Altshuller's writings where the problem of weevils is considered. How can one measure the temperature of a weevil with a common thermometer? The weevil must be large to insert the thermometer, but it must also be small because that is the only way that weevils come. The problem is solved by inserting a thermometer into a large container of weevils. Some of the best solution options come by trying to resolve this sort of contradiction.

Notice that there is no technical contradiction . This is another good reason that ARIZ should not start with a technical contradiction. In some cases, it does not exist.

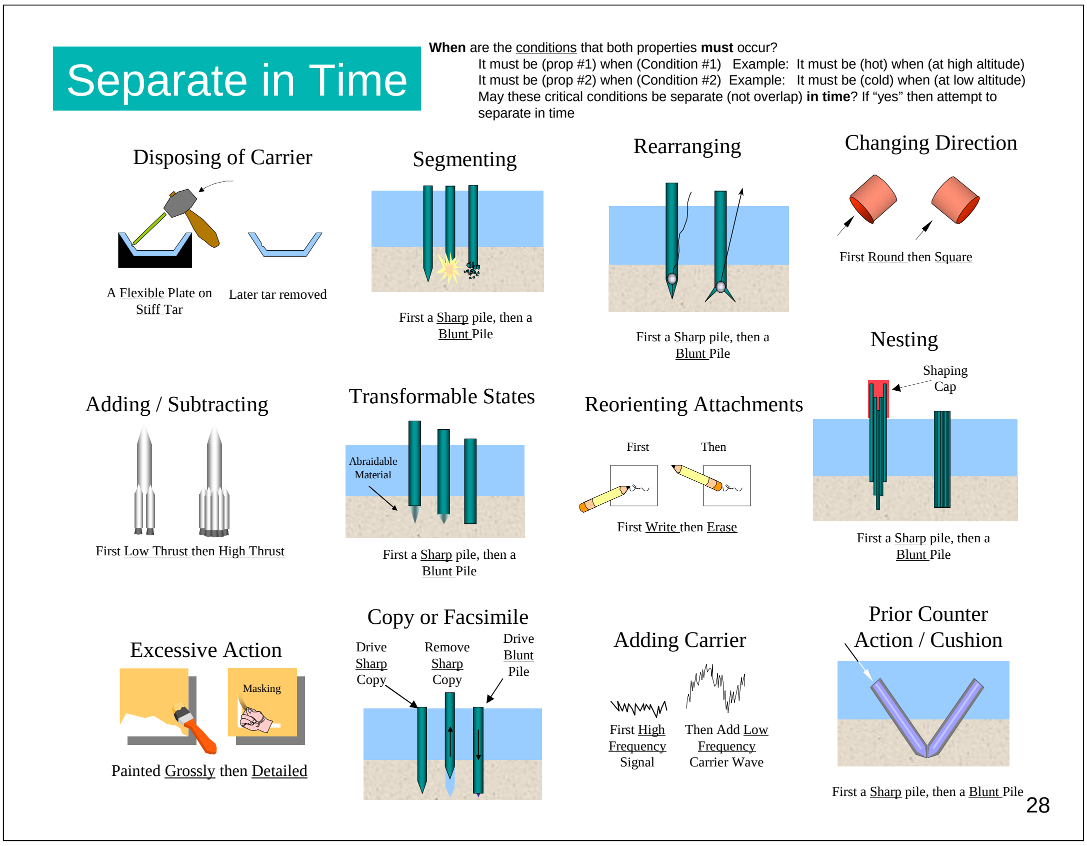



Notice that we are making an expansion of the cause-effect diagram in our mind as we turn each knob. That is because we usually form the diagram in the compact form. The only contradictions that are visually formed on the diagrams are the ones that result in something else getting worse, or the alternative problem path.

Next, we mentally turn knobs that most people are unwilling to turn, since these attribute values are created by other attribute levels. If we were writing an equation: y = f(x1,x2….), the knob that we are considering is the "y" in the equation. Since we are already considering the variable x1, x2, x3 … separately, we must now consider that y is flawed, but it must not be flawed. For instance, something is broken, but not broken.

