

On Models Underlying Performance-Based Design

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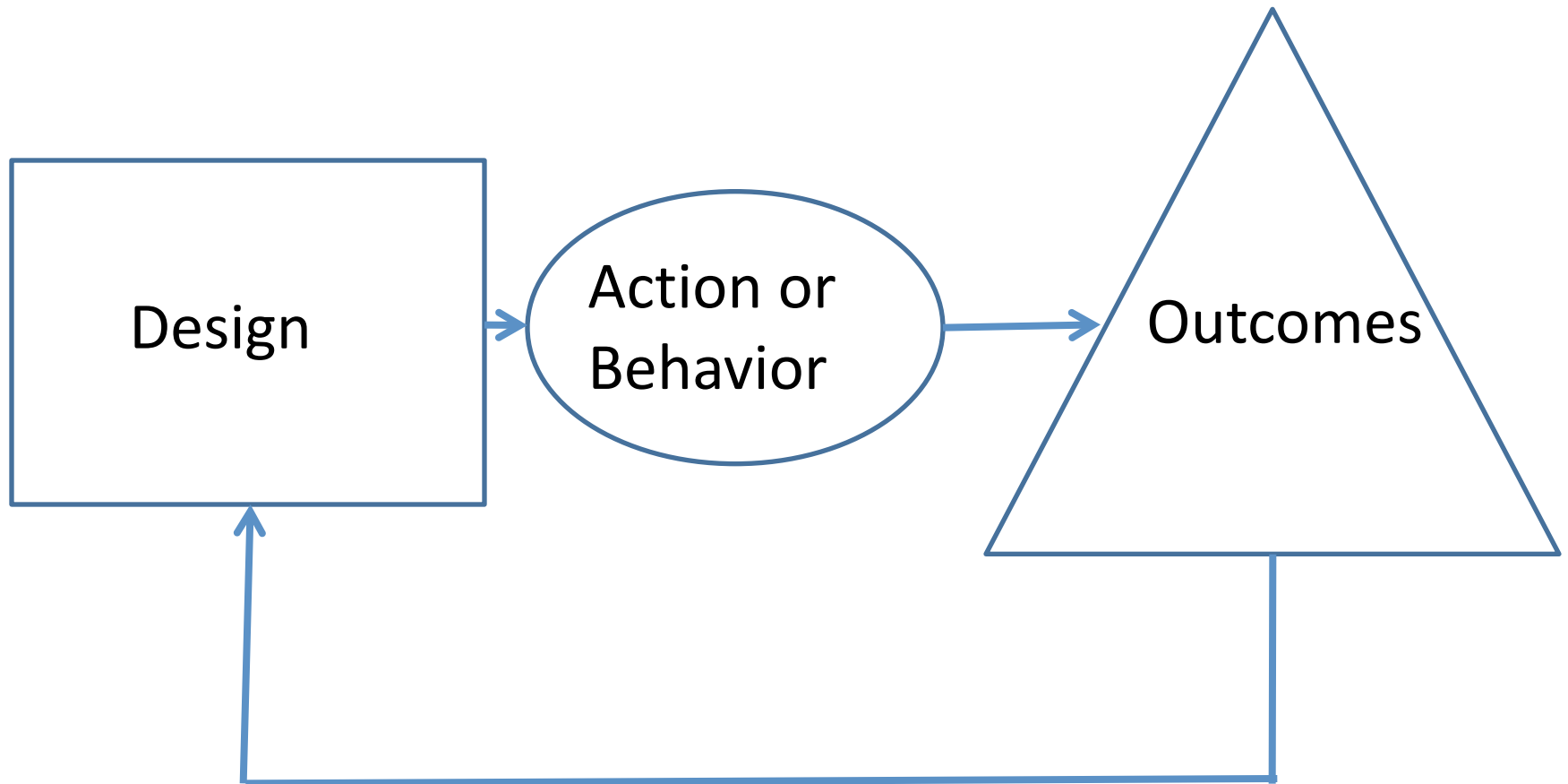
Pennsylvania State University

