



Goal Systems International

CONSTRUCTING AND COMMUNICATING COMMON SENSE™

Logic and Hare Krishnas

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Most people who are familiar with the Logical Thinking Process (LTP) have experienced difficulty in learning how to construct effective cause-and-effect connections in Current Reality (CRT) and Future Reality (FRT) Trees. As a result, most people consider these two trees the most challenging—even frustrating—to complete. And human nature being what it is, few people eagerly embrace or seek out frustration. Consequently, I typically see one of two outcomes in CRTs and FRTs. Either people avoid attempting them altogether or the trees they actually do complete are less than logically “tight”.

In an earlier incarnation, I flew big military aircraft. The most difficult thing I ever had to learn in that endeavor was aerial refueling. I had to perfect the skill of flying a 400,000-pound airplane in close proximity—about 20 feet away—from another equally large aircraft (the aerial tanker) and maintaining that position for about 30 minutes at a time without colliding in flight. [Figure 1] Besides being a very scary proposition, it was really hard to do—at first. It was so hard, and I was so bad at it, that I in every mission I dreaded that time when I would have to do that. I would finish each aerial refueling drenched in sweat.



Figure 1. B-52 refueling in flight from a KC-135

What I discovered, however, was that equipped with the *right techniques* and with *sufficient practice*, aerial refueling wasn't nearly as hard as I had found it at first. Eventually, not only could I complete a 30-minute aerial refueling without disconnecting from the tanker, I could do it at night, in the weather, and I could follow the tanker staying connected (at a distance of 20 feet) through a 180-degree turn. And I could finish that experience without being drenched in sweat! Invoking the words of Aldous Huxley in his classic novel *1984*, I learned to “love big brother”!

The lesson I took from this is that there's pretty much nothing I can't figure out how to do if a) I use effective techniques and b) I practice until it becomes second nature. And when I do that, eventually the learning curve takes over. [Figure 2] I submit that learning to construct effective, tightly logical CRTs and FRTs is equivalent to learning to air-refuel a 400,000-pound airplane. It's just a lot less dangerous (though it might require a little sweat!).

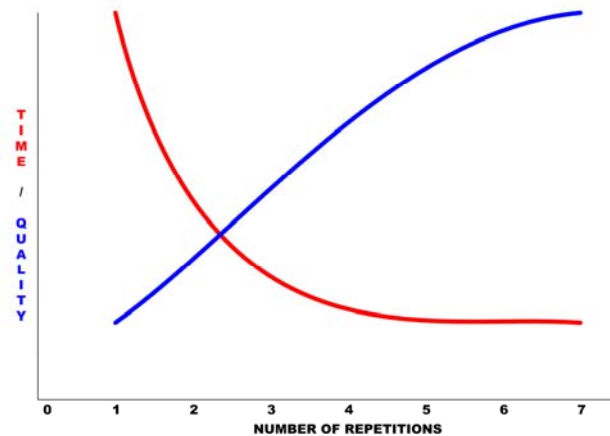


Figure 2. The Learning Curve

Success in Creating Cause-and-Effect Trees

There are three essential prescriptions for success in developing cause-and-effect trees. The first is subject matter knowledge. The second is knowledge of the Logical Thinking Process. And the third is committed use of a comprehensive checklist.

Subject Matter Knowledge. Any Current or Future Reality Tree depends above all else on deep knowledge of the subject one is trying to model with the tree. I liken the Logical Thinking Process to a gun. Absent bullets, a gun is no better than a hammer. You might as well use it to drive nails into a wall. But add the bullets and you have a powerful weapon, one that produces disproportionate effect. In the same way, the thinking process is just an empty shell without the content to put into each block (entity). So, first you must have knowledge of the subject matter. Ideally, you have that yourself. More likely, though, you'll need help in the form of expertise from someone else. Maybe more than one person.

Logical Thinking Process Knowledge. Presuming you have access to the subject matter knowledge, the next essential ingredient is a thorough knowledge of the LTP. This comes from an effective reading source, high-quality instruction, and “practice, practice, practice”—as I explained above. Facility in the LTP depends more on the latter than on the two former. One can absolve a lot of “logical sins” with everlasting practice. Skill in the LTP comes faster with advance reading and regular reference to that source as needed, plus decent instruction. But it can eventually be attained with streamlined versions of the first two and everlasting practice. You might call this the “brute force” approach.

