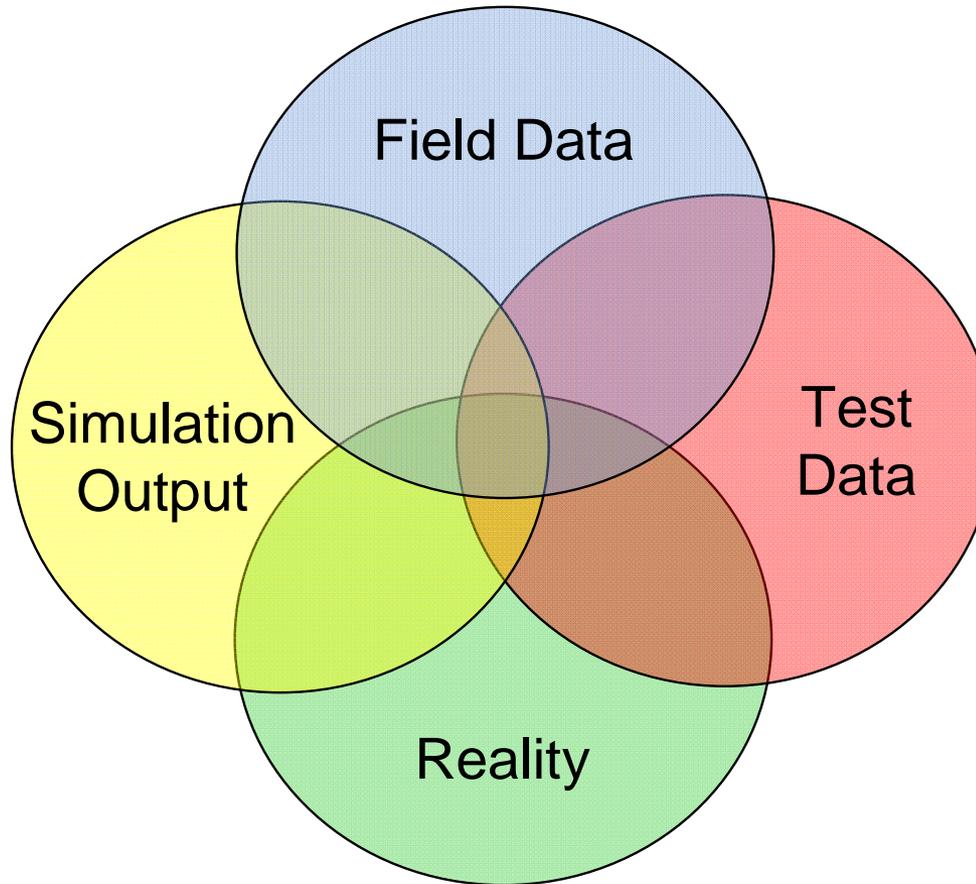


Comments on Physics-Based Modeling & Simulation in Support of T&E Requirements

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