About Myself

- Twenty years of experience in the field
- Started full-time career as a consultant, and moved to government research and then to academia
- Faculty member (first at the University of Washington, Seattle) for nine years
- Have done a few projects in my life – around 150 or so in planning, operations, design, ITS
- Non-academic experience has been very helpful in retrospect – it affords thought that is surprisingly fundamental, something a pure academic may not have the benefit of
- Got to learn from some of the brightest and the best engineers early on when I was 22 – I mean those of the vintage era, with a BS and certificates in graduate studies
- I do like math. Started off as a math major in college and for whatever reason, actually listened to my parents who told me to find a field that can keep me gainfully employed

Overview

- I wish to talk about why modeling is useful
- Integrative in terms of the other talks in this session



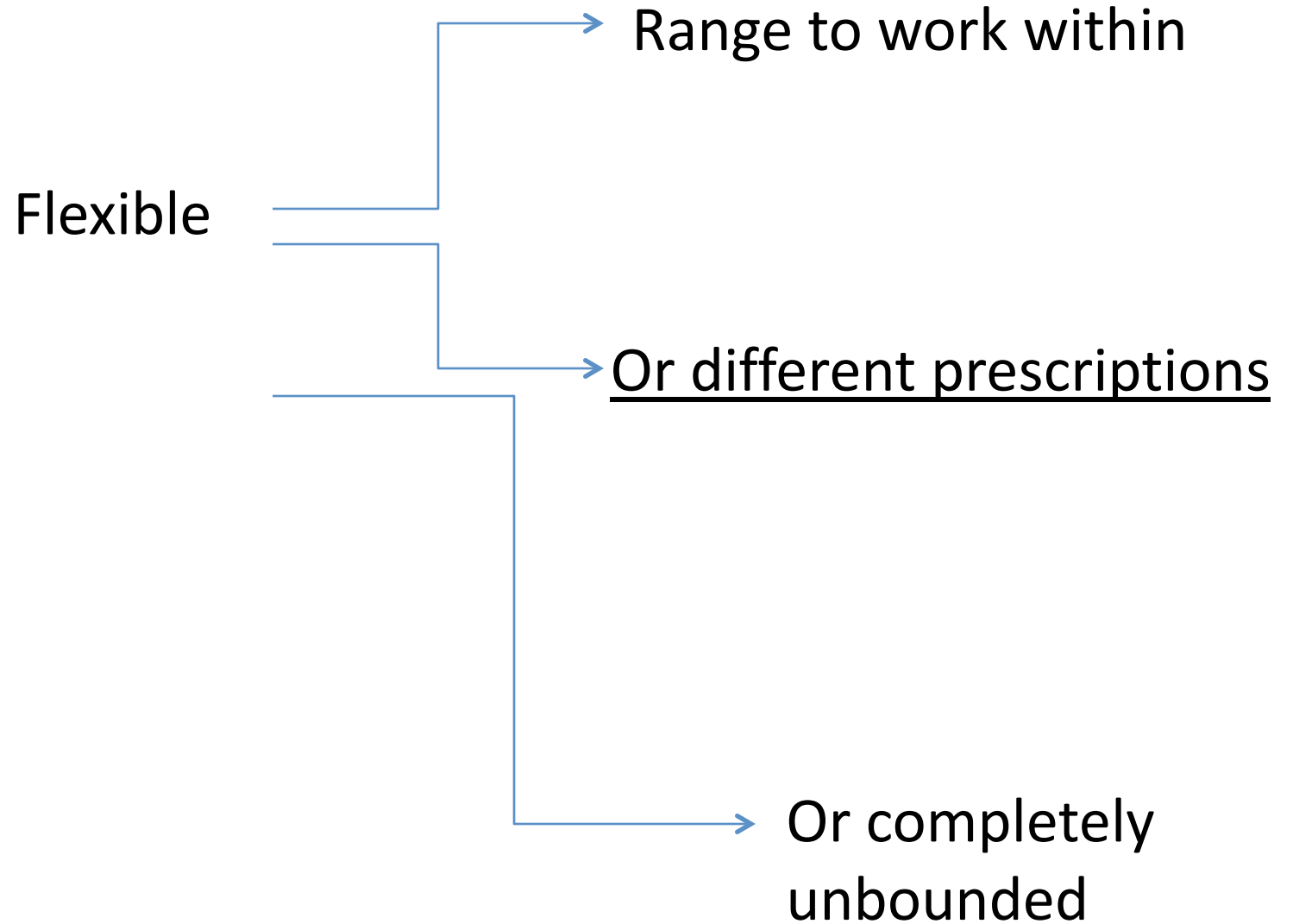
The Connection Between Engineering and Performance Based Design

