BME 590: FUNDAMENTALS OF ENGINEERING DESIGN

TESTING

Salinas

WHAT IS DEVICE TESTING?

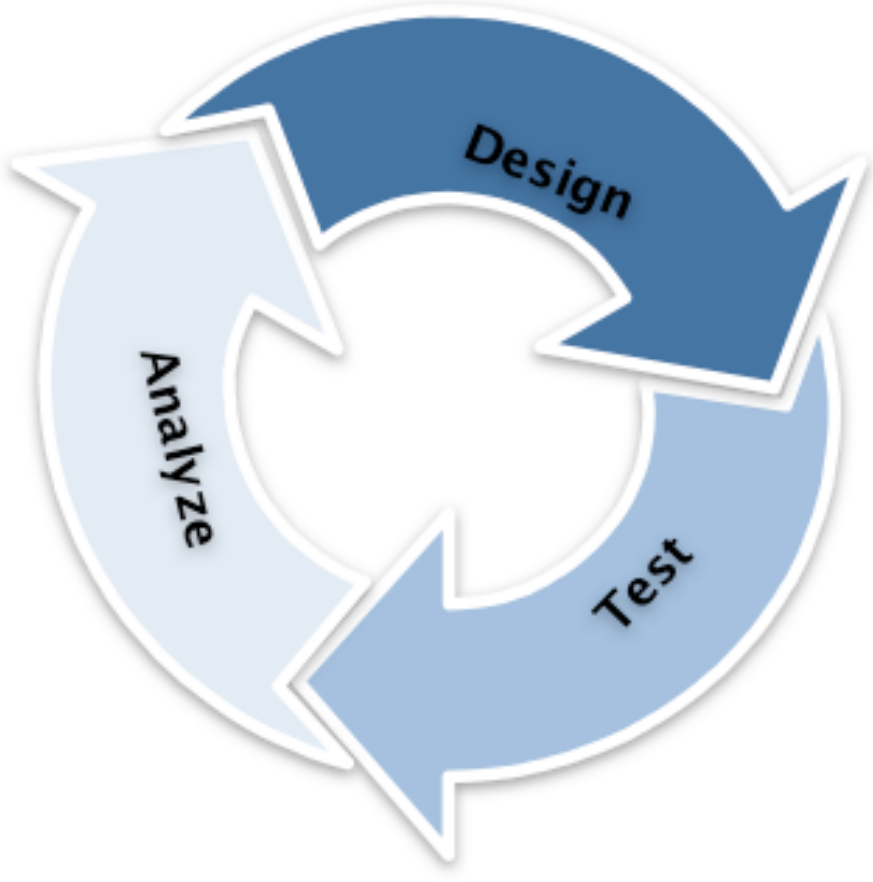
Evaluate your solutions against design criteria and specifications:

1. What spec is being measured?

2. How are the measurements made?

3. How many times should the tests be run?

4. Who is involved in testing?

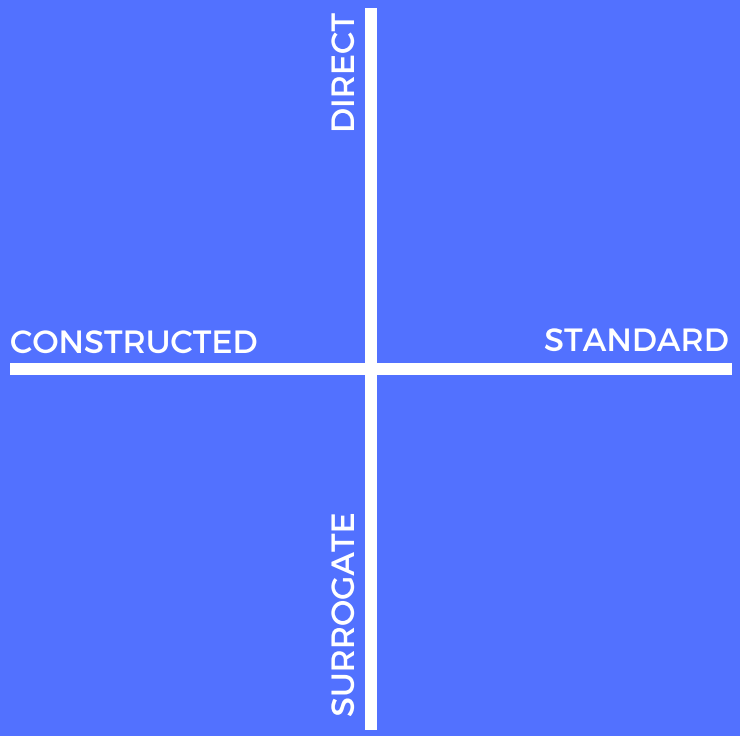


EVERY SPEC/CRITERIA NEEDS A TEST:

- EVALUATE YOUR DESIGN SPECS
- SEPARATE THEM INTO GROUPS FOR TESTING
- IDENTIFY THOSE SPECIFICATIONS THAT MAY REQUIRE ADDITIONAL TIME IN TESTING

CATEGORIES OF MEASUREMENT

HOW ARE MEASUREMENTS MADE?



