U.S. Department of Transportation
Federal Transit Administration

5th State of Good Repair Roundtable

MARTA
Optimizing TAM
Using a Systems Approach

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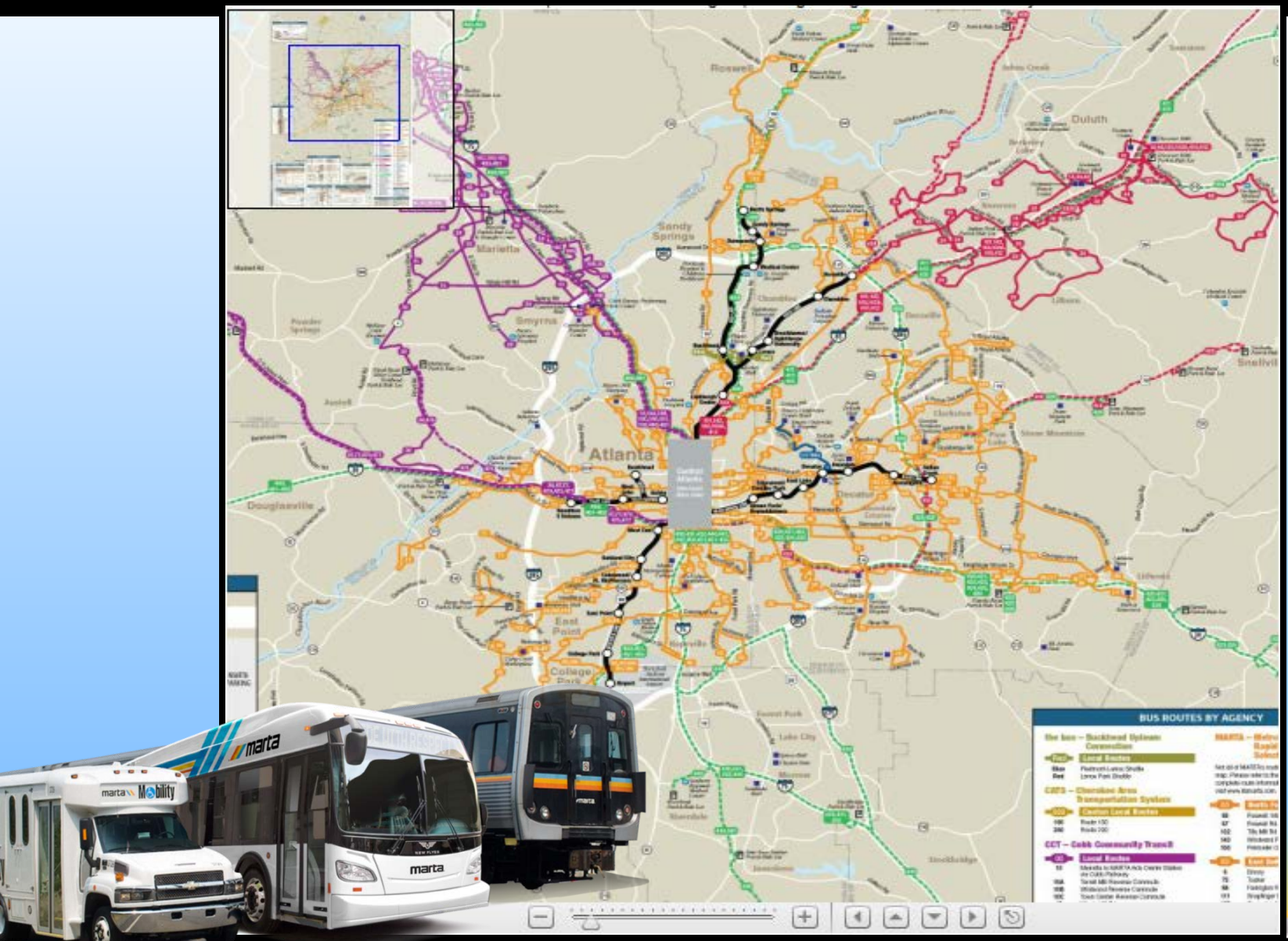
June 3, 2015
Denver, Colorado

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

Architectural

1. Wall System
2. Ceiling Systems
3. Floor Materials
4. ADA Tactile Edging
5. Entrance Canopies
6. Fare Gate Barriers
7. Customer Service Booth
8. Escalators
9. Elevators
10. Elevator Enclosure and Cars
11. Signage and Supports
12. Green Roof
13. Building Façade Design/ Materials
14. Staircases
15. Platform Barriers/Screens
16. Steel Structures
17. Concrete Structures
18. Retaining Walls
19. Slurry Walls
20. Secant Pile Walls
21. Underground Structures
22. Waterproofing
23. Fire Protection/Ratings

Mechanical

24. Heating
25. Air Conditioning
26. Tunnel Ventilation
27. Emergency Exhaust Systems
28. Over-track Exhaust Systems

Electrical

29. Decorative/Architectural Lighting Systems in Public Areas
30. Back of House Lighting Systems
31. Electronic Signs
32. Power Systems