An example of this type of contradiction is the problems of cement walkways that fracture due to heat expansion and contraction. We will allow the sidewalk to fracture, but it must not fracture! One way to accomplish this is to create a notch in the sidewalk which is a naturally weak point. The sidewalk now breaks down this notch and the problem is not noticeable. The sidewalk is broken and not broken. It is truly broken, but not in a way that we care about.

Notice, again, that no technical contradiction is mentioned. (Are you getting the idea that there are several ways to have a contradiction, but not have a technical contradiction?)



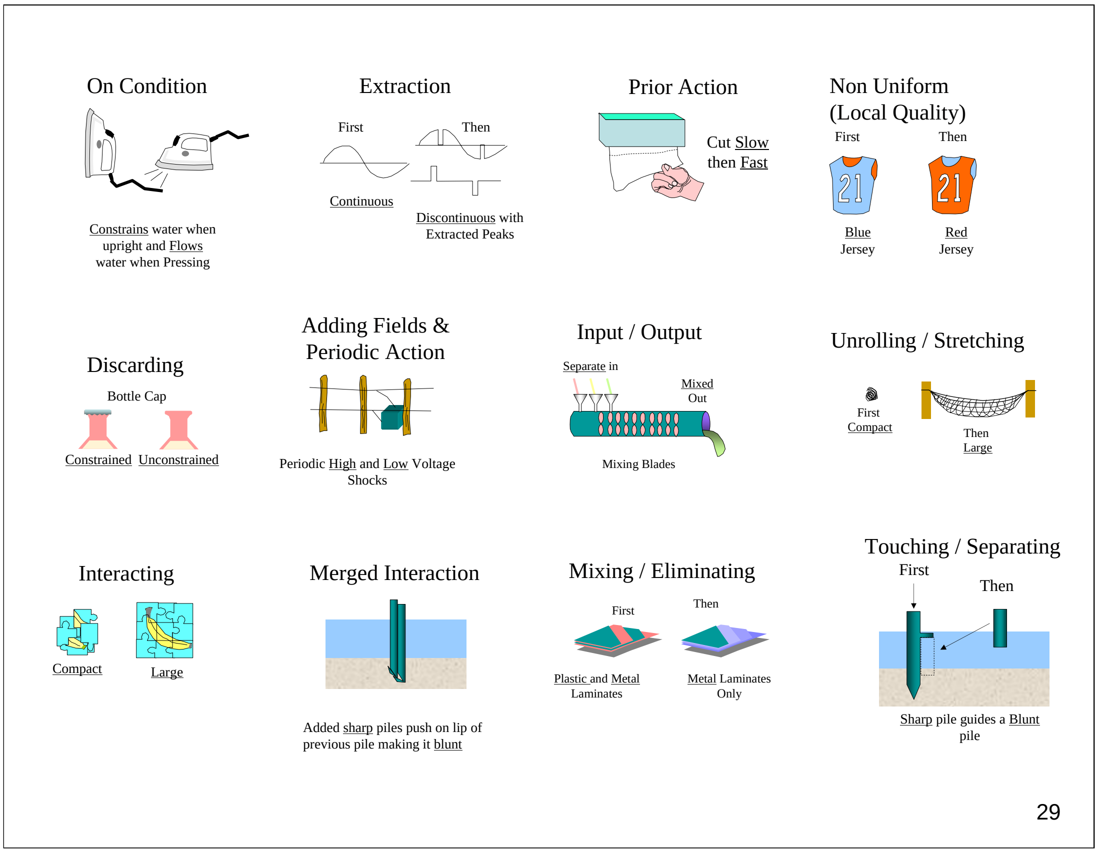

Now I want to show you some additional ways to resolve physical contradictions. Classical TRIZ mentions three ways. Separation in Time, Space and between the parts and the whole. There are at least five more ways that are not sub-categories of these three ways.

