FTA RESEARCH

FEDERAL TRANSIT ADMINISTRATION

Mobility Services for All Americans (MSAA): System Requirements and Architecting Overview

January 18, 2017

Rik Opstelten,
MSAA Project Manager
and
Dawn Hardesty, Noblis

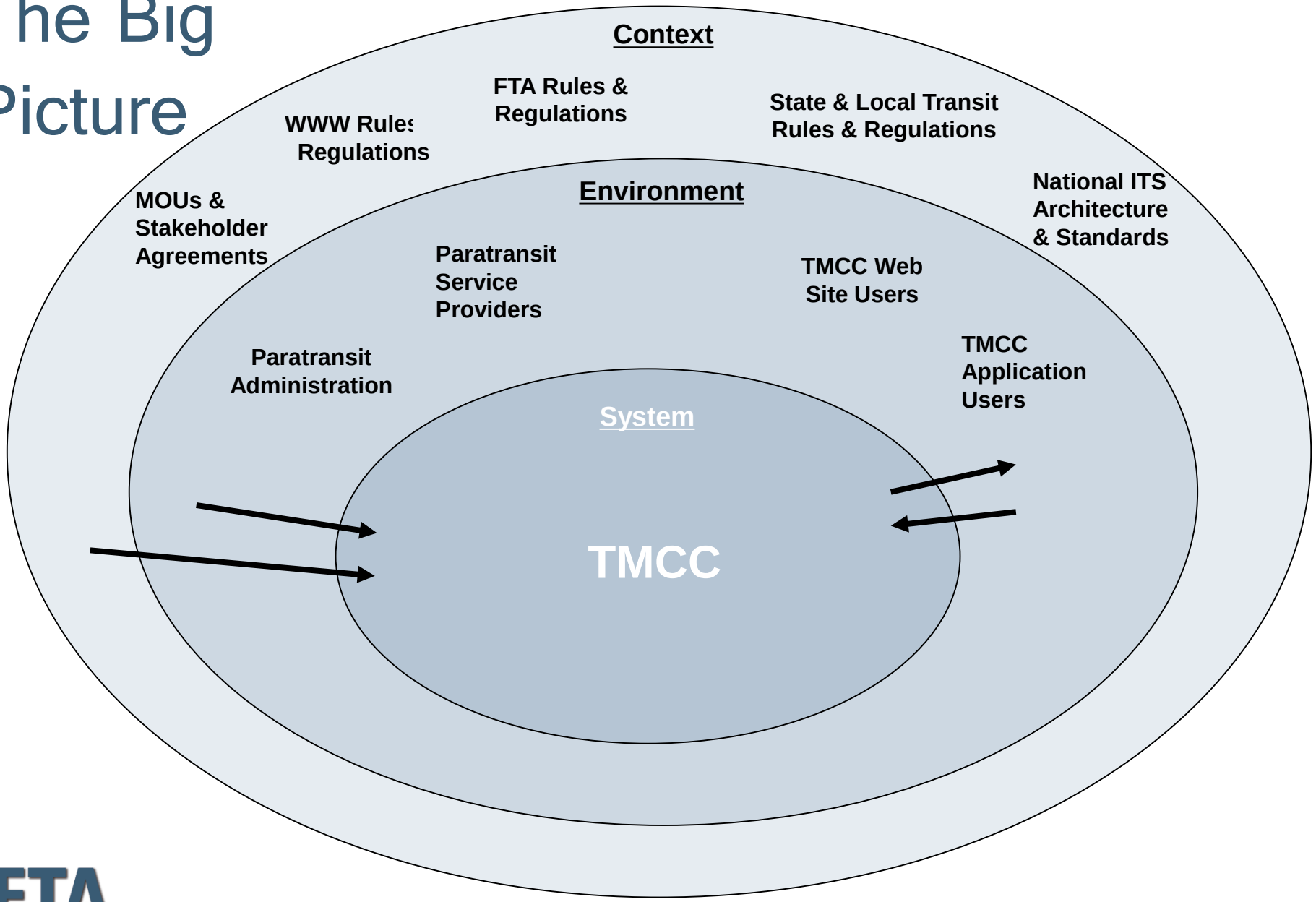
U.S. Department of Transportation
Federal Transit Administration

