Buckets and Depreciation in the CTLA Trunk Formula Technique

By James Komen, RCA #555

The 10th Edition of the CTLA *Guide for Plant Appraisal* has changed the depreciation factors used in the Trunk Formula Method (now "Technique"). Although the condition rating remains, the species and location ratings have been eliminated and have been replaced by functional limitations and external limitations.

Functional limitations are intended to account for incurable genetic-based conflicts between the tree and its immediate environment or conflicts that are manageable through costly repeated treatments. For example, if a tree tends to be a large species, but the planting area is too small for its mature size, then there will be a limitation to how much value that tree will create, all else being equal. External limitations are intended to account for conflicts beyond the control of the property owner, such as municipal ordinances, zoning, and easements.

After brief testing with this formula, one will find that there are many scenarios in which there is overlap between the three depreciation ratings. For example, a side-trimmed tree near utility lines could be depreciated for condition (e.g., poor form and structure), functional limitations (e.g., inability to provide intended aesthetic function), or external limitations (e.g., utility easement is outside the control of the property owner). As another example, a tree with a sidewalk close to its trunk could be depreciated for condition (e.g., damage to root structure/health), functional limitations (e.g., anticipated future damage to the sidewalk), or external limitations (e.g., sidewalk easement is outside the control of the property owner). In response to questions of how to deal with these scenarios, the council gave the analogy of depreciation "buckets." Each component of depreciation was a bucket into which attributes could be placed, and it didn't matter which bucket was chosen so long as each attribute was only counted once.

In the following research, I show that the bucket analogy is not effective in dealing with the problem of overlap. The allocation of depreciable tree attributes matters. First, I show analytically why allocation is not equivalent between buckets. Next, I show theoretical examples to illustrate

my conclusions. In one of my examples, the allocation of a set amount of depreciation affects the combined depreciation rating by 120%.

The current ISA Tree Risk Assessment Qualification (TRAQ) method of assessing risk uses three separate categories that require subjective input on the part of the risk assessor: likelihood of failure, likelihood of impact, and consequences of failure and impact. These categories are independent of one another, so there are no "buckets" to choose between. Each attribute of a given tree risk scenario is accounted in only one of those three categories, and there is no overlap among them. In contrast, there is significant overlap among all three of the depreciation categories of the Trunk Formula Technique.

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The origin of the concept of buckets may relate back to the subcategories within the condition and location ratings of the Trunk Formula Method from the 9th edition of the guide. Within the condition ratings, there were subcategories for health and structure of various tree parts. Within the location rating, there were subcategories for site, contribution, and placement for the location rating. Occasionally, questions arose regarding where the roots ended and the trunk began or the trunk ended and the scaffold branches began. Questions also arose when deciding whether an attribute of the tree's location belonged in the placement or contribution subcategory.

To address this concern, the answer was simple: pick a bucket. Since the subcategories were additive, there was no effect on the outcome if one arborist classified a defect as a trunk defect and another classified the same defect as a scaffold branch defect. By the commutative property of addition, adding the assigned subcategory ratings of tree condition in any order resulted in the same outcome. The same was true for the location rating. Even though the subcategories of site, contribution, and placement were averaged to calculate the final location rating, the outcome was the same because each subcategory was multiplied by a constant, so the choice of "bucket" did not affect the final appraised cost solution.

In contrast, when the bucket method is applied to multiplicative categories, the answer is not always the same. In this next section, I show analytically why this is true.

Analytical Derivation

Consider two of the depreciation categories proposed for the 10th edition of the guide: functional limitations (F) and external limitations (E). Also, suppose there are two separate defects being accounted for, such as sidewalk over roots and power lines through the canopy. Finally, suppose an appraiser has assigned some amount of depreciation to each of those defects (a) and (b).

If both attributes are allocated to functional limitations, then the combined depreciation rating is as follows:

$$(F + a + b) \times E = FE + aE + bE$$

If one depreciation rating is allocated to functional limitations and one is allocated to external limitations, then the combined depreciation rating is as follows:

$$(F + a) \times (E + b) = FE + aE + bF + ab$$

The two combined depreciation ratings are different. For them to be equal, some condition must be met. To derive that condition, I set the two equations equal to each other and simplified:

$$FE + aE + bE = FE + aE + bF + ab$$
$$bE = bF + ab$$
$$E = F + a$$

For the allocation of (b) to have no effect on the outcome of the appraisal, external limitations must equal functional limitations plus (a). In a scenario with only two attributes that warrant depreciation (sidewalk AND power lines), functional limitations and external limitations would have the same starting value prior to the allocation of the depreciable attributes. Therefore, we are left with:

$$0 = a$$

This final step shows that the only time it doesn't matter which "bucket" is chosen is when there is only one attribute for depreciation (sidewalk OR power lines) or the amount of depreciation attributable to a given attribute is zero. In all other cases, the combined depreciation will be different, and it will matter how the depreciable attributes are allocated.

