Context Maps-Classifying Contextual Influence for Decision Support System Design

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Motivation

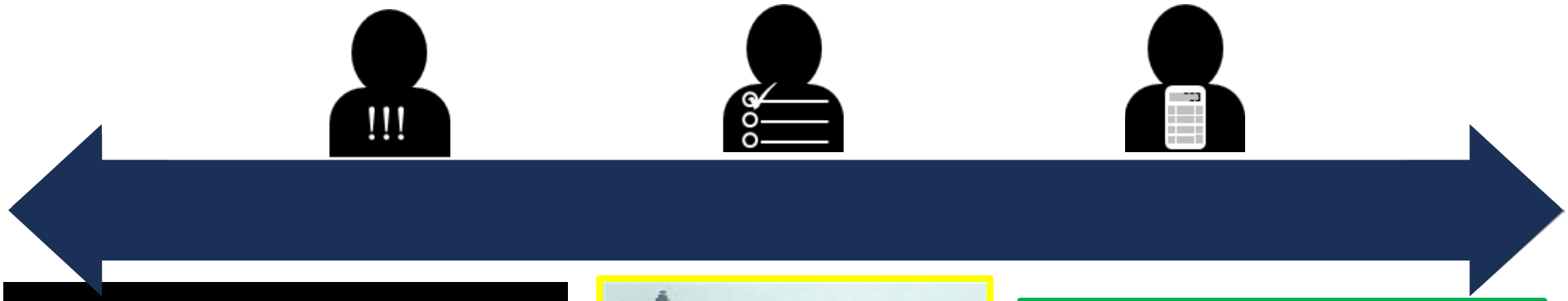
- Decision Support Systems (DSS) are becoming increasingly common
  - **The Good**: Great at quick computation, collecting data
  - **The Bad**: Blind to context, inflexible, generally unable to prioritize data

SOLUTION

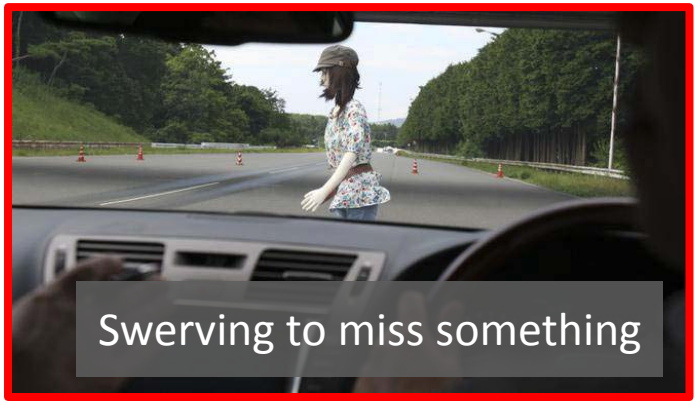
Make DSS Proactive / Context Aware

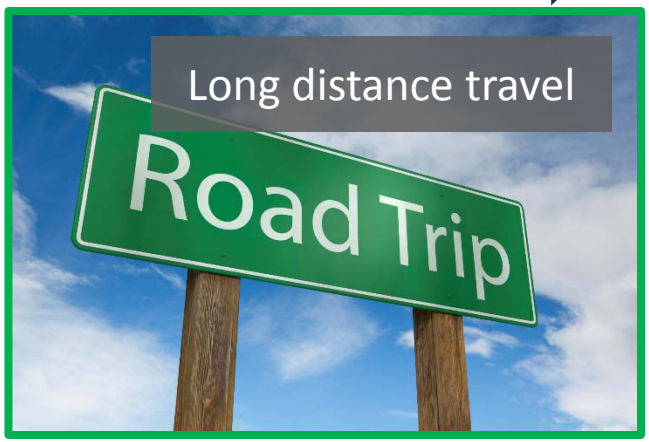
The Problem

Hollnagel's Contextual Control Modes (CCM)



Example: Navigating a car





Research Objectives

Create a methodology for engineers to systematically account for varying context in DSS design

- Enable engineers to evaluate their current DSS
- Provide guidance on how to leverage this methodology to improve DSS with **interface requirement** and **evaluation metrics**
- Implement the methodology in a complex, dynamic, and safety critical environment

Human-In-The-Loop (HITL) Experiments

- See how users react to a given task in various decision modes
- How do these different decision modes impact performance when using current DSS
- What tools are they using and what information do they lack?

This Work's Objectives

- Systematically construct realistic scenarios using environmental context
- The scenarios must experimentally drive users into the three primary decision modes
- The scenario needs to be operationalized by breaking down environmental context into independent variables

Domain Requirements

Task:
Instrument Rated GA Pilot planning and re-planning due to weather

What data is collected?
How is the data analyzed?
What is the output of each step?

4 Step Methodology

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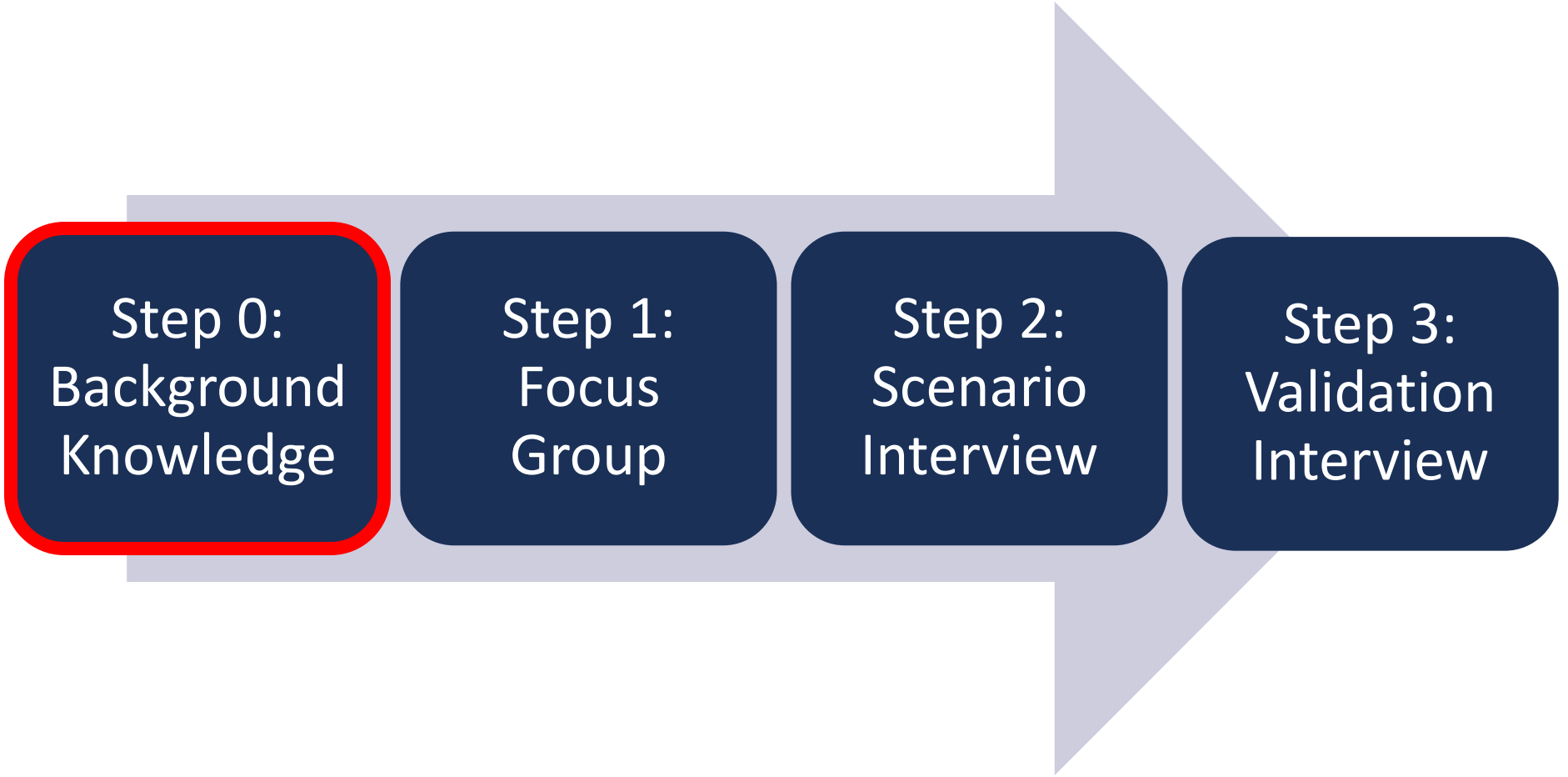
4 Step Methodology



Background Research:

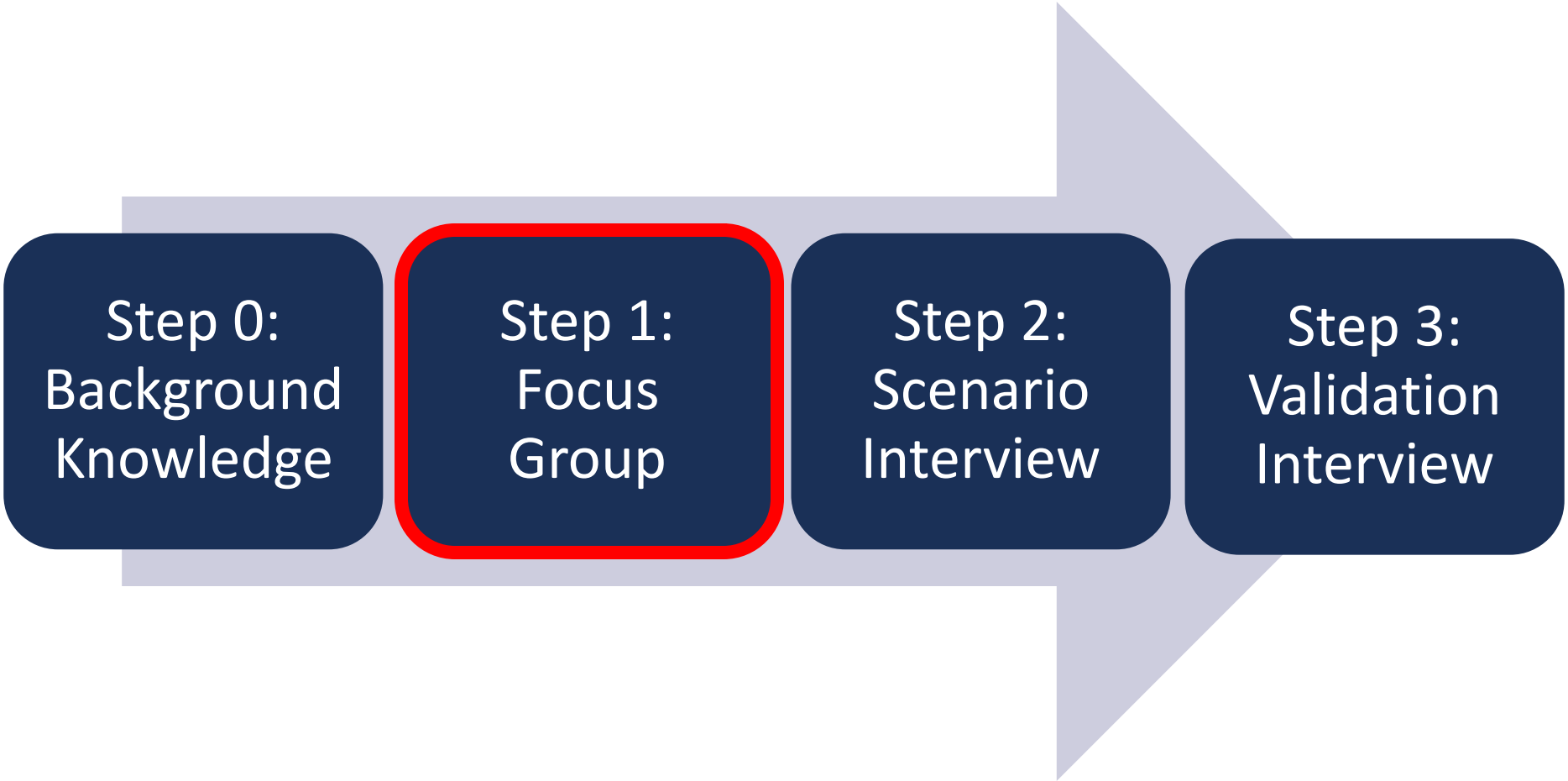
Purpose & Data Collection

- Enable the designer to follow up with an expert with informed questions
- Make the interviews and subsequent transcription process more time efficient.
- Will be specific to the work domain of interest and the designer's current knowledge.
  - Very structure domains may be able to rely on available documentation
  - Others may need to collect data via surveys, etc.

Background Research: Deliverable

- A comprehensive list of the tools, aids, and any other resources available to your user population when making decisions
- A list of acronyms, terminology, and informal jargon used in the domain.
- Be forewarned that that 1 minute of an interview takes approximately 10 to 11 minutes to transcribe

4 Step Methodology



Focus Group: Purpose

- The group format should allow the operator population to 'feed' off of each other
  - e.g. 'oh yeah, something similar happened to me…'
- Weed out any 'outlier' experiences
  - e.g. 'I have no idea what you're talking about; that's never something that concerns me.'
- Initially explore the decision space and identify the boundaries

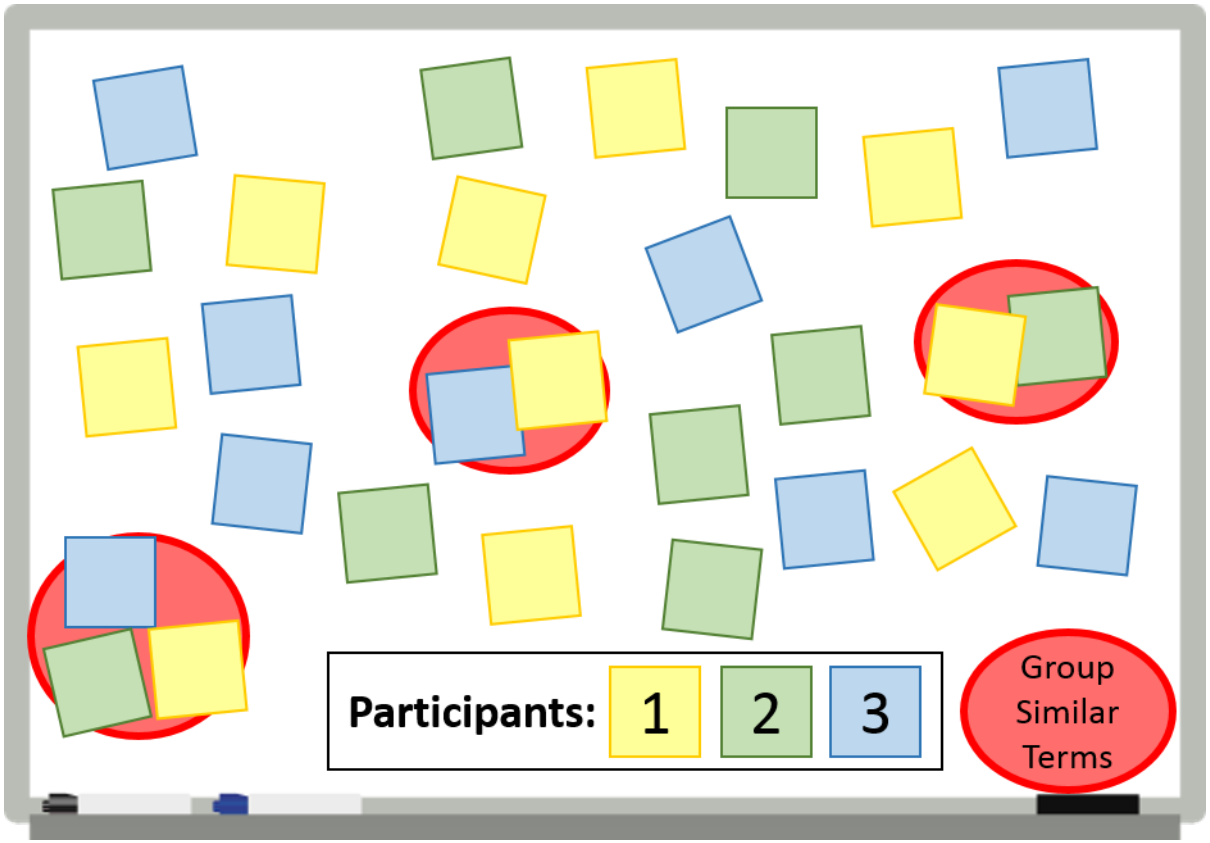
Focus Group:

Data Collection

- Invite roughly 3 -5 participants
- Identify the key context features that impact your operator population
- Begin to associate the manifestation of these context features with the three decision modes.

Focus Group:

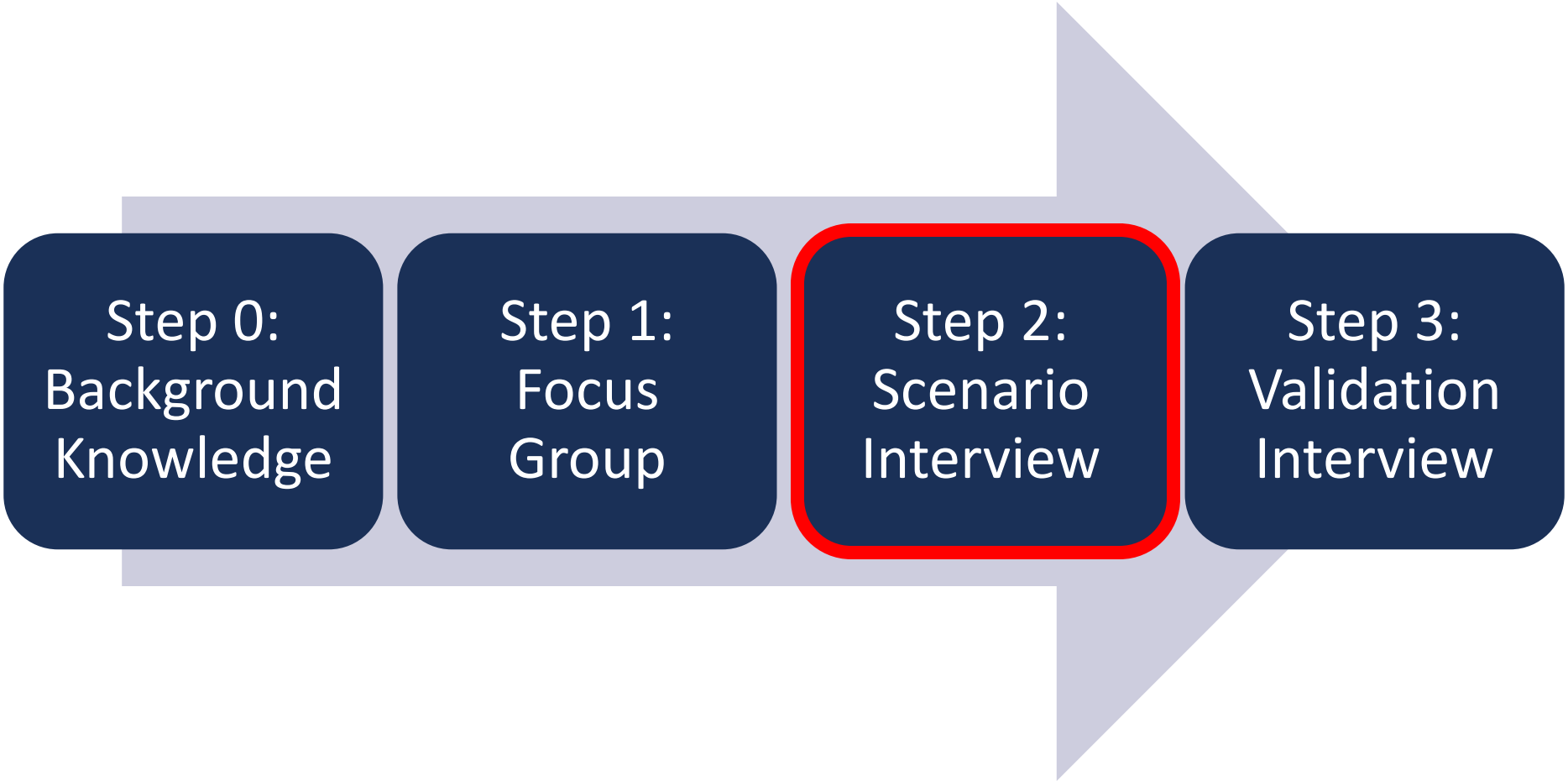
Data Collection



Focus Group: Deliverable

Context Feature	Reactionary	Procedural	Optimizing
Weather Location	En route, Arrival airport [2,3,5]	En route [1,2,3]	Arrival Airport [1,2,3]
Weather Predictability	Low [2,4,5]	High [1,4,5]	Low [1,2,3,5]
ATC Involvement	Reactive [1,2,3,4]	Proactive [1,2,3]	Reactive [3,4,5]
Stage of Flight	On arrival [1,2]	En route[3,4,5]	At departure airport [2,3,4,5]

4 Step Methodology



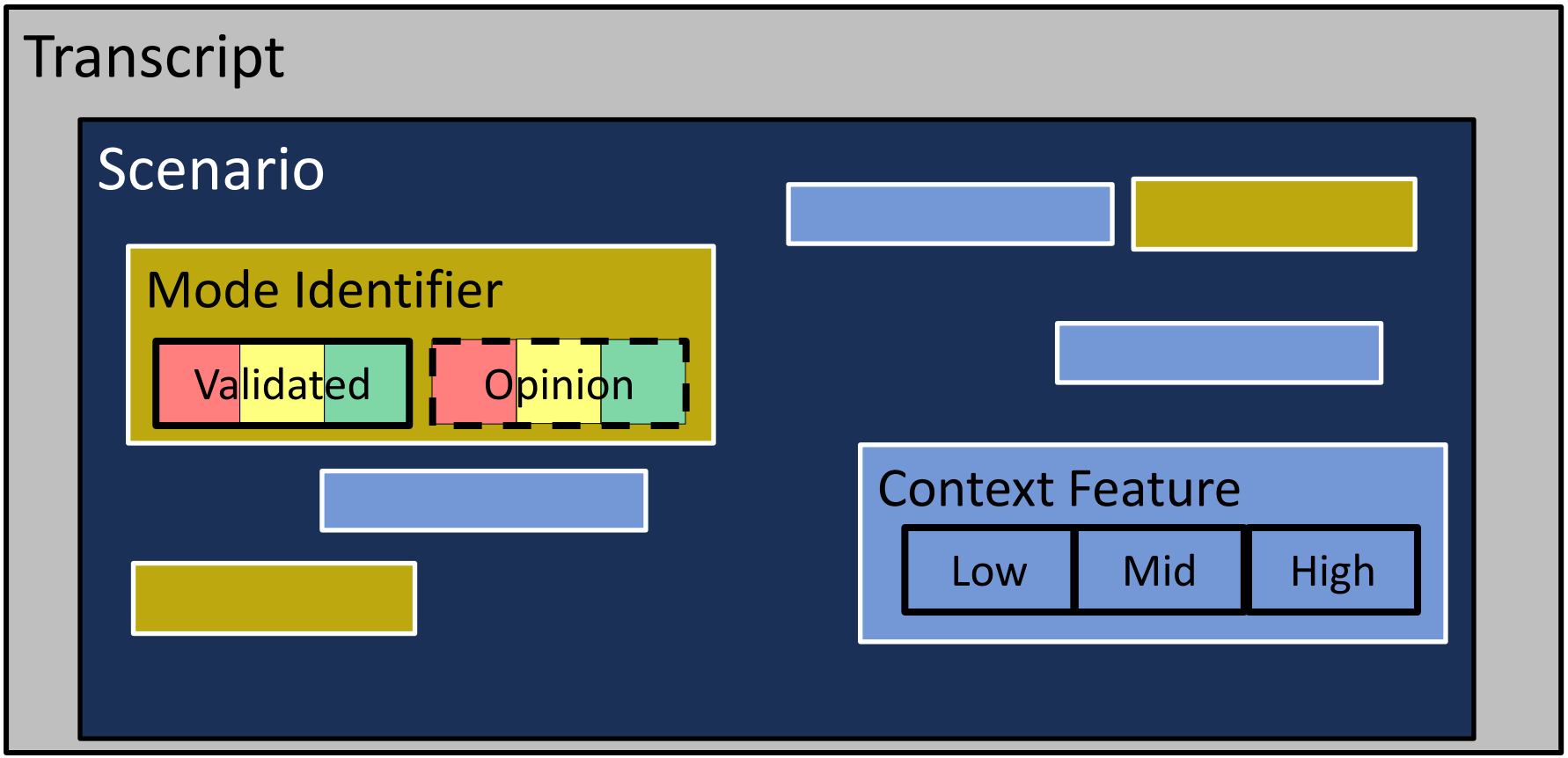
Scenario Interview: Purpose & Data Collection

- First pass at realistic scenarios that can be operationalized using environmental context
- Introduce the task to the participant and ask them to describe experiences that fit into each mode
  - Maintain a focus on the 'story' as opposed to a question and answer session
  - At the end of a story, follow up on any context features identified in the focus group that were not mentioned in their recollection

Step 0	Step 1	Step 2	Step 3

Scenario Interview:

Data Analysis

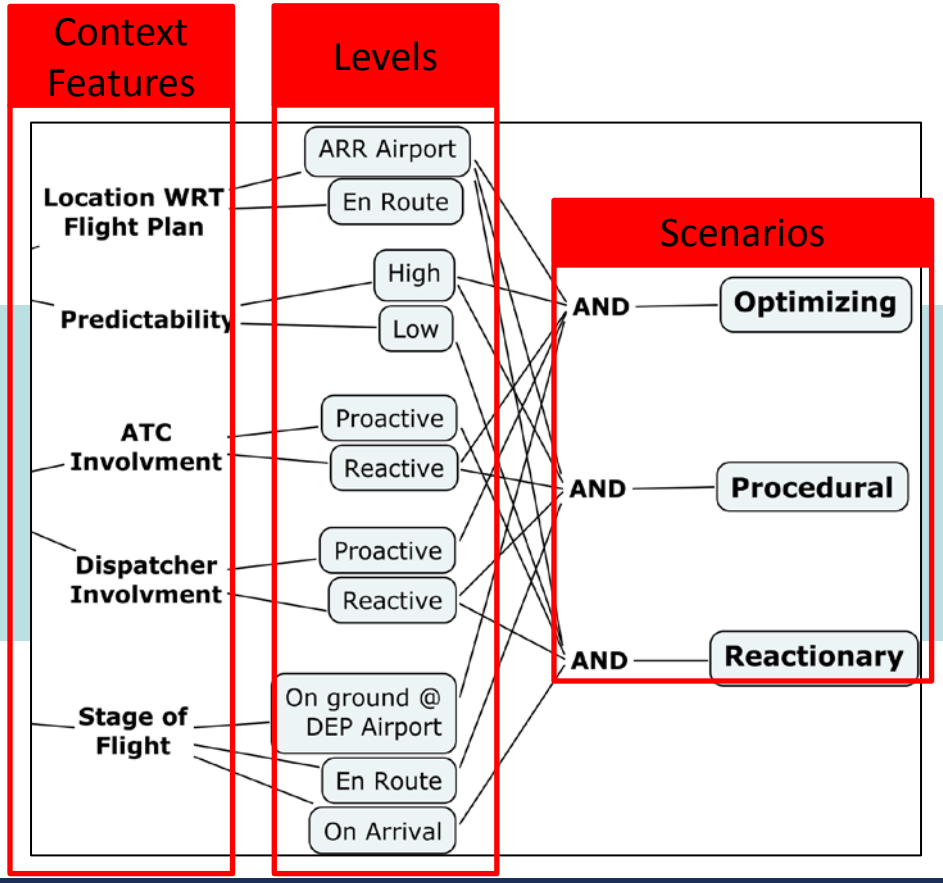


Scenario Interviews:

Deliverable

Interviews

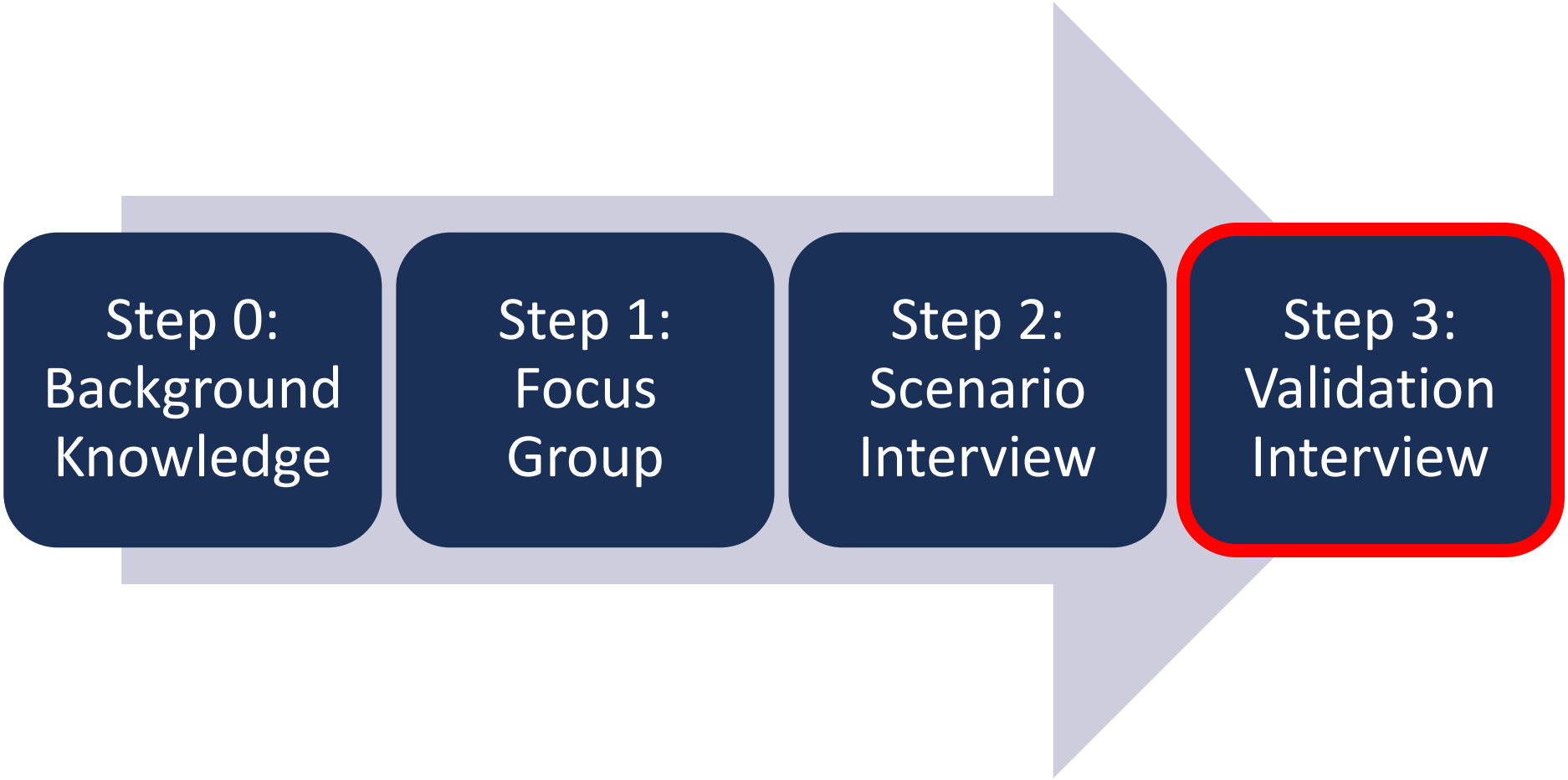
Narrative Stories



Experiment

Experimental Scenarios

4 Step Methodology

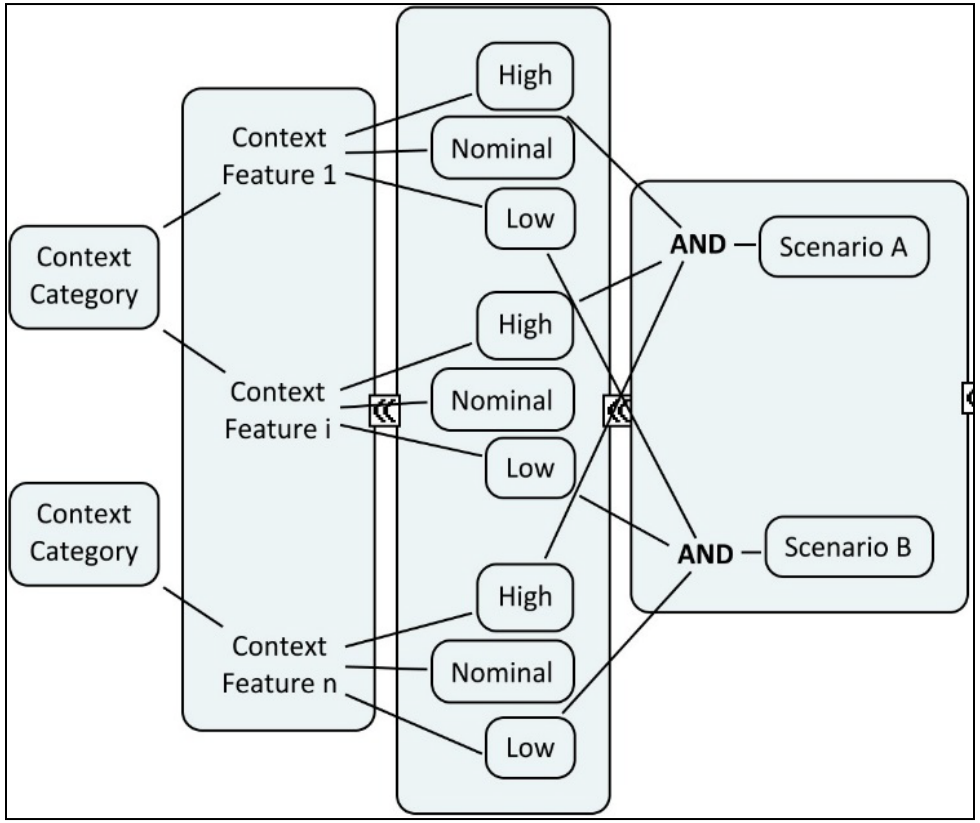


Validation Interview:
Purpose & Data Collection

- Used to review the individual context maps
  - Determine the validity of the scenarios, context levels, and their relationships to CCMs
  - Confirm that you correctly captured the participant's experiences.
- Used to consolidate the individual context maps into a final aggregate context map
  - Scenarios that are similar to other SMEs
  - Scenarios from other SMEs not mentioned by current interviewee

Validation Interview:

Deliverable



Unsolicited Advice

- When collecting any type of qualitative data, there is a fine line between leaving no stone unturned and leading your participants
  - Avoid the temptation to drive down into specifics too quickly
- Avoid examples from your domain of interest when explaining CCM
- Consider giving the CCMs ‘code names’ to avoid biasing the SMEs

Conclusions

Summary

- The Problem
  - What is context? How do we bound it?
  - Hollnagel's Contextual Control Modes
- The Objectives
  - Create a methodology for engineers to systematically account for varying context in DSS design
  - Systematically construct realistic scenarios using environmental context
- The Solution
  - 4 Step Methodology to translate user narratives into experimental scenarios

Questions?

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Extra Slides

Create a methodology for engineers to systematically account for varying context in DSS design

- Enable engineers to evaluate their current DSS
  - Which decision modes do they currently support and what impact does this have on performance?
  - Which DSS features are used when?
  - What information do users need that they are not getting?

Create a methodology for engineers to systematically account for varying context in DSS design

- Provide guidance on how to leverage this information to improve DSS
  - Generic **interface requirements** for DSS design to support operator across decision metrics
  - **Evaluation metrics** to assess existing DSS

Create a methodology for engineers to systematically account for varying context in DSS design

- Implement the methodology in a complex, dynamic, and safety critical environment

4 Step Methodology