Topics for Discussion

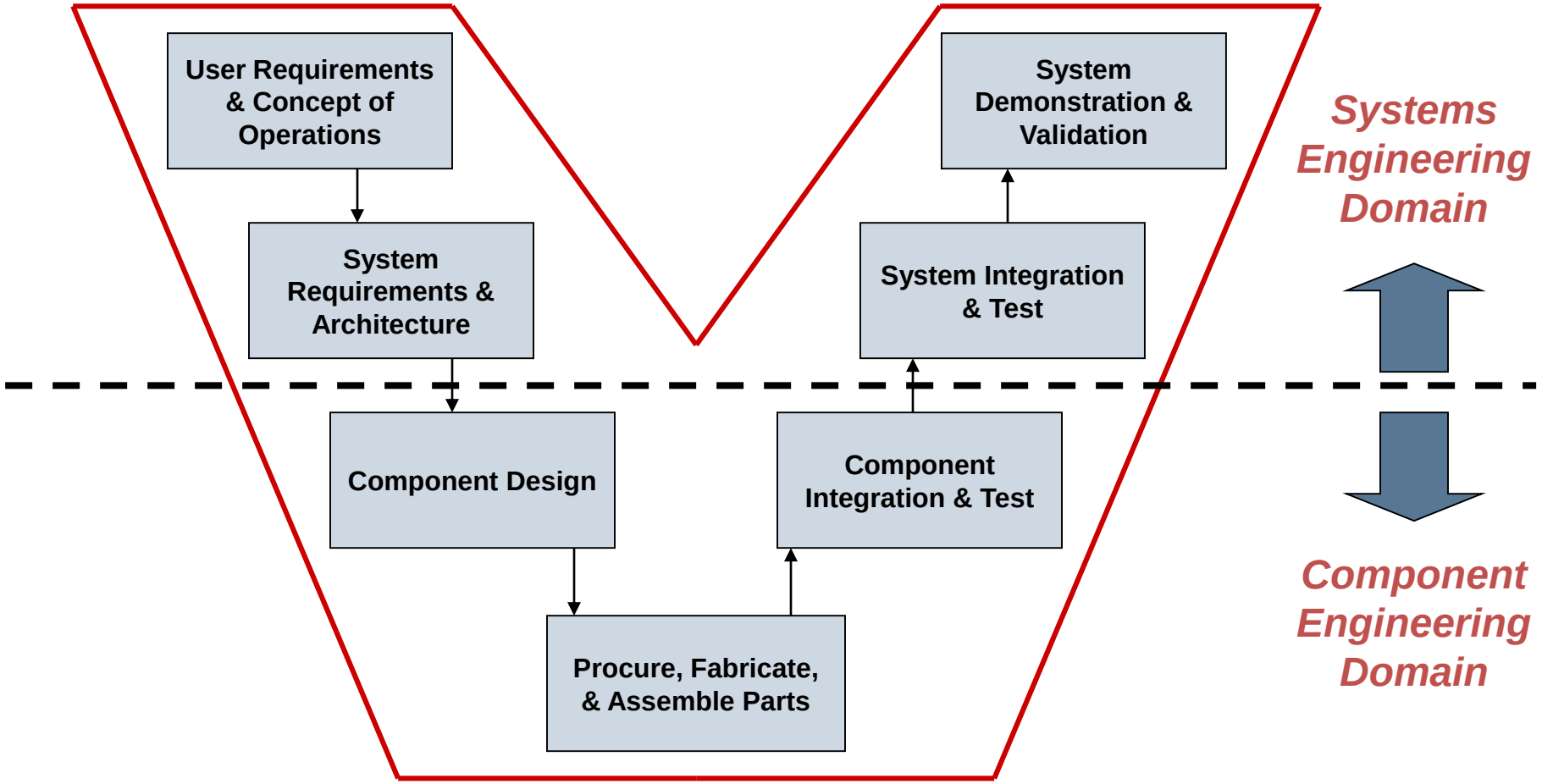
- Systems Thinking – what's in and what's out
- System Architecting – a piece of cake
- System Requirements – capturing the basics
- System Requirements Specification Template
- Implementation Plan Template

SYSTEMS THINKING

The Big Picture



The “Vee” Model of System Development



System Lifecycle Phases

- Development Phase
- Procurement/Manufacturing Phase
- Deployment Phase
- Training Phase
- Operational Phase
- Maintenance Phase
- Refinement Phase
- Retirement Phase

