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TRANSPORTATION RESEARCH BOARD

Trust But Verify–Validating Contractor Test Data

June 3, 2021

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at RGillum@nas.edu

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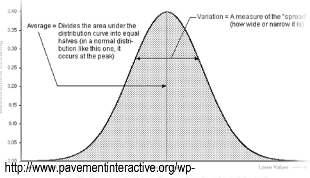
REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

Learning Objectives

1. Evaluate procedures used by state DOTs to validate contractor data

2. Identify risk areas that may lead to incorrect acceptance and payment decisions



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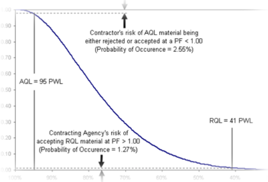

http://www.pavementinteractive.org/wp-content/uploads/2008/08/Oc_plot5.gif

Trust but Verify: *Validating Contractor Test Data*

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Transportation Research Board
Webinar June 3, 2021

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- NCHRP Project 10-100
  - Senior Program Manager
    - Amir Hanna
  - Panel Members
  - SHA's that Shared Real Data
  - Research Team Members
    - Mohamed Nimeri
    - Chuck Hughes
    - Shiraz Tayabji
    - Randy West
    - Mike Heitzman
    - Fan Yin

NCHRP NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Outline

- *Requirements When Using Contractor Data in Agency Acceptance Decisions Regulatory Requirements*
  - Regulatory Requirements
  - NCHRP Project 10-100 Overview

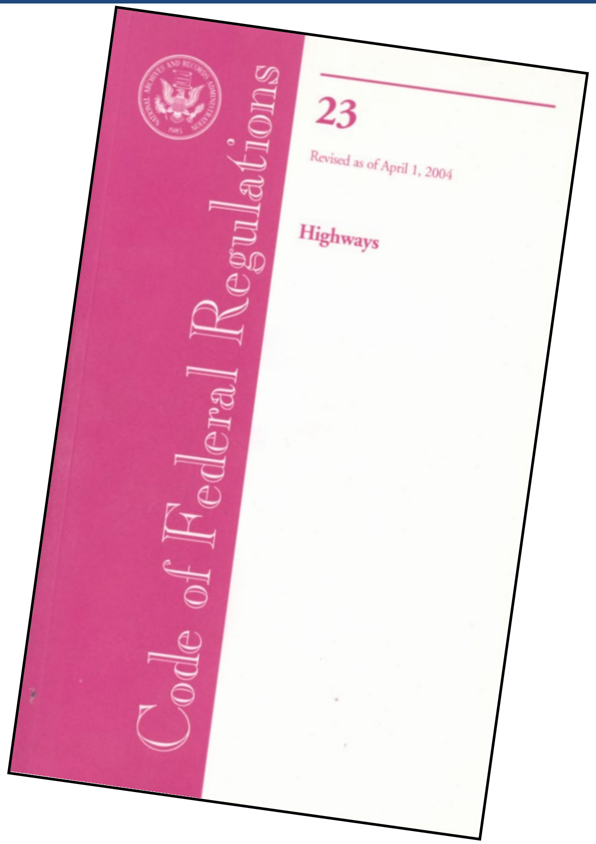
- *Best Practices for Validating Contractor Data Used in Agency Acceptance Decisions*
  - NCHRP Project 10-100 Recommended Guidelines for Validation
  - Illustrated & Important Scenarios / Risks to Consider

Background – Regulatory Requirements

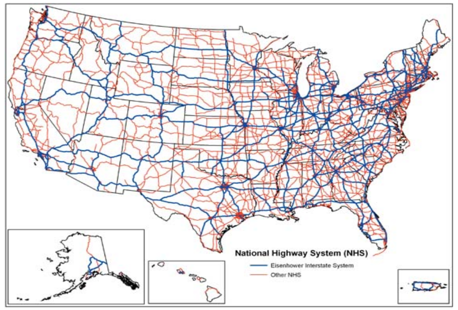
Code of Federal Regulations:

23 CFR 637 Subpart B -
Quality Assurance Procedures for Construction

Policy: Quality Assurance (Non-Regulatory Supplement to 23 CFR 637) July 2006



- 23 CFR 637B permits the use of Contractor test data for construction materials acceptance.
- As long as SHAs ***validates*** the Contractor data with ***independent*** test results.
- Applies to NHS & SHA's also use on other route classifications



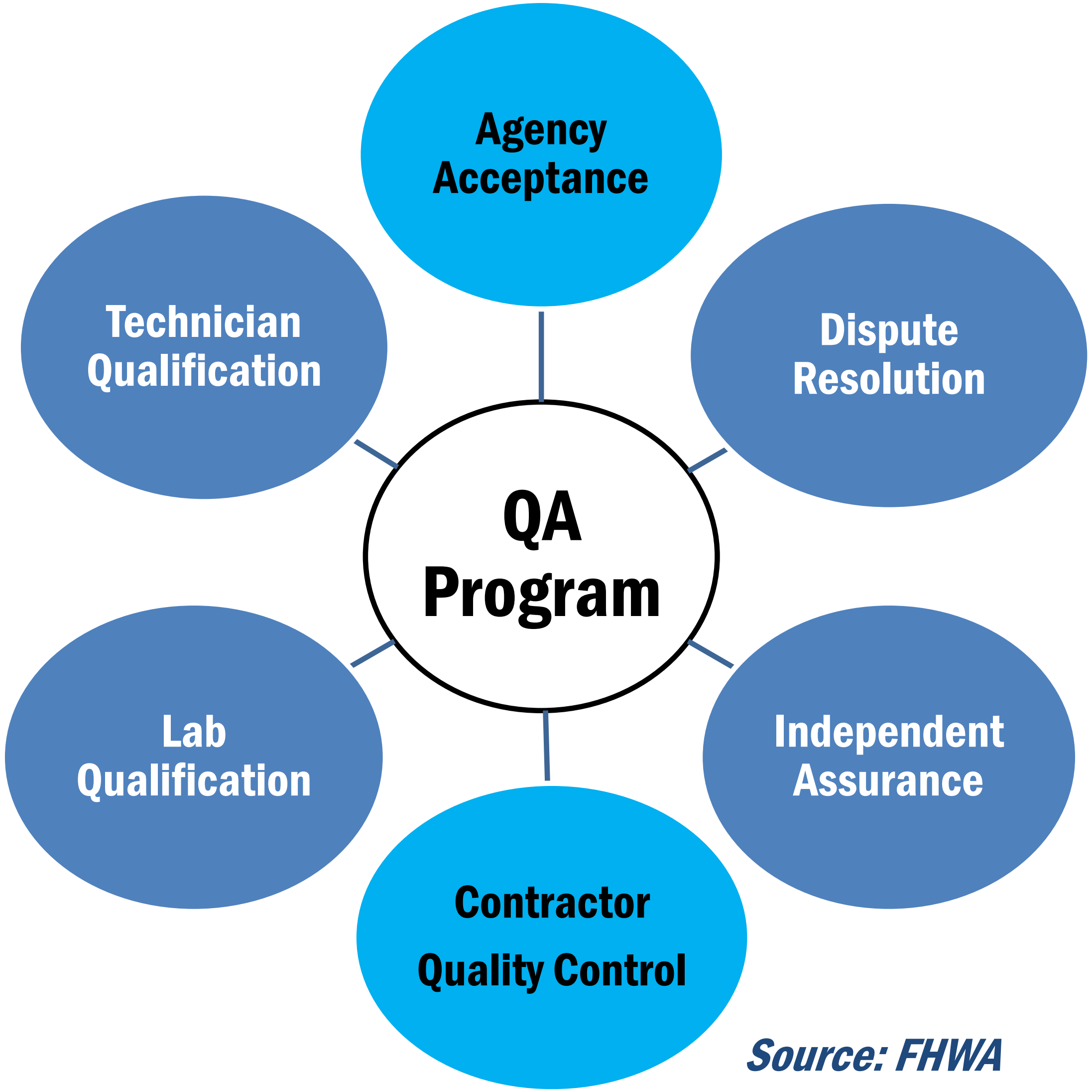
AGENCY RISK MANAGEMENT

Testing and Inspection Costs

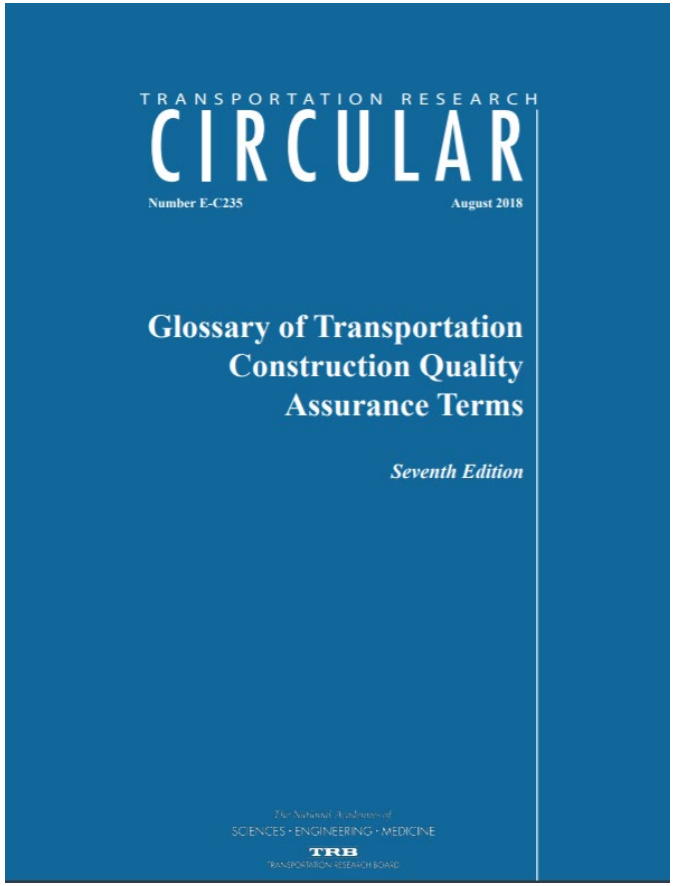
Quality and Performance Risk

Source: FHWA

6 Core Elements of a Quality Assurance (QA) Program



Source: FHWA



TRB E-C235

QA Program - *Contractor Quality Control (QC)*

- Materials sampling, testing & inspection
- *If part of acceptance decision*
  - Independent of agency verification
  - Qualified technicians
  - Qualified laboratories
  - Independent assurance evaluation

See 23 CFR 637.207(a)(1)(ii).

Source: FHWA

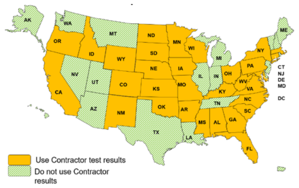
QA Program – *Agency Acceptance*

- Verification sampling, testing & inspection
- Quality evaluation
- Acceptance & payment
  - May include contractor test results *if validated* – …

See 23 CFR 637.205(d) and 637.207(a)(1)(ii)(B).

Source: FHWA

NCHRP PROJECT 10-100 *BACKGROUND*



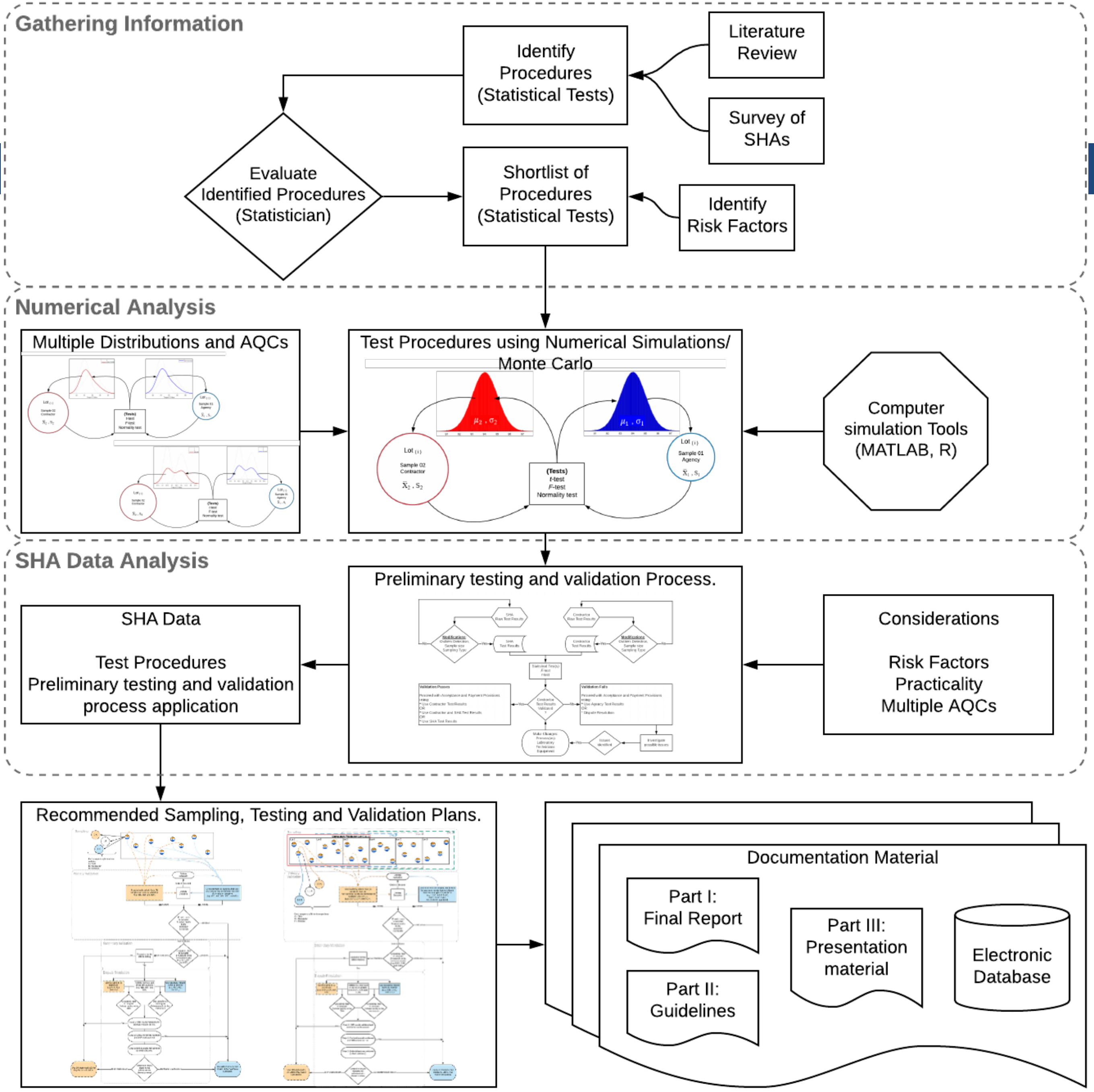
- Many SHAs use Contractor test results in ***acceptance*** decisions
- A need to identify procedures ***currently available*** for validating Contractor test data
- A need to develop ***statistically sound*** and ***practical*** procedures for validating Contractor test data

NCHRP Project 10-100 *Objectives*

- Recommend ***procedures*** for ***validating*** Contractor test data for construction materials
- Prepare ***guidelines*** for the application of the recommended procedures in the form of a proposed AASHTO practice
- ***Illustrate*** for 5 Scenarios/Risks Identified including Non-validation

Research Plan

- Gathering Information
  - Literature Review
  - SHA Survey
  - SHA Specs
- Identified Statistical Tests
  - Shortlisted with Statistician
  - Identified and Evaluated Risks
    - Underlying assumptions, n, …
  - Apply to DOT Data
  - Recommend Sampling, Testing and Validation Plans

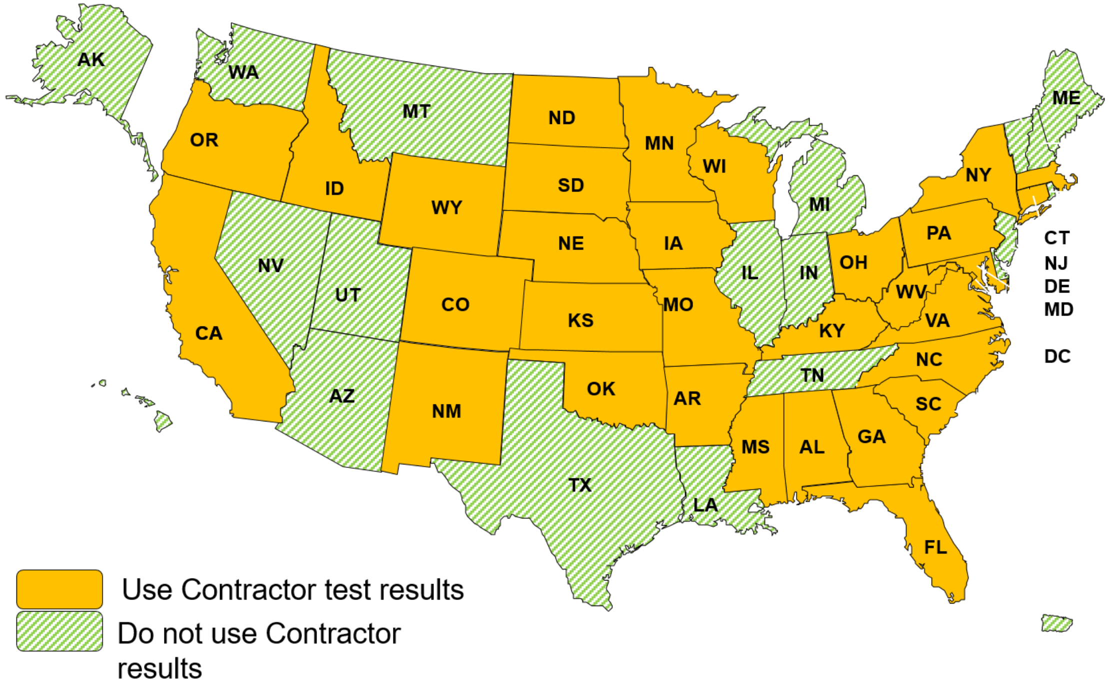


Literature Review - *Summarized into Seven Categories*

1. Validation Techniques and Diversity in Procurement Methods
2. Existing, Modified or New Statistical Tests
3. Concern with Bias
4. Nonparametric tests
5. Potential Risks associated with Mean and Variance tests
6. State of the Practice
7. Policy, Standards, and Guideline

