MARTA
Optimizing TAM
Using a Systems Approach

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Senior Director of Engineering & Development
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Denver, Colorado
Topics

1. Transit is a... System of Systems
2. Transit Assets in Today’s Markets
3. Transit Has Challenges
4. What is Systems Engineering (SE)?
   a. Optimization of TAM Using SE Approach
   b. Examples of Real Projects
5. MAP-21
   a. Safety Management Systems (SMS)
   b. Why SMS and TAM are the perfect match!
   c. ISO55000 or Not?
A System of Systems
A System of Systems

Public Transportation Infrastructure Creates Jobs in Communities Across America

Putting local citizens to work, building stronger communities, and helping create a more energy-efficient America

Quick Facts
- Every dollar communities invest in public transportation generates approximately $4 in economic returns.
- Public transportation investment can create or save more than 500,000 private sector jobs per year through reduced congestion.

APTA Excerpt
75 INTER-RELATED SYSTEMS
Transit Relevance in Technology Markets

- New Products are Largely Driven by **Commercial Markets**
- New Products are **Not Often Designed for Transit Use**
- **Transits are Unique** and Complex Systems
- **Customer Expectations** are Higher Than Ever
  No Longer About Getting from Point A to Point B
- Time Management - **Access to Information** (Wireless)
- Many Transit **Business Processes are Outdated**
- Very **Traditional Procurement Methods** & Standards
- **Technical Specifications** are Obsolete & **Lack Integration**
- Technology Purchases are **Rarely Fully Optimized**
NOT-SO-GOOD Transit has Challenges

- Constrained revenue stream & shrinking Federal Dollars
- Increasing **backlog** of systems and assets needing replacement
- Poorly defined **project scopes**, schedules & budgets (plug #’s)
- Projects not linked to Authority strategic goals & objectives
- No formal project prioritization process (lobbyist forum)
- No standardized processes within & across business units
- Limited visibility and timely controls (**Financial vs Project**)
- Unreliable asset data
  - Inventory
  - Condition Assessment
  - Safety (Risk) Assessment
  - Configuration Management
  - Performance Data
- Long procurement cycles
Start with...The BIG Picture

Asset Planning & Management

Prioritization & Decision Making

Project Delivery/Project Controls

AssetWORKS

FASuite

PD/PC

CIP Development

expertchoice

We Serve With Pride
Reinvesting
Ten Year Capital Program (funded) by Asset Category (in $M)

- $157 million (7%)
- $1,253 million (55%)
- $499 million (22%)
- $358 million (16%)

Funded Approx. $2.67B

- Maintenance of Way
- Systems
- Vehicles
- Facilities/Stations

“System Renewal Phase”
**FY2015 OPERATING & CAPITAL BUDGETS**

**CAPITAL BUDGET OVERVIEW**

**Capital Improvement Program**

MARTA launched capital improvement projects that will help preserve its capability for high-quality service delivery over a ten-year range. The long-range CIP consists of a portfolio of programs and projects organized by the major asset categories of a transit authority. The CIP also includes a category for non-asset projects. These categories, which were adapted from the Federal Transit Administration’s (FTA) asset management guidelines are as follows:

- **Facilities & Stations**: Maintenance of Way, Structural, Mechanical, Electrical, Lighting, Security, System Planning & Controls.
- **Equipment**: Revenue Collection, Automatic Trans-Central, Environmental Sustainability, Safety & Regulatory, Performance Management, Congestion/Standards.
- **Non-Asset**: Vehicles, $33,890,876.

**FY15 Capital Expenditures Summary Table**

<table>
<thead>
<tr>
<th>FY15 Capital Expenditures</th>
<th>Federal</th>
<th>State</th>
<th>MARTA</th>
<th>TOTAL</th>
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<td>$55,432,000</td>
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<td>Maintenance of Way</td>
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<td>Vehicles</td>
<td>6,965,173</td>
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<td>46,642,425</td>
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<td>Systems</td>
<td>15,776,827</td>
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<td>Facilities</td>
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<td>29,945,962</td>
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<td>Non-Asset</td>
<td>520,000</td>
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<td>33,370,413</td>
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<td>Debt Service on Bonds</td>
<td>-</td>
<td>-</td>
<td>$149,200,987</td>
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<tr>
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<td>$1,000,000</td>
<td>$413,677,391</td>
<td>$470,109,391</td>
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</table>

**MARTA BUDGET BOOK (excerpts)**
Project Delivery

- Ongoing project monitoring and reporting throughout project lifecycle
- Proposed adjustments to project budgets evaluated through capital project decision model
- Actual project costs captured and stored in FASuite database for future capital planning
- New asset data delivered by contract and entered into EAM
20-30 yr. life

1-2-3 years to launch a project

SE Impact
Opportunity to Optimize

“A Systems Approach adds value!”
What’s Systems Engineering? (classic definition)

• interdisciplinary approach
• focused on defining customer needs
• focused on required functionality (early)
• focused on best performance at lowest cost of ownership
• business and technical needs fully understood
• documenting those requirements
• proceeding with design synthesis
• verifying and validating performance
• implementing, operating & sustaining
• replace and renew
Systems Engineering is a discipline - like electrical, mechanical, civil etc. focused on optimizing value & performance by bridging the gaps!