Before I do this, I would like you to notice the structure of this slide. At the top is a stepwise procedure to determine whether you can use separation in time at all. The question is asked:

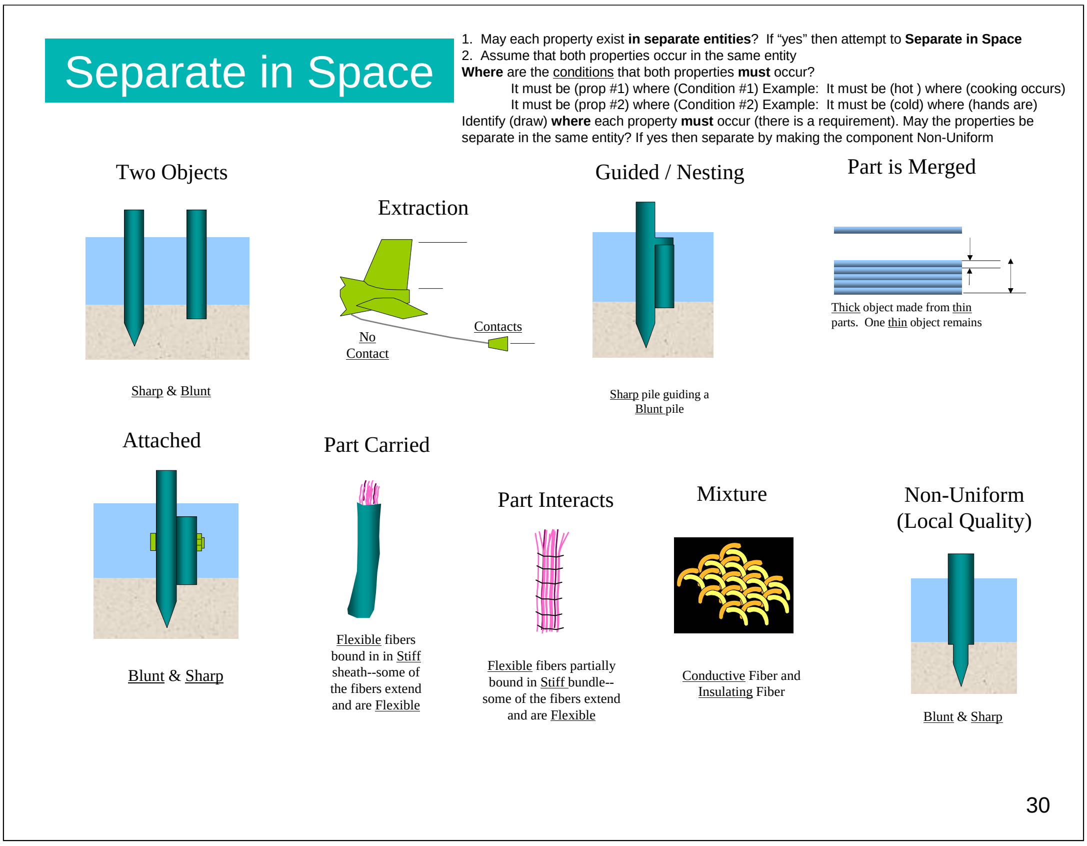
**When** are the conditions that both properties **must** occur?

> It must be (prop #1) when (Condition #1) Example: It must be (hot) when (at high altitude)
>
> It must be (prop #2) when (Condition #2) Example: It must be (cold) when (at low altitude)
>
> May these critical conditions be separate (not overlap) **in time**? (May high altitude and low altitude be separate in time?) If "yes" then attempt to separate in time.

Secondly, notice that many methods for separating in time are given. Some of these methods should be familiar to you since they come from the 40 principles, etc. Some will not be familiar to you. Each are powerful methods for resolving contradictions.




This is a continuation of Separation in Time.