SYSTEMS ARCHITECTING

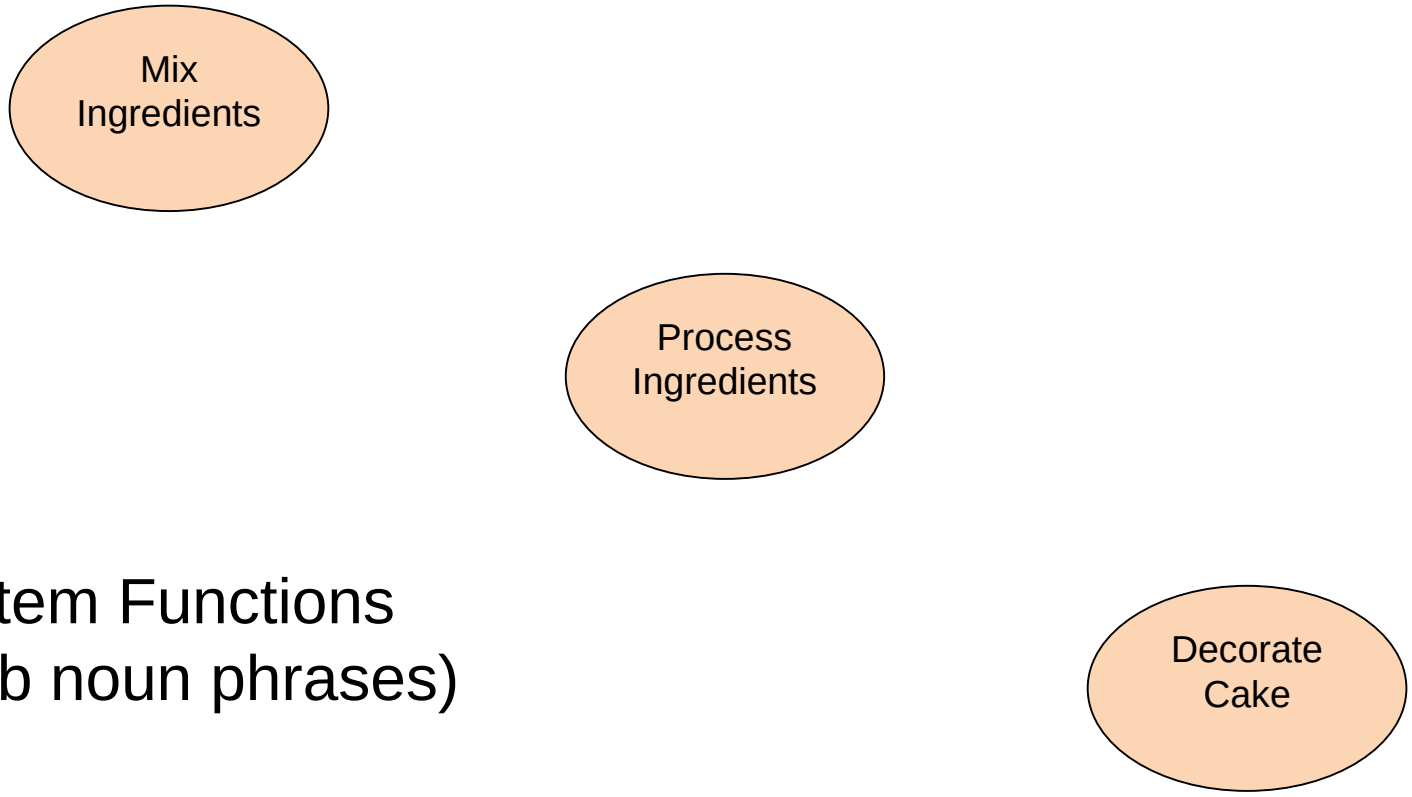
Systems Architecting Exercise

- Get ready to work
- You are the architect
- You have domain expertise
- The system: making a cake
- You have 3-4 minutes to write down your cake making requirements
- You don't have to turn these in
- Start now

System Functions

- What were the main functions for the system?
  - Mix ingredients (cake and frosting)
  - Transform or process ingredients (traditional or ice cream)
  - Decorate cake

Start Architecting

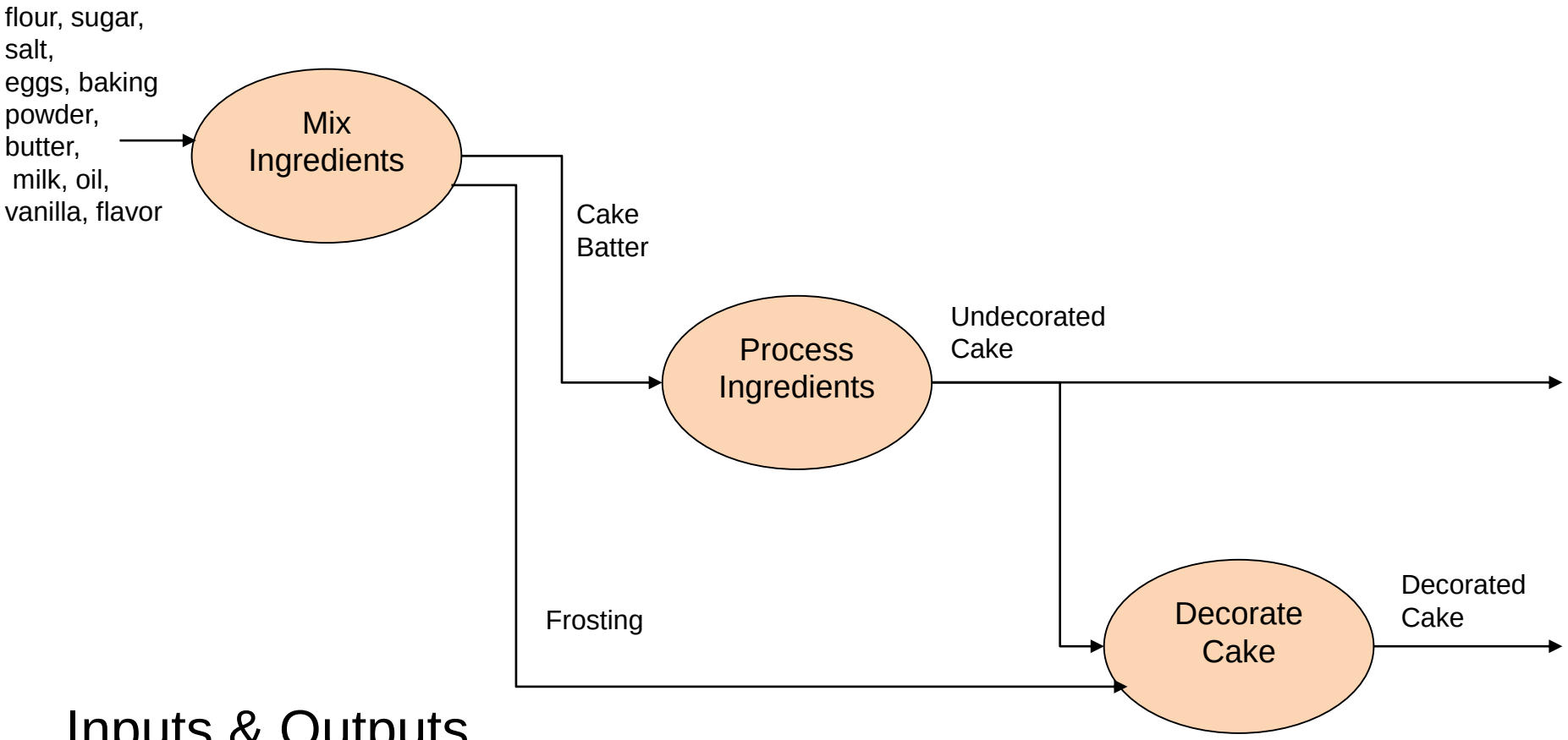


System Functions
(verb noun phrases)