Plumbing

33. Sanitary Systems
34. Track Drainage
35. Cavern Drainage Systems
36. Water Supply

Fire Protection

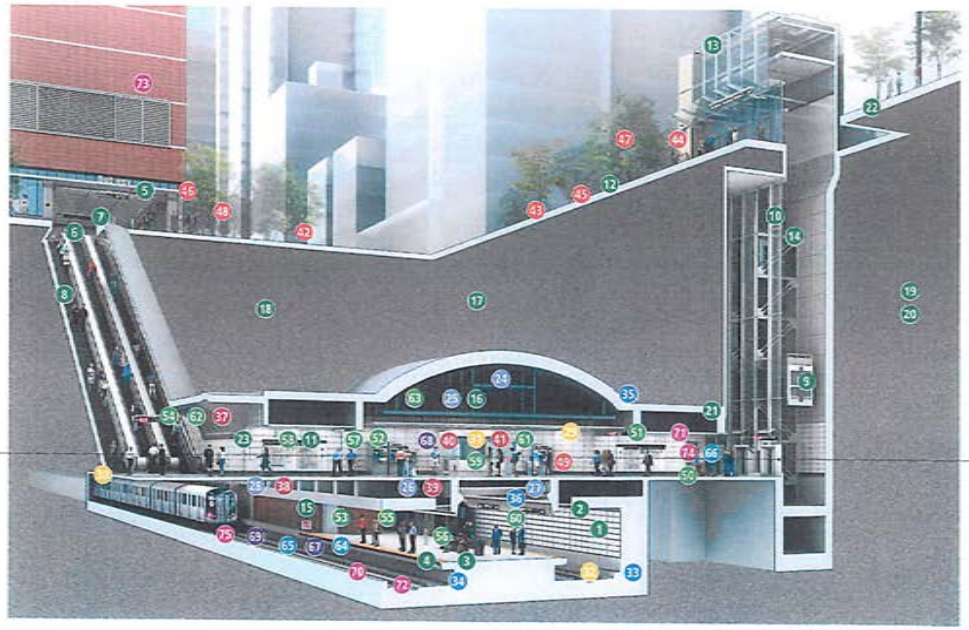
37. Wet Sprinklers
38. Dry Sprinklers
39. Water Mist Systems
40. Halon Systems
41. Inergin Systems

Amenities

42. Street Restoration
43. Sidewalk Restoration
44. Signage
45. Pavement Markings
46. Street Lights
47. Trees and Landscaping
48. Bus Shelters
49. Fare Vending Equipment

Communication Systems

50. Fiber Optic Network
51. CCTV
52. Intrusion Access Control
53. Fire Alarm
54. Public Address and Customer Information Signs
55. Help Point and Safe Point Intercoms
56. Emergency and Office Telephone Systems
57. Mobile Communications Network
58. Supervisory Control and Data Acquisition Systems
59. Emergency Alarm (Blue Light & Emergency Shutdown of 3rd Rail)
60. Emergency Booth Communication Systems
61. Time Clock Synchronization
62. Induction Loop Intercom (ADA wireless system for deaf)
63. WiFi Networks



Track

64. Track Fixation (attachments)
65. Rail
66. Rail Switches and Crossovers

Signal Systems

67. Component Infrastructure
68. Wayside Signal Display Boxes
69. Track Circuit Hardware

Traction Power

70. Trackbed Infrastructure
71. SCADA Train Control System
72. Third Rail (and third rail material)
73. Substation
74. Power Control Room
75. Regenerative Braking Equipped Railcar

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

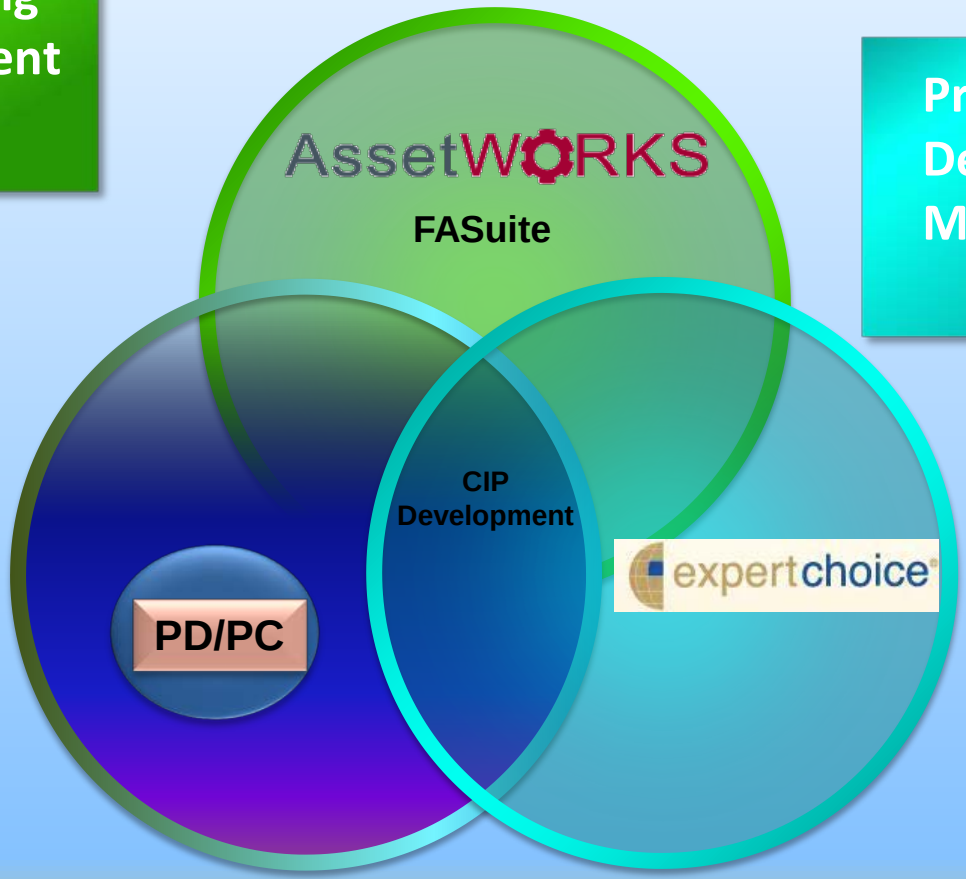
  No Longer About Getting from Point A to Point B
- Time Management - **Access to Information** (Wireless)
- Many Transit **Business Processes are Outdated**
- Very **Traditional Procurement Methods** & Standards
- **Technical Specifications** are Obsolete & **Lack Integration**
- Technology Purchases 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