State of the Practice – FHWA Stewardship Reviews

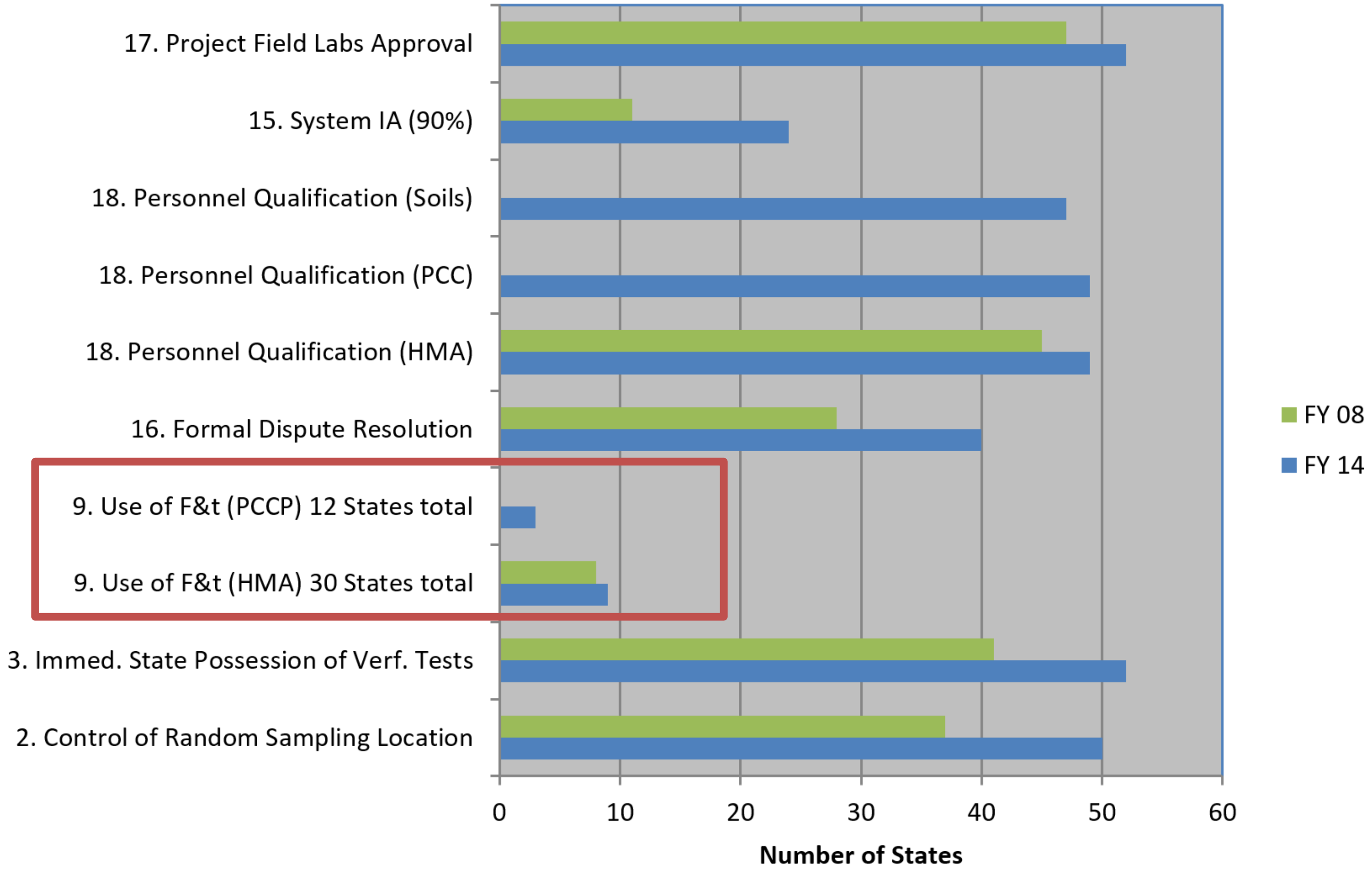
- FHWA Quality Assurance Assessment Report
- 30^{+} SHAs were using Contractor test results in acceptance decision process



Rafalowski, M., J. Withee, and D. Dvorak, "*2014 Quality Assurance Assessment Report*," Federal Highway Administration, Washington, D.C., December 2015.
Rafalowski, M., J. Withee, D. Dvorak, and J. Dietz, "*FHWA Materials Quality Assurance (QA) Assessment*," PowerPoint Presentation, Federal Highway Administration, Washington, D.C., December 2015.

State of the Practice – FHWA Stewardship Reviews

- SHAs using *F*- and *t*-tests for validation
  - 25% for PCC
  - 30% for HMA



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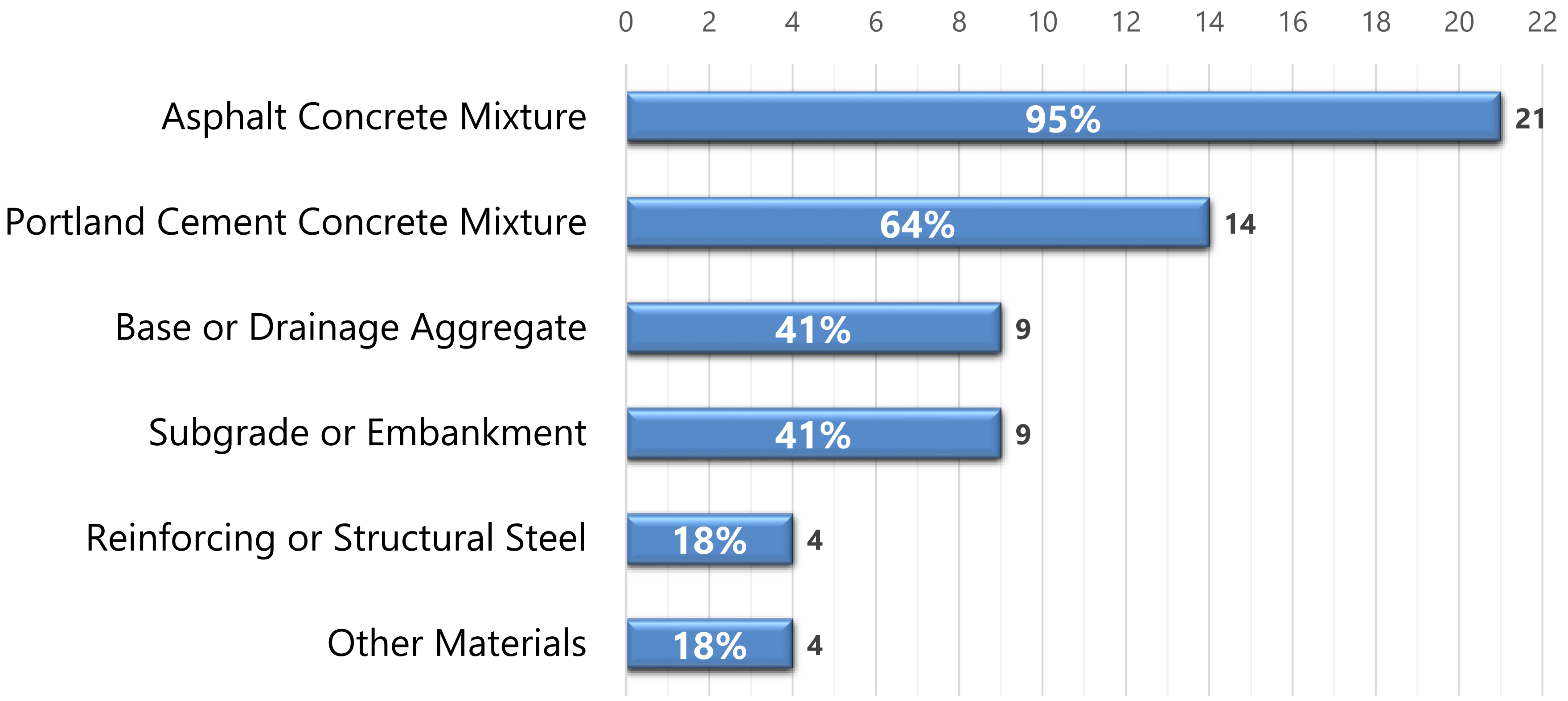
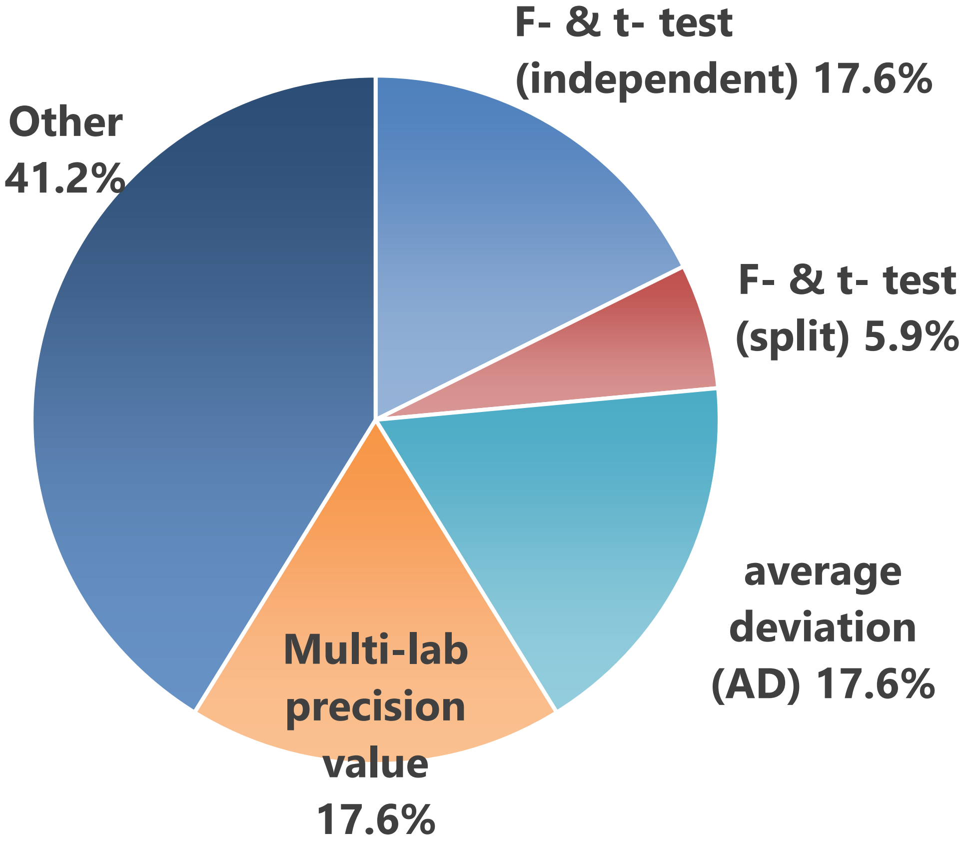
Survey of SHAs

- **Low Response Rate** – *Take with Grain of Salt*
  - 29 SHAs completed the survey
  - 76% (22 of 29 SHAs) use Contractor test results in acceptance procedure
  - For:

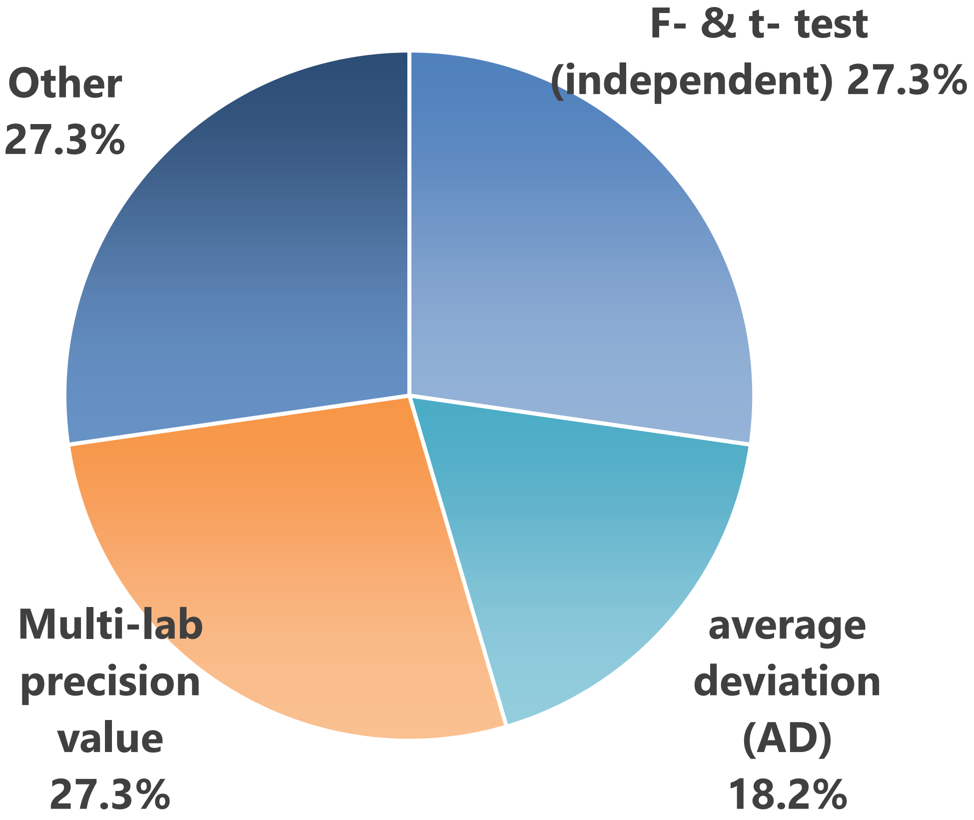


Survey of SHAs – Tests Used for HMA

HMA



PCC



SHORTLIST OF STATISTICAL TESTS

Test	Also Known As	Comments
D2S limits	–	1 on 1 comparison (tests method variability only)
$\bar{X} \pm CR$	–	Low power range test
equal variance *t*-test	Student's *t*-test	mean comparison
unequal variance *t*-test	Welch's, Satterthwaite's	mean comparison
paired *t*-test	–	mean comparison
Ansari-Bradley test	–	non-parametric
Mann-Whitney	Wilcoxon test, Mann–Whitney U, Mann–Whitney–Wilcoxon (MWW)	non-parametric
Fligner-Killeen test	–	non-parametric
F-test	–	variance comparison
Levene's test	–	variance comparison
Bartlett's test	–	variance comparison
Friedman's test	–	variance comparison
Kruskal-Wallis test	–	variance comparison
Kolmogorov-Smirnov test	–	mean comparison
Anderson-Darling test	–	Normality
Shapiro-Wilk test	–	Normality
Permutation test	–	Randomization
bootstrap-based test	–	randomization

–No data

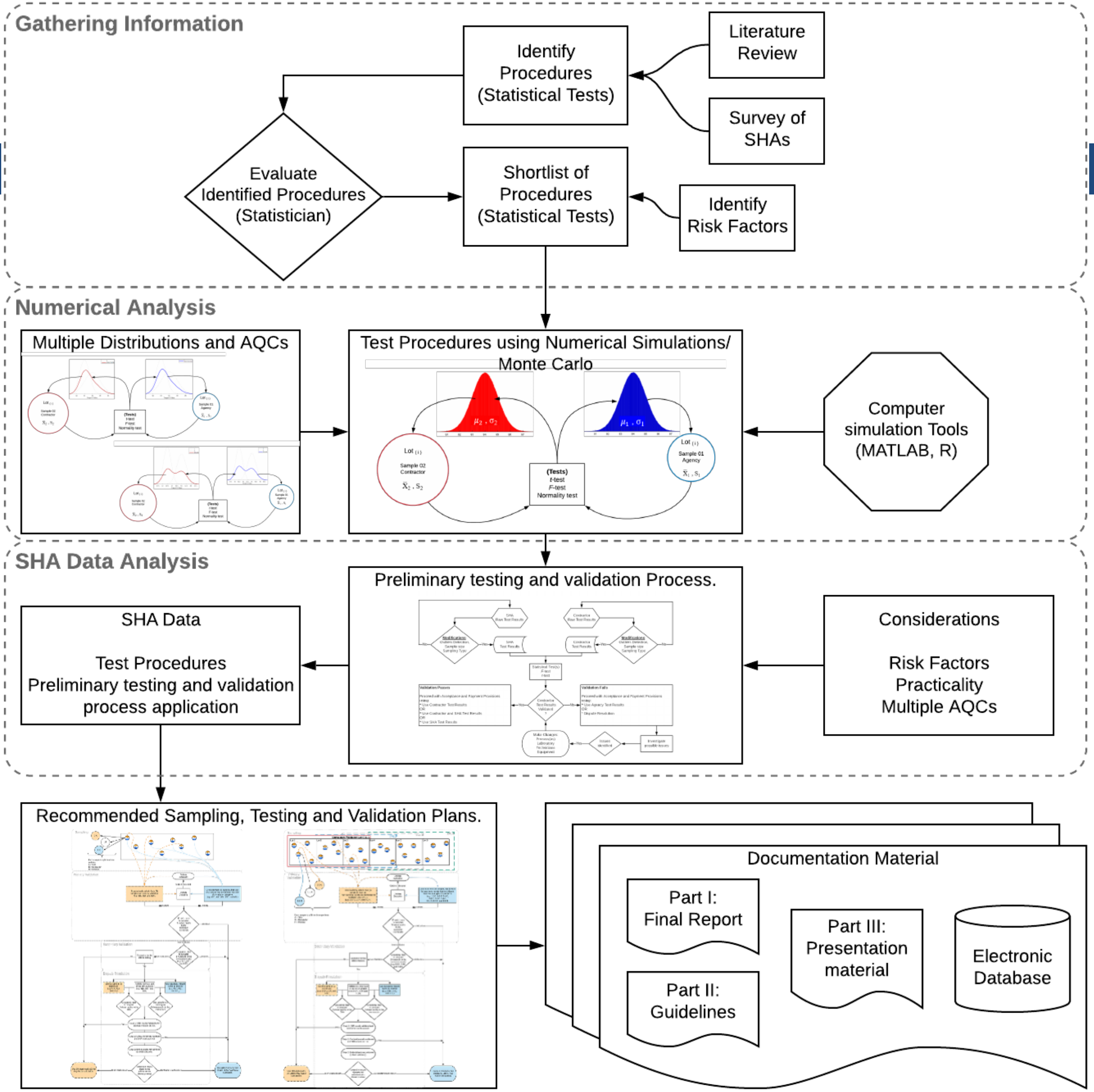
Risk Identification and Mitigation

#	Risk / Procedure	Proposed Mitigation / Modification	Observations	Reference
		Require contractor quality	This potentially relives the	
	based tests		SHA projects	