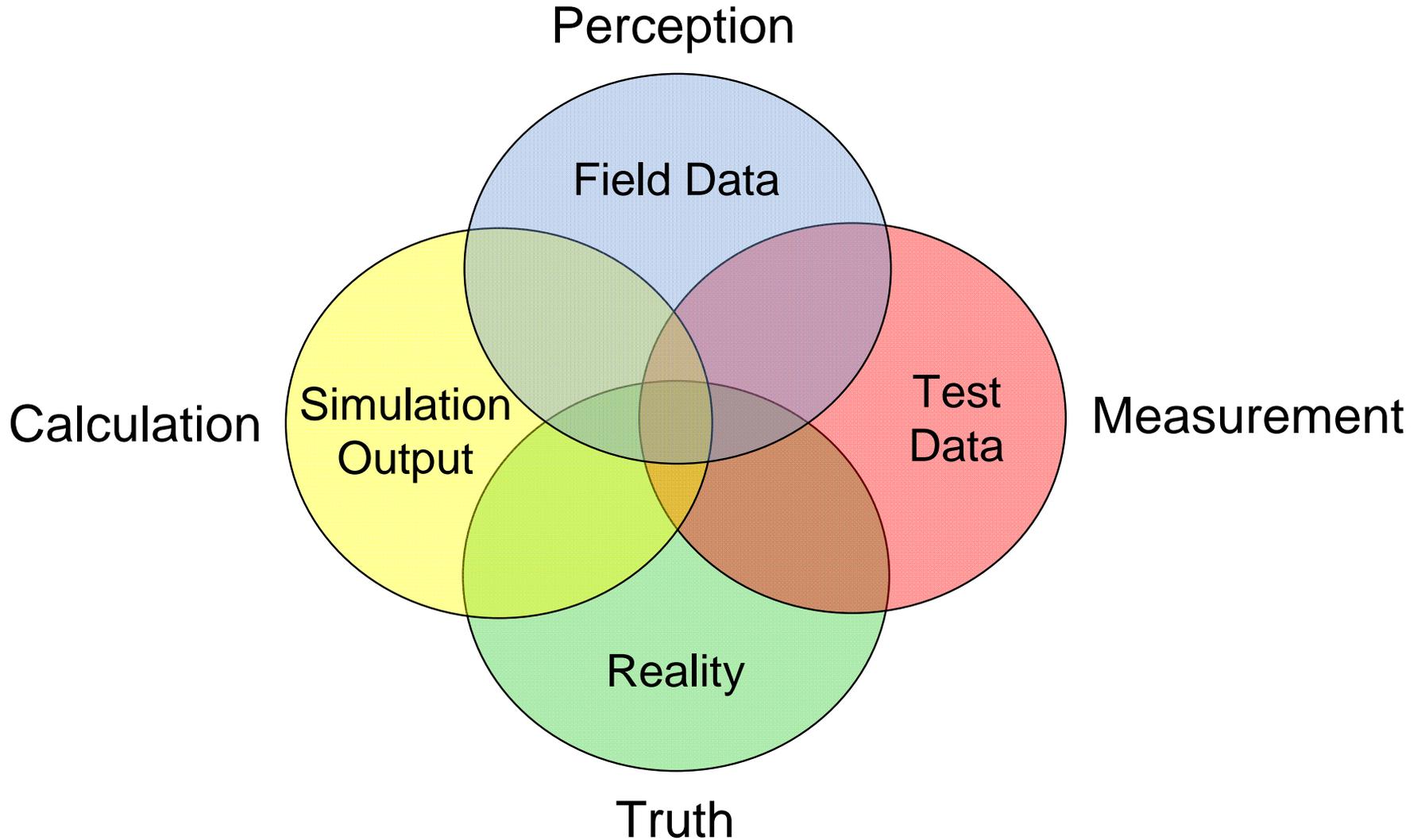
March 15, 2012

Walbert's view of the world**



**Not to scale

Walbert's view of the world



Two Simple Physics-Based Models

#1:

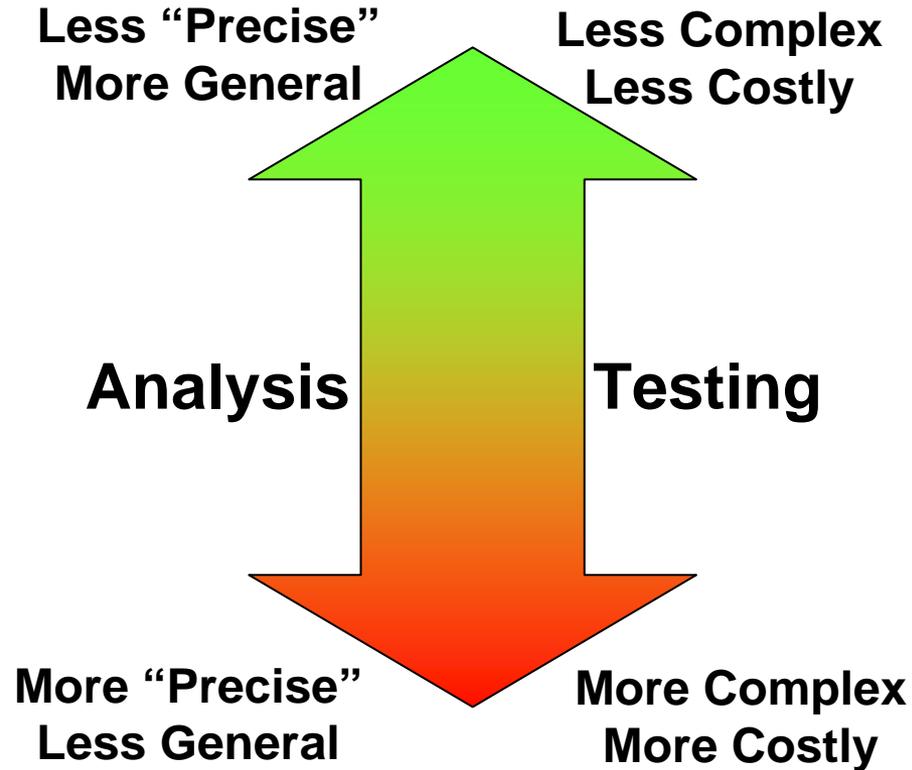
$$E = mc^2$$

#2:

$$\text{Penetration Depth} = \text{Penetrator Length} \sqrt{\text{Penetrator Density} / \text{Target Density}}$$



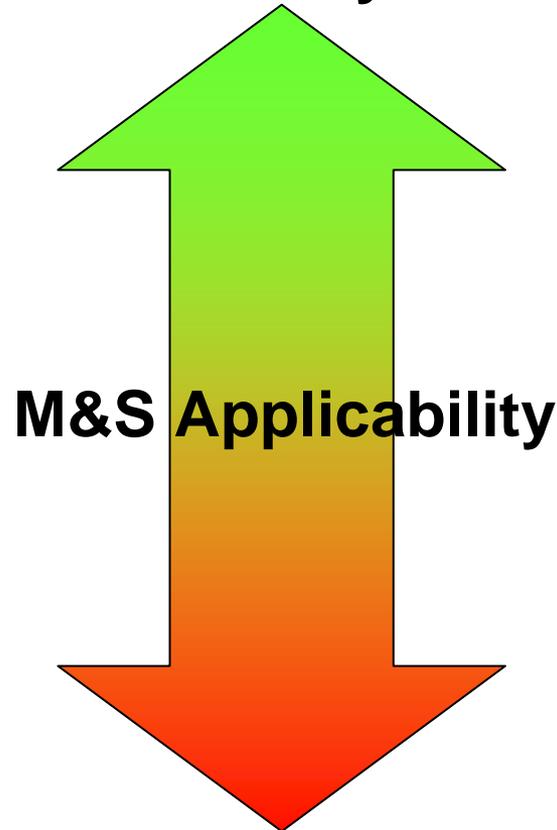
Mission-Based T&E and M&S



**Do you want to be precisely incorrect
or approximately correct?**

The dangers of a very specific model

More Universally Accurate



Less Universally Accurate

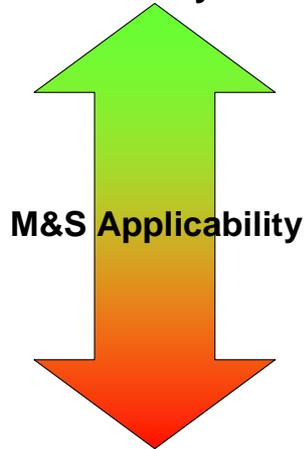
A President was Elected
(very general, but correct)