Committed Use of a Checklist. There are well defined steps for constructing Current and Future Reality Trees. These steps constitute a sequential checklist. You'd be surprised (or maybe not!) at how many people are exposed to these checklists, either by reading or through direct instruction, yet when it comes to actually building their own trees seem to resort to conjuring them up from memory. Or worse, stare at a large sheet of paper with a few Post-it® notes on it and wonder what to do next. The most common question I ask participants in my workshop who seem to be floundering is, “What step of the checklist are you on?” And the response, not usually verbalized but more commonly conveyed through the guilty smiles on their faces is, “Oh yeah... the checklist!” It's a wonder what that light bulb coming on does for breaking their mental logjams!

The Most Common Errors in Cause-Effect Trees

Goldratt conceived the Categories of Legitimate Reservation (CLR) to assure the logical sufficiency of CRTs and FRTs. Over more than 20 years of reviewing CRTs and FRTs (my own as well as others'), I've been able to determine that there are three specific deviations from the CLR are the more common than any other. In fact, I'm certain that avoiding just these three errors alone will cure more than 80 percent of the deficiencies in the majority of CRTs and FRTs.

1. The first of these reservations is Clarity on the (causal) Arrow. By definition, this means understanding *how the cause produces the effect*. In practicality, a Clarity-on-the-Arrow reservation refers to the fact that some intermediate effect is omitted, perhaps even more than one layer of effect. Goldratt referred to this as a “long arrow”, mean an unwarranted leap of logic over intermediate effects. Here is a typical example of such a long arrow. [Figure 3] The dotted lines indicate the omitted intervening layers. The solid lines indicate what is actually expressed that constitutes the deviation. Long arrows are typically not the most critical errors—just the most common ones.

2. The second reservation most commonly invoked is Entity Existence. From my perspective, this is the most critical of all the CLR. Here's why. Good Entity Existence requires the satisfaction of three criteria. Two of these are structural requirements. One is that the entity must be expressed as a complete, grammatical sentence (subject-verb-object). The second is that the sentence must be simple: no compound or complex sentences allowed. These criteria are easy to ap-

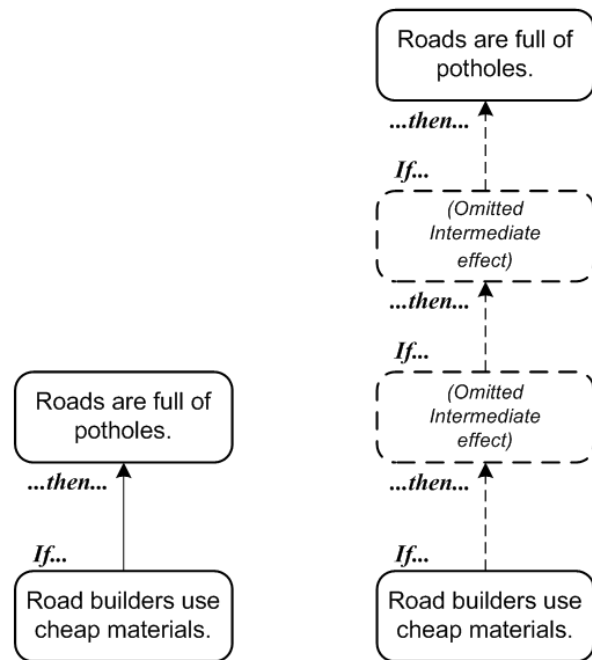


Figure 3. Long Arrow (Example)

ply, merely by visual inspection. It's the third criterion that is crucial: *validity*.

A statement in an entity can be considered valid *only if it can be proven*. Such verification can be accomplished in one of two ways. The preferred way is by documented evidence. If that's not possible, then expert testimony may suffice. (What constitutes expert testimony? Opinions on that might differ, but I'd be willing to accept the definitive opinion of someone with deep experience in the subject matter of the entity.)