#	Assumption	Risk	Suggested mitigation	Reference(s)
1	Independence of observations	Bias, control of sampling	Sample location or time has been randomly selected by the SHA and is only given to the contractor immediately prior to sampling	47
2	No significant outliers	Significant outliers in data	Test the statistical significance of outliers (ASTM E 178 Standard Practice for Dealing with Outlying Observations)	*80, 82*
3	Normally distribution	Data violates the normal distribution assumption	1. Detect data distribution 2. Use nonparametric tests (See flow charts for more details)	36, 37, 38, 39, 40
4	Homogeneity of variances	Type I and type II errors	Unequal variance t-test (for mean) Modified Levene Equal-Variance (for variance) (See flow charts for more details)	36, 37, 38, 39, 40

Research Plan

- Numerical Analysis
  - Monte Carlo Simulation
    - Shortlisted Tests
    - PCC & HMA AQCs
    - 4 μ and σ scenarios
    - 3 Distribution Types
    - 7 ratios of n_C vs n_A

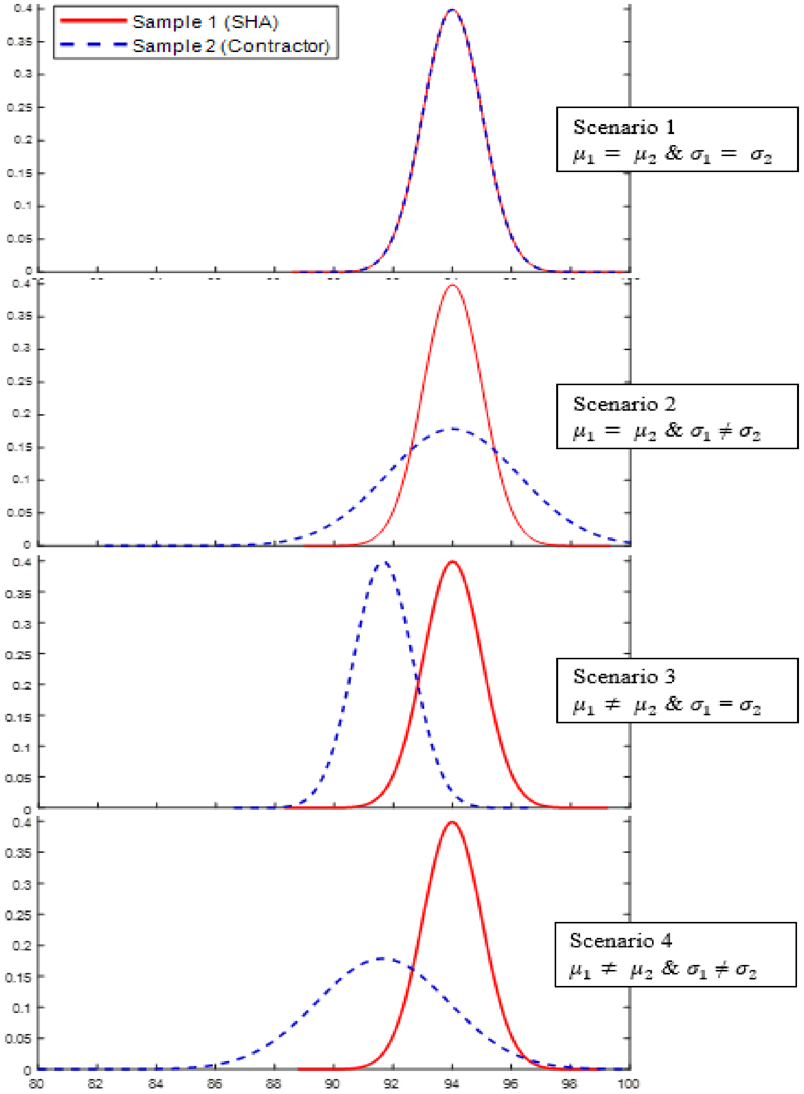


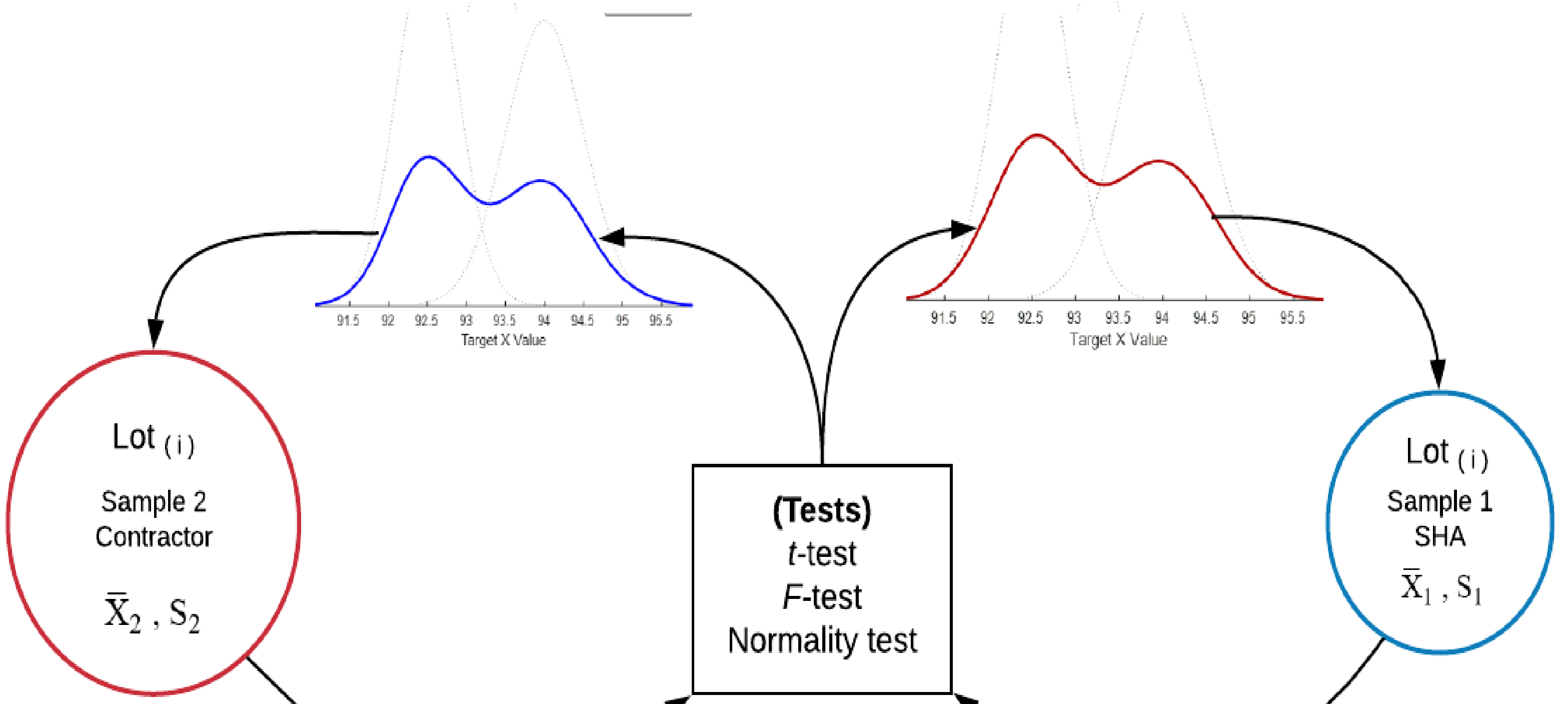
Numerical Analysis

- AQC's
- Typical Values
- Typical Variability

Pavement Type	AQC	Units	Representative Values		
			Mean (μ)	Standard Deviation (σ)	Coefficient of Variation (CV)
HMA	Asphalt Binder content	%	5.5	± 0.50	9.1 %
	In-place density	%	94	± 1.0	1.1 %
	Air Voids	%	7	± 0.5	7.1 %
PCC	Flexural Strength	psi	550	± 100.0	18.2 %
	Compressive Strength	psi	6,000	± 1000.0	16.7 %
	Thickness	inch	10	± 0.25	2.5 %

NUMERICAL ANALYSIS





$$\textbf{Success Rate } (\%) = \frac{N_{H_0}}{N_T} \times 100$$

Compared Performance of Tests

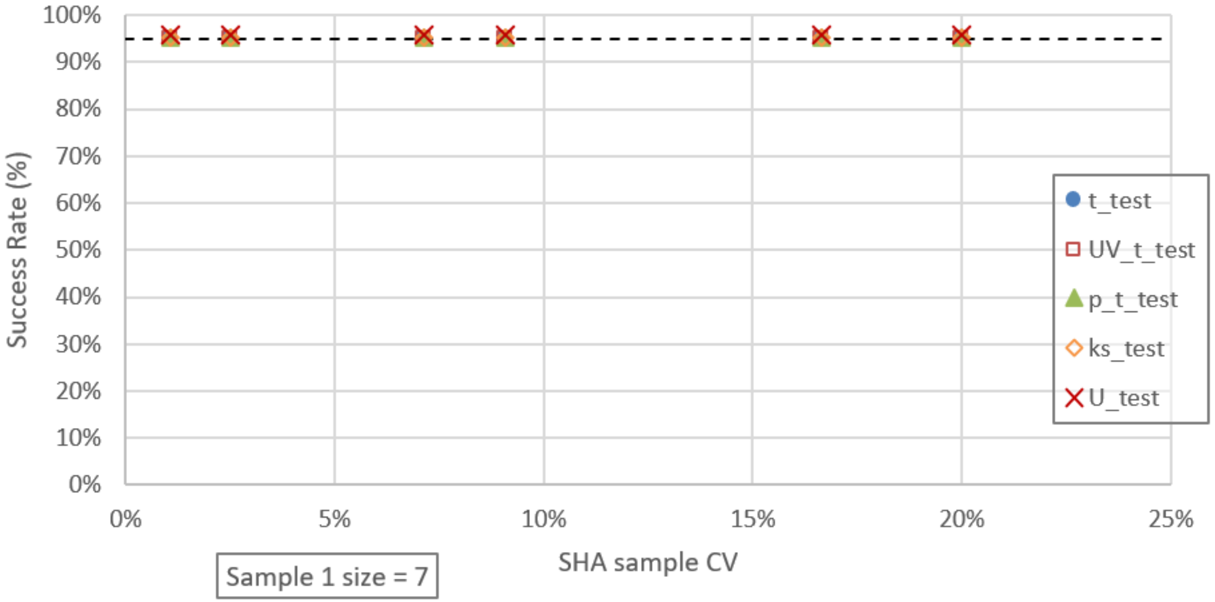


Figure 11. Results for Hypothesis Tests for Scenario 1 ($\mu_1 = \mu_2$ and $\sigma_1 = \sigma_2$).

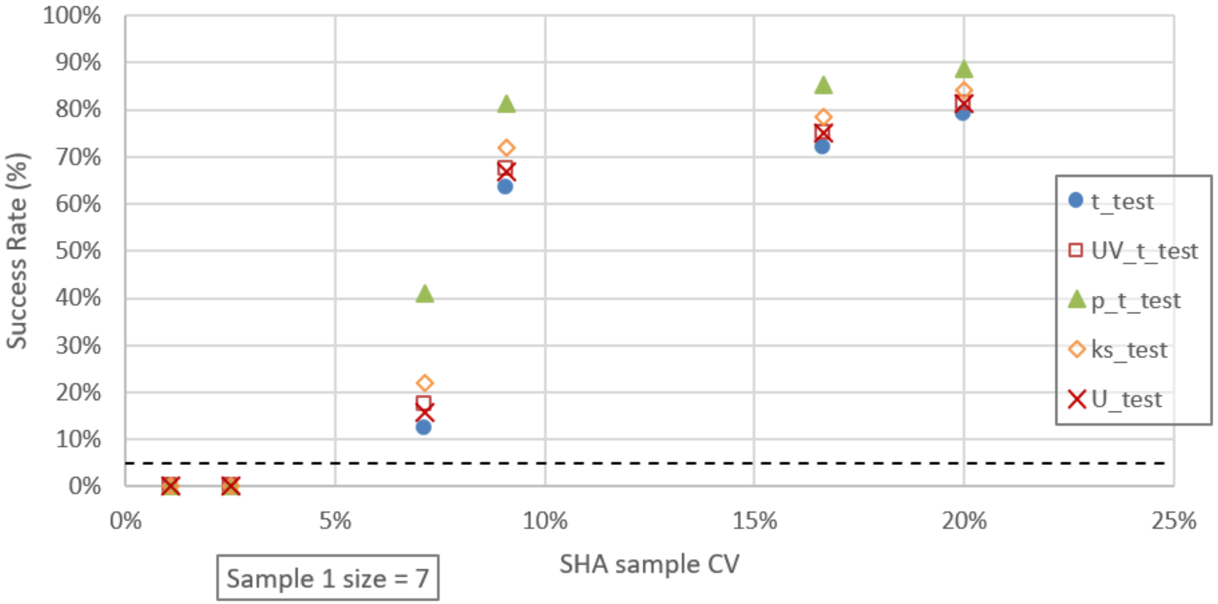


Figure 13. Results for Hypothesis Tests for Scenario 3 ($\mu_1 \neq \mu_2$ and $\sigma_1 = \sigma_2$).

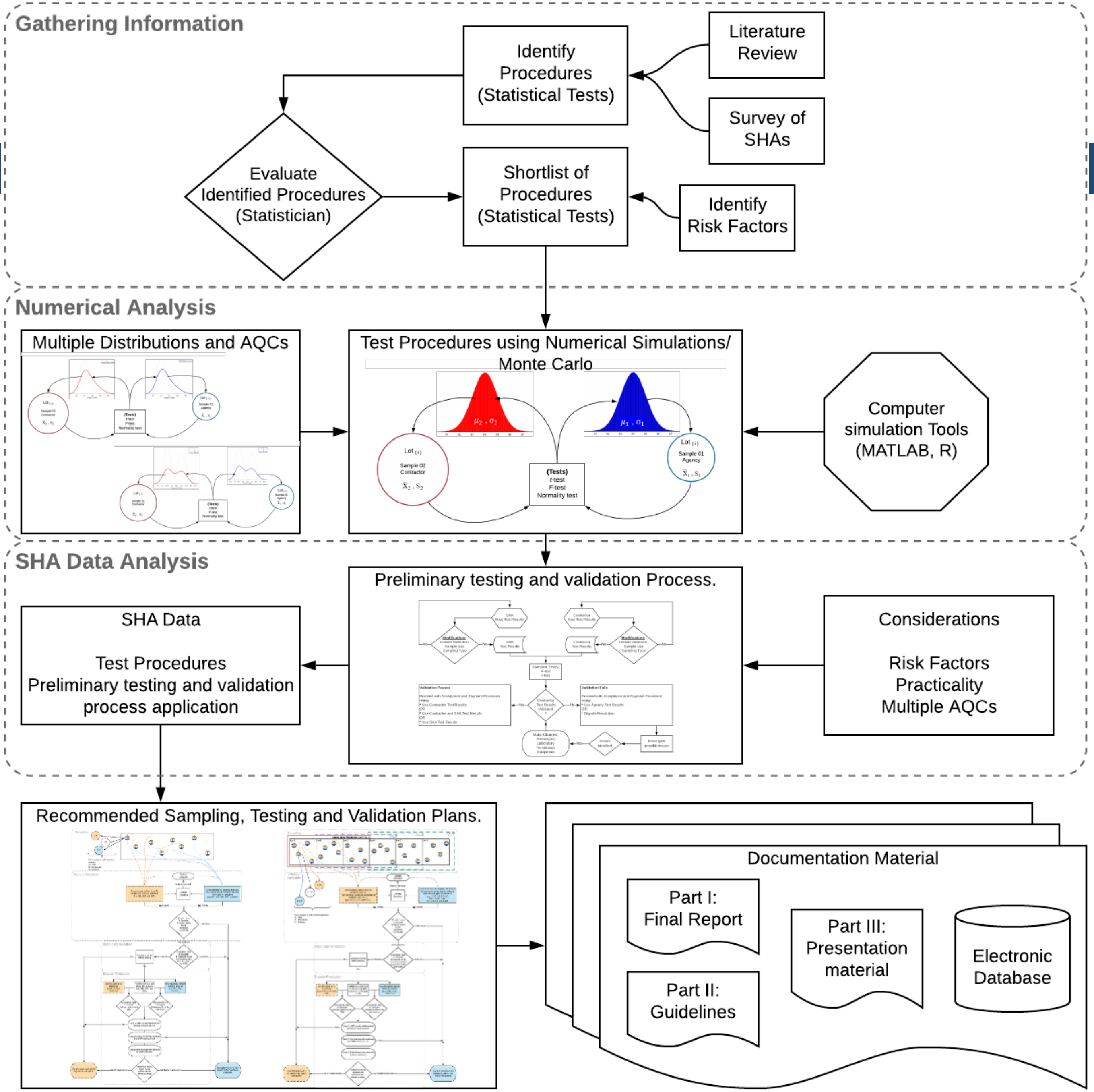
REPEATED NA WITH REAL PROJECT DATA (5 SHAs)

SHA ID	Material Type	AQC	No. of Projects	Average Lots per Project	Total Samples (Lots)
SHA 1	HMA	Density	259	15	3,804
		Air Voids	302	7	2,050
	PCC	Strength	16	22	354
		Thickness	16	22	354
SHA 2	PCC	Strength	18	1	25
SHA 3	HMA	Density	690	7	5,084
		Air Voids	708	8	5,620
		AC	720	9	6,488
		No. 8 Sieve	720	9	6,487
		No. 200 Sieve	720	9	6,490
SHA 4	Aggregates Base	2 inch Sieve	3	41	123
		1 inch Sieve	3	41	123
		3/8 inch Sieve	3	41	123
		No. 10 Sieve	3	41	123
		No. 40 Sieve	3	41	123
		No. 200 Sieve	3	41	123
		Liquid Limit (LL)	3	41	123
		Plasticity Index (PI)	3	41	123
		Moisture Content (MC)	3	41	123
SHA 5	HMA	Air Voids	289	6	1,734
		AC	289	6	1,734
		VMA	289	6	1,734