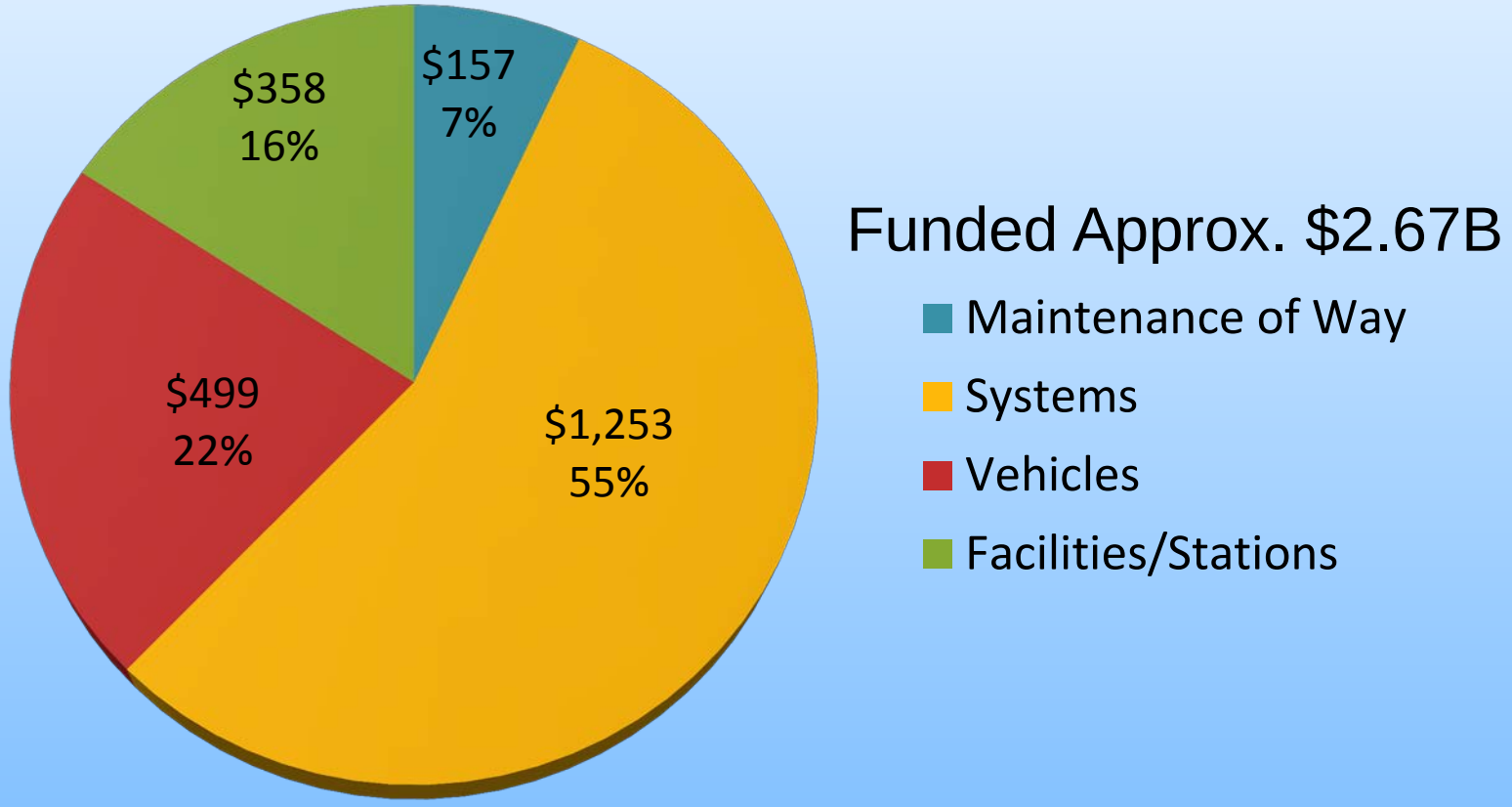
Asset Planning & Management



Prioritization & Decision Making

Project Delivery/ Project Controls

Ten Year Capital Program (funded)
by Asset Category (in $M)



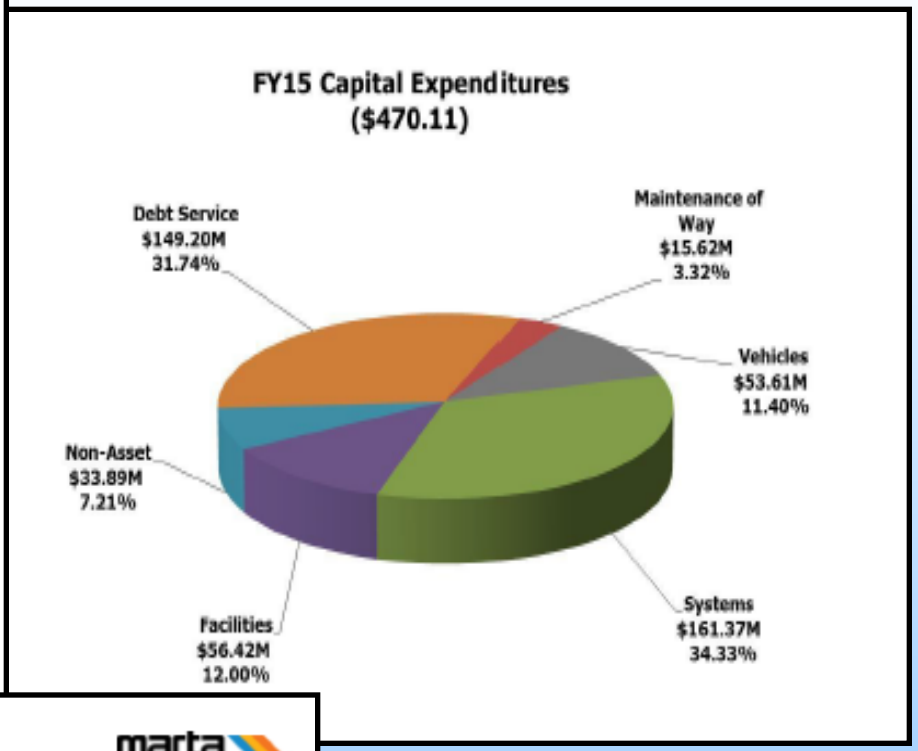
“System Renewal Phase”