DIRECT :

- MEASUREMENTS ARE MADE DIRECTLY

SURROGATE:

- MEASUREMENTS ARE MADE VIA ESTIMATES/INFERENCES

STANDARD:

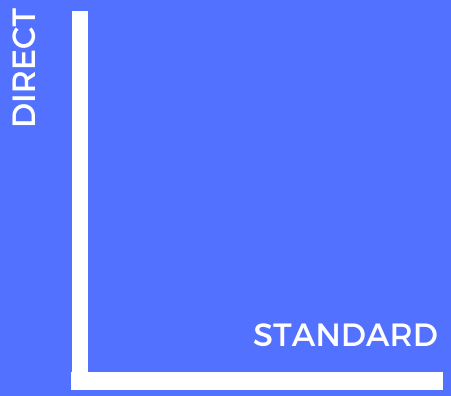
- MEASUREMENTS ARE ESTABLISHED/DEFINED

CONSTRUCTED:

- MEASUREMENTS ARE SET BY TEAM OR OTHERS

CATEGORIES OF MEASUREMENT

DIRECT VS. STANDARD



DIRECT VS. STANDARD

- MEASUREMENTS MADE DIRECTLY WITH KNOWN STANDARD

EXAMPLES:

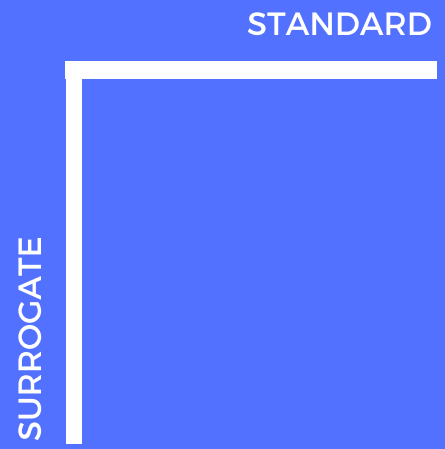
- TIME
- WEIGHT
- VOLUME
- LENGTH

TOOLS:

- STOPWATCH
- SCALE
- RULER
- CALIPER
- AMMETER
- VOLTMETER

CATEGORIES OF MEASUREMENT

STANDARD VS. SURROGATE



STANDARD VS. SURROGATE

- MEASUREMENTS NOT MADE DIRECTLY (MAY TAKE TOO LONG) BUT USE EXISTING STANDARD

EXAMPLES:

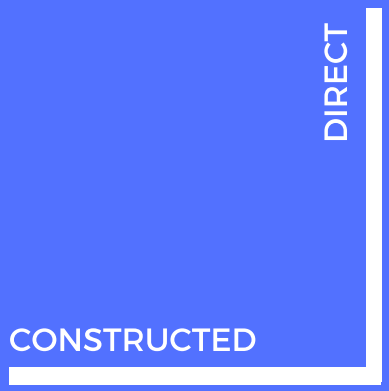
- COST
- BATTERY LIFE
- FLOW RATE

TOOLS:

- ESTIMATE COST FROM PROTOTYPE
- EXTRAPOLATE FLOW RATE FROM BENCH TOP TESTING
- LOOK UP TYPICAL BATTERY LIFE

CATEGORIES OF MEASUREMENT

DIRECT VS. CONSTRCUTED



DIRECT VS. CONSTRUCTED

- DIRECTLY MEASURABLE THOUGH NO STANDARDS EXIST.
- OFTEN REQUIRES USER INTERACTION

EXAMPLES:

- PERSON CARRYING KNOWN SIZE DEVICE OVER CERTAIN DISTANCE FOR CERTAIN PERIOD OF TIME

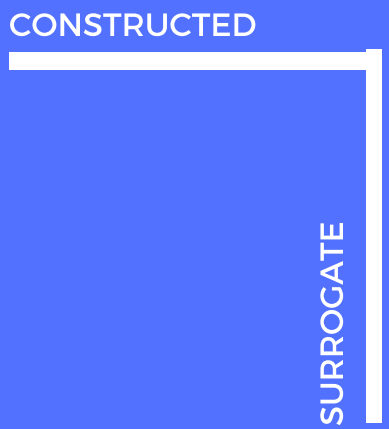
METHODS:

- USER TESTING
- DIRECT OBSERVATION
- USER DEFINED SCALES

- ** USABILITY AND PORTABILITY COMMON FOR THIS QUADRANT*

CATEGORIES OF MEASUREMENT

CONSTRUCTED VS. SURROGATE



CONSTRUCTED VS. SURROGATE

- NO DIRECT TEST OR STANDARD SCALE. TEAM MUST DEVELOP MEANS AND SCALE.

EXAMPLES:

- SAFETY
- DURABILITY
- MAINTENANCE

METHODS:

- 10 EXPERTS EVALUATE DEVICE USING TEAM DEFINED SCALE TO MEASURE SAFETY
- DROP TESTING/ACCELERATED USAGE TESTING

TESTING WITH PEOPLE

METHODS TO TESTING WITH VARIETY OF USERS

TEST DEVICE WITH VARIETY OF PEOPLE

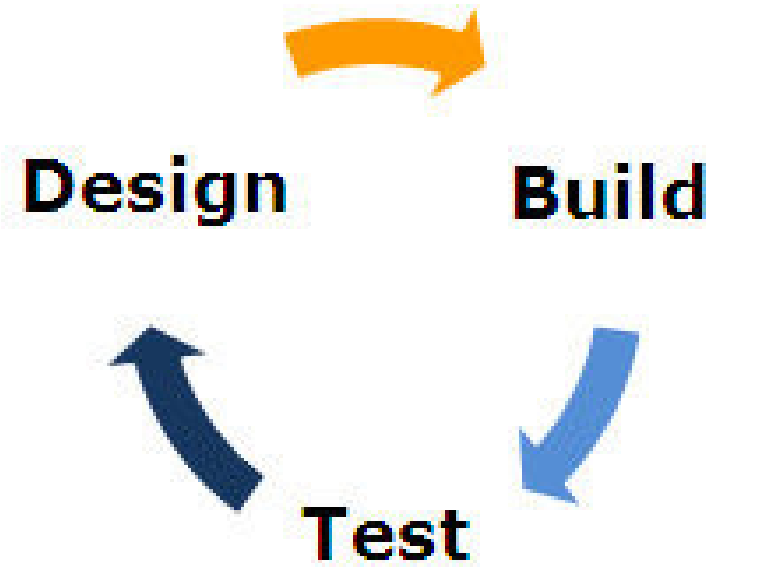
- CLIENTS
- USERS
- NURSES
- RESIDENTS
- FRIENDS
- OTHERS

ASK TESTERS THEIR OPINION ON PARTICULAR FEATURES

- TESTS WITH USERS OFTEN CONSTRUCTED TESTS
- GAIN FEEDBACK
- KEY FEATURES
- EASE OF USE

TESTING WITH PEOPLE

METHODS TO TESTING WITH VARIETY OF USERS



CLOSE ENDED USER TESTS

- FIXED SET OF RESPONSES
- LIKERT SCALE
- YES/NO
- NUMERICAL ASSESSMENT

OPEN ENDED USER TESTS

- USER GIVES FREE RESPONSES
- WHAT LIKE/DON'T LIKE
- NOT GUIDED ANSWER
- UNCOVER ASPECTS NOT CONSIDERED BEFORE

TESTING WITH PEOPLE

WHAT METHODS WILL BE USED?
WHAT QUESTIONS/FEEDBACK ARE MOST IMPORTANT?
WHAT ARE THE METHODS FOR DATA COLLECTION?

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
(1)	(2)	(3)	(4)	(5)

METHODS:

- STRUCTURED INTERVIEW
- FOCUS GROUP
- WATCH INDIVIDUAL USE DEVICE
- WRITTEN SURVEY
- MEASURE DATA DIRECTLY

USER TESTING

- PROVIDES GREATER VARIABILITY
- INTERACT WITH 20-30 PEOPLE (LOWER BOUND)
- UNDERSTAND THEIR PERSPECTIVE
- LISTEN CAREFULLY
- DON'T ARGUE

TEST RESULTS

WHAT DO UNCERTAIN OR FAILED TESTS RESULTS MEAN?

UNCERTAIN TEST RESULTS

- ISOLATE SOURCE OF UNCERTAINTY
- DISCUSS RESULTS WITH TEAM
- POSTPONE TEST UNTIL PROTOTYPE REFINED

FAILED TEST RESULTS

- ISOLATE FAILED COMPONENT
- IDENTIFY MECHANISM OF FAILURE OR WEAK COMPONENT
- ITERATE PROTOTYPE
  - SUBSTITUTE COMPONENTS/PARTS
  - REVISE VS. REMAKE
  - BUILD VS. BUY PARTS
  - INCREASE FIDELITY OF PARTS

WHEN IS YOUR PROJECT DONE?

Your device is completed when:

1. All tests have been passed

2. All design criteria and specs have been satisfied

3. Device is ready to give to your client