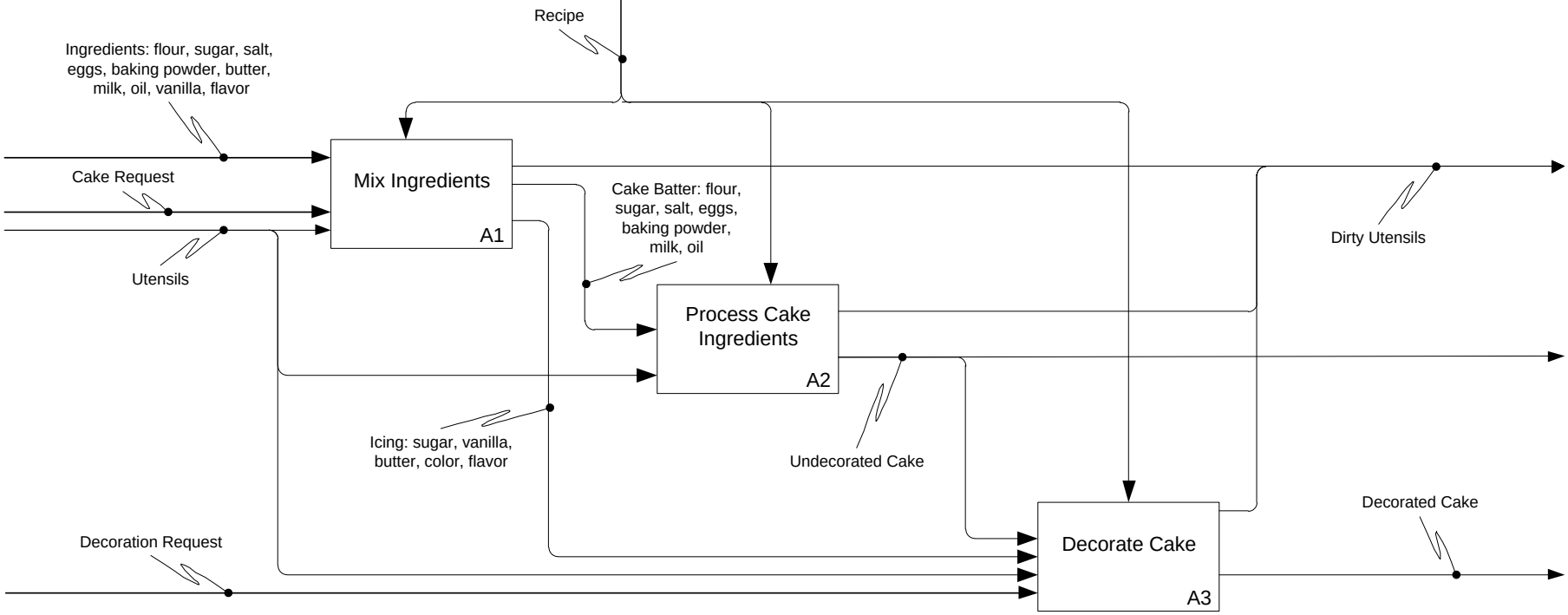
System Inputs and Outputs

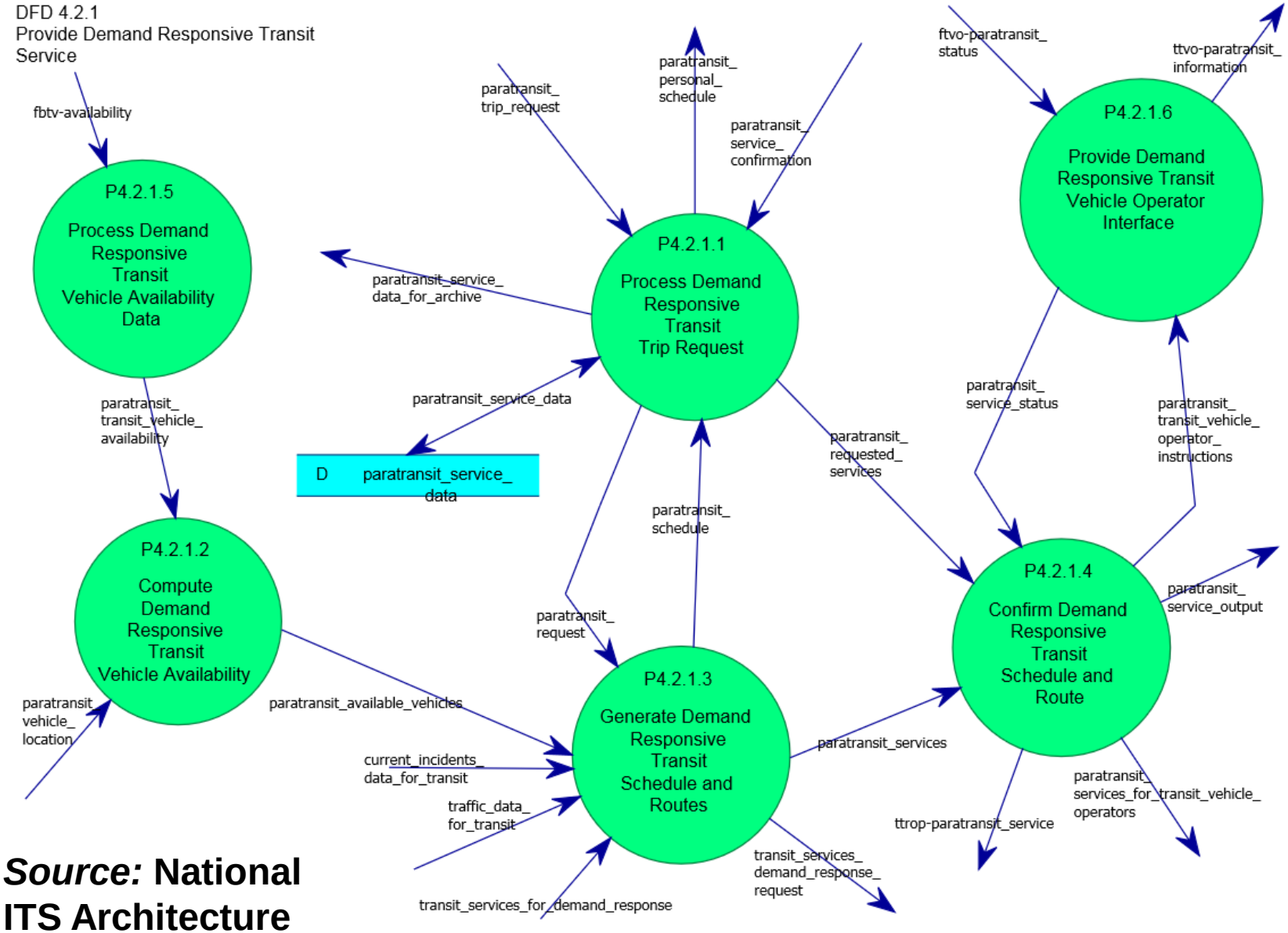
- What are the main inputs?
  - Cake request
  - Ingredients
  - Utensils
- What are the main outputs?
  - Decorated cake
  - Plain cake
  - Dirty utensils