Why do I consider Entity Existence the most important of the CLR? For two reasons. First, because *it's possible to have a cause-effect tree that fully satisfies every other one of the CLR and yet be totally invalid because the ultimate effect is based on one or more invalid (false) statements*. The tree "looks like a million dollars, but it ain't worth a crap!" The second reason is that I have seen too many people in my LTP courses put statements in their CRTs (or FRTs) that constitute speculation: *they have no evidence or expert testimony, but in order to fulfill the sufficiency requirement, they contrive a statement about reality that they don't know is actually factual*. This has happened in just about every LTP course I've conducted. Speculation without substantiation completely compromises the validity of a CRT or FRT even in spite of perfect sufficiency. **Figure 4** is an example taken from my LTP course. The causality is just fine. The conclusion is ludicrous because of the two highlighted speculated causes.

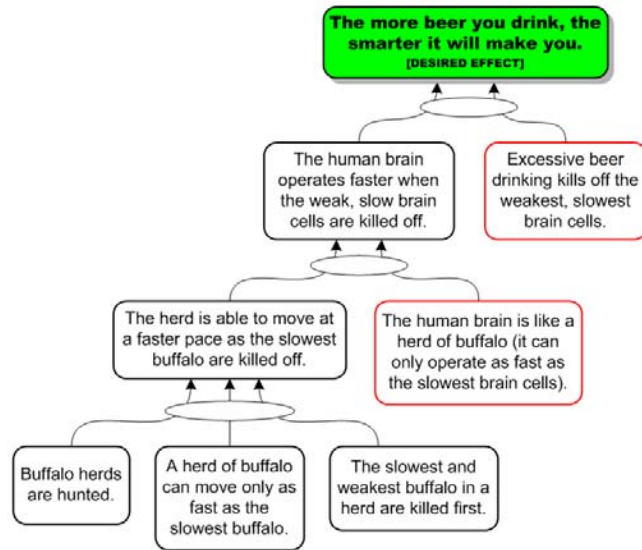


Figure 4. "The Buffalo Theory"

3. The third most common logical deficiency in most Current and Future Reality Trees is Cause Insufficiency: the absence of a non-trivial contributing cause. Every time a logical connection in a cause-and-effect tree is expressed with only a single arrow, unstated contributing assumptions are implied. These unstated assumptions are crucial to the cause and effect—without them, the causal connection is actually invalid.

However, in building trees we often omit the contributing causes because their presence seems to us to be obvious to everyone without having to state it. In other words, *we take it for granted that everyone else who might read the tree will assume that the unstated contributing causes are present without our having to state them*. Goldratt referred to this tendency as the concept of "oxygen". We don't see the oxygen in the air around us, but we all tacitly accept that it's there—otherwise, we couldn't survive. **Figure 5** shows an example.

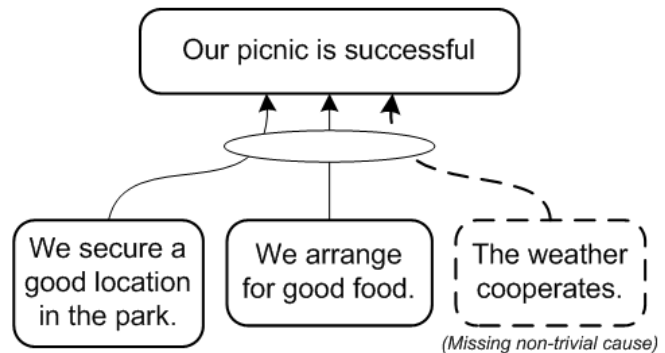


Figure 5. Cause Insufficiency

But the problem is that what seems obvious to us may not be so obvious to others. And therein lies a problem. If the readers of our tree don't make the same assumptions we do, then for them our logic is insufficient. This deficiency in logic trees is only slightly less common than the long arrow, so for all intents and purposes I'd say it's equally prevalent—and equally important.

Because it's important to us (or it should be) for readers of our trees to be able to follow—and accept—our logic, the effect we should be striving for is that readers can silently read our logic tree using "If...", "...and..." and

“...then...” without any amplifying explanation from us, reach the final conclusion (the top of the tree), and say, “It makes perfect sense to me!”

[NB: This constitutes perfection in cause-and-effect trees. But I have never seen a C-E tree, my own included, that has ever reach this Nirvana. Nevertheless, it should be the outcome we all strive for!]