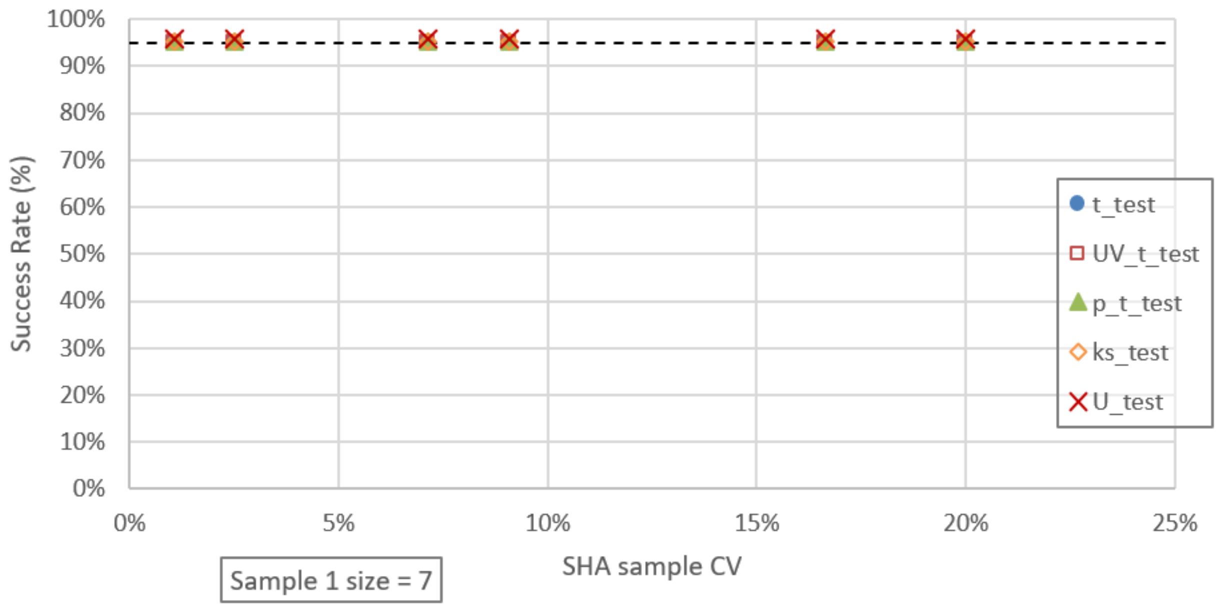
AQC	No. of Scenarios	Sample 1 Sizes	Sample 2 Sizes	No. of Iterations	No. of Simulations
HMA - In-place density	4	5	10	1,000	200,000
HMA – Asphalt Binder Content	4	5	10	1,000	200,000
HMA - Laboratory Air Voids	4	5	10	1,000	200,000
PCC - Compressive Strength	*4*	*5*	*10*	*1,000*	*200,000*
PCC - Flexural Strength	*4*	*5*	*10*	*1,000*	*200,000*
PCC - Thickness	*4*	*5*	*10*	*1,000*	*200,000*
HMA - In-place density	4	5	10	20	4,000
HMA - Asphalt Binder Content	4	5	10	20	4,000
HMA - Laboratory Air Voids	4	5	10	20	4,000
PCC - Compressive Strength	*4*	*5*	*10*	*20*	*4,000*
PCC - Flexural Strength	*4*	*5*	*10*	*20*	*4,000*
PCC - Thickness	*4*	*5*	*10*	*20*	*4,000*
HMA - In-place density	4	5	10	10	2,000
HMA - Asphalt Binder Content	4	5	10	10	2,000
HMA - Laboratory Air Voids	4	5	10	10	2,000
PCC - Compressive Strength	*4*	*5*	*10*	*10*	*2,000*
PCC - Flexural Strength	*4*	*5*	*10*	*10*	*2,000*
PCC - Thickness	*4*	*5*	*10*	*10*	*2,000*
HMA - In-place density	4	5	10	5	1,000
HMA - Asphalt Binder Content	4	5	10	5	1,000
HMA - Laboratory Air Voids	4	5	10	5	1,000
PCC - Compressive Strength	*4*	*5*	*10*	*5*	*1,000*
PCC - Flexural Strength	*4*	*5*	*10*	*5*	*1,000*
PCC - Thickness	*4*	*5*	*10*	*5*	*1,000*
Total number of simulations for normal distribution					**1,242,000**
Total number of simulations for all three distributions (1,242,000 × 3)					**3,726,000**

Research Plan

- SHA Data
- Recommended Procedures



COMPARED PERFORMANCE OF TESTS WITH REAL PROJECT DATA



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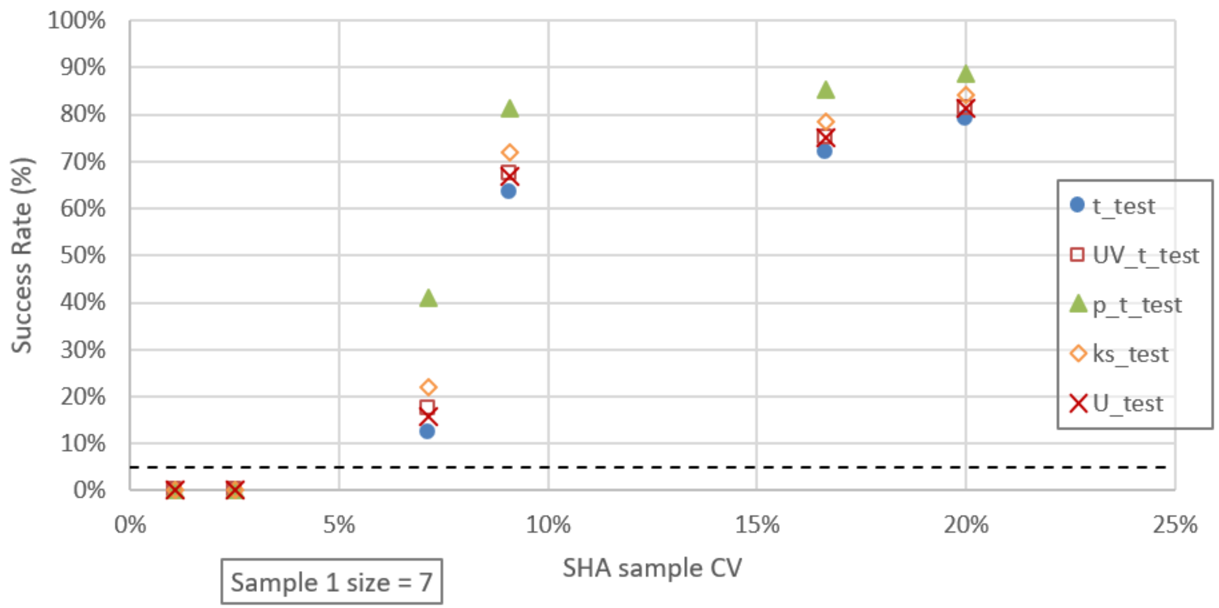


Figure 13. Results for Hypothesis Tests for Scenario 3 ($\mu_1 \neq \mu_2$ and $\sigma_1 = \sigma_2$).

Recommended Tests

- Welch's t-test
  - Unequal variance t-test

Welch's *t-test* performs better than Student's *t-test* whenever sample sizes and variances are unequal between groups, and gives the same result when sample sizes and variances are equal.

- F-test

- Tests Do Not Eliminate All Risks, More to Come…

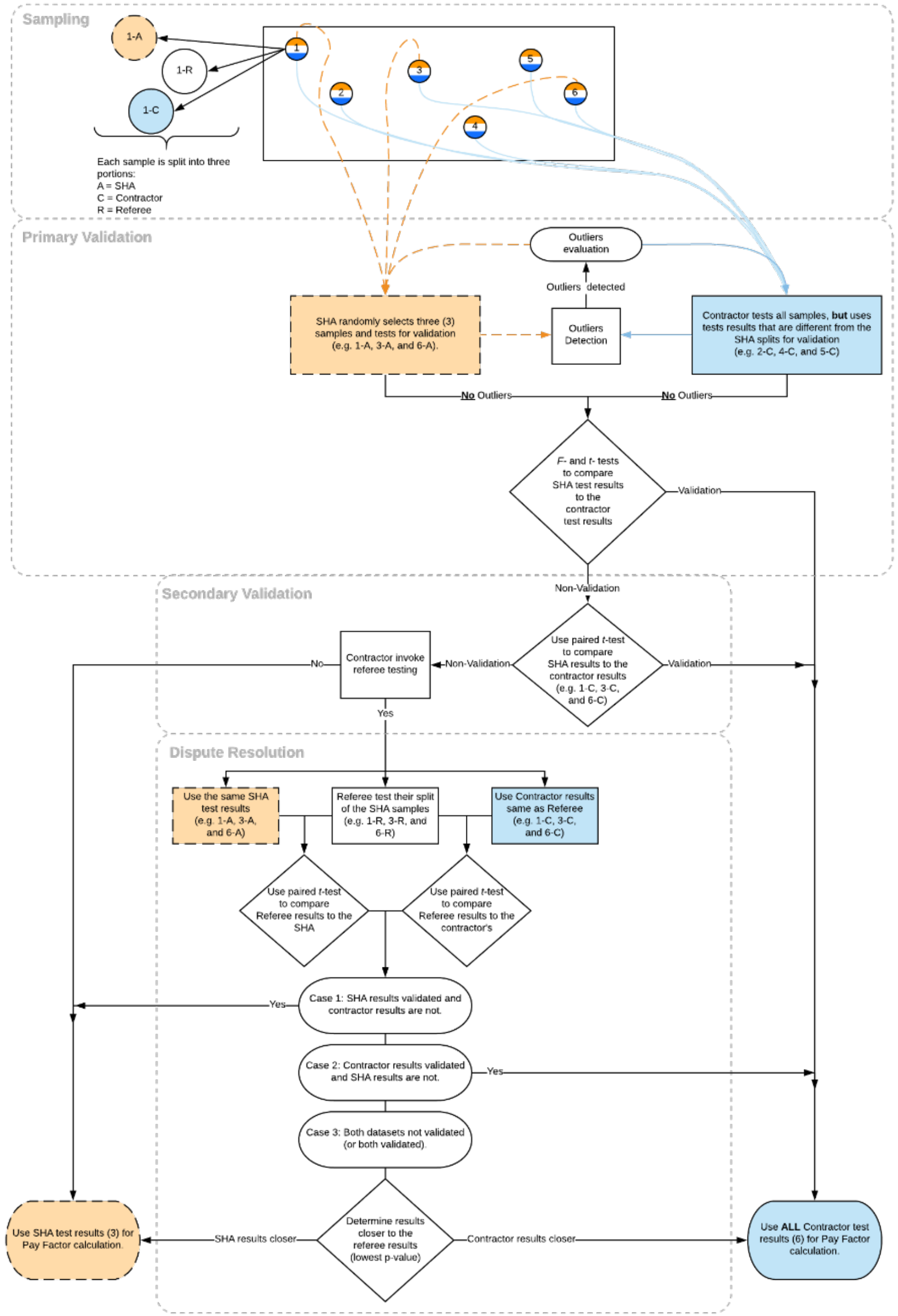
Validation Procedure

1. Sampling

2. Primary Validation

3. Secondary Validation

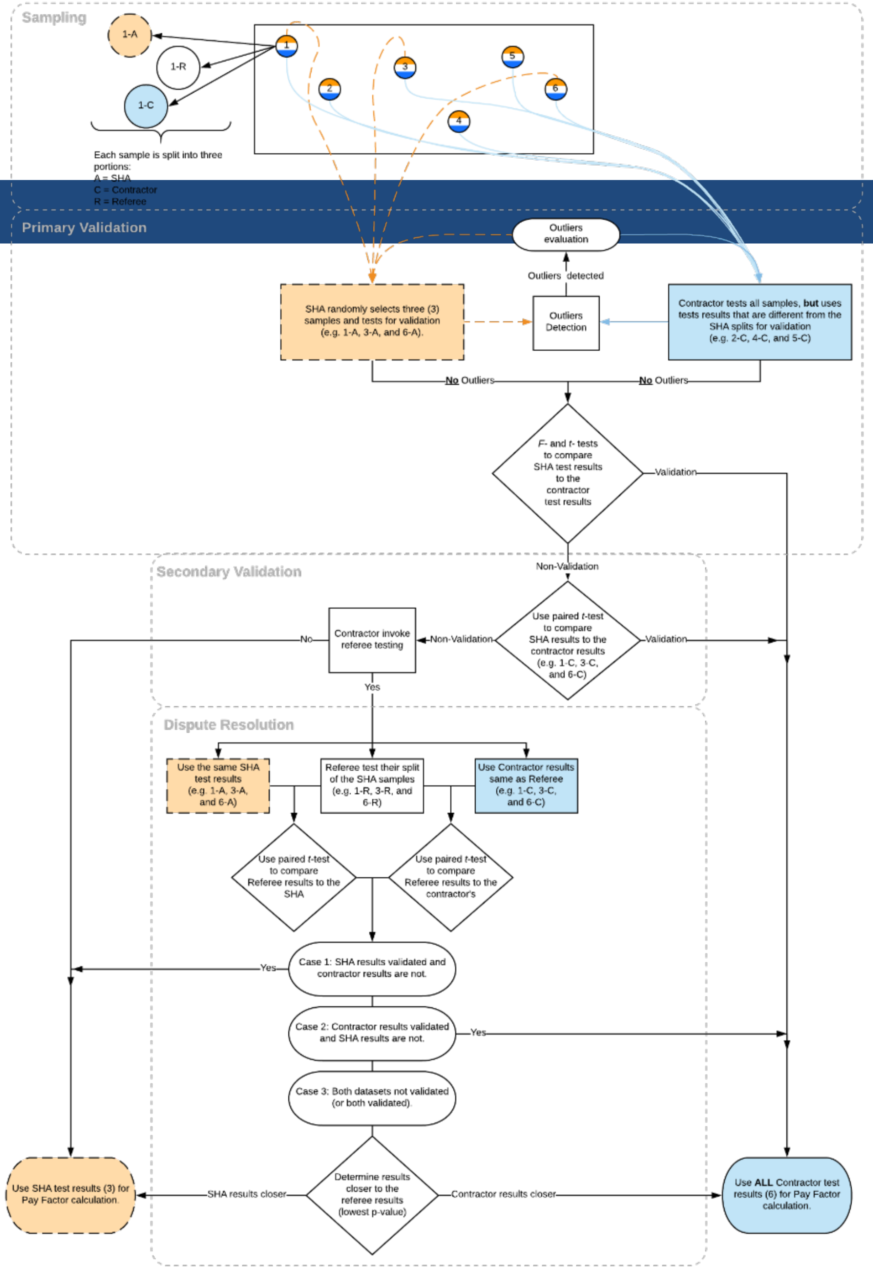
4. Dispute Resolution



Validation Procedure

1. Sampling

VALIDATION PROCEDURE

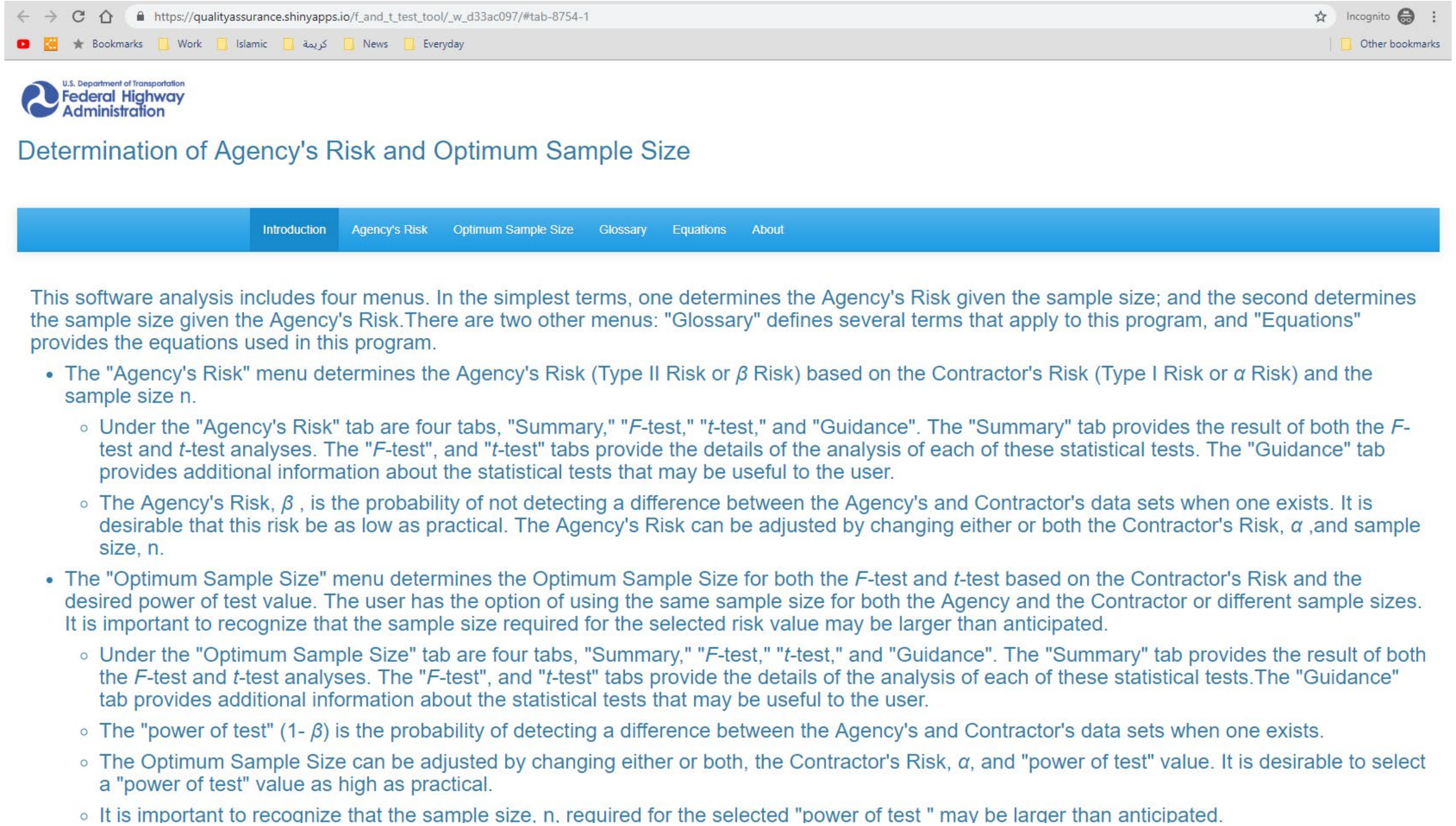


- Sampling
  - Lot and sublot definitions?
    - A pour, a day's production,…
    - Resources required, time required, …
    - Minimum n tolerable (must do risk analysis)
    - Be conscious of $ at risk for contractor
  - Where and process?
  - Purpose – sample size, # splits needed?
  - Labeling, chain of custody, storage and integrity
  - Not in scope…tests and application of them
  - *Illustrate w/* ***Minimum*** *to use Validation Procedure*

SAMPLING

DETERMINATION OF SHA'S RISK AND OPTIMUM SAMPLE SIZE

- FHWA-RD-02-095
  - Chapter 7
- OC curves
- Risk
  - Hypothesis tests
  - $/lot



https://qualityassurance.shinyapps.io/f_and_t_test_tool/_w_d33ac097/#tab-8754-1

U.S. Department of Transportation Federal Highway Administration

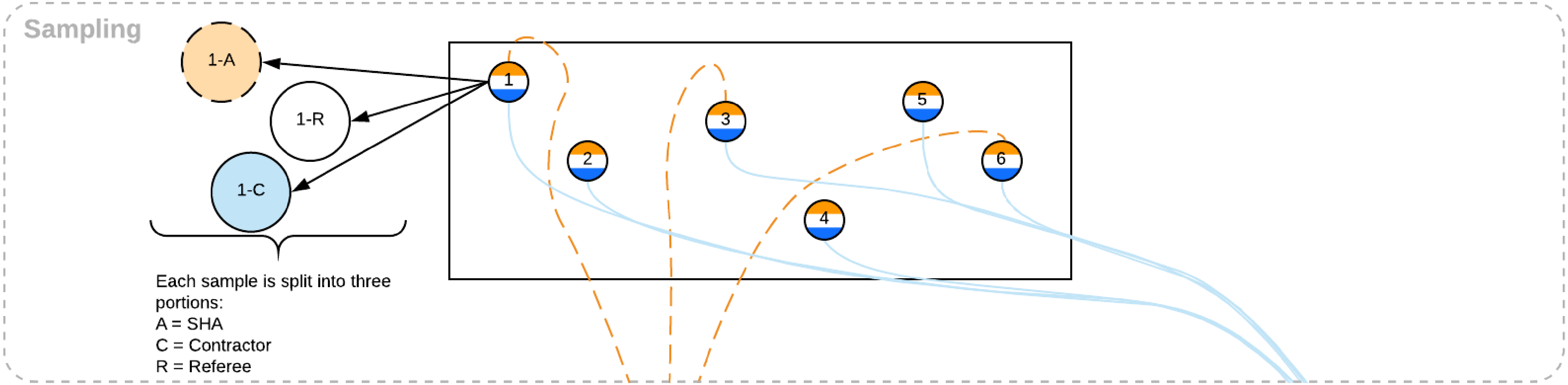
Determination of Agency's Risk and Optimum Sample Size

Introduction | Agency's Risk | Optimum Sample Size | Glossary | Equations | About

This software analysis includes four menus. In the simplest terms, one determines the Agency's Risk given the sample size; and the second determines the sample size given the Agency's Risk.There are two other menus: "Glossary" defines several terms that apply to this program, and "Equations" provides the equations used in this program.