An Approach or Strategy that considers all aspects that contribute towards a desired outcome - level of performance!
Systems is Simple...Really!

Systems Engineering (SE) focuses on the asset before it is selected and follows fundamental **value-added** steps considering cost, risk and performance that includes a:

- concept of operations (how you plan to use the asset)
- requirements/specifications
- acquisition/procurement
- test/implementation
- operations/maintenance
- rehabilitation/replacement and eventually disposal.
For a Transit Agency it means...

Selecting the **Right People** to implement your projects
Selecting a **Proven Technology** to meet your needs
Selecting the **Best Delivery Method**, minimizing risk & cost
  - Introducing **Non-Traditional Methods** - when needed
    Ex: CSI vs. Systems Specification (Building vs. System)

Understanding **Organizational Readiness**
Understanding **Change Management**
Understanding **Whole Life Cycle Management**

**PEOPLE + PROCESS + TECHNOLOGY**
Influencing Project Outcomes: Cost Influence Curve

What’s Missing?
Just the entire life of the asset.
Time to Shift Focus for a minute!

Customer - “I need …”

SE’s
1. Con-Ops
2. Requirements
3. V&V
4. RAMS

1. Inventory
2. Condition Assessments
3. Measures and Targets
4. TAM Plans
It is already being done...successfully!

Time for Transit to Get on Board !!!
Challenges

• **Agency Culture & Processes**
  awareness, buy-in, structure, participation
  – How to Implement SE in a Non-Mature Environment?
  – Break the traditional mold
    • Within Engineering
    • Within Contracts & Procurement
    • Within Operations & Maintenance (Stakeholder/End-User)
    • All Other Contributing Business Units – including leadership team!

• **Lack of Resources**
  – Where to find personnel that have a basic SE understanding?
  – Where to find SE expertise to deliver your projects?
  – How to “gather requirements” from a busy Operations & Maintenance units?
  – How to deliver once awarded?
Industry Resources and Talent

• Look within your own Agency!
• APTA - Systems Engineering Sub-Committee
• INCOSE - International Council of Systems Engineers
• Peer Agencies (MARTA, NYCT, BART...)
• International Peers (UK – London Underground)
• Outside Transit (Aviation, Medical, Telecom...)
• Consultant Support - wealth of knowledge
• Supply Chain - vendor community
Project Demonstration Method

- Identify upcoming projects that could be used as a proving ground for an SE approach
- Conceptualize, plan, develop and implement these projects
- Demonstrate success and/or contrast against projects that fully or in-part failed to apply a systems engineering approach
Delivery Methods

Two Contracts:
1) IFB for the Integrated Operations Center (IOC)
2) RFP for Train Control & SCADA Upgrade (TCSU)
Single Platform for Integrated Systems

$60M investment

- Fire Monitoring System
- Radio/Telephone Communication
- Vital/Non-Vital Relays
- Auto/Ad Hoc
- Broadcast

$38M investment

- Trapeze
- Track Allocation System
- ITS MARTA
- MARTA Data Warehouse
- Audio-Visual
- Announcements
- Incident Report/Service Req./Work Order

$185M+ investment

- Yard Tower Management
- Encroachment Detection System
- Escalator & Elevator SCADA
- Train – Wayside Communication
- Status Data Points

$30M investment

- MAVS
- MAXIMUS FASuite
- Status

$93M investment

- AVIS Server
- AVIS
- Send Call Commands
- Receive Video
- Send/Receive Communication
Tunnel & Station Lighting

Before

After

LED

Renewing, Rebuilding, Reinvesting
Brady Mobility Facility Renovation

2nd Floor Training Center

Renewing, Rebuilding, Reinvesting
Hamilton Bus Facility Expansion

“Leveraging Existing Assets and Seeking New Opportunities”
Tunnel Ventilation System
Lifecycle Considerations (approx. $200M investment)

MARTA Vision
Business Need
Operational Needs
“Safe, and Reliable …”

Business Aspect

“Cost-Effective”
Risk Mitigation

Financial Aspect

SGR Solution
Performance Requirements
“Sustainable”
“Maintainable”