When we separate in space we ask:

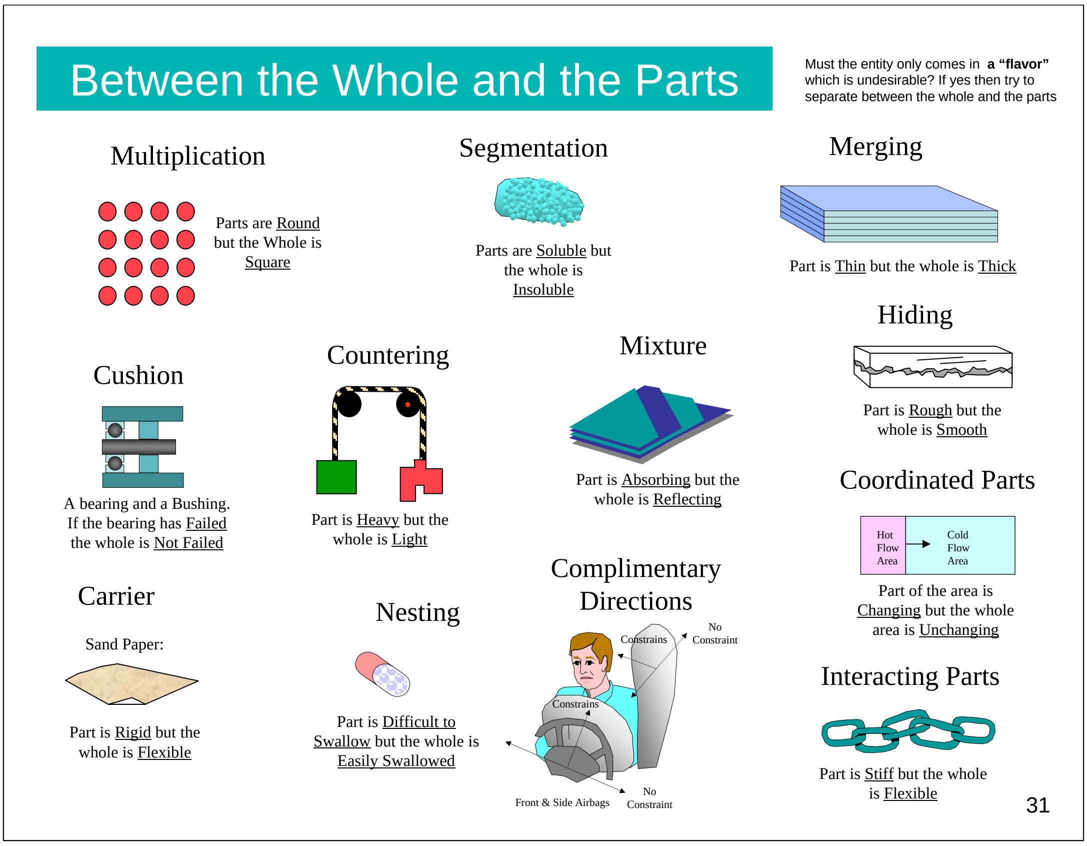
1. May each property exist **in separate entities**? If "yes" then attempt to **Separate in Space**

2. Assume that both properties occur in the same entity

**Where** are the conditions that both properties **must** occur?

> It must be (prop #1) where (Condition #1) Example: It must be (hot ) where (cooking occurs)
>
> It must be (prop #2) where (Condition #2) Example: It must be (cold) where (hands are)