- Reflects the importance of “theory from practice”
 - Nuances of design
 - Design has standards
 - Means design is certified just as we all are
 - But some designs are better
 - The vintage engineers did nuances well; took design to the art level; wasn’t just blind number-crunching science
 - Today people call this context sensitive design

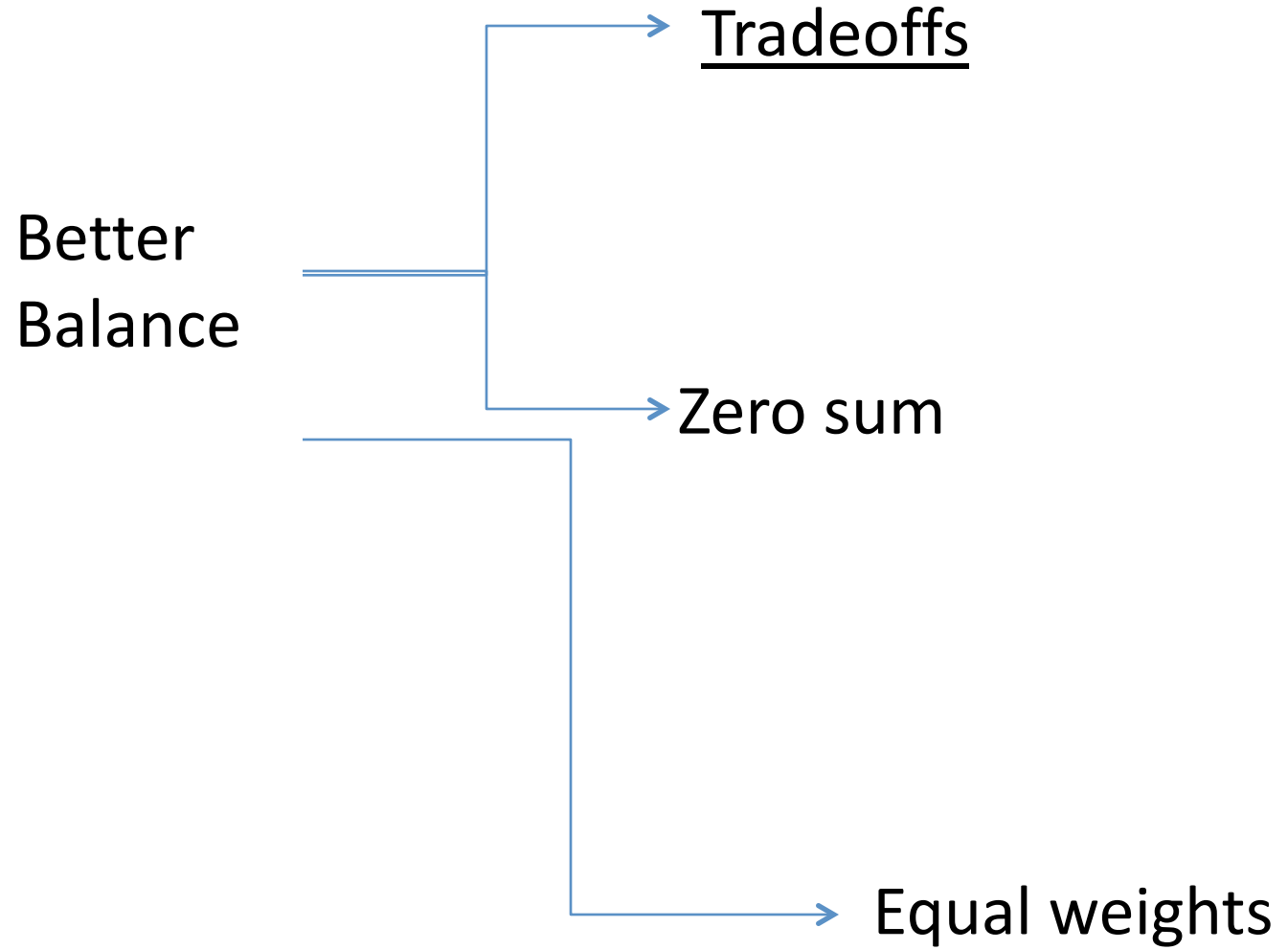
Context is the Connection...But Words Matter