Technology Aspect

Renewing, Rebuilding, Reinvesting
### 10.0 SYSTEM ASSURANCE

#### 10.1 EQUIPMENT RELIABILITY

##### 10.1.1 RELIABILITY PREDICTION

#### 10.2 MAINTAINABILITY

#### 10.3 TRAINING

##### 10.3.1 TRAINING PROGRAM

##### 10.3.2 TRAINING PLAN

##### 10.3.3 USERS TRAINING

##### 10.3.4 MAINTENANCE TRAINING

##### 10.3.5 SYSTEM ADMINISTRATOR TRAINING

##### 10.3.6 STAFF CATEGORY

##### 10.3.7 SYSTEMS DOCUMENTATION AND TRAINING MATERIALS

- 10.3.7.1 SYSTEM DOCUMENTATION CONTENT
  - 10.3.7.1.1 STANDARD OPERATING MANUAL
  - 10.3.7.1.2 EMERGENCY OPERATING MANUAL
  - 10.3.7.1.3 SYSTEM ADMINISTRATOR MAINTENANCE MANUAL

- 10.3.7.2 TRAINING MATERIAL CONTENT

##### 10.3.8 TRAINING TECHNIQUES

##### 10.3.9 INSTRUCTOR QUALIFICATIONS

##### 10.3.10 TRAINING FACILITIES AND LOCATION

##### 10.3.11 TRAINING SCHEDULE

##### 10.3.12 TUNNEL VENTILATION SYSTEM SIMULATOR

#### 10.4 SUPPORT SERVICES

- 10.4.1 SYSTEM DATA ENTRY INTO ASSET MANAGEMENT SYSTEM

- 10.4.2 SYSTEM SETUP

- 10.4.3 INSTALLATION AND START-UP

- 10.4.4 TECHNICAL SUPPORT

- 10.4.5 CHANGE NOTIFICATION SERVICE

- 10.4.6 MARTA PROCESS AND PROCEDURE REVIEW

#### 10.5 SYSTEM MAINTENANCE

- 10.5.1 MAINTENANCE RECORDS

- 10.5.2 MAINTENANCE DURING INSTALLATION, FIELD TESTS, AND THROUGH FINAL ACCEPTANCE

- 10.5.3 WARRANTY SUPPORT

- 10.5.4 POST-WARRANTY SYSTEM MAINTENANCE SERVICES

- 10.5.5 EXTENDED LONG-TERM MAINTENANCE ALTERNATIVE – OPTION 1

  - 10.5.5.1 COMPUTER AND PERIPHERAL EQUIPMENT MAINTENANCE CONTRACT(S)

- 10.5.6 TVS HARDWARE REFRESH – OPTION 2

- 10.5.7 TVS EXTENDED OPERATIONS AND MAINTENANCE – OPTION 3

#### 10.6 MAINTENANCE SUPPORT EQUIPMENT

- 10.6.1 INITIAL PRODUCT PROVISIONS

- 10.6.2 RECOMMENDED SPARE PARTS LIST

- 10.6.3 SPECIAL TOOLS AND SPECIAL TEST EQUIPMENT

#### 10.7 TVS LIFE SPAN

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**Table:**

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<thead>
<tr>
<th>Field</th>
<th>Format/Length</th>
<th>Example</th>
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**Image:**

- The image shows a page from a document with various sections and tables, including headings for System Assurance, Training, Support Services, System Maintenance, and Maintenance Support Equipment. Each section has subsections with detailed content.

- The table includes fields such as Model Year, Manufacturer ID, Model ID, Equipment Description, Serial Number, Physical Location, Estimated Useful Life, In-Service Date, Original Cost, Estimated Replacement Date, Equipment Type, From Marker, From Segment, From Offset, To Marker, To Segment, To Offset, Latitude, Longitude, and various other specifications and information related to system maintenance and training.

- The document is part of a larger report or manual, likely related to a specific system such as MARTA, with sections on technical support, training, and maintenance procedures.
“The goal of this paper is to encourage all agencies to include requirements for asset data that is most efficiently provided by the contractor, supplier or vendor at the time of procurement and prior to the asset being placed into operation.”
Mainline, Yard and Maintenance Facility Not Optimized

Limited SE Approach Used: Lack of Stakeholder Input

Armour Yard Facility 2005: $300M
• On schedule - under budget - state of the art

Operations-wise:
• Yard location is not optimal; problematic
• Dead-end tracks (wash track & cleaning platform) and lack of a run-around track
Transit Asset Management MAP-21 Implementation
National Transit Asset Management System

Define state of good repair, including objective measures of asset conditions

Establish SGR performance measures -- each grantee must set SGR performance targets and report to FTA annually

All recipients and sub-recipients must develop transit asset management plans

Report to the NTD data on asset inventories and condition assessments

Technical assistance from FTA

go to www.fta.dot.gov
MARTA & MAP-21

FTA/GDOT Safety Management System Requirements

- SMS Hazard/Risk Assessment
- Establish Safety Targets
- Develop Risk Controls & Monitoring Strategy
- Public Transportation Agency Safety Plan