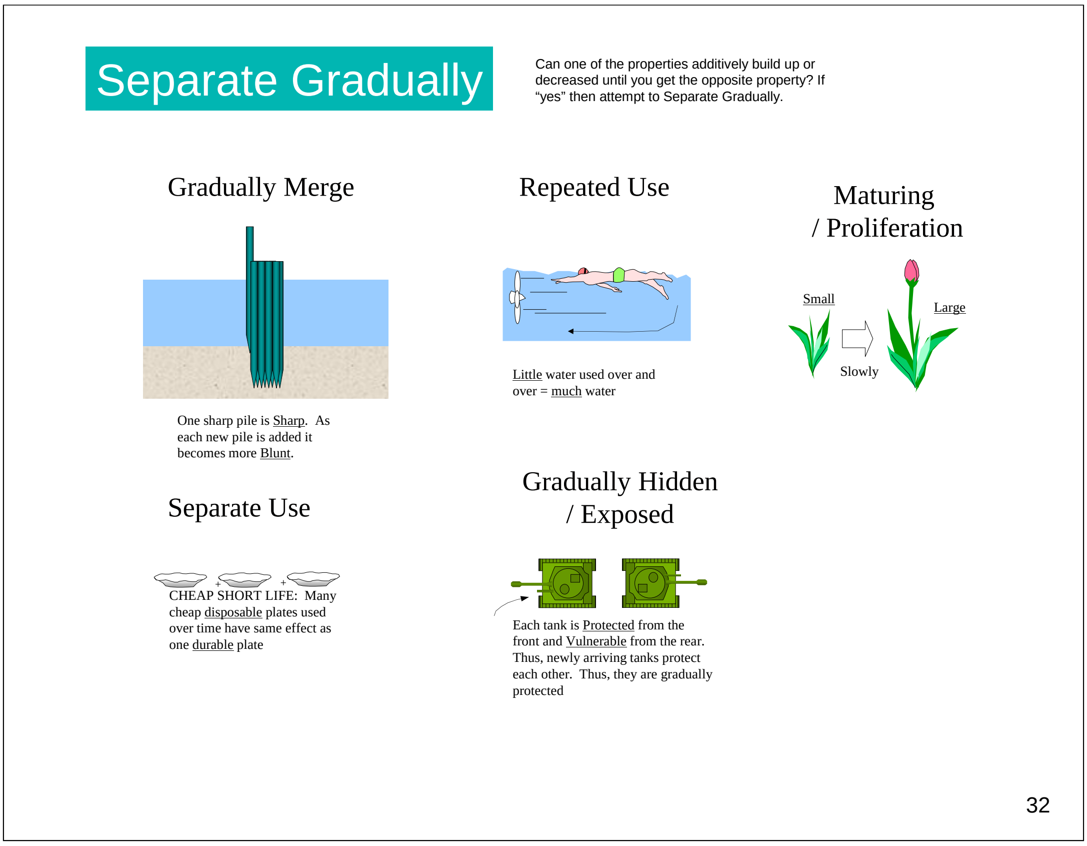
Identify (draw) **where** each property **must** occur (there is a requirement). May the properties be separate in the same entity? If yes then separate by making the component Non-Uniform




When we Separate Between the Whole and the Parts we ask:

Must the entity only comes in **a "flavor"** which is undesirable? If yes then try to separate between the whole and the parts.

An additional clue to this is to ask yourself whether several may be used at once or whether we are allowed to segment the entity.




Now we will consider some new ways. This first way may at first appear to be a separation in time, but notice that there is no clear distinction in time where the contradiction is resolved. It simply occurs over the course of time.

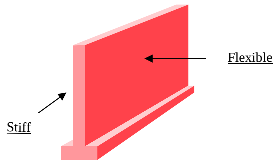
For instance, if we need a blunt and sharp pile, we may start adding piles one at a time. At the insertion of the first pile, the collective pile is still sharp. A second makes it more blunt and so on until the collection of sharp piles effectively forms a blunt pile.

When using this method we ask:
Can one of the properties additively build up or decreased until you get the opposite property? If "yes" then attempt to Separate Gradually.

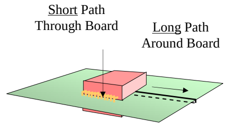
# Separate by Direction, Path or Dimension

Does one of the conflicting properties already exist in a different direction, path or dimension, or can it be changed to do so?  If yes, then attempt to solve the contradiction here.