**Thomas Dewey was
Elected President**
(very specific, but incorrect)

The dangers of a very specific model

More Universally Accurate



Less Universally Accurate

A President was Elected

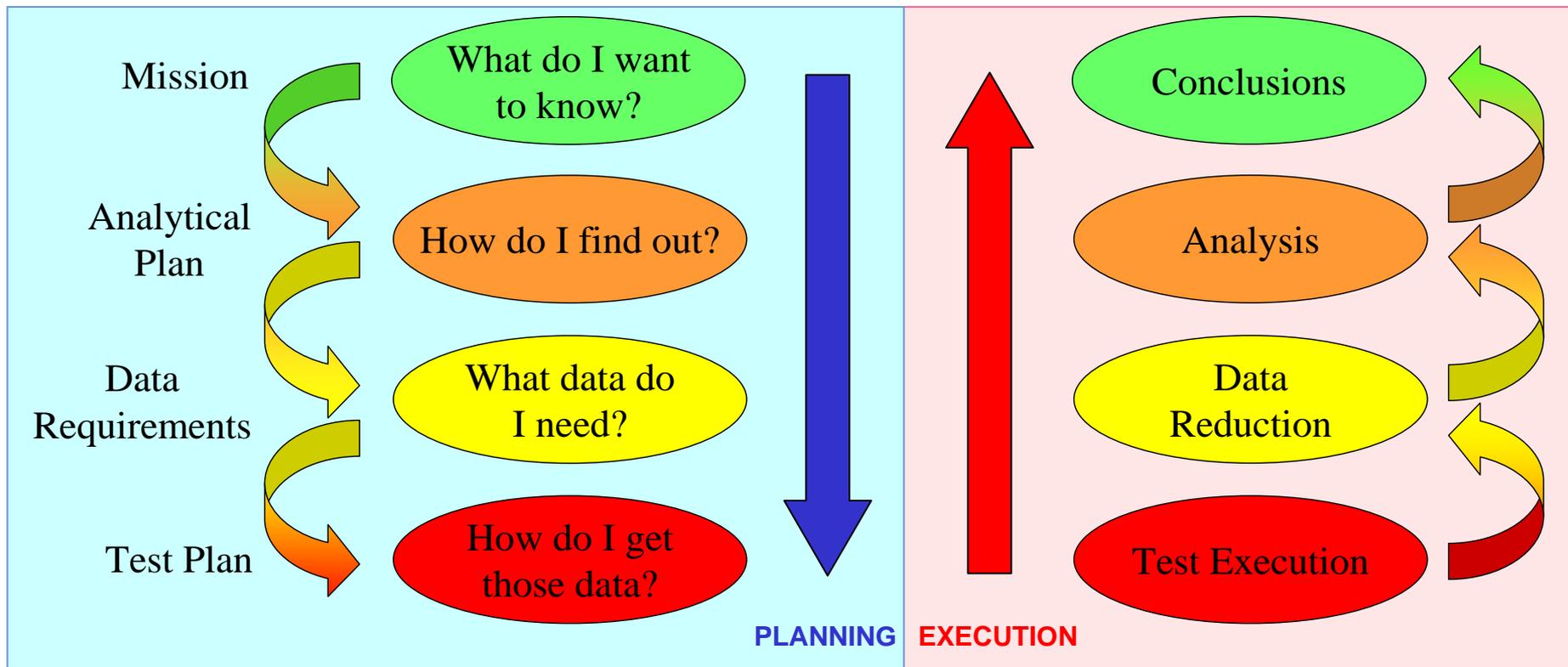


Thomas Dewey was Elected President

This very precise model does **not** explain **how** the President was elected. The model of at least part of the process is flawed; everything that follows is probably incorrect, such as **by** **how much** (how many votes).

If the prediction was precisely incorrect because 17 precincts voted the opposite from the assumption, then “tweaking” the model to change the way those 17 precincts vote may or may not to produce “better” results in the next election.

A Very Old Concept



**The analytical plan is based on the mission.
The data requirements are based on the analytical plan.
The test plan is based on the data requirements.**

ANY OTHER ORDER FOR THESE EVENTS IS NONSENSE!

The Paradigm

Organize the M&S and T&E using the same logic flow.
(I highly recommend MMF.)

Determine the number of levels (intermediate outputs) required.

Align the data collection (instrumentation) with the levels.

Develop the M&S to output the same intermediate levels (values).

Don't $\left\{ \begin{array}{c} \text{test} \\ \text{model} \end{array} \right\}$ ***more detail than you need, and***

don't $\left\{ \begin{array}{c} \text{model} \\ \text{test} \end{array} \right\}$ ***more detail than you*** $\left\{ \begin{array}{c} \text{test} \\ \text{model} \end{array} \right\}$.

Points to Ponder

Should we always design a $\left\{ \begin{array}{c} \text{test} \\ \text{model} \end{array} \right\}$ that fits all missions?

(just in case...Scope, Time, Budget)

Is it better to be ***precisely incorrect*** or ***approximately correct***?

(The Chicago Tribune is not remembered because of its superbly detailed model for predicting the outcome of a presidential election.)

Are we doing a certain level of M&S because we can, or because we need it to answer the mission (question)?

(How did we get to the moon without finite element codes?)

Two *very* different questions:

- 1) How well did the model predict the outcome of the test?**
- 2) Was the test outcome a member of the population of possible outcomes predicted by the model?**

The first question is mathematically intractable; the second question is the correct one to ask.

Simulation & Modeling

has the same acronym as

Smoke & Mirrors

***Or, no single test event has ever had
as its outcome a probability
distribution***