So, there you have it: the three most common errors that can compromise the effectiveness of cause-and-effect trees:

- Entity existence
- Clarity on the arrow (“long arrow”), and
- Cause Insufficiency

Substantiating Entity Existence

Where Entity Existence is concerned, I have only been able to come up with two ways to ensure it. The first and best is to demand (and provide) documented evidence that a statement in a cause or an effect is valid. Can you find data to support your statement? Quantitative, perhaps, but qualitative might be acceptable, too. You should ask that question for each entity: *Can I prove that this is a valid statement, or am I just speculating?* If you are speculating, you might find yourself falling into the trap of the eighth of the Categories of Legitimate Reservation: tautology. (“Of course it *has* to be this... what else *could* it be?”)

If you’re unable to find any hard evidence to support the validity of a statement, the next best thing to find is expert testimony. When a “10,000-hour master” offers an opinion, it can carry a lot of weight. But the reason expert testimony is a fall-back position to documented evidence is that even experts can be wrong. Until Galileo came along in 1632 with the hypothesis (for which he offered proof) that the earth revolved around the sun, all the experts espoused the earth-centric theory. In fact, so sure were they that they were right, they had Galileo brought before the Roman Inquisition to answer for this “crime”. When Galileo refused, he was ultimately sentenced to house arrest for the remainder of his life.

[NB: It could have been worse. He had actually been threatened with torture, though the Inquisition never followed through with that.]

The Syllogism

The Long Arrow and Cause Insufficiency defects in logic trees can both be resolved (and avoided) through the application of the syllogism.

Syllogisms date back to Aristotle. They reflect deductive reasoning, which is the basis for the Current and Future Reality Trees (or at least it should be... though I have seen instances of thinking process trees using inductive logic, to the detriment of their valid causality).



Aristotle (384-322 BC)

As conceived by Aristotle, a syllogism is composed of three elements: a major premise, a minor premise, and a conclusion. The major premise is a general statement about a population or broad category of persons, places, or things. The minor premise is a statement about an individual member of that population. And the conclusion relates the two premises in a way that imputes characteristics of the broader population to the individual.

The salutary characteristic of the syllogism for our purposes is that it lends itself very well to the graphical format of the Logical Thinking Process. **Figure 6** shows a syllogism rendered in cause-effect form.

Notice that the syllogism creates a lateral dependency between the major premise and the minor premise (**Figure 7**). That lateral dependency allows us to attribute the characteristics of the



Figure 6. Syllogism (Example)

general population, in this case Hare Krishnas, to a member of that population, John. Harking back to the Entity Existence issue for a moment, notice in the image below the major premise the evidence that Hare Krishnas are bald. Now notice below the minor premise the certificate that establishes John’s membership in the group. Finally, notice that in the image beside the conclusion—the effect—that John is, in fact bald. Valid Entity Existence established for both causes and the effect!

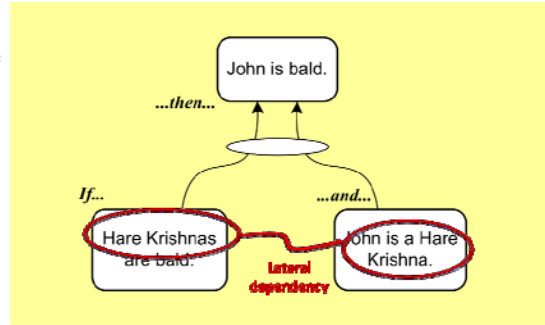


Figure 7. Lateral Dependency

Entity Existence provides another bit of support to syllogistic logic as well. Recall that two of the criteria for Entity Existence are structural: complete sentences and simple sentences.

A complete, simple sentence expresses a single idea and follows the form of subject-verb-object (or, at a minimum, subject and verb). If we construct our cause-and-effect connections using this form, it becomes relatively easy to establish the lateral dependency and the vertical relationship.

Figure 8 shows the concept of subject-verb-object applied to a three-cause logical connection. To achieve a syllogistically sound logical connection, it’s essential to find evidence of *all parts* of the effect in one or more of the causes. In Figure 8, the first two causes have the same subject. The second and third causes are related through the use of the same verb. And the first and third causes are linked by the object. In the effect we find the common subject, verb, and object.