Numeric Example

Because analytical derivation is sometimes difficult to interpret conceptually, I will also illustrate this same conclusion using example values. Suppose again the previous scenario where there are two attributes of sidewalk over roots and power lines running through the crown. The appraising arborist assigns a depreciation amount of -30% to the attribute of sidewalk over roots (a) and -20% to the attribute of power lines through the

crown (b). If (a) were the only attribute warranting depreciation, then either functional limitations (F) or external limitations (E) would equal 70% (100% – 30% = 70%). However, since there are two attributes, there are four possible ways to allocate their depreciation amounts between functional limitations (F) and external limitations (E):

a	-30%		
b	-20%		
Scenario	**Functional**	**External**	**Combined (F x E)**
Both allocated to (F)	50%	100%	50.00%
a to (F) and b to (E)	70%	80%	56.00%
b to (F) and a to (E)	80%	70%	56.00%
Both allocated to (E)	100%	50%	50.00%

When (a) and (b) are allocated separately to each respective component of depreciation, the combined depreciation is greater than if (a) and (b) are both assigned to the same component of depreciation. In this scenario, simply choosing how to allocate the same amount of depreciation has an impact on the final appraised value of 12%, all else being equal.

When there is a greater amount of total depreciation to allocate, the effect is more pronounced. Suppose that instead of two attributes warranting depreciation, there is a set of many attributes such that the sum of their depreciation amounts is 80%. These attributes could be allocated in any combination in increments of 10% to either functional limitations or external limitations, per the discretion of the appraising arborist. The possible combinations are as follows:

Depreciation to Allocate:	80%			
Scenario	**Functional**	**External**	**Combined**	
All allocated to Functional	20%	100%	20.00%	<---Maximum depreciation
	30%	90%	27.00%	
	40%	80%	32.00%	
	50%	70%	35.00%	
Equally divided	60%	60%	36.00%	<---Minimum depreciation
	70%	50%	35.00%	
	80%	40%	32.00%	
	90%	30%	27.00%	
All allocated to External	100%	20%	20.00%	<---Maximum depreciation

When the depreciable attributes are equally allocated to both functional limitations and external limitations, the combined depreciation is at a minimum. When the depreciable attributes are all allocated to either functional limitations or external limitations, the combined depreciation is at a maximum. The decision on how to allocate depreciable attributes between functional and external limitations will impact the final appraised cost solution by up to 80% in this scenario, all else being equal.

The decision to allocate depreciable attributes extends beyond the two components of functional limitations and external limitations. There is also some overlap with the condition rating. So now assume the same scenario as above, but instead of allocating the 80% total depreciation among two components, I have allocated it among all three components in various combinations:

Depreciation to Allocate:	80%				
Scenario	**Condition**	**Functional**	**External**	**Combined**	
Equally divided	76%	76%	76%	44%	<--Minimum depreciation
Split between two	60%	60%	100%	36%	
All allocated to one	20%	100%	100%	20%	<--Maximum depreciation

When the total depreciation amount is equally divided between the three components, the combined depreciation is at a minimum. When the total depreciation amount is allocated entirely to one component, the combined depreciation is at a maximum. In this scenario, the decision on how to allocate depreciable attributes between three components will impact the final appraised cost solution by up to 120%, all else being equal.

Potential Solutions

Now that I have established that allocation of depreciation affects the outcome of the Trunk Formula Technique appraisal, I would like to present some possible courses of action for addressing this potential for discrepancy:

- *No action:* If no action is taken, Trunk Formula Technique appraisals may vary greatly between arborists simply by how overlapping depreciation is allocated. It may be up to the respective appraising arborists to defend why they allocated as they did. I suspect this will be the favored outcome by the industry. If so, appraisers should be aware of the need to not only justify depreciation attributes, but also how the point ratings are allocated.

- *Prescriptive allocation:* A future edition of the *Guide for Plant Appraisal* could specifically define how the depreciation should be allocated in scenarios of overlap. It may be difficult to come to agreement, and it may take a significant amount of time and resources to compile and evaluate overlap scenarios. Prescriptive allocation also may end up posing an unnecessarily rigid restriction on field arborists who find that the prescriptive allocation is not appropriate for their specific scenarios.

- *Additive depreciation:* Rather than multiplying functional limitations and external limitations together, perhaps they can be merged into two subcomponents of the same depreciation rating. An analog to this would be the subcomponents of the location rating as outlined in the 9th edition: site, contribution, and placement are all assigned and then averaged. Perhaps external and functional limitations could be averaged or otherwise combined in the same way, rather than combining them multiplicatively.

- *Category redefinition:* The depreciation categories could be redefined to eliminate overlap to more closely model the ISA TRAQ method of risk assessment. Category redefinition may be the most challenging alternative.

Conclusion

The allocation of depreciable attributes affects the final appraised cost solution of the Trunk Formula Technique. The greatest amount of depreciation occurs when all of the attributes are allocated to the same component of depreciation, and the least amount of depreciation occurs when the attributes are equally allocated among the components. An appraiser's choice of how to allocate attributes among the depreciation components can have a large impact on the final appraised cost solution. With such a large possible discrepancy between outcomes, the allocation of depreciation into each bucket must be defensible by the appraising arborist. In some cases, there may be a "best bucket," and in others, it may not be as clear.

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