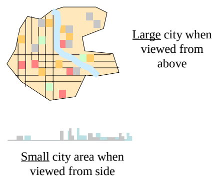
Direction




Path




Dimension

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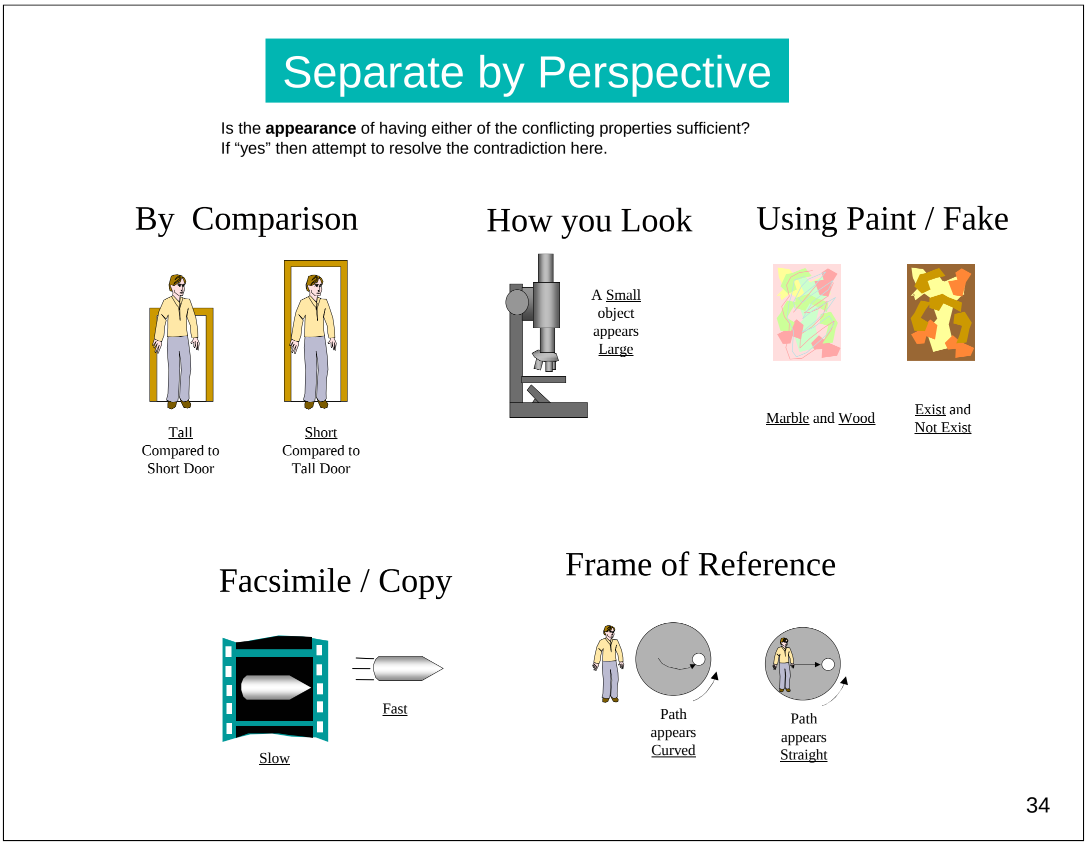
Here is another example of a way to resolve contradictions.  An object may have very different properties in different directions or on a different path or in a different dimension.  These different properties occur in the same space and time and are not as the result of forming a whole from parts with opposite properties.

A very good example is shown with the beam.  In one direction it is very stiff.  In another direction, it is comparatively flexible.