FTA/GDOT Transit Asset Management Requirements

- Asset Inventory / Condition Assessment
- Establish SGR Targets
- Required Reports on System Condition
- Prioritize Investments / Program of Projects
- Transit Asset Management Plan

Establish Safety Targets

Develop Risk Controls & Monitoring Strategy

Public Transportation Agency Safety Plan

6/16/2015
Change in approach to safety oversight
Transition to risk-based oversight

- Ongoing monitoring of industry safety performance
  - FTA monitors, not manages
  - Set performance targets
  - Assure agencies are managing their own safety risk
- Prioritized decision-making
- Data driven activities
Questions needing answers

- At the transit agency, state and federal level
  - What are our most serious safety concerns?
  - How do we know this?
  - What are we doing about it?
  - Is what we are doing working?

…and importantly…how do we know what we are doing is working?
A New Model

- We need to understand our safety risk and effectively manage it
- We need tools that support executive level decision-making on risk prioritization and resource allocation
- We need to align industry safety oversight with agency safety mission achievement
Organizational Accidents

Some holes due to latent conditions

Some holes due to active failures

Safety Breakdown

Systems Approach – People, Process and Technology
MAP-21

FTA/GDOT Safety Management System Requirements
- SMS Hazard/Risk Assessment
- Establish Safety Targets
- Develop Risk Controls & Monitoring Strategy
- Public Transportation Agency Safety Plan

FTA/GDOT Transit Asset Management Requirements
- Asset Inventory / Condition Assessment
- Establish SGR Targets
- Required Reports on System Condition
- Prioritize Investments / Program of Projects
- Transit Asset Management Plan

ISO 55000 Asset Management Requirements
- Lifecycle Management
- Continual Improvement
- Cost and Performance Optimization
- Risk Management in Individual AMPs
- Agency Certification

6/16/2015
ISO55000 Certification Process Roadmap


- ISO 55000 Documents
- Develop ISO Checklist
- Conduct Gap Assessment

- AM Policy
- STAMP
- Implementation Plan
- Ancillary Plans

- Asset Owner Templates
- Work with Asset Owners to Develop AMPs

- Asset Owners Implement Plans
- Prepare for Certification Process

We are here
### Integration of Asset Management across MARTA

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<thead>
<tr>
<th>ISO Elements</th>
<th>Participants</th>
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<tr>
<td>Asset management planning</td>
<td>Executive Management, Risk Management, Project Managers, Asset Owners, Finance</td>
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<td>Contingency planning</td>
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<td>- maintenance of assets</td>
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**DON’T PUT SLIDES UP THAT PEOPLE CAN’T READ!**

We Serve With Pride  Reinvesting
• Each stakeholder will have specific roles and responsibilities for implementing the Asset Management Program. The chart below shows the possible levels of influence and interest for each stakeholder.

---

**Keep Satisfied**
- Ensure stakeholder positions are understood
- Ensure continuous feedback

**Involve**
- Involve in decision making
- Key stakeholders

**Inform**
- Provide information
- Limited input

**Consult**
- Seek out feedback on alternatives and decisions

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Level of Interest

Low

High

Level of Influence

Low

High

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6/16/2015 46D

Renewing, Rebuilding, Reinvesting
Asset Management Transcends the Agency
“Everyone has a Role to Play”

**Subject Matter Experts (SME’s) for MARTA’s Maintenance departments**
Strategic Transit Asset Management Plan (STAMP)

- The purpose of the STAMP is to develop a long-term optimized approach to the management of MARTA’s assets, consistent with the organizational strategic plan and the asset management policy.

- Defines the expected achievement of asset management activities and timelines. Results oriented.

- Addresses the condition and performance requirements of MARTA’s assets and lays out a blueprint on how MARTA intends to satisfy these requirements.

- Contains information on stakeholder requirements, asset lifecycle requirements and asset related risks.
Key Elements of MARTA’s STAMP

1. Dedicated Asset Manager
2. Internal & independent verification of asset priority and condition
3. System automation for asset replacement/decision-making with link to CIP – accessible to all departments
4. Governance documents in place for asset management
5. Comprehensive and accurate asset data
6. Asset Management Policy and Plan in place
7. Operational compliance – staff are executing the plan
8. Culture change – must see the value of asset management practices
9. Utilization of industry resources - APTA, TRB, FTA, FHWA, IMM, PAS, ISO
10. MAP-21 compliant
11. Detailed user training, SUPER user training
12. SOPs across all relevant MARTA departments
13. Senior management invested in the process
14. Total organization participation
Renewing, Rebuilding, Reinvesting

Paul Edwards, UTA
PEdwards@rideuta.com