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 vehicles; facilities and stations; maintenance of way; systems; and non-asset. Each of these categories then includes a number of on-going programs and each program may contain one or more projects. The CIP categories are depicted below, followed by a description of each of the categories.

Vehicles	Facilities & Stations	Maintenance of Way	Systems	Non Asset
Bus Procurement & Enhancement - Vehicles & On Board Systems	Rail Facilities & Equipment	Track Maintenance & Replacement	Revenue Collection	Transit Planning
Rail Procurement & Enhancement - Vehicles & On Board Systems	Bus Facilities & Equipment	Track Structures	Automatic Train Control	Environmental Sustainability
Paratransit (Vehicles, Lifts, AVL)	Buildings/Offices & Equipment	Work Equipment	Electrical Power & Equipment	Safety & Regulatory
Non-Revenue (Police, Maintenance)	Parking Lots & Decks		Lighting	Customer Service
	Paving, Structures & Drainage		Security	Performance Management
	Roofing & Skylights		Tunnel Ventilation	Asset Management
	Underground Storage Tanks		Fire Protection	Design Criteria/Standards
			Elevators & Escalators	CIP Planning & Controls
			Radio & Communications	
			IT Hardware/Software	
			Fuel Systems	



FY2015 OPERATING & CAPITAL BUDGETS

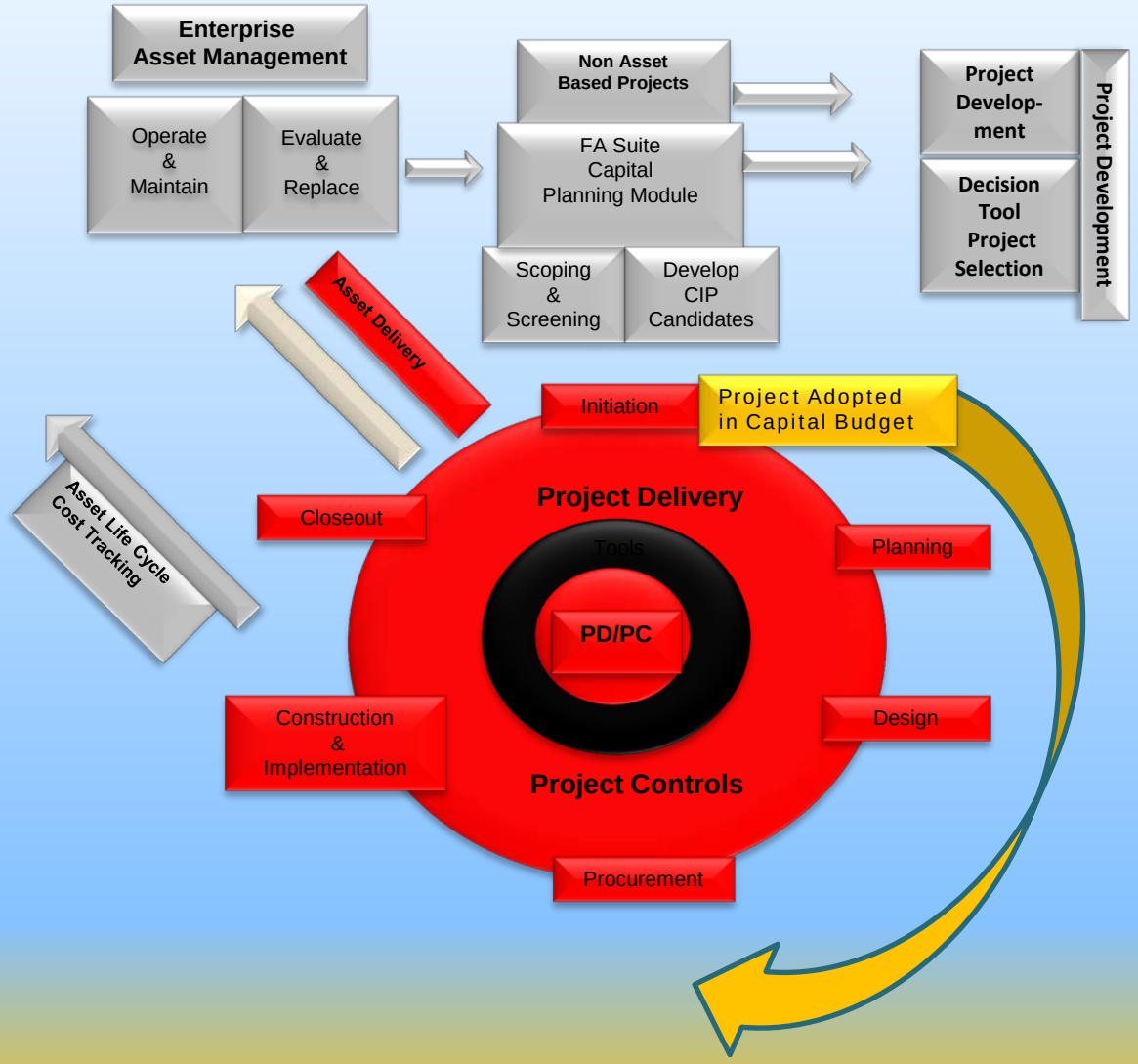
CAPITAL BUDGET OVERVIEW

FY15 Capital Expenditures Summary Table

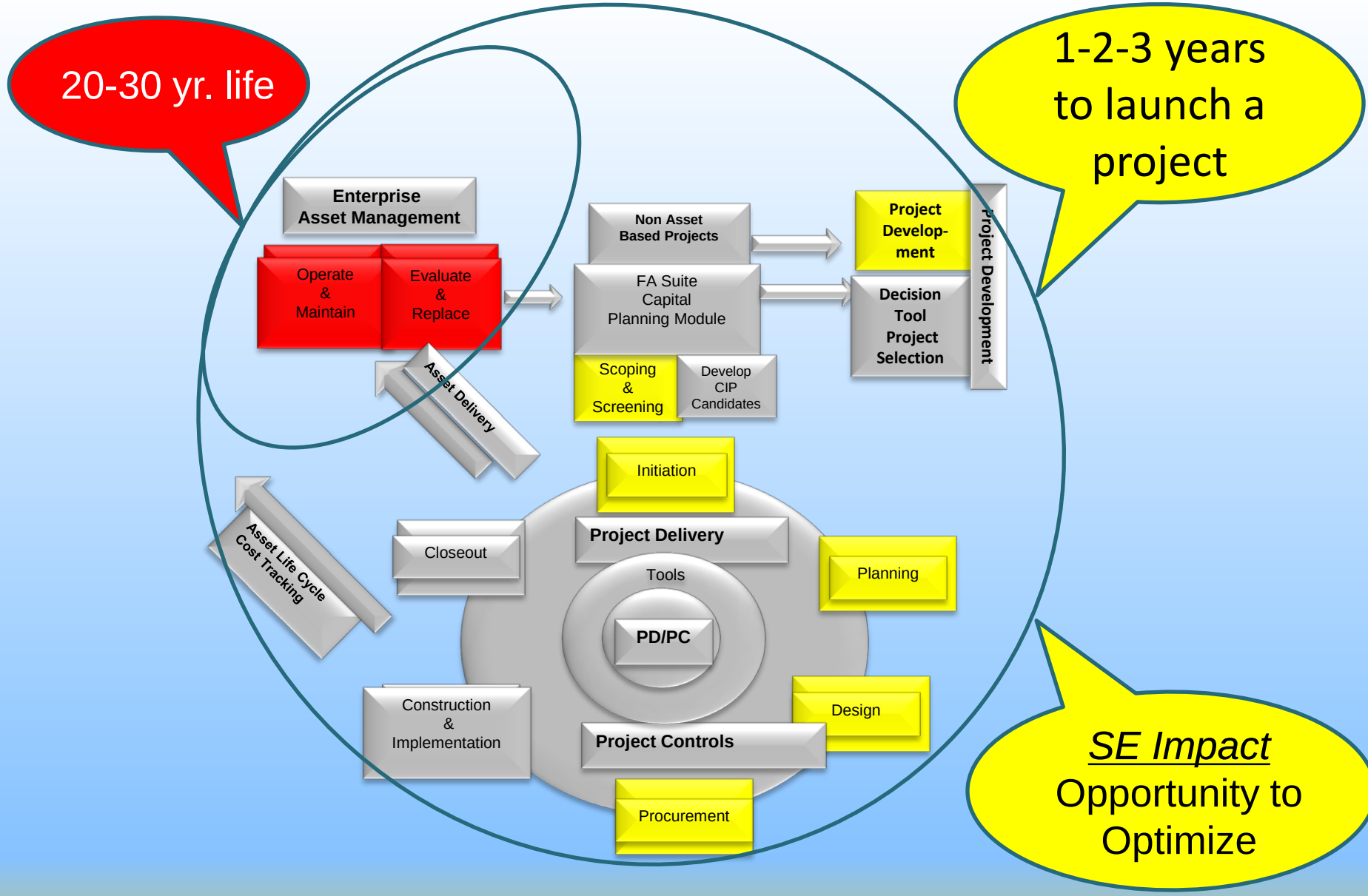
FY15 Capital Expenditures	Federal	State	MARTA	TOTAL
Capital Improvement Projects	$55,432,000	$1,000,000	$264,476,404	$320,908,404
Maintenance of Way	5,700,000	1,000,000	8,920,000	15,620,000
Vehicles	6,965,173	-	46,642,425	53,607,598
Systems	15,776,827	-	145,597,604	161,374,431
Facilities	26,470,000	-	29,945,962	56,415,962
Non - Asset	520,000	-	33,370,413	33,890,413
Debt Service on Bonds	-	-	$149,200,987	$149,200,987
Total	$55,432,000	$1,000,000	$413,677,391	$470,109,391

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



"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**

Translation Please?