- The "Agency's Risk" menu determines the Agency's Risk (Type II Risk or β Risk) based on the Contractor's Risk (Type I Risk or α Risk) and the sample size n.
  - Under the "Agency's Risk" tab are four tabs, "Summary," "*F*-test," "*t*-test," and "Guidance". The "Summary" tab provides the result of both the *F*-test and *t*-test analyses. The "*F*-test", and "*t*-test" tabs provide the details of the analysis of each of these statistical tests. The "Guidance" tab provides additional information about the statistical tests that may be useful to the user.
  - The Agency's Risk, β , is the probability of not detecting a difference between the Agency's and Contractor's data sets when one exists. It is desirable that this risk be as low as practical. The Agency's Risk can be adjusted by changing either or both the Contractor's Risk, α ,and sample size, n.
- The "Optimum Sample Size" menu determines the Optimum Sample Size for both the *F*-test and *t*-test based on the Contractor's Risk and the desired power of test value. The user has the option of using the same sample size for both the Agency and the Contractor or different sample sizes. It is important to recognize that the sample size required for the selected risk value may be larger than anticipated.
  - Under the "Optimum Sample Size" tab are four tabs, "Summary," "*F*-test," "*t*-test," and "Guidance". The "Summary" tab provides the result of both the *F*-test and *t*-test analyses. The "*F*-test", and "*t*-test" tabs provide the details of the analysis of each of these statistical tests.The "Guidance" tab provides additional information about the statistical tests that may be useful to the user.
  - The "power of test" (1- β) is the probability of detecting a difference between the Agency's and Contractor's data sets when one exists.
  - The Optimum Sample Size can be adjusted by changing either or both, the Contractor's Risk, α, and "power of test" value. It is desirable to select a "power of test" value as high as practical.
  - It is important to recognize that the sample size, n, required for the selected "power of test " may be larger than anticipated.

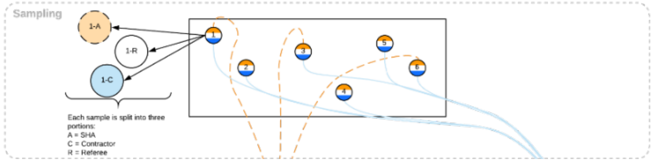
1. SAMPLING



- A ***minimum*** of six sublots per lot, more is better…
- Split each sample into three *or more* equal portions
- Label samples 1-A, 1-C, 1-R, 2-A, 2-C, 2-R and so on

  A = SHA, C = Contractor, R = Referee

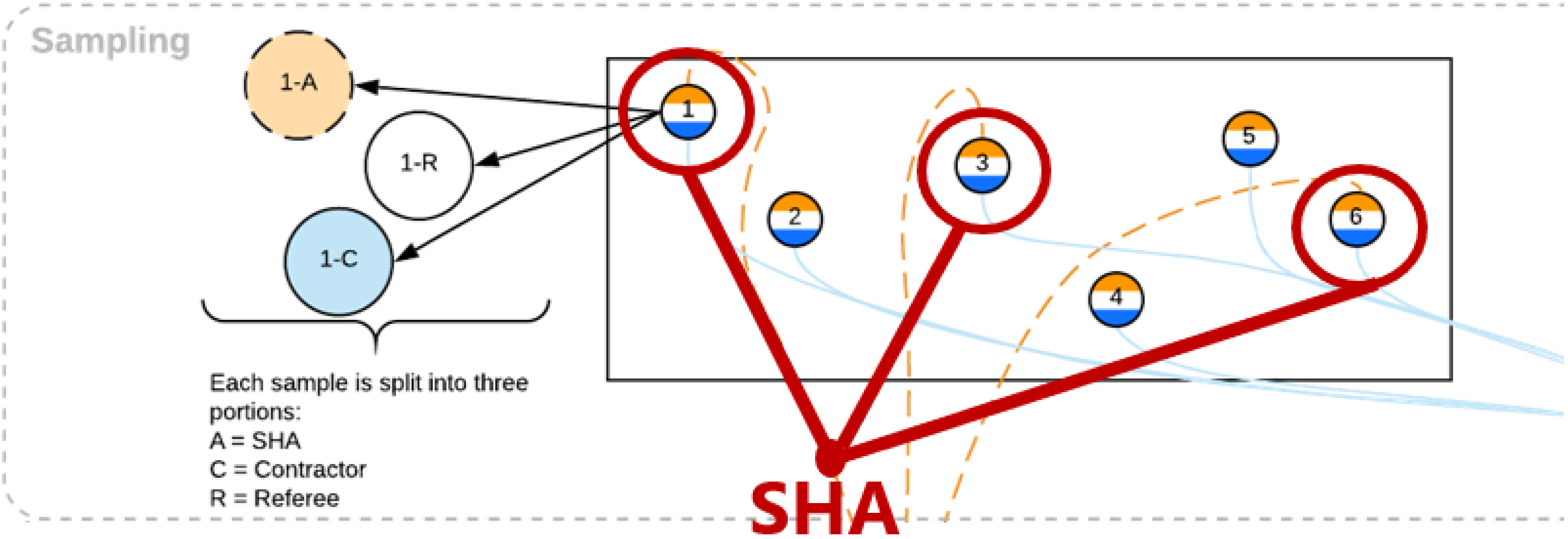
1. SAMPLING



- Chain of custody to maintain sample integrity
- SHA standard for security & integrity of Validation and Referee sample portions
- Integrity:
  - Clearly labeled
  - Securely sealed
  - Properly stored
  - …

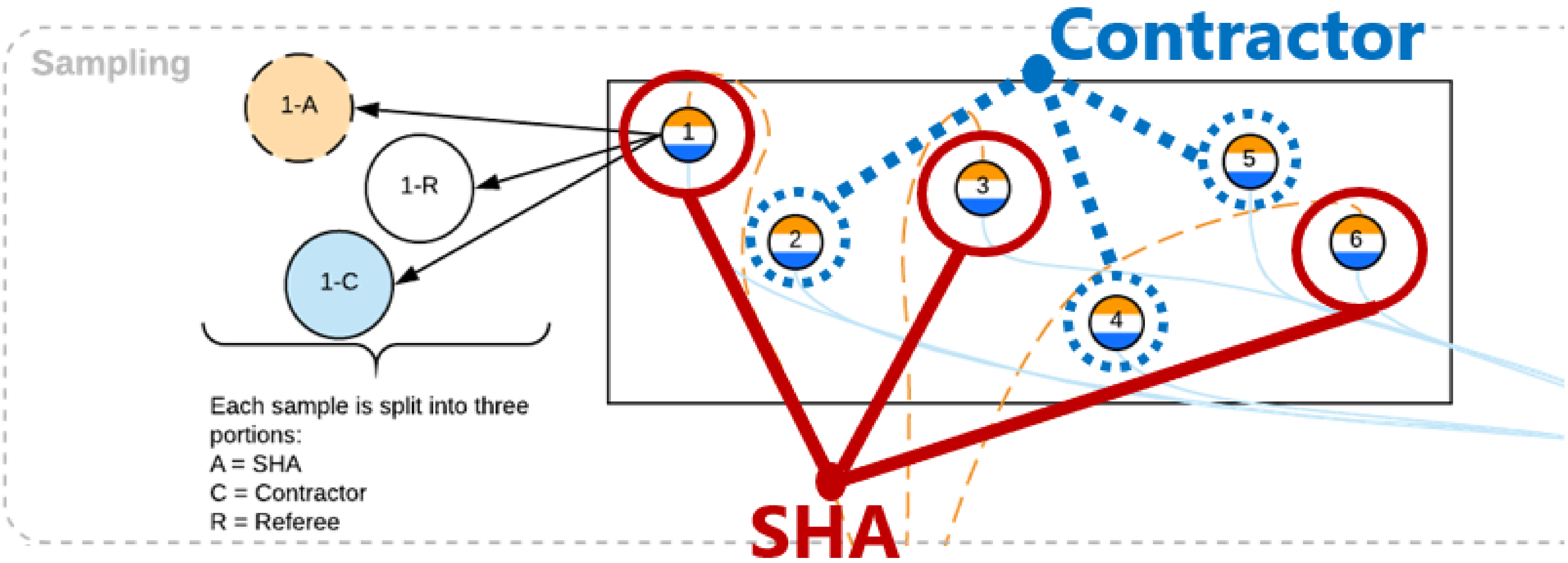
1. Sampling

- Contractor tests all sublot splits (1-C, 2-C, 3-C, 4C, 5C, 6C)
- SHA *randomly* selects 3 sublots for validation testing (e.g., 1-A, 3-A, and 6-A)
- 3 verification results is ***minimum*** number to produce statistically valid results



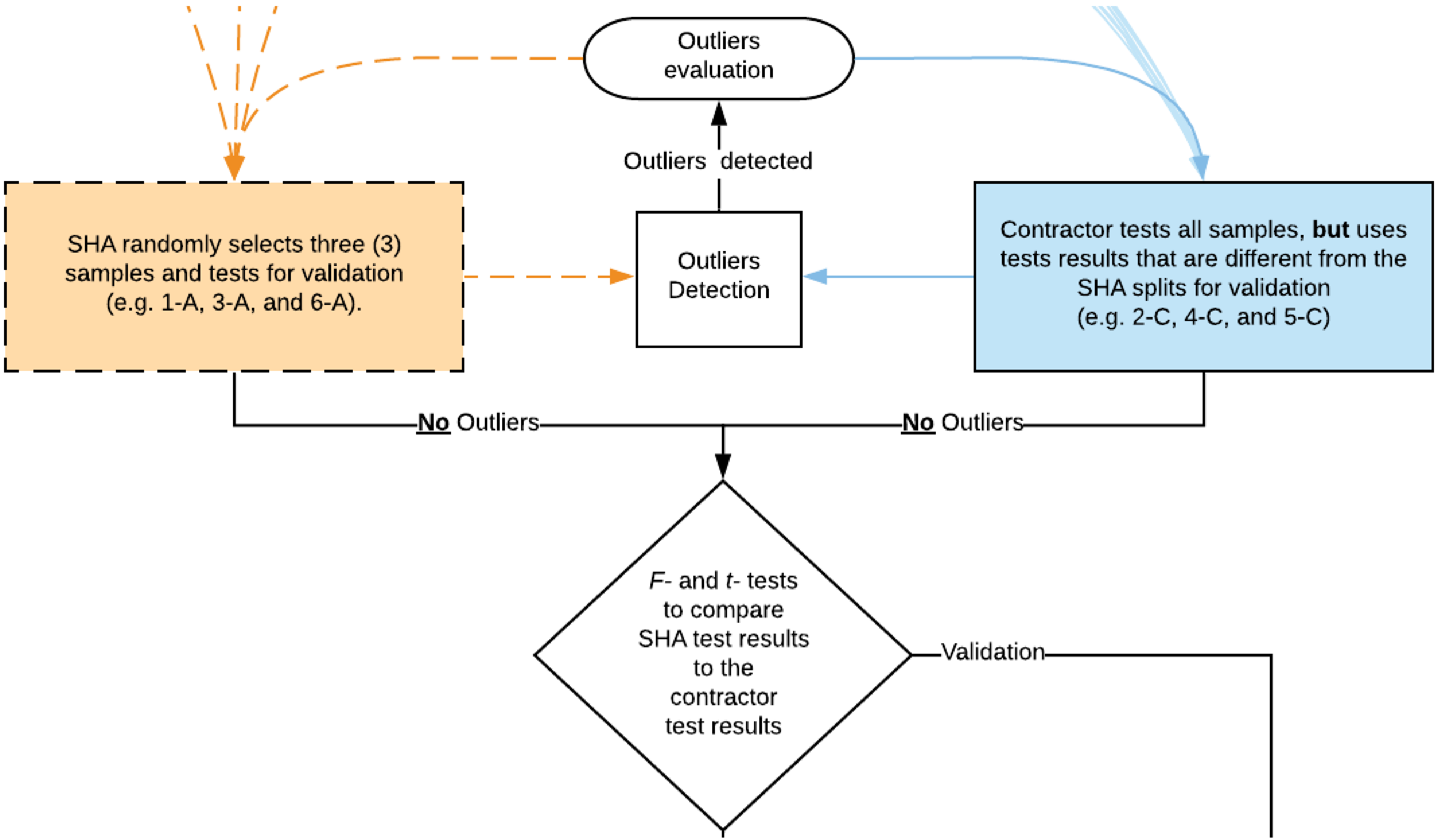
1. Sampling

- Contractor tests sublots corresponding to the SHA samples excluded from *F*- and *t*-tests in the **primary validation** (e.g., 2-C, 4-C, and 5-C)
- Independent samples used, CFR satisified



Validation Procedure
2. Primary Validation

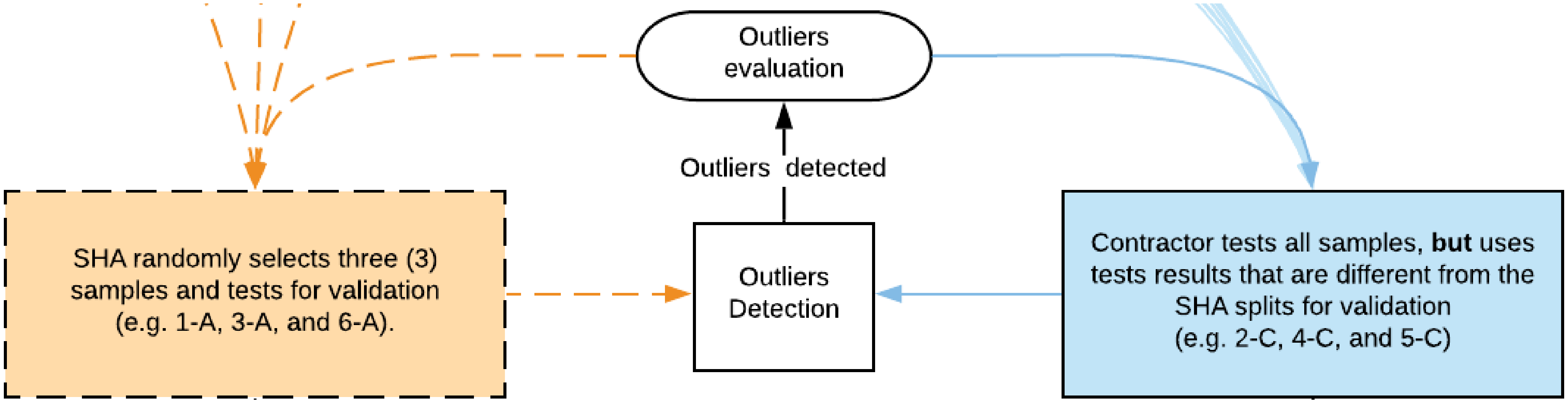
2. Primary Validation



2. PRIMARY VALIDATION

OUTLIERS DETECTION

- Evaluate SHA and Contractor data sets for outlying observations
- ASTM E178 "*Standard Practice for Dealing With Outlying Observations*"



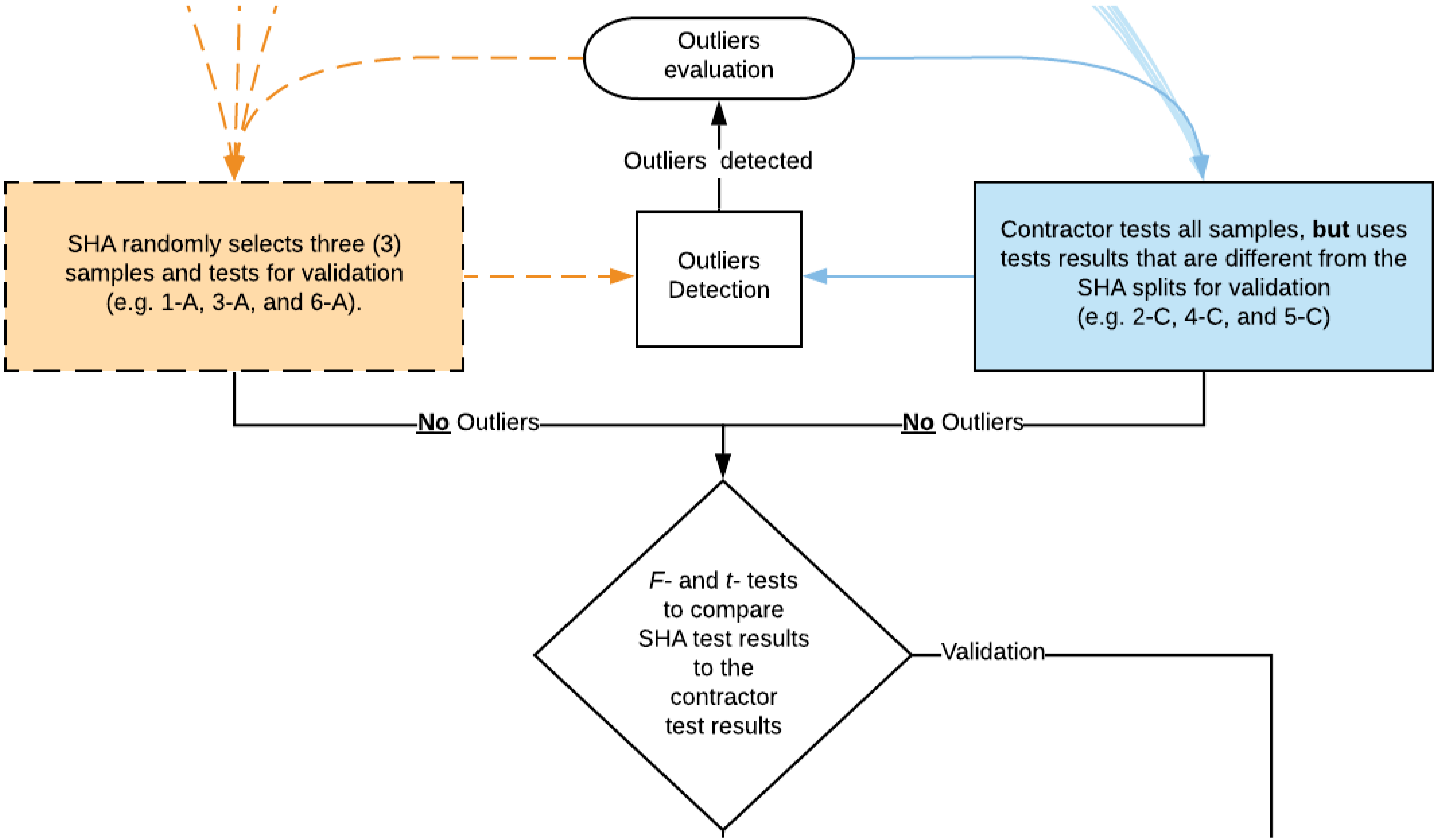
2. Primary Validation

Outliers Detection

- If an outlier is detected in either set:
  - Investigate to determine probable cause(s) of the outlying data
  - Make a decision to discard or not
    - Only if explainable - *"flyer"*
  - Correct the cause(s) for subsequent sampling and testing
  - QA plan should address resampling and testing
    - No, Yes, if so procedure and how used in QA plan
  - Don't abuse – frequency - IA

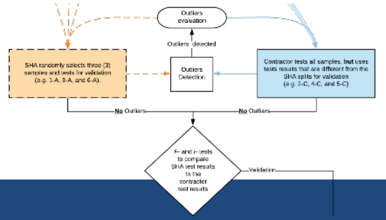
2. PRIMARY VALIDATION

HYPOTHESIS TESTING



2. Primary Validation

Hypothesis Testing



- Compare variabilities with *F*-test

Some suggest F-test not needed

- Compare means with **Welch's *t*-test**
- If *F*-test and Welch's *t*-test Pass, data sets are from the same population, Contractor's data are considered validated
- If either the *F*-test (Fail) or Welch's *t*-test (Fail), then the Contractor's data are not validated
- Proceed to secondary validation

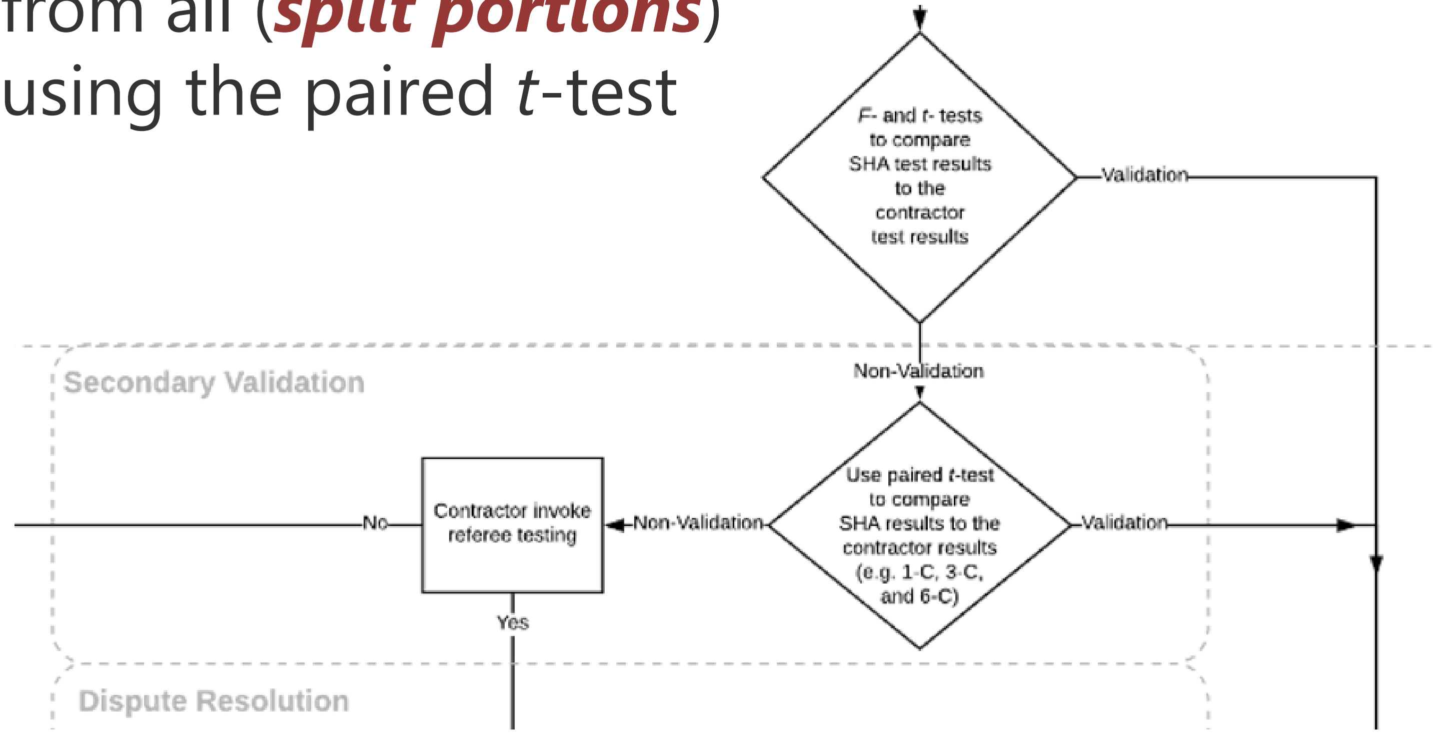
Validation Procedure

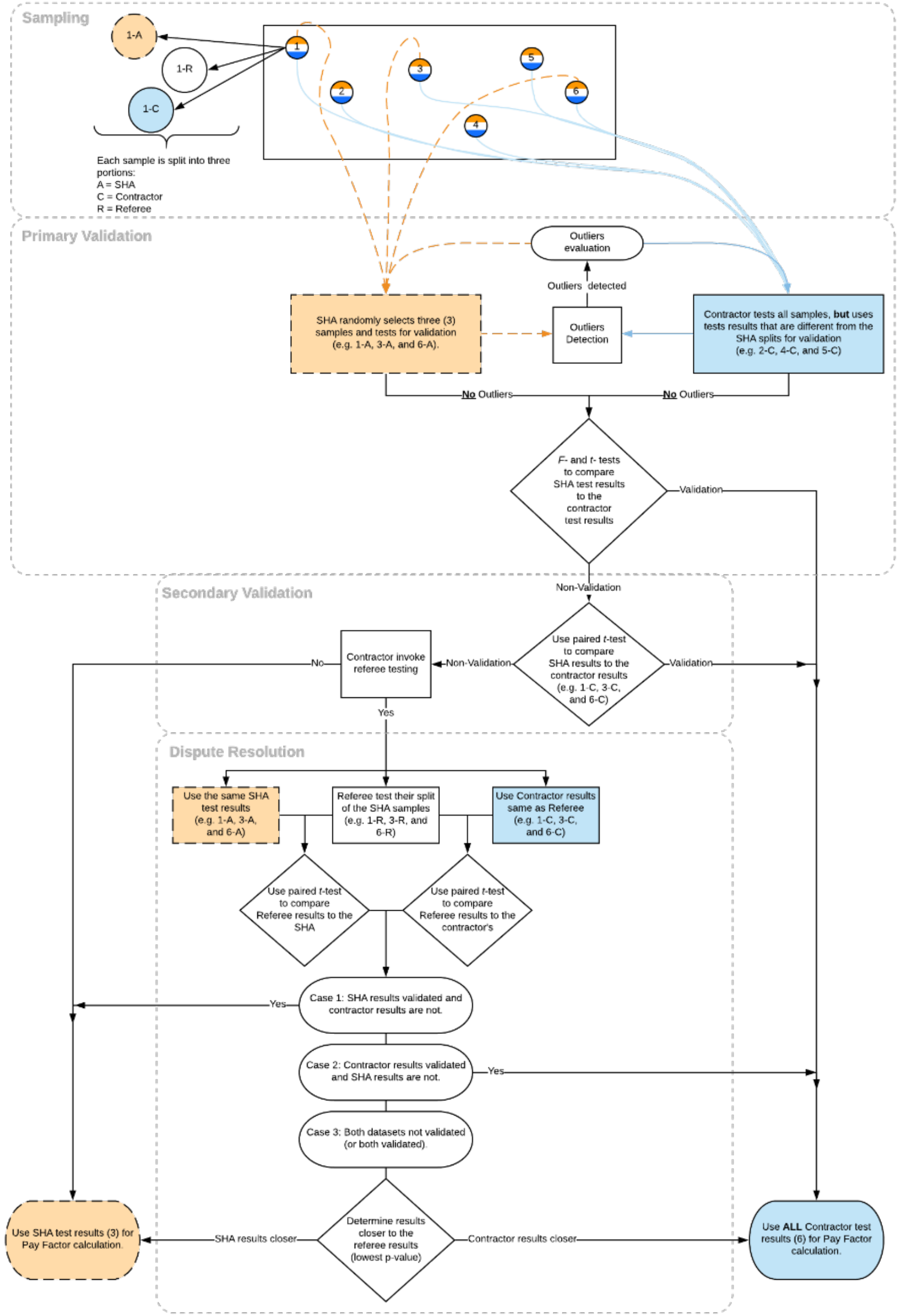
3. Secondary Validation

3. Secondary Validation

Paired t-testing

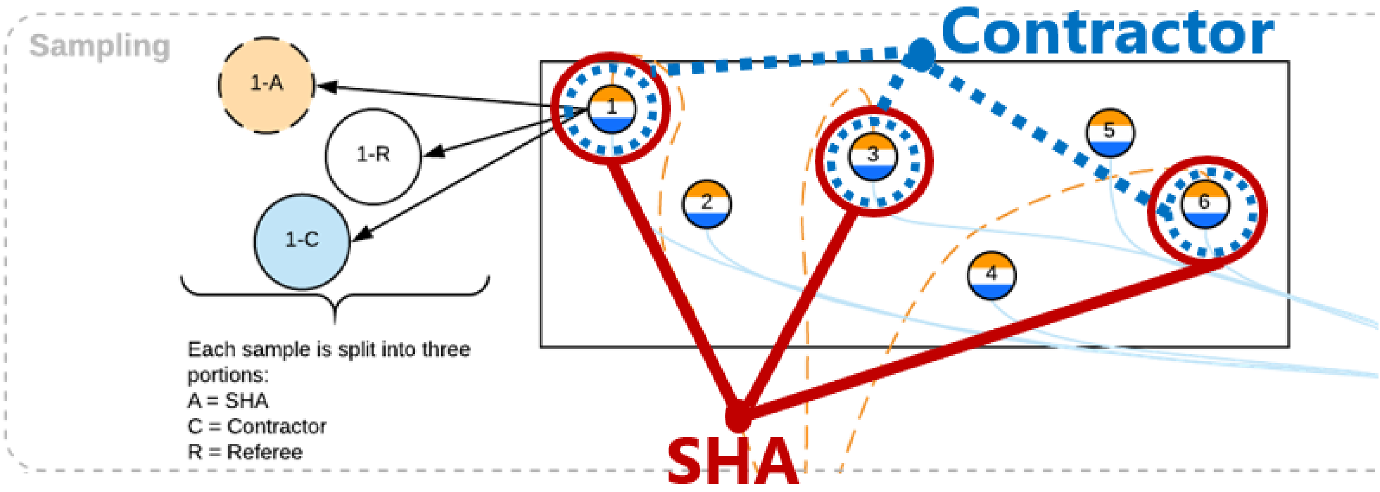
- Compare means of Contractor and SHA results from all (***split portions***) using the paired *t*-test





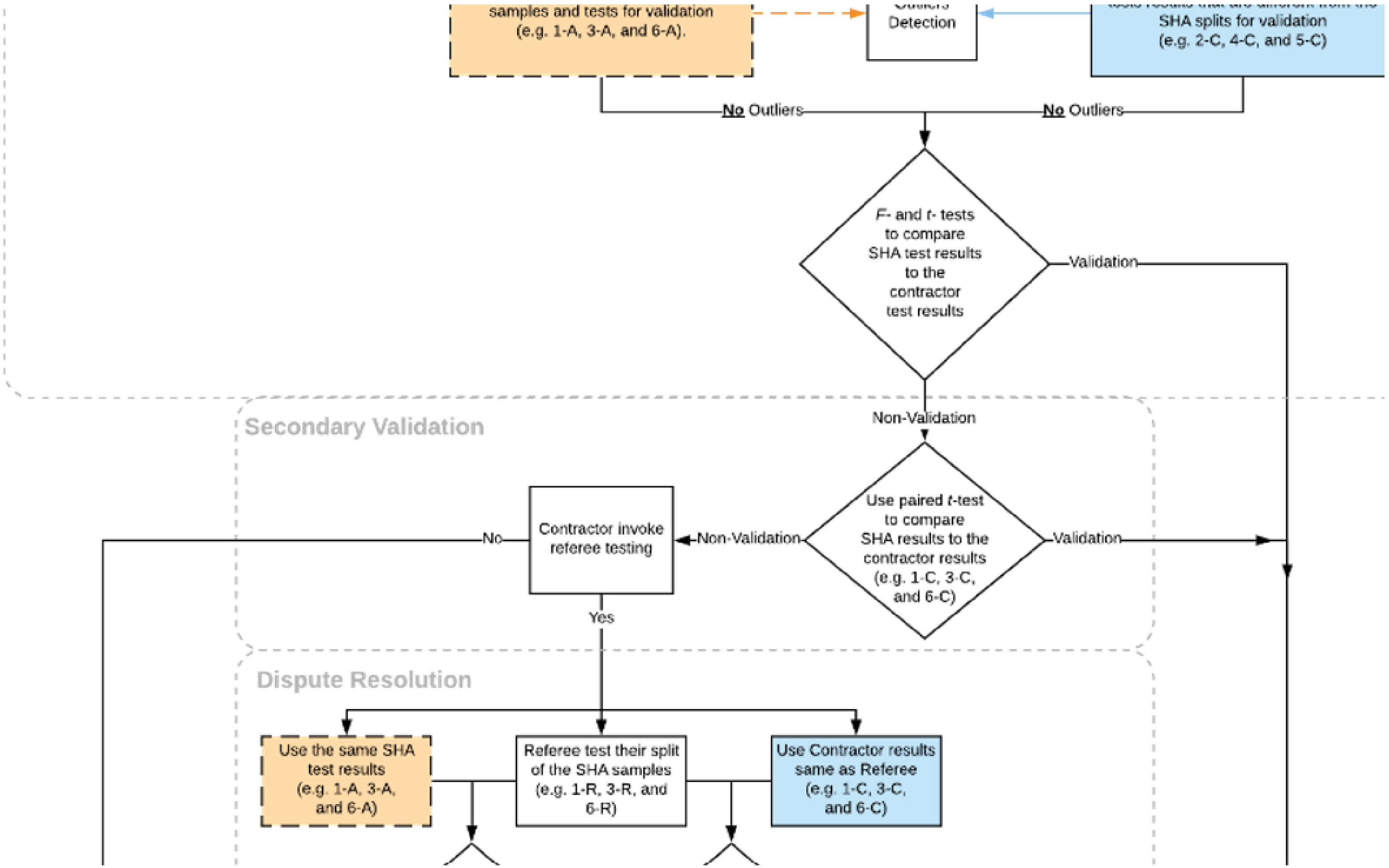
3. Secondary Validation

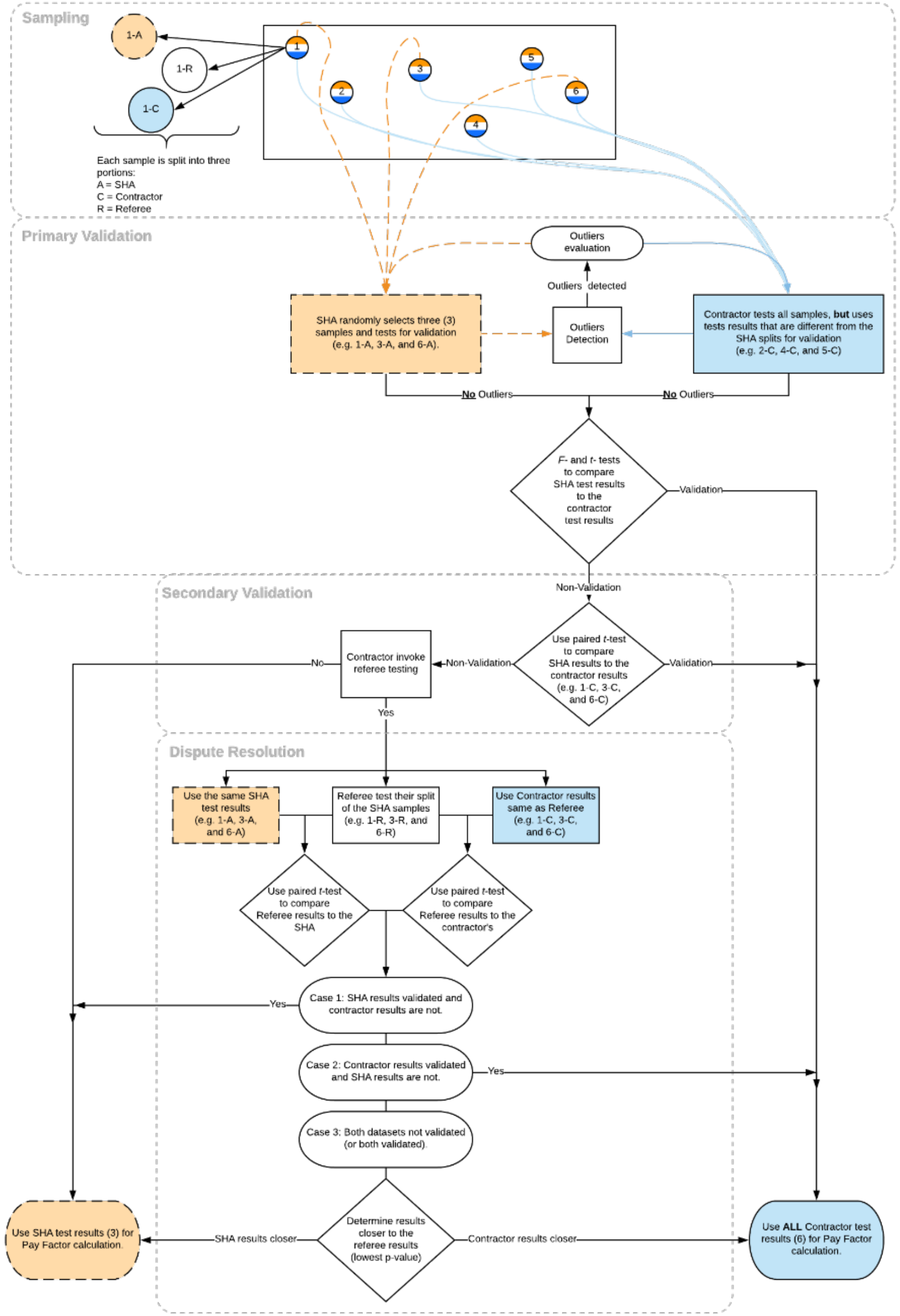
- Compare means of Contractor and SHA results from all (***split portions***) using the paired *t*-test (1-A, 1-C, 3-A, 3-C, 6-A, 6-C)
- If paired *t*-test (Pass), Contractor's data are validated
- If paired *t*-test (Fail), then the Contractor's data not validated
- The comparison **may** proceed to Dispute Resolution



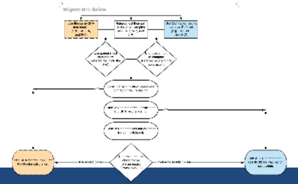
Validation Procedure
4. Dispute Resolution

4. Dispute Resolution

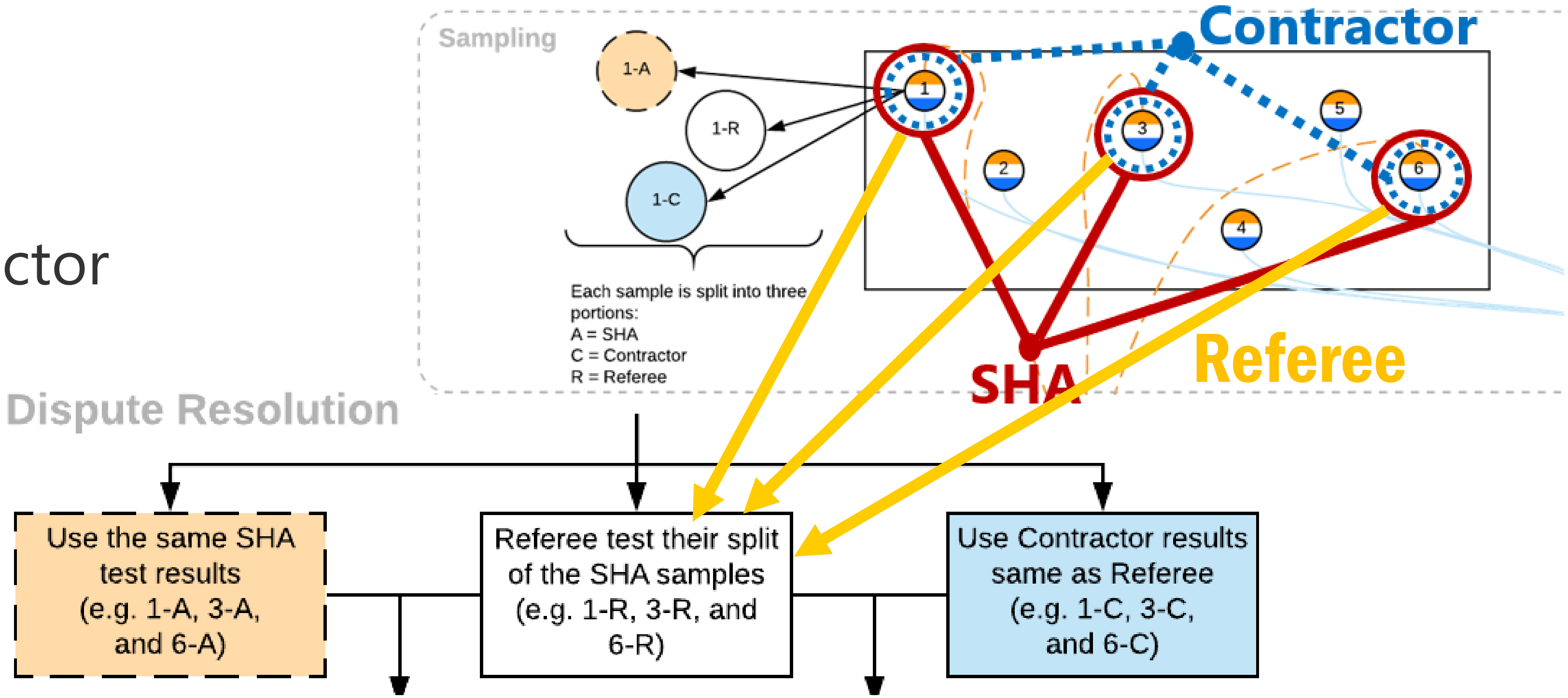




4. Dispute Resolution

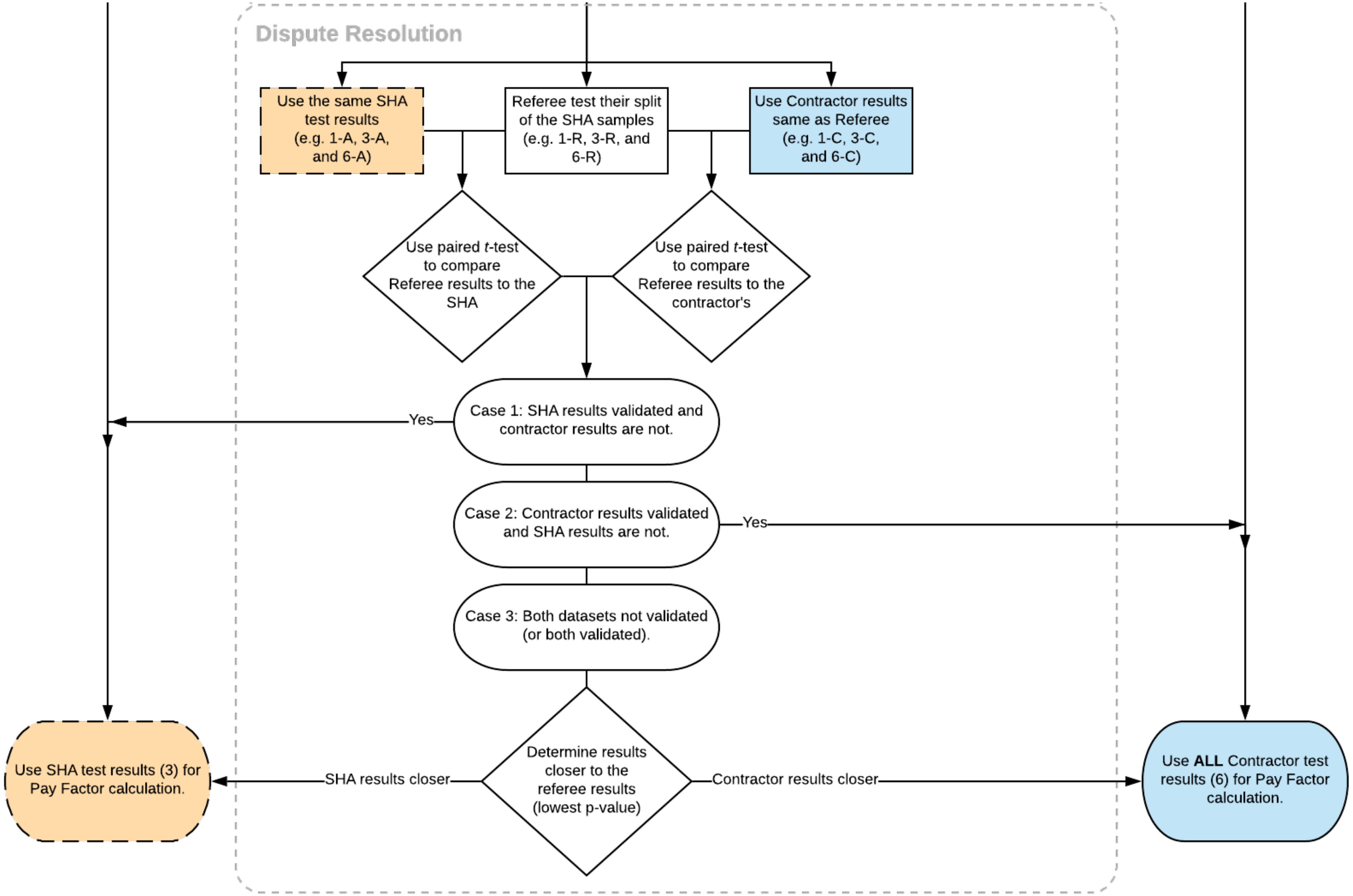


- Test the Referee portion of each sublot corresponding to the SHA samples used for verification - splits 1-R, 3-R, 6-R (independent accredited lab)
- More powerful statistical procedure than a single split sample comparison
- 2 Paired *t*-tests:
  - Referee vs SHA
  - Referee vs Contractor
- Who pays for it?
  - Loser
  - Why



4. Dispute Resolution

- 3 possible outcomes of the 2 paired *t*-tests:



4. Dispute Resolution

- 3 possible outcomes of the 2 paired *t*-tests:

<table>
<tr><th>Outcome</th><th>Referee vs SHA</th><th>Referee vs Contractor</th><th>Validation Decision</th></tr>
<tr><td>1</td><td>Fail</td><td>Pass</td><td>Validated</td></tr>
<tr><td>2</td><td>Pass</td><td>Fail</td><td>Not Validated</td></tr>
<tr><td rowspan="2">3</td><td>Pass</td><td>Pass</td><td rowspan="2">lowest p-value wins the comparison</td></tr>
<tr><td>Fail</td><td>Fail</td></tr>
</table>

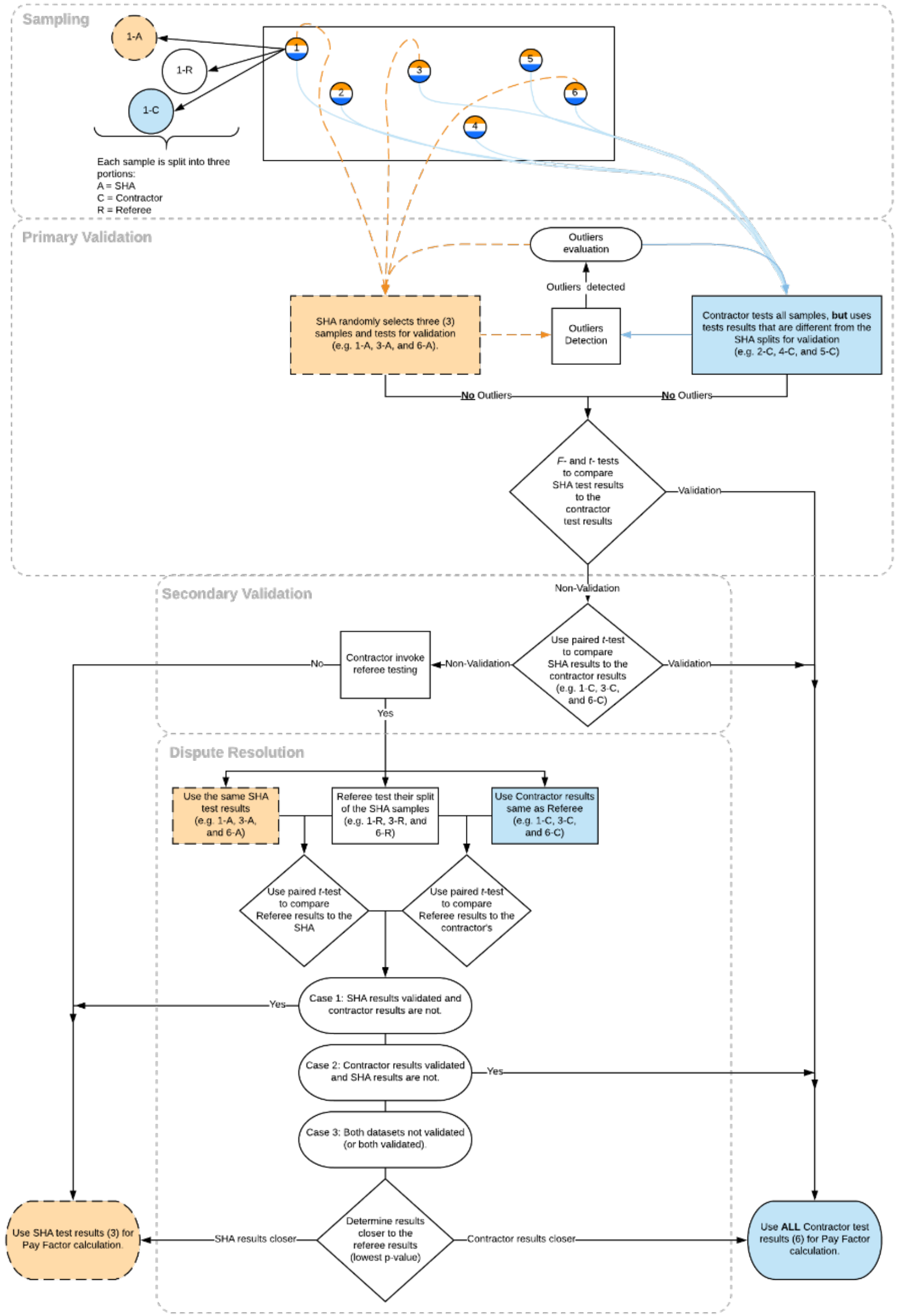
VALIDATION PROCEDURE

1. Sampling

2. Primary Validation

3. Secondary Validation

4. Dispute Resolution



EXAMPLES

TO ILLUSTRATE USE OF RECOMMENDED PROCEDURES

EXAMPLES

- Examples to illustrate use of the recommended procedures for different scenarios
- The data used for these 5 examples was all actual project data obtained from SHAs
  - Sample Size
  - Sampling method - split vs. independent
  - Outlier Detection
  - Retesting or Resampling and Retesting
  - Validation vs. Non-Validation of Contractor Results

Examples

Sample Size

EXAMPLES

SAMPLE SIZE

- 3 SHA samples is minimum number required to perform the statistical tests (*F*- and *t*-tests)
  - ***Not Recommended – Used to Illustrate Procedure***
- SHAs should always assess risk when establishing minimum sample sizes
- Select optimum number of samples for validating Contractor test data as a function of SHA buyer's risk (β) and Contractor seller's risk (α), and sample size, n

Examples

Sample Size

- Some SHA data contained 1 SHA sample / lot
- The *F*-test cannot be performed in this case
- Some SHAs use D2S limits X ± R (survey of SHAs)
- This puts SHAs at higher risk of making wrong acceptance decisions

Cumulative sampling proposed to overcome this challenge…

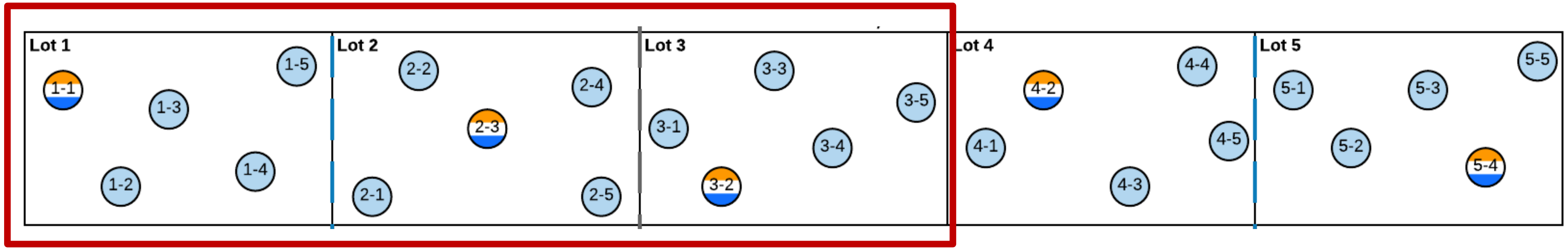
Examples

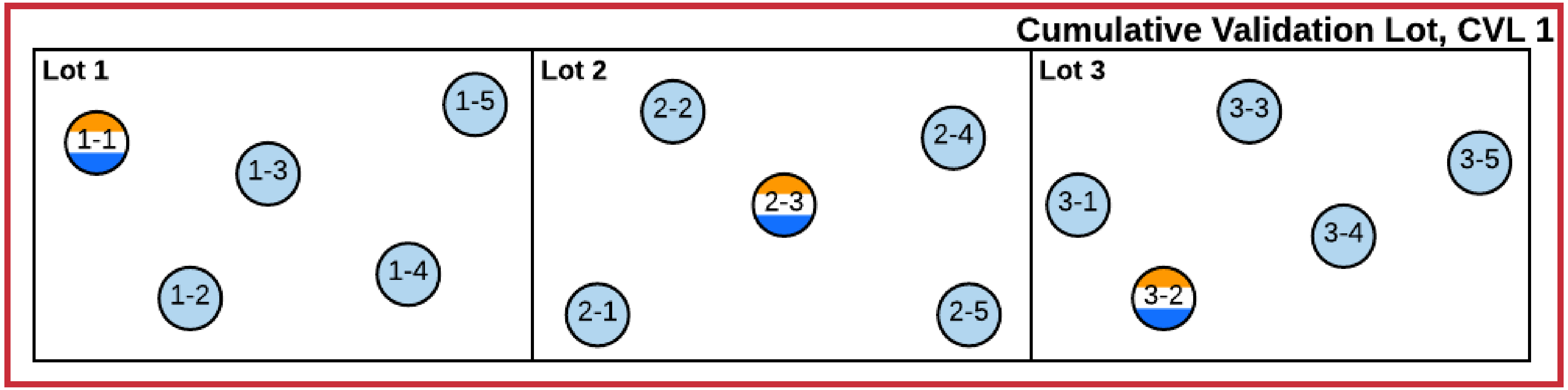
Sample Size - Cumulative Sampling

- Cumulative sampling utilizes a concept similar to a moving average
- A fixed number of lots (e.g., 3) are accumulated to form a single Cumulative Validation Lot (CVL)
- Lots 1, 2, and 3 form CVL 1
- Lot 1 in the set is dropped and a new lot is added (lot 4) to form CVL 2

Examples

Sample Size - Cumulative Sampling

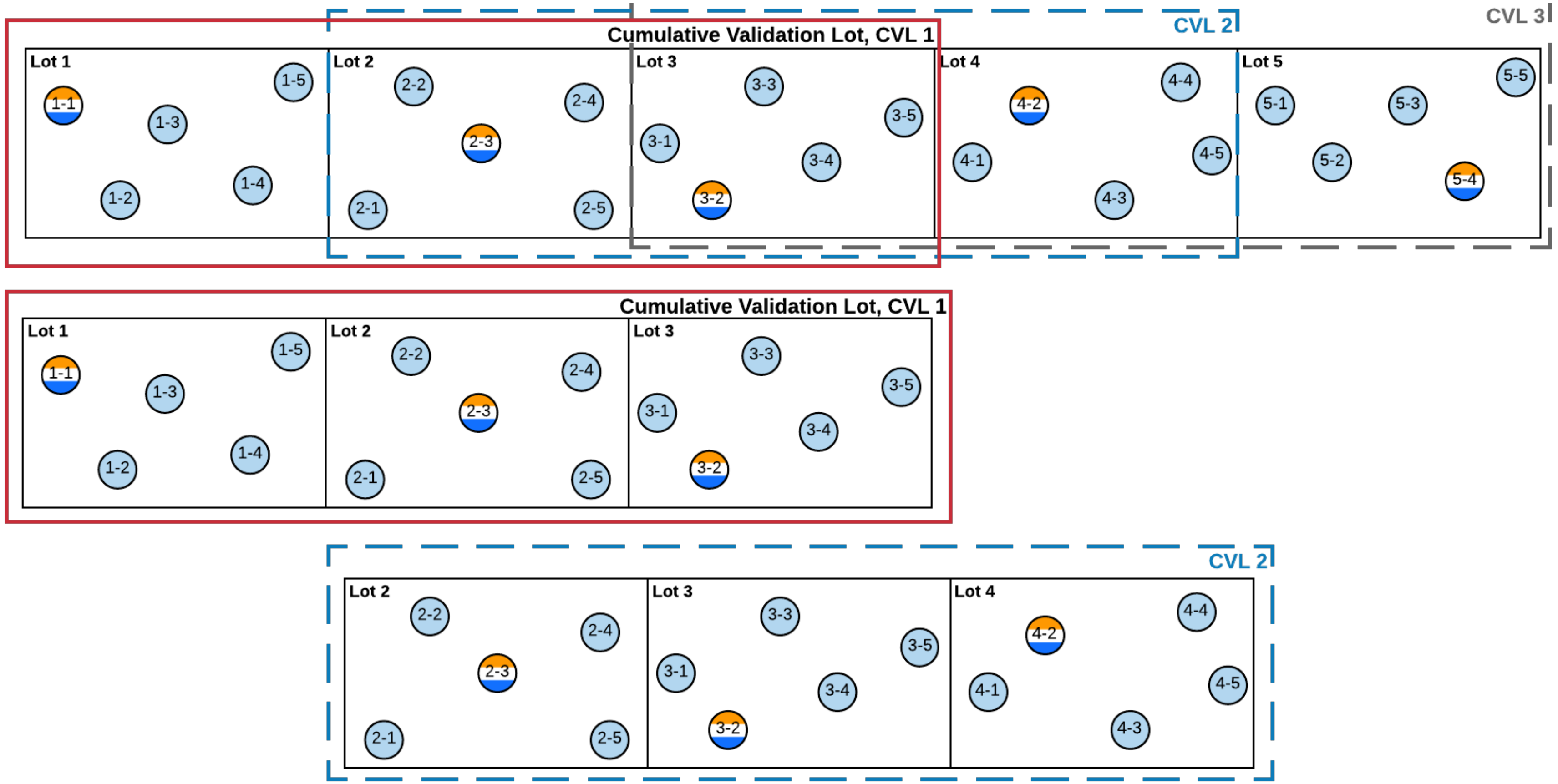




Lots 1, 2, and 3 form CVL 1

Examples

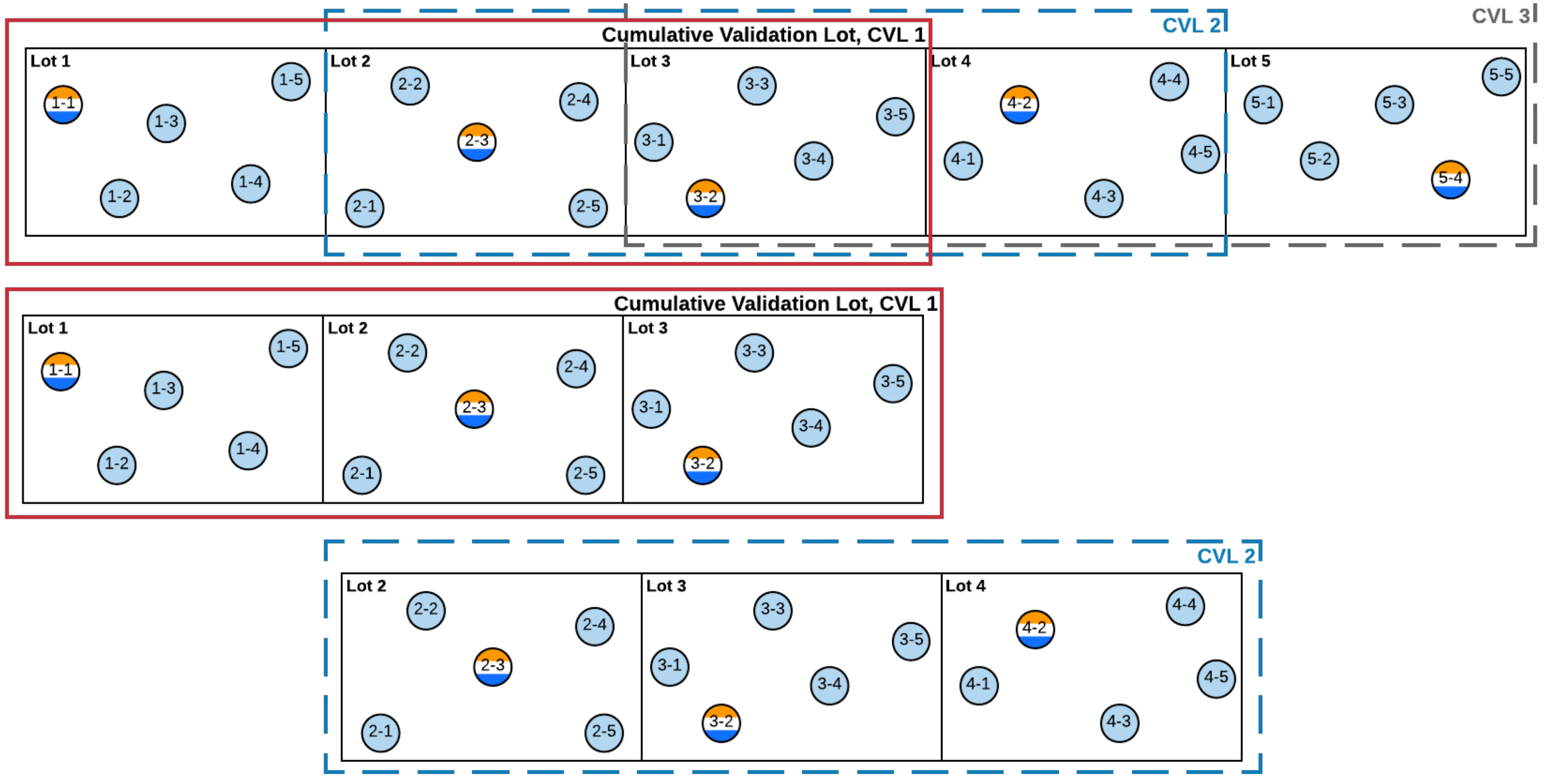
Sample Size - Cumulative Sampling



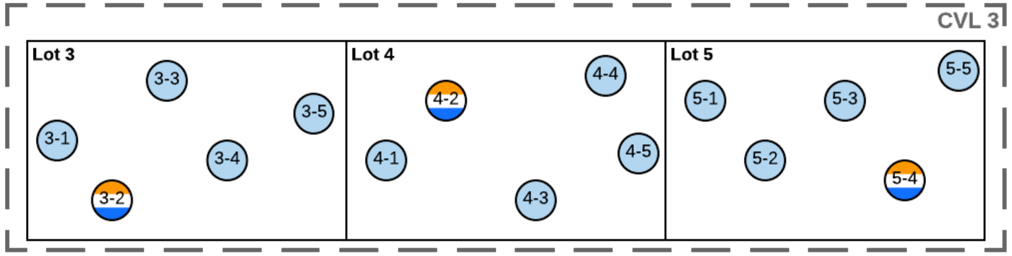
Lot 1 is dropped and a new lot is added (lot 4) to form CVL 2

EXAMPLES

SAMPLE SIZE - CUMULATIVE SAMPLING



And so on ...



EXAMPLES

SAMPLE SIZE - CUMULATIVE SAMPLING

- The window of three lots (or more) continue until a CVL is not validated
- Then the process restarts, and a new CVL is formed
- Same Validation process occurs

- ***Warning*** – Watch cumulative quantity / $ at Risk
  - Think CVL quantity / $

PROPOSED AASHTO PRACTICE

- Proposed AASHTO practice Outline:
  - Background
  - Referenced documents
  - Definitions of key concepts
  - Procedures and guidelines for validating Contractor test data
  - Recommended sampling plans
  - A procedure for determining statistical outliers
  - Statistical Tables

Proposed AASHTO Practice

Proposed Practice for Validating Contractor Test Data

AASHTO Designation: R xx–

1. SCOPE

1.1 Purpose – The purpose of this practice is to provide guidance on how State Highway Agency (SHAs) should validate Contractor data that are used in acceptance decisions for materials and construction.

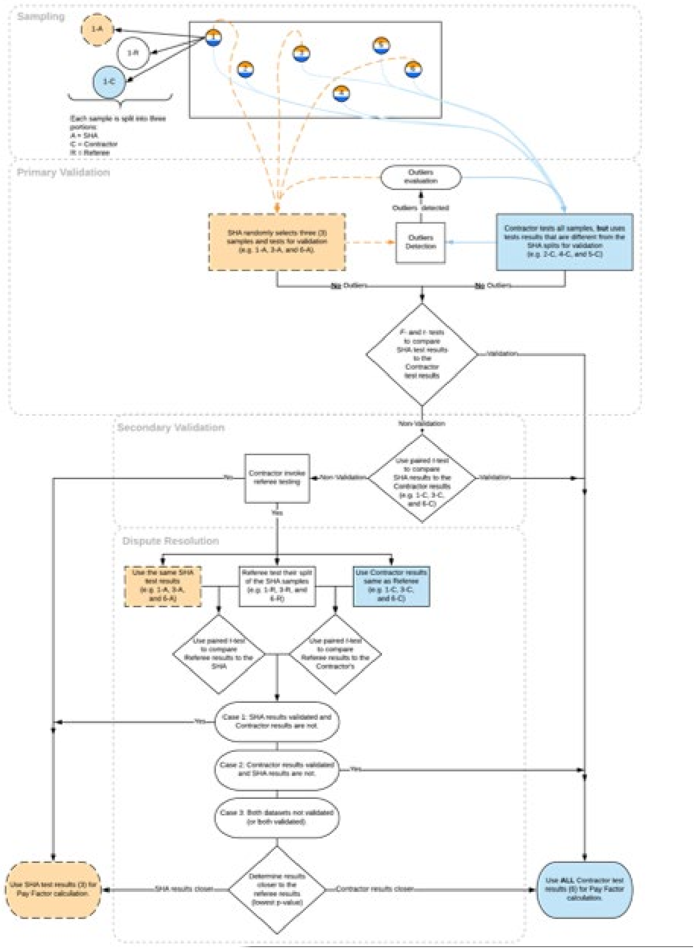
1.2 Target audience – This practice is intended for SHA materials and construction engineers responsible for establishing and maintaining Quality Assurance programs for highway materials and construction, Contractor personnel responsible for managing testing used in acceptance decisions. And consultants and third party testers that are involved in validation.

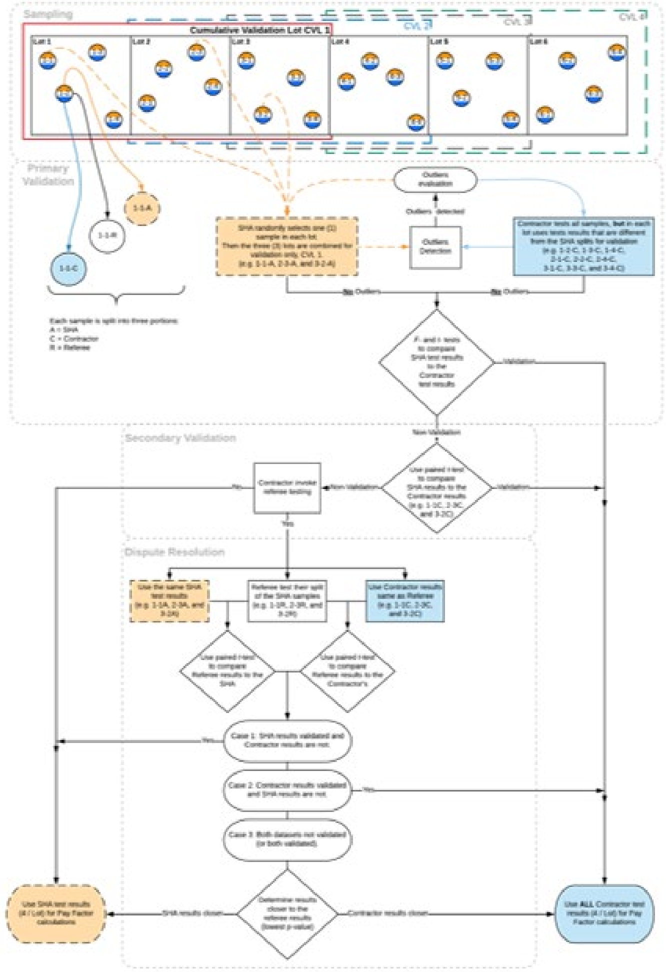
1.3 Background resources – Relevant resources are NCHRP Research Report xxx, Validation of Contractor Test Data, Federal Highway Administration's (FHWA's) Technical Advisory T 6120.3 *Use of Contractor Test Results in the Acceptance Decision, Recommended Quality Measures, and the Identification of Contractor/Department Risks* (August 2, 2004) which provides the legal interpretation of Title 23 Code of Federal Regulations Part 637 Subpart B (23 CFR 637B). *Optimal Procedures for Quality Assurance Specifications* (Burati et al, 2002) and Transportation Research Circular Number E-C037, Glossary of Highway Quality Assurance Terms (2002), and other references listed in Section 2.

1.4 Application of recommended procedures – This practice is applicable to highway construction materials (e.g., asphalt concrete, portland cement concrete, aggregate base) which are evaluated for quality through characteristics used to assess compliance with project specifications. There may be certain circumstances that limit or preclude use of some aspects of the practice. For example, properties of some materials change substantially with time which precludes the ability to resample the material or make comparisons of material properties measured at different times.

1.5 This practice does not provide recommendations regarding the selection of Quality Characteristics for acceptance decisions.

1.6 This practice does not provide recommendations for frequency of sampling and testing. However, recommendations are provided regarding the minimum number of results that should be used in data validation.





Summary

- 6 Key Elements to QA Program
- 23 CFR 637B ***permits*** the use of Contractor test data for construction materials acceptance, as long as SHAs ***validates*** the Contractor data with ***independent*** test results
- About 30 SHAs use Contractor test data
- Some use *F*- & *t*-tests, some use less rigorous higher-risk methods
- Evaluation of available statistical test methods with consideration of risks
- Applied to state DOT HMA & PCC QC and Acceptance data to select tests

SUMMARY

- NCHRP Project 10-100 Recommendations
  - Use *F*- and Welch's *t*-tests for Primary Validation
  - Use paired *t*-test for Secondary Validation
  - Consider use of Proposed AASHTO Practice – Recognizing Identifies Risks
  - Cumulative sampling technique helps with n – Watch quality / $ risk
  - D2S & X ± R, high risk – Not recommended
  - Clearly Address in QAP Requirements
    - Sampling and Sample types
    - Data quality - outlying data
    - Dispute resolution,
    - Re-testing in QAP Requirements
  - Project Report will illustrate Scenarios

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Trust But Verify–Validating Contractor Test Data

June 3, 2021

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- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Elaine Ferrell at EFerrell@nas.edu

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REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

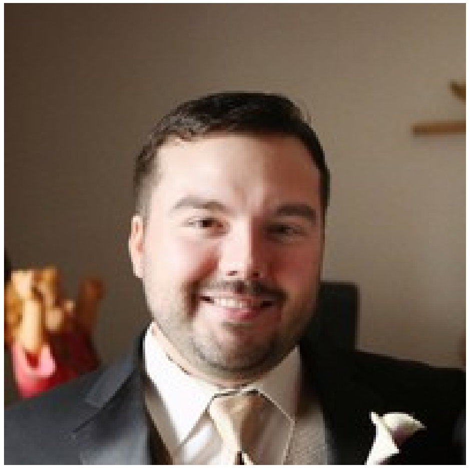
Learning Objectives

1. Evaluate procedures used by state DOTs to validate contractor data

2. Identify risk areas that may lead to incorrect acceptance and payment decisions

Today's Panelists

#TRBWebinar



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Massachusetts DOT

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King County International Airport

Adam Hand,
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Randy West, *National Center for Asphalt Technology, Auburn University*