When we use this method we ask:

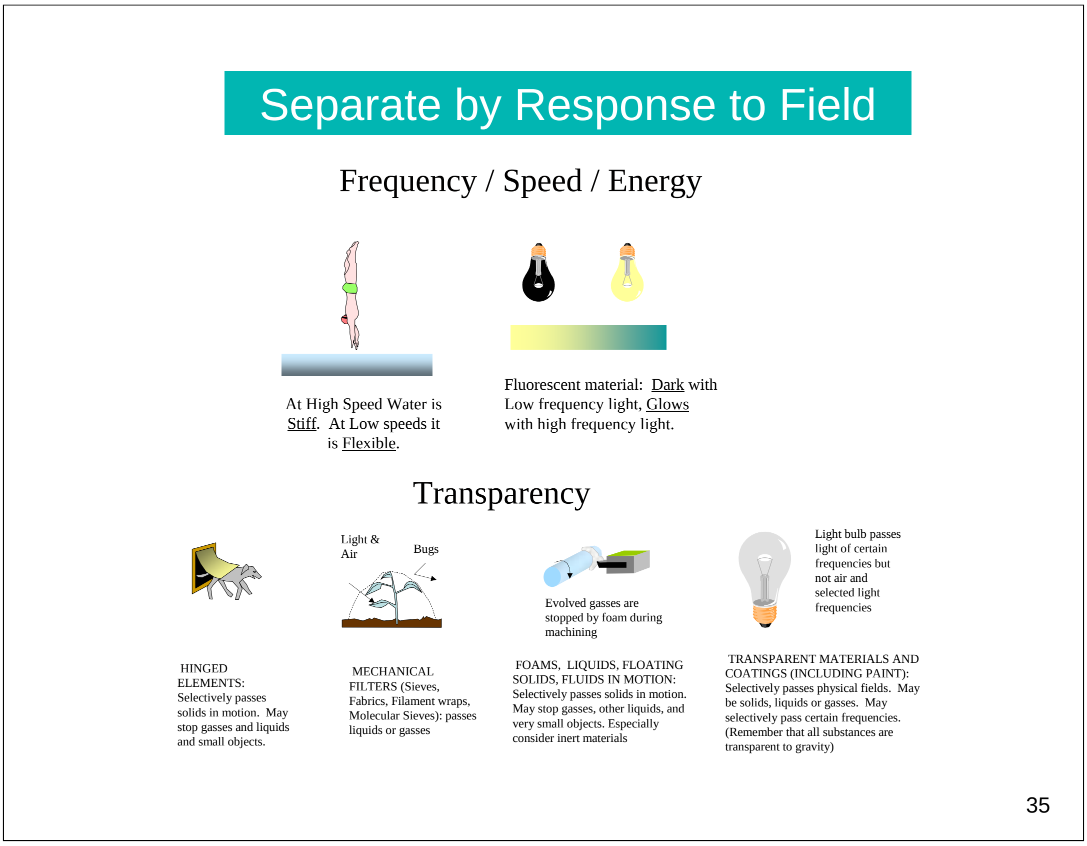
Does one of the conflicting properties already exist in a different direction, path or dimension, or can it be changed to do so?  If yes, then attempt to solve the contradiction here.




This next class of methods for resolving contradictions is clearly different from the others. We separate by how something is looked at. The question that we ask is:

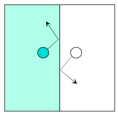
Is the **appearance** of having either of the conflicting properties sufficient?

If “yes” then attempt to resolve the contradiction here.

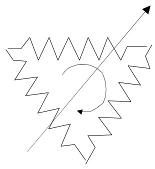



In the same space and at the same time, an object can be both transparent and opaque. It all depends upon how a substance responds to fields in various forms. For instance, objects will resonate or transmit at different frequencies.

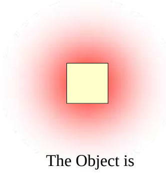
## Separate Between Substance and Field



The Gasses are Unmixed, but the Heat field is Mixed



The Coils are Stationary, but the Field Generated by the Coils appears to Rotate



The Object is Square, but the emanating heat field is Round

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The final method of separation is between the substance and the field. All three examples will illustrate this. In the first example, two gasses must be mixed and not mixed. By providing a barrier between the gasses, they are not mixed, but allowing the heat energy to flow across the barriers allows for the energies or temperatures to be mixed or to become homogeneous.

The second example is the field generated by the field coils needs to rotate and not rotate. The coils are stationary, but the phasing of the current that flows through the coils causes the field to rotate.

The last example is something that needs to be square and round. The heat field emanating from a square object becomes round as it moves away from the square.

# Summary

Progressing from

Causal Analysis → Idealizing Flawed Functions → Resolving Contradictions

is Very Powerful

- More Natural than ARIZ (Easier to Teach) –The Causal Logic is Corrected
- Can effectively attack *very difficult* or *entangled* problems
- Can use on problems never encountered—No obvious TC
- Provides MANY solution paths

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In summary, the general direction of solution is from providing a causal analysis which exposes flawed functions and contradictions. Idealizing the flawed functions first allows us to resolve the problem by removing elements This is more ideal than fixing existing objects. If we cannot do this, or in addition, we may consider fixing the existing objects by resolving the contradictions.

The causal logic is more correct than ARIZ.

This methodology can be used on very difficult or entangle problems.

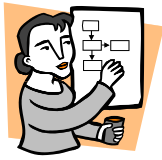
One can use it on problems that they have never encountered, which means that a technical contradiction need not be obvious.

Finally, it is possible to pursue many solution paths. This is contrary to many popular explanations of TRIZ which depict that there is an ideal path to follow. In reality, there are many paths which more ideal results.

# A Challenge

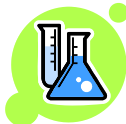
- Write Down What You Are Doing Now

- Keep it Visible



- Use it Everywhere

- Experiment and Improve Regularly



- Get Feedback

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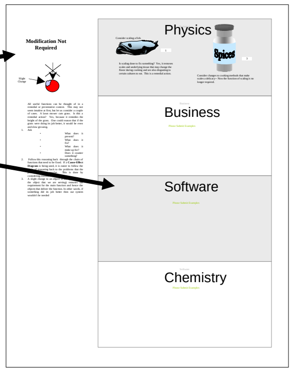
In order to learn TRIZ, I would like to offer this challenge.  This may seem like heresy, but we do this anyway.  Almost all people, once they have learned a methodology, will modify the methodology to fit the way that they think about the world.  So, let us institutionalize this in a way that allows us to constantly improve.

1. Write Down What You Are Doing Now.  You are doing something but not consciously.  Write it down.
2. Keep it Visible.  Put it in a place or several places where you will see it often.
3. Use it Everywhere.  Use it often and regularly. Force yourself to use it.
4. Experiment and Improve Regularly.  Look for ways to improve your personal algorithm.
5. Get Feedback.  As part of looking for ways to improve it, talk to experienced people that you admire and find how they do it.

# Invitation to Become a Coauthor

1. Each Page is an Innovation Tool
   – Step-by-step use of tools
   – Examples: Physics, Business, Software, Chemical … Many Blank spaces! (Currently 570 Pages)
   – Algorithms give structure
2. Currently & Always Sold “As Is”
3. Uses a Wiki for Editing (password protected)
4. Proceeds go to humanitarian aid
5. Coauthors can use for own works
6. http://trizalgorithms.jot.com

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This is an invitation to become the coauthor of a book. This is the continuation of a work to categorize and clarify TRIZ tools. Each page shows a mini-algorithm and examples for using a tool.

Overarching algorithms are given for each section.

The book is long, but has a lot of blank space to be filled by examples from various disciplines. Currently, examples are needed for business, chemical and software applications. These seem to be problematic areas where people stumble in the use of TRIZ

The book is sold in an “As-Is” state. It is even being sold right now.

In order to keep money from clouding the picture, all proceeds are given to humanitarian aid.

If you are not satisfied with the direction of the collaboration, then you can take the contents of the book and rearrange it to fit your own needs.

To learn more go the link shown.