Architecting Continued



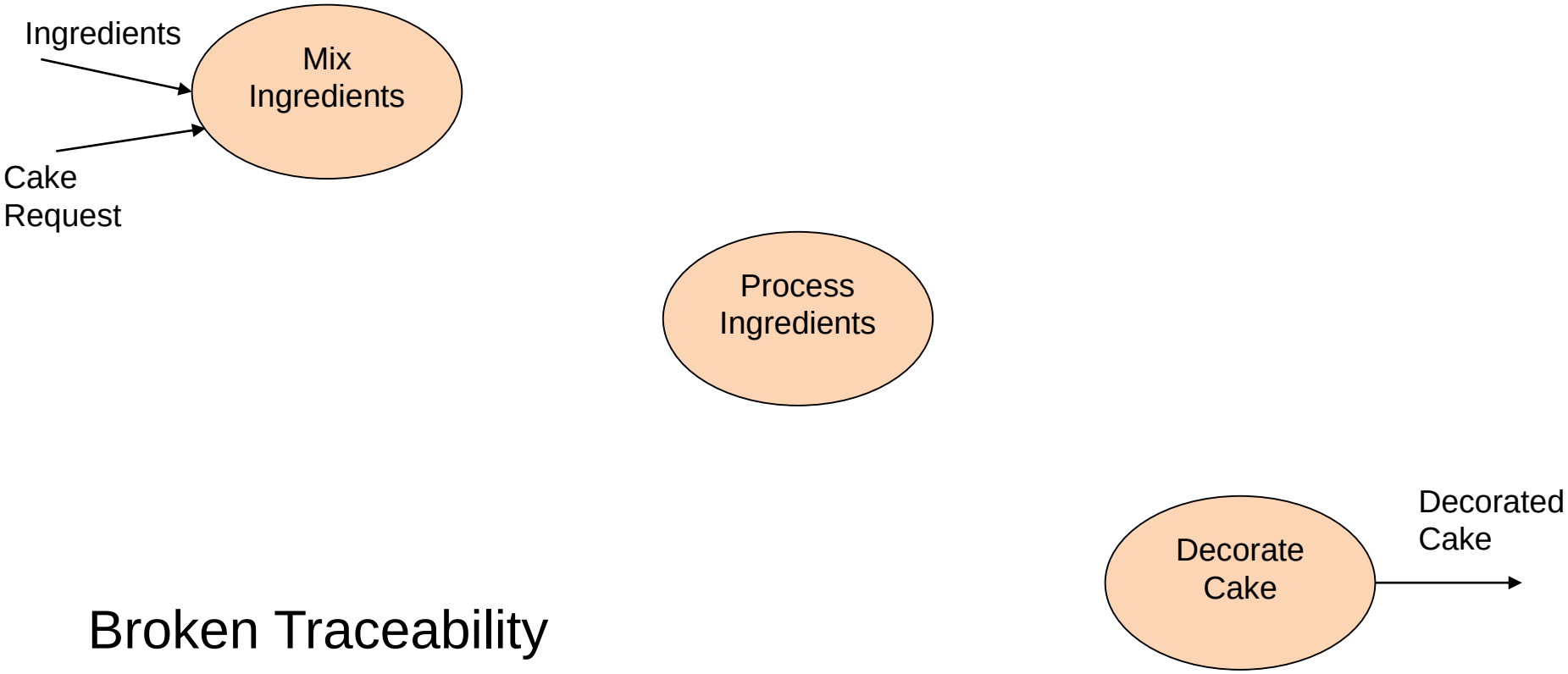
Inputs & Outputs (nouns)


Recipe
Ingredients: flour, sugar, salt, eggs, baking powder, butter, milk, oil, vanilla, flavor
Cake Request
Utensils
Mix Ingredients
A1
Cake Batter: flour, sugar, salt, eggs, baking powder, milk, oil
Dirty Utensils
Process Cake Ingredients
A2
Icing: sugar, vanilla, butter, color, flavor
Undecorated Cake
Decorated Cake
Decoration Request
Decorate Cake
A3



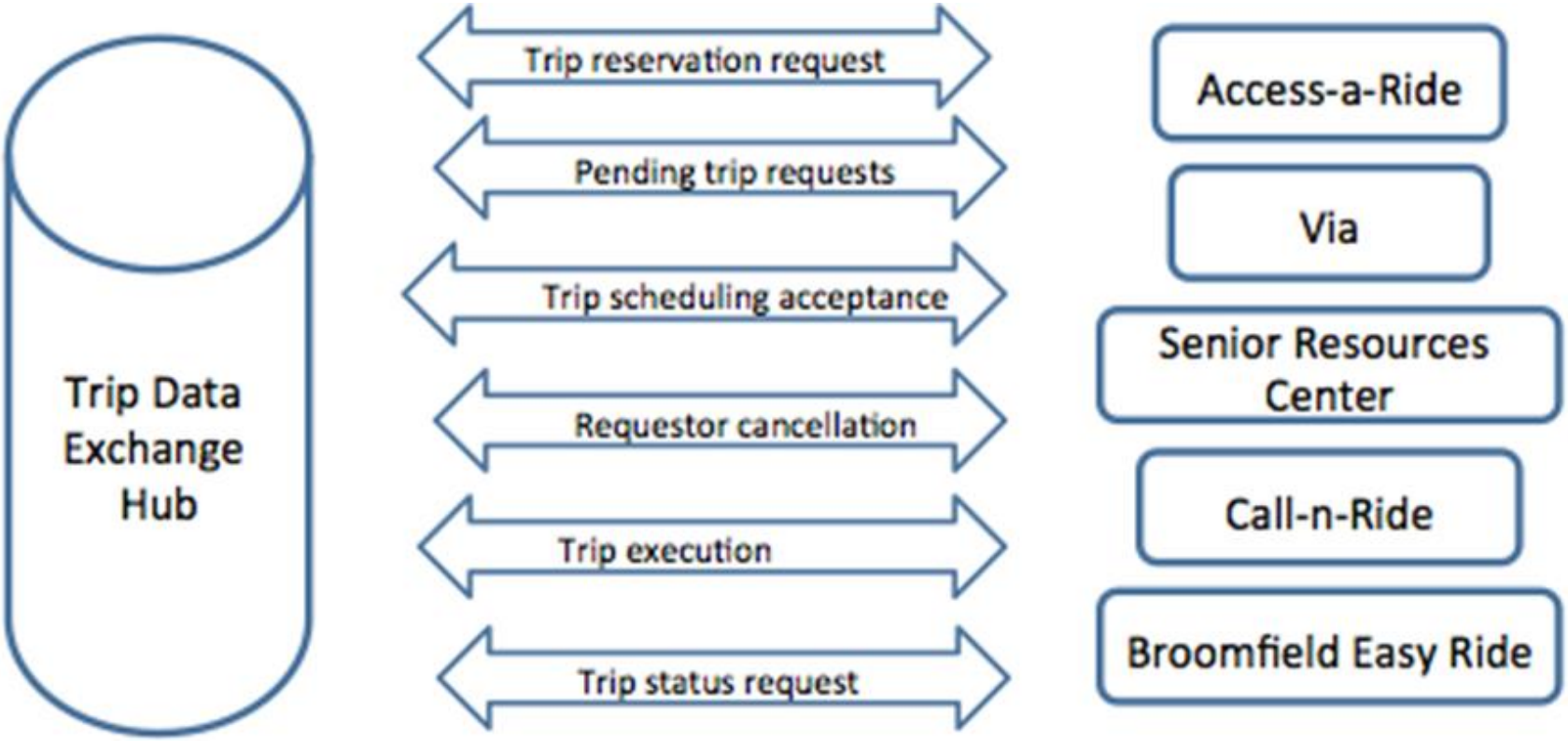
Source: **National ITS Architecture**

Common Architecting Errors

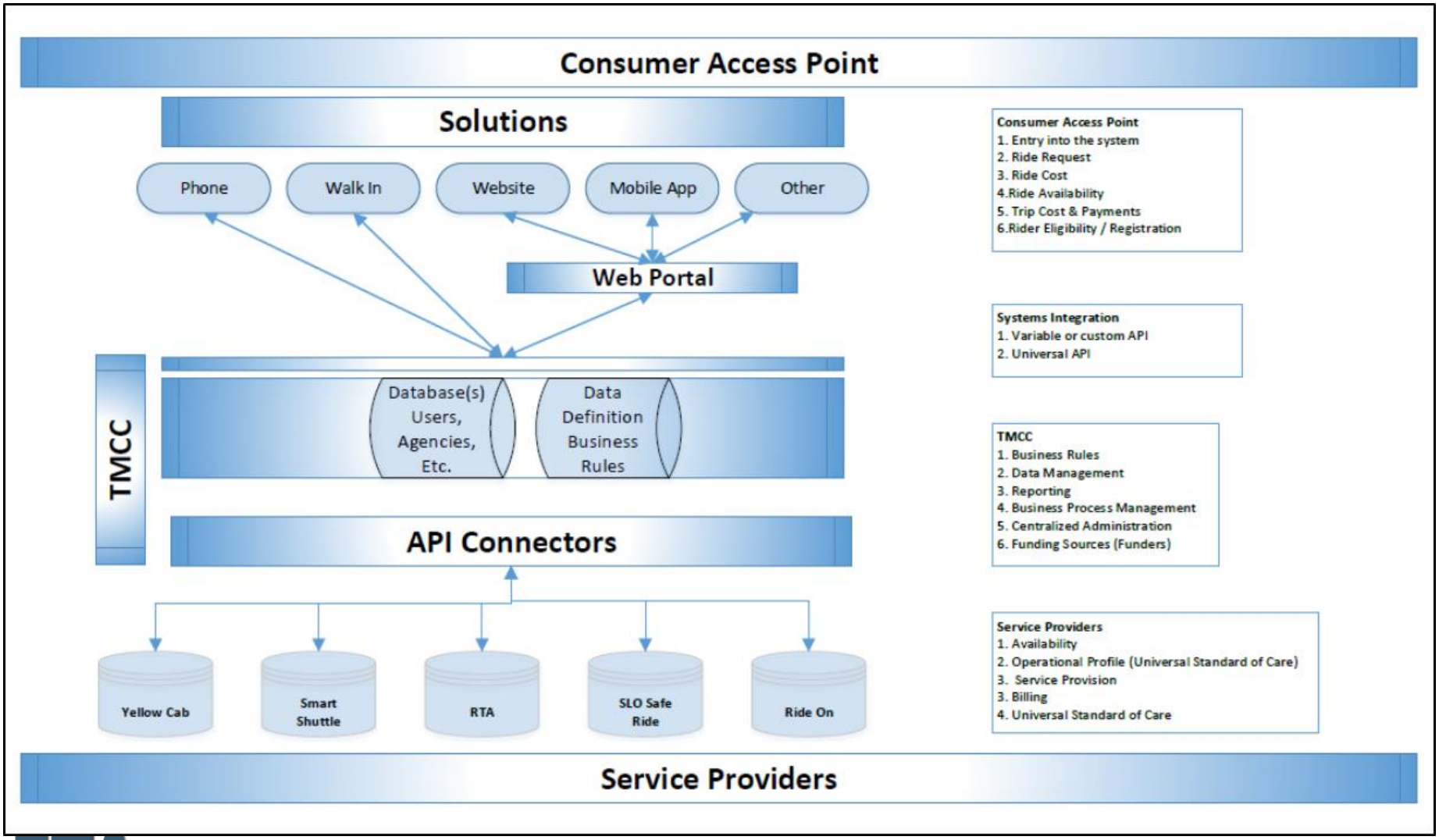


Broken Traceability

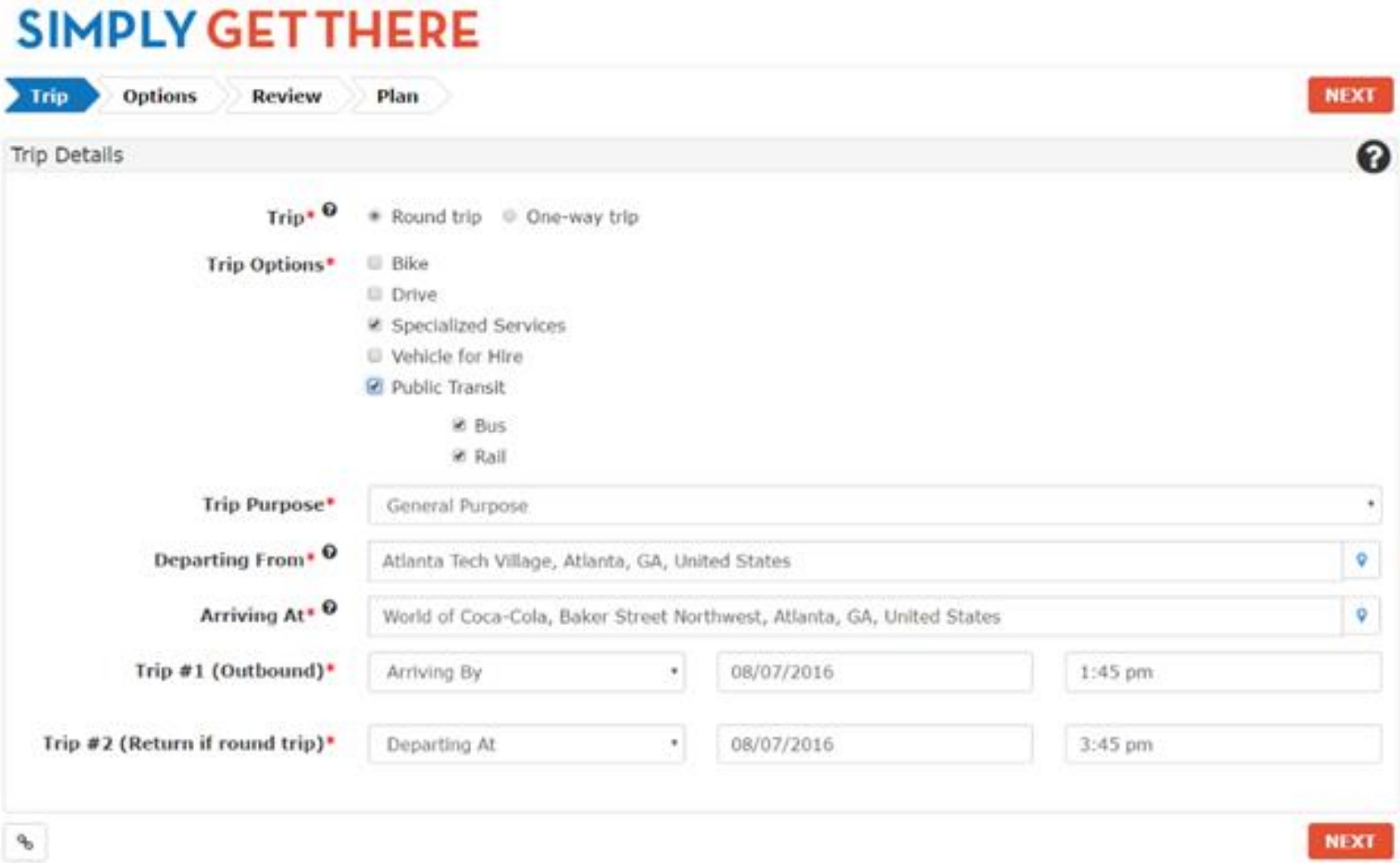
VIA Mobility



SLO TMCC


Consumer Access Point
Solutions
Phone
Walk In
Website
Mobile App
Other
Web Portal
TMCC
Database(s) Users, Agencies, Etc.
Data Definition Business Rules
API Connectors
Yellow Cab
Smart Shuttle
RTA
SLO Safe Ride
Ride On
Service Providers
Consumer Access Point
1. Entry into the system
2. Ride Request
3. Ride Cost
4.Ride Availability
5. Trip Cost & Payments
6.Rider Eligibility / Registration
Systems Integration
1. Variable or custom API
2. Universal API
TMCC
1. Business Rules
2. Data Management
3. Reporting
4. Business Process Management
5. Centralized Administration
6. Funding Sources (Funders)
Service Providers
1. Availability
2. Operational Profile (Universal Standard of Care)
3. Service Provision
3. Billing
4. Universal Standard of Care

Simply Get There



GWAAR

- Coming soon

SYSTEM REQUIREMENTS

System Requirements Purpose

- Are the key to success in the design and development of any complex system.
  - Ensure the product will meet users and stakeholders needs
  - Define expectations for what the system must accomplish
  - Provide clear guidance for what system capability needs to be developed

Requirements Writing

- Is the requirement uniquely identifiable?
- Does it have a title and does the title reflect the meaning of the requirement?
- Is the requirement unambiguous?
- Is the requirement feasible?
- Is the requirement verifiable?
- Is the requirement logically consistent with the need?

Requirements Writing (cont.)

- Is the requirement well-formed?
  - Does the requirement contain an actor [who]?
  - Does the requirement contain an action [shall do/not do something to]?
  - Does the requirement contain a target [the object of the action]?
  - Does the requirement contain any constraints [how, how often, how many, how fast]?
  - Does the requirement contain any conditions or localizations [if, when, where]?

https://ep.jhu.edu/about-us/news-and-media/writing-good-requirements-checklists

Requirements Type Key

- F = Functional
- I = Interface (interface between the system of interest and external systems)
- D = Data (send and receive data within the system of interest)
- C = Constraint
- P = Performance

Parent, Sibling, and Child Relationships

- F1.2 {Parent Requirement}
  - F1.2.1 {F1.2.1 thru F1.2.3 are child requirements of F1.2 and also siblings}
  - F1.2.2
  - F1.2.3 {Parent Requirement for Sub-functions F1.2.3.1 and F1.2.3.2}
    - F1.2.3.1 {F1.2.3.1 and F1.2.3.2 are child requirement of F1.2.3}
    - F1.2.3.2 {F1.2.3.1 and F1.2.3.2 are also siblings}

Example: Poorly Written Requirement

1.4.2.2 The system operator shall have the capability to distribute parking entrance location, parking availability, and parking price to traveler information service providers.

Three errors associated with the above requirement are described below.

- Error 1: The requirement is written from the perspective of the system operator and not the system. The system operator already has the capability to distribute parking information, if she/he so desires. It is important to remember that, in the SyRS, the capabilities of the operator are not being documented, but the capabilities of the proposed system do need to be documented.
- Error 2: The requirement includes superfluous words “have the capability to.” These words can be removed and the requirement conveys the same intent.
- Error 3: The data elements in the requirement are not uniquely identifiable. This can cause problems during testing, because if the distribution of one of the data elements fails the entire requirement fails.

Example: Better Requirements Practice

A suggested rewrite for the requirement is as follows:

1.4.2.2 The system shall distribute the following parking information to traveler information service providers:

a. Parking entrance location
b. Parking availability
c. Parking price

SYSTEM REQUIREMENTS SPECIFICATION (SYRS) TEMPLATE

SyRS Template

- Overview
- Reference Documents
  - Government Documents
  - Nongovernment Documents
- Requirements
  - System Definition
    - Operational Assumptions
    - System Interface Requirements (internal & external)

Note:
Don't be afraid to tailor the SyRS to meet your project needs.

SyRS Template (cont.)

- System Requirements
  - Performance
  - Physical Characteristics
  - Reliability
  - Maintainability
  - Environmental Requirements
- Design and Construction
  - Electromagnetic Radiation
  - Workmanship
  - Interoperability
  - Safety and Security Requirements

SyRS Template (cont.)

- Human Factor Requirements
- Documentation
- Personnel and Training
- Subsystem (functions) Requirements
  - Subsystem A Requirements
    - Subsystem A Definition
    - Interfaces
    - Subsystem A Requirements (functional first and then allocation to physical components)
      - Component 1 Requirements
      - Component 2 Requirements

SyRS Template (cont.)

- Subsystem B Requirements
  - Subsystem B Definition
  - Interfaces
  - Subsystem B Requirements
- Subsystem C Requirements
  - Subsystem C Definition

SyRS Template (cont.)

- Precedence
- Quality Assurance Provisions
- General
  - Responsibility for Tests
  - Special Tests and Examinations
- Quality Conformance Inspections
  - Inspection
  - Analysis
  - Demonstration
  - Testing

SyRS Template (cont.)

- Software Quality Assurance
- Requirements Traceability Matrix
- Notes
- User Definitions
- Configuration Management and Version Control

Questions