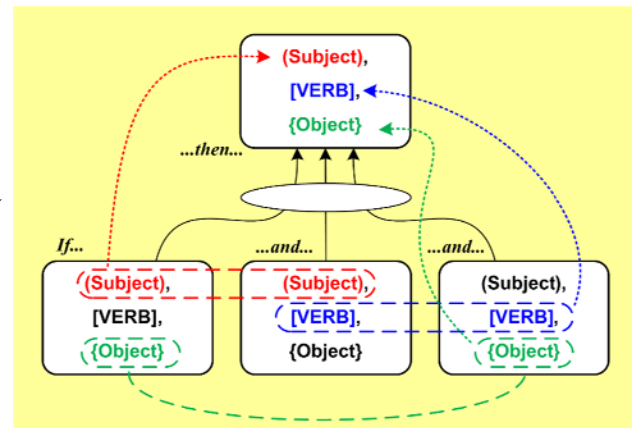


Figure 8. Subject-Verb-Object

Let’s return to our roads-with-potholes example [Figure 9]:

If “cheap” (less durable) materials result in potholes in roads, and...

If road builders use cheap materials, then

Roads are full of potholes.

The two causes are linked by the words “cheap materials” and “roads”/“road builders”. “Potholes” in the effect comes from “potholes” in the cause.

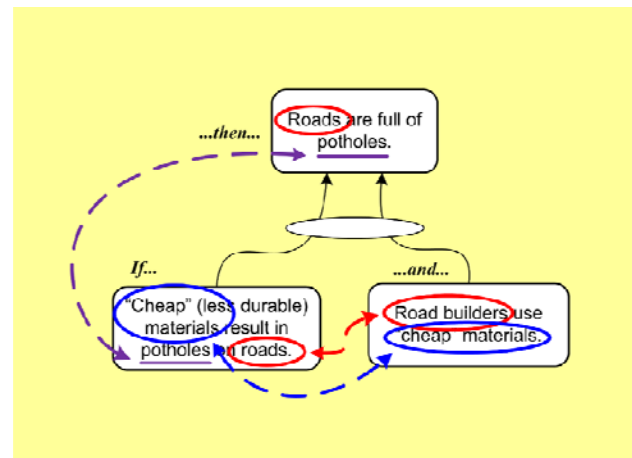


Figure 9. Roads and Potholes

The syllogism is easy to see in this example. The first cause (“Cheap” (less durable materials)...) is the major premise—the general statement about the broader population. The second cause (Road builders use cheap materials) is the minor premise—the statement about a specific situation involving the cheap materials. And the effect (Roads are full of potholes.) is the conclusion that represents the linkage between the major and minor premise.

Notice how, in this example, the syllogism resolves both the Cause Insufficiency problem and the Clarity on the Arrow (“long arrow”) problem. The effect is “the next domino in line”.

If we continue this process through all successive layers [Figure 10], the net result is a Current or Future

Reality Tree that is logically sound. You shouldn't be able to insert a playing card between the vertical layers, much less find a long arrow. And the major premise-minor premise relationship ensures logical sufficiency within each layer.

Summary and Conclusion

In summary, for each logical connection in a Current or Future Reality Tree, look for evidence of all parts of the effect in one or more of the causes. Add causal statements as necessary to ensure that this condition is met. These could be explicitly stated related assumptions or "states of nature".

For example, "Asphalt is a cheap material" would be an assumption. "Harsh weather (excessive heat or cold) accelerates deterioration of asphalt" would be a state of nature.

The benefits of striving for tightly connected logic in cause-and-effect trees should be self-evident. Logically sound trees communicate more clearly and are ultimately more persuasive. And why construct a cause-and-effect logic tree in the first place, if not to persuade? ♦

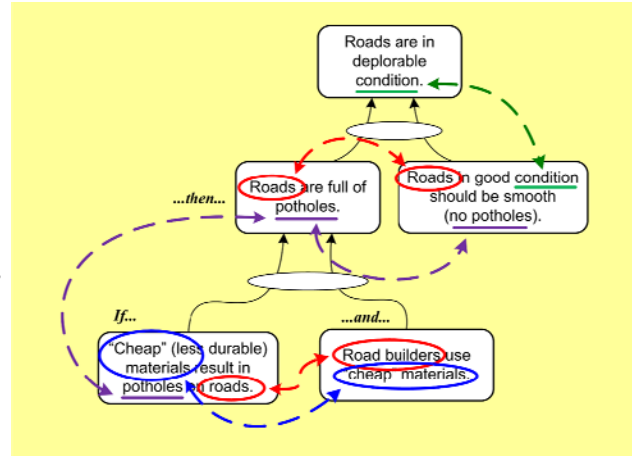


Figure 10. Continue Through Successive Layers