- *Context Sensitive Design* (CSD, also called *Context Sensitive Solutions*) refers to roadway standards and development practices that are flexible and sensitive to community values. CSD allows roadway design decisions to better balance economic, social and environmental objectives
- Context Sensitive Design uses a collaborative, interdisciplinary approach that includes early involvement of key stakeholders to ensure that transportation projects are not only “moving safely and efficiently,” but are also in harmony with the natural, social, economic, and cultural environment

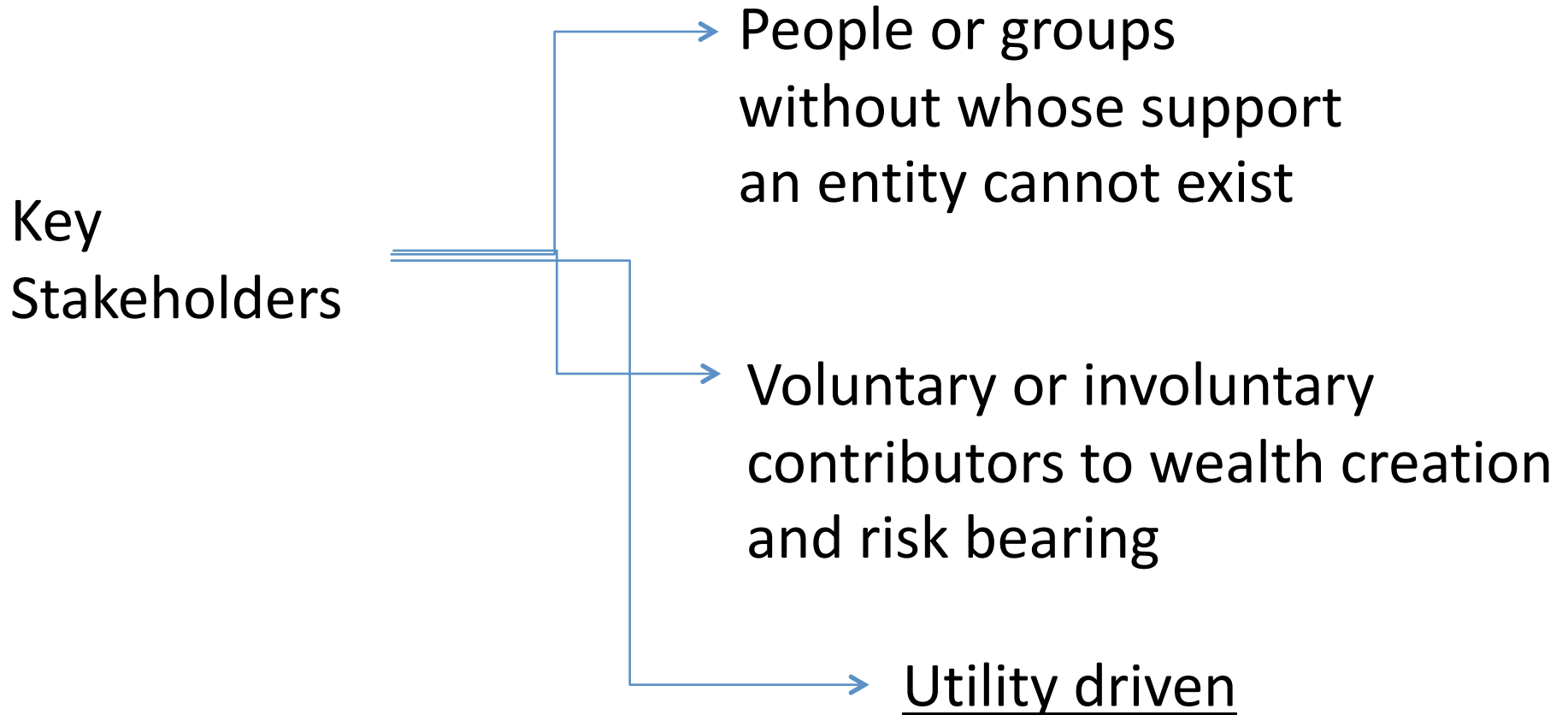
Words Matter...