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)

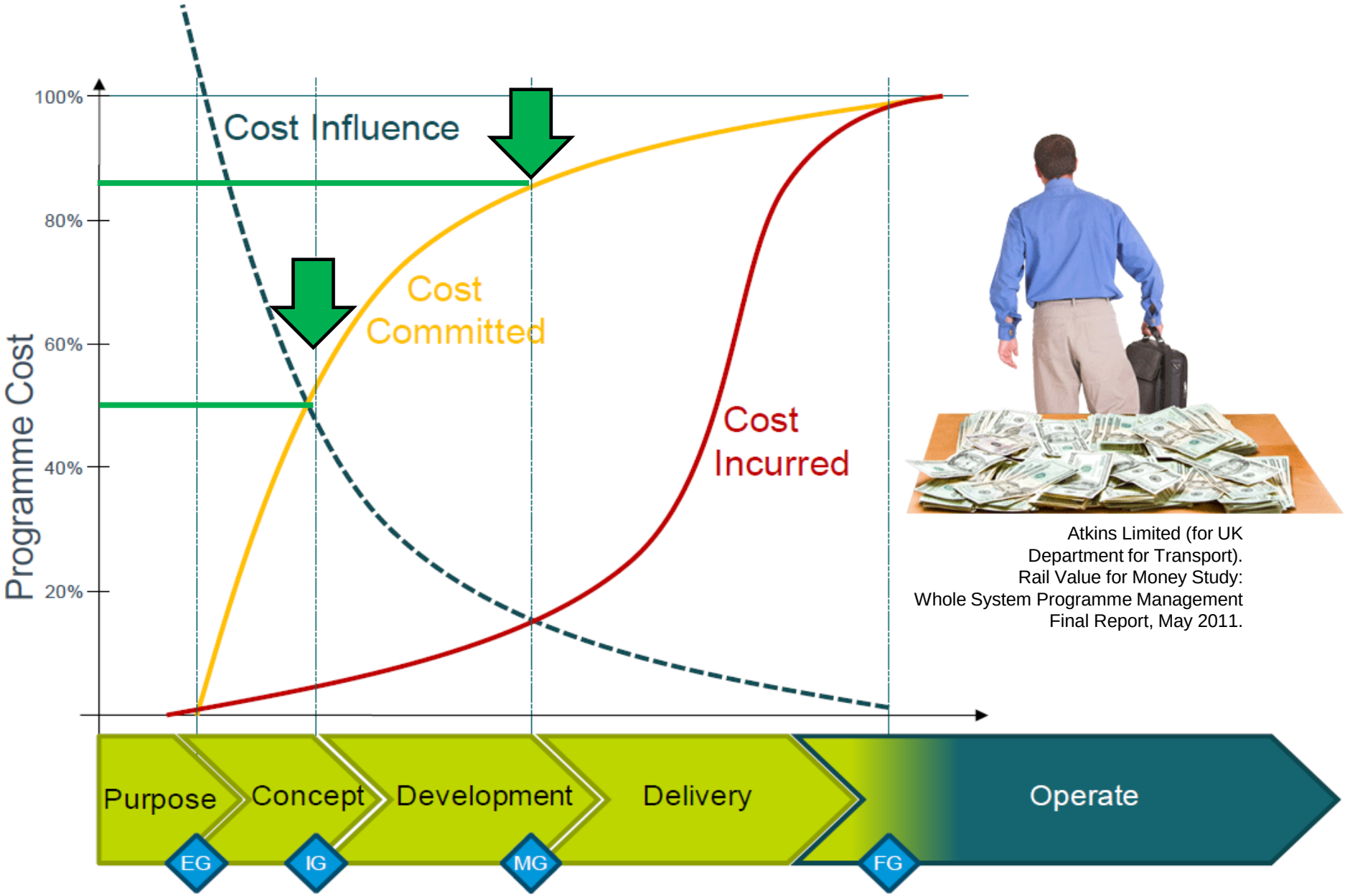
Understanding Organizational Readiness

Understanding Change Management

Understanding Whole Life Cycle Management

PEOPLE + PROCESS + TECHNOLOGY

Influencing Project Outcomes: Cost Influence Curve



Atkins Limited (for UK Department for Transport). Rail Value for Money Study: Whole System Programme Management Final Report, May 2011.

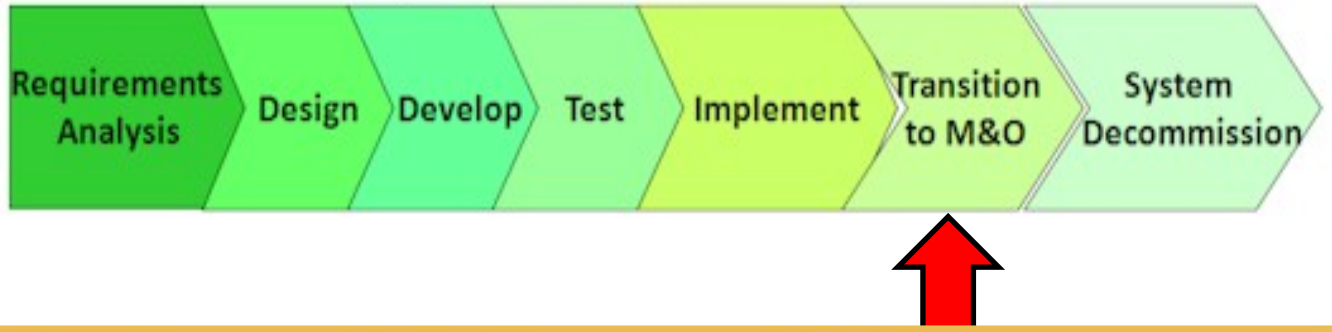
Project Management Life Cycle

Project Funding Approval Life Cycle

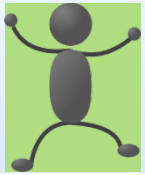
What's Missing?
Just the entire life of the asset.

Acquisition Life Cycle

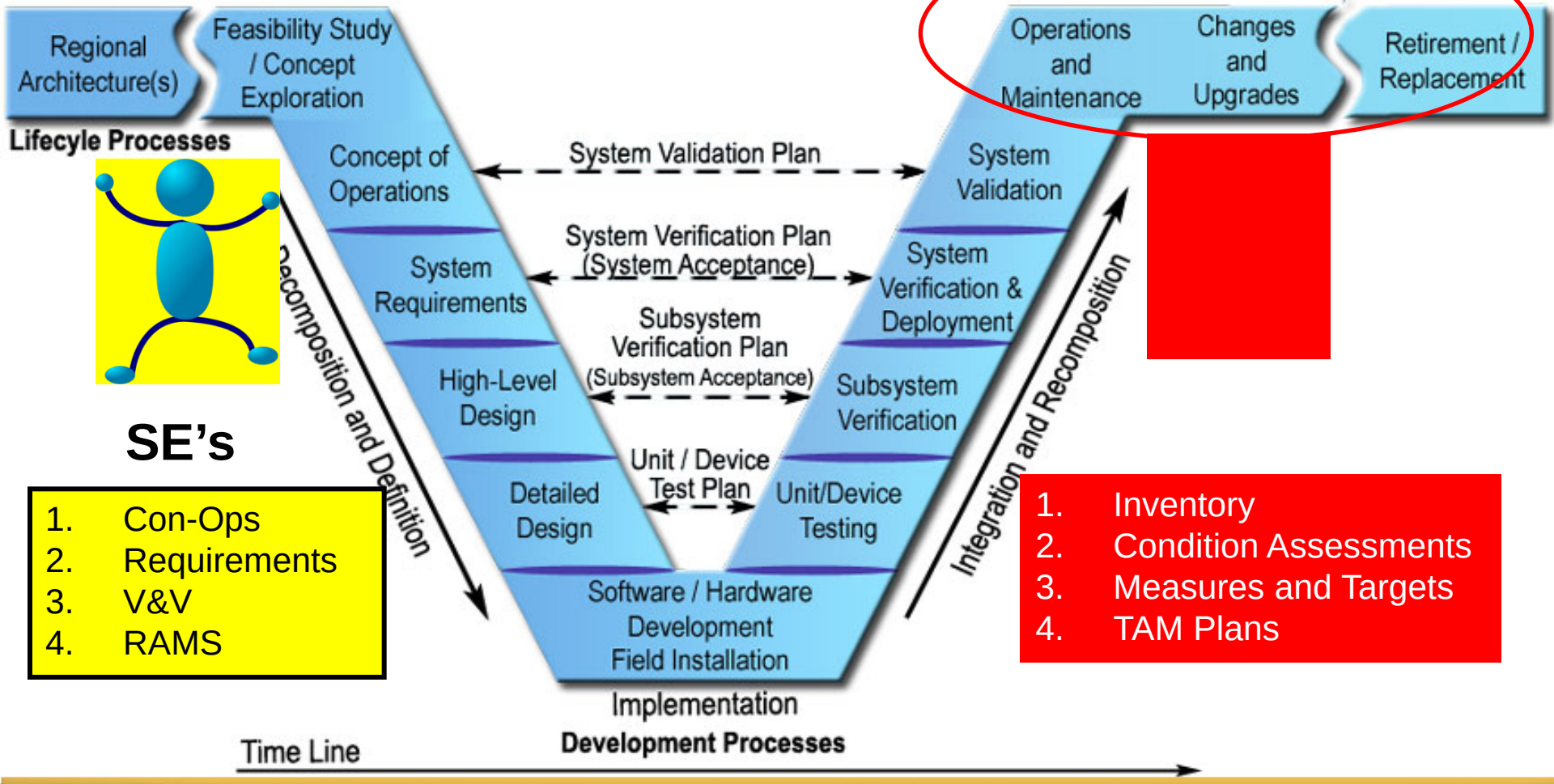
System Development Life Cycle



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?

You Are Not Alone!

(There's a Body of Knowledge Out There)

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

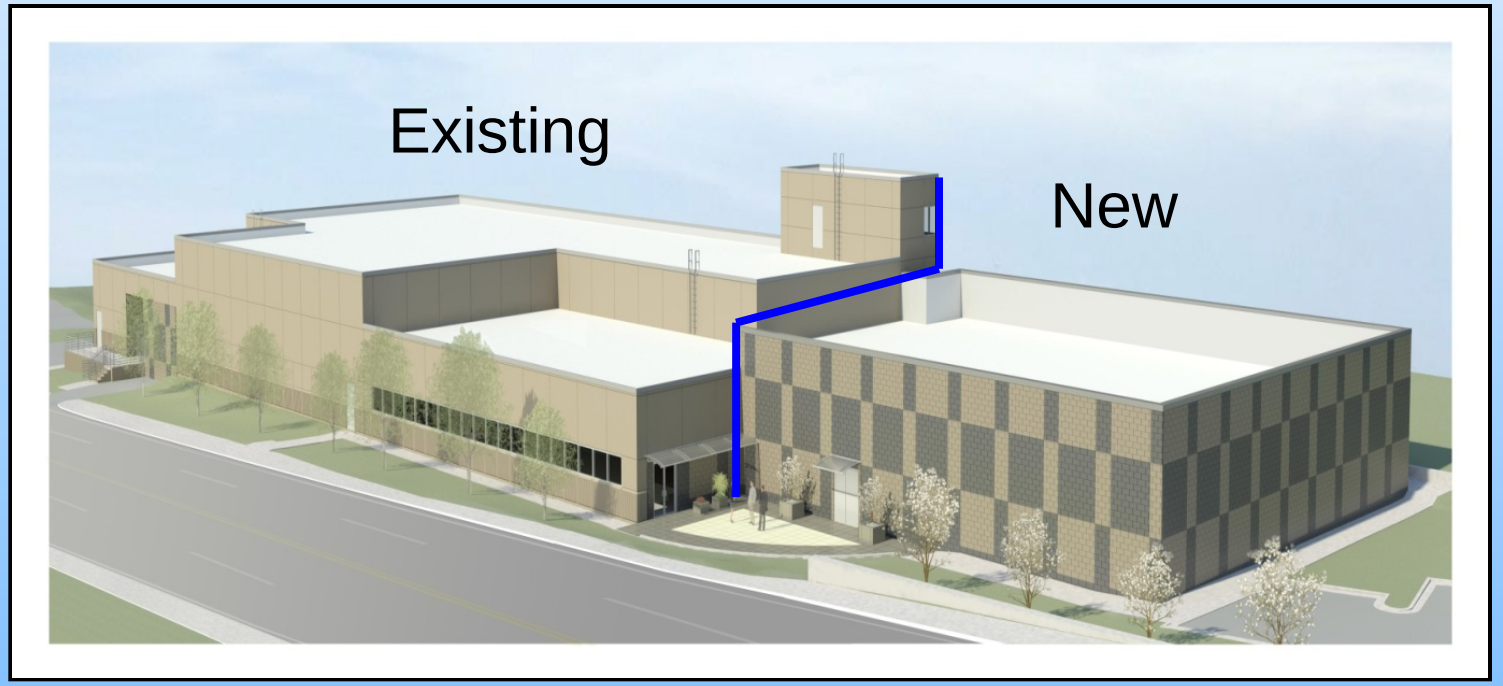
- Identify upcoming projects that could be used as a proving ground for an SE approach
- Conceptualize, plan, develop and implement these projects
- Demonstrate success and/or contrast against projects that fully or in-part failed to apply a systems engineering approach

Delivery Methods

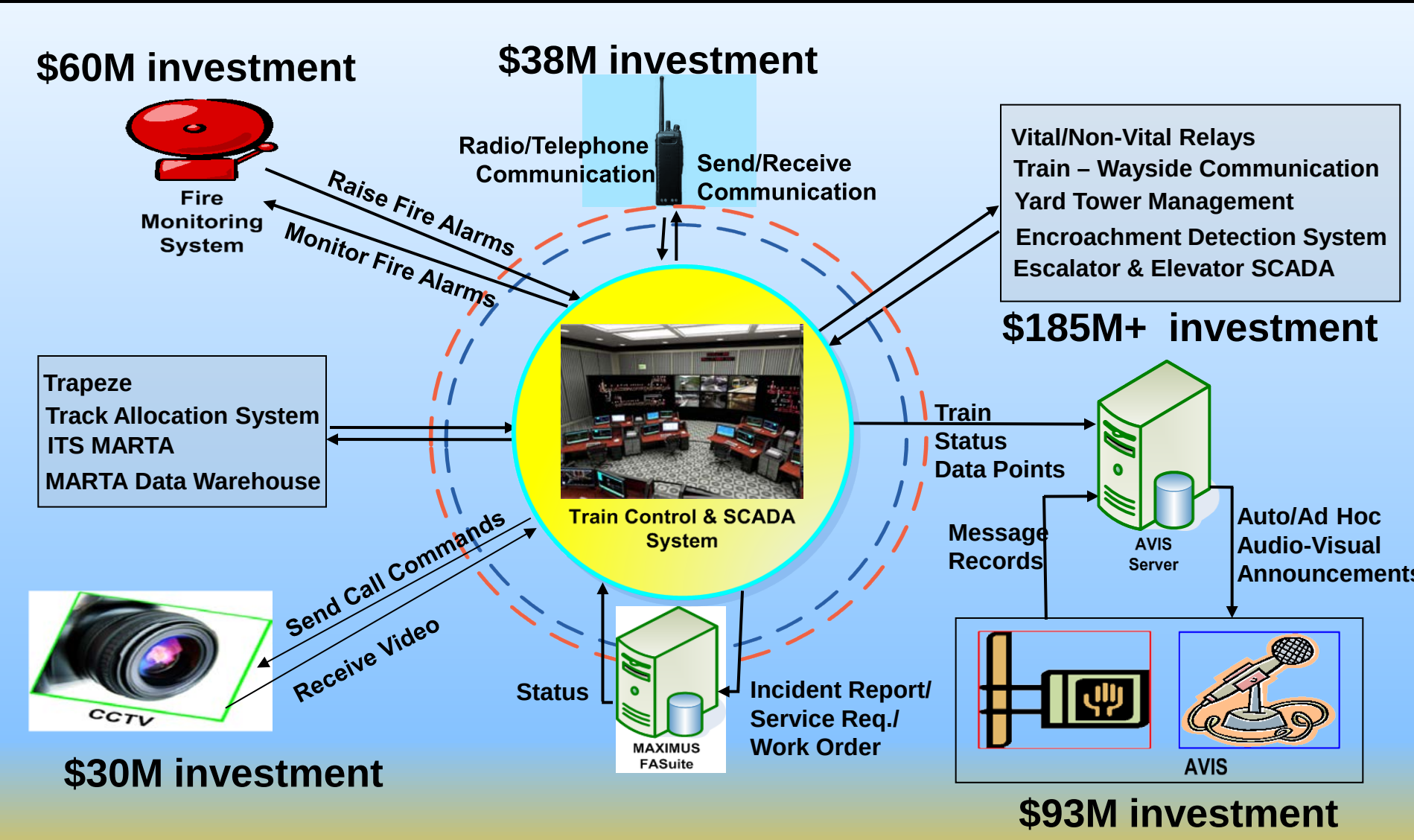
Two Contracts:

