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

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Rik Opstelten, MSAA Project Manager and
Dawn Hardesty, Noblis
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

Context
- WWW Rules & Regulations
- FTA Rules & Regulations
- State & Local Transit Rules & Regulations
- National ITS Architecture & Standards

Environment
- Paratransit Administration
- Paratransit Service Providers
- TMCC Web Site Users
- TMCC Application Users

System
- TMCC

MOUs & Stakeholder Agreements
The “Vee” Model of System Development

- User Requirements & Concept of Operations
  - System Requirements & Architecture
  - Component Design
  - Procure, Fabricate, & Assemble Parts

- System Demonstration & Validation
  - System Integration & Test
  - Component Integration & Test

Systems Engineering Domain
Component Engineering Domain
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

Mix Ingredients

Process Ingredients

Decorate Cake

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

Mix Ingredients

Inputs & Outputs (nouns)

flour, sugar, salt, eggs, baking powder, butter, milk, oil, vanilla, flavor

Cake Batter

Processes Ingredients

Undecorated Cake

Frosting

Decorate Cake

Decorated Cake
Ingredients: flour, sugar, salt, eggs, baking powder, butter, milk, oil, vanilla, flavor

Mix Ingredients
A1

Process Cake Ingredients
A2

Undecorated Cake

Icing: sugar, vanilla, butter, color, flavor

Decoration Request

Undecorated Cake

Dirty Utensils

Recipe

Recipe

Cake Request

Cake Request

Utensils

Decoration Request

Decoration Request

Decorated Cake

Decorated Cake

Utensils

Dirty Utensils

Recipe

Recipe

Cake Request

Cake Request

Utensils

Decoration Request

Decoration Request

Decorated Cake

Decorated Cake

Utensils

Dirty Utensils

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Cake Request

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Common Architecting Errors

Ingredients
Mix Ingredients

Process Ingredients

Cake Request

Decorated Cake

Broken Traceability
VIA Mobility

Trip Data Exchange Hub

- Trip reservation request
- Pending trip requests
- Trip scheduling acceptance
- Requestor cancellation
- Trip execution
- Trip status request

- Access-a-Ride
- Via
- Senior Resources Center
- Call-n-Ride
- Broomfield Easy Ride
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

Systems Integration
- Variable or custom API
- Universal API

TMCC
- Business Rules
- Data Management
- Reporting
- Business Process Management
- Centralized Administration
- Funding Sources (Funders)

Service Providers
- Availability
- Operational Profile (Universal Standard of Care)
- Service Provision
- Billing
- Universal Standard of Care

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
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]?

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.
• **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
• 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