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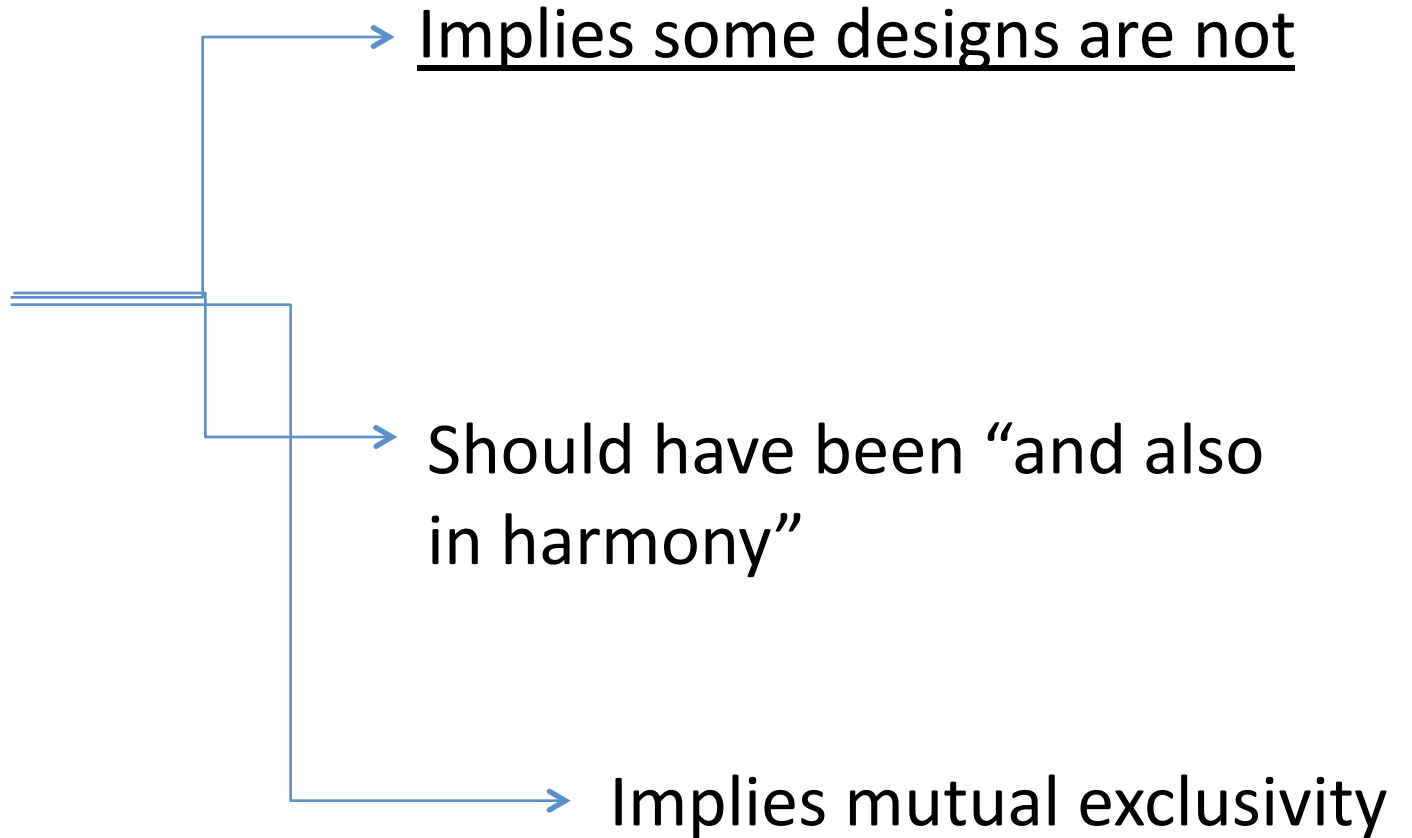


Words Matter...



Words Matter...

But also in
harmony



Fundamentally Grounded Thoughts Lead to Useful Models of Design

- Fundamental as in...
 - Prescriptions
 - Context specific as opposed to design in general
 - Tradeoffs
 - Intended versus outcomes
 - Utilitarian view of design
 - How do we recover the intentions behind a particular design
 - Implies some designs are not in harmony
 - Reasons as to why some were rejected

Useful Models of Design

- A model is an abstraction
- We can have many abstractions and therefore infinite models
- Similar to a fashion show – in a sense, models are displays of something...
- One that is useful is one that can help recover the process underlying human decisions
- In this sense, all models are wrong, but some are useful

Does This Mean Useful Models Tell Us Something?

- A model shows the relationship between “facts”
- Fact means different things to different people
 - To some it is pure fact
 - To some it is just a fact
 - To some it represents something other than what we thought it measured
- So, a model to be useful needs to be based on useful measures first
- Useful means utility

Does This Mean Useful Models Tell Us Something?

In the sense of performance based design models

- We are talking about
 - The utility of a measure of the utility of a design
 - The first part asks what we should be measuring, the second asks what the engineer intended
 - In some sense, making the connection between the two is impossible, but to be as close to the truth, this is what we should be doing
 - Model building in this sense is forensic
 - Therefore we measure several “things” in order to talk about utilities of several designs
 - We think that by measuring several things, we can make some final sense

Does This Mean Useful Models Tell Us Something?

OK, so does the model tell us something now?

- No, it shows what was done and what happened as a consequence
- It is up to us to make sense out of it

How do we make sense out of it?

Adopt a forensic approach

Look at measures in relation to context

Ask counterfactual questions, meaning

What would the outcomes be if it were a different context

Be aware of the limits of measurement

Integrative Examples – State College Pedestrian Lead Interval and Naturalistic Driving Analysis

Adopt a forensic approach

Look at measures in relation to context

State College pedestrian lead intervals – ask the question of the city as what the motivating factors were

One will find out that not all factors are measurable

Ask counterfactual questions, meaning

What would the outcomes be if it were a different context

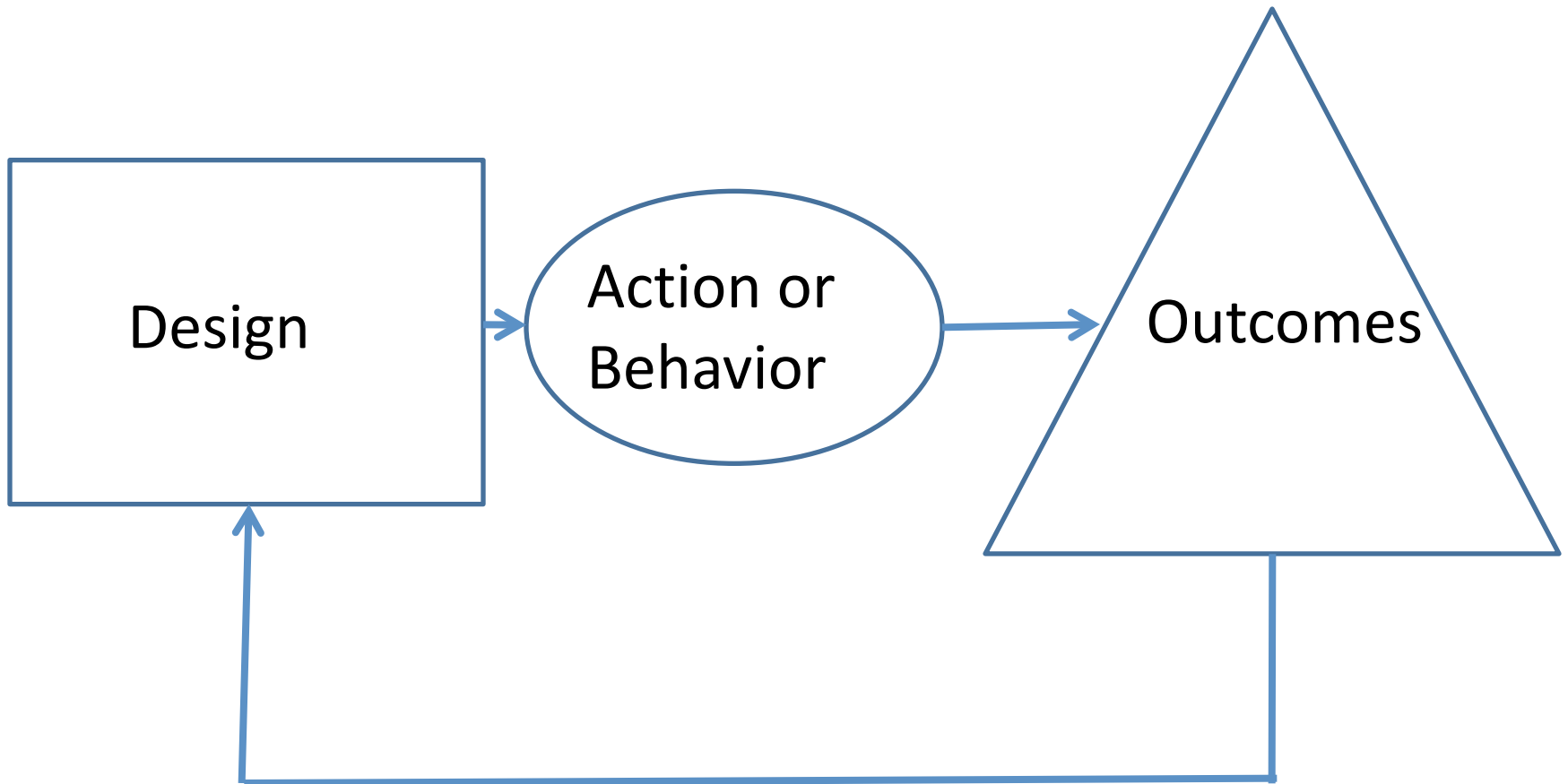
Cannot be done using one study from State College because counterfactuals require experimental design at multiple sites

Be aware of the limits of measurement

You cannot do this experiment at any place, on any population, at any time

Since none of the above questions are completely answerable, we will have by necessity some statistical sophistication in the model

The Essential Modeling Process



Summarizing

- Before-After studies answer some questions that are context specific but come at an expense
- With-Without studies are useful for counterfactuals, but come with a different cost, as in cost of outcome measurement systemwide
- Finer resolution versus coarser in terms of measurement
- Combining the two insights

Design → Behavior → Outcomes



Now, there is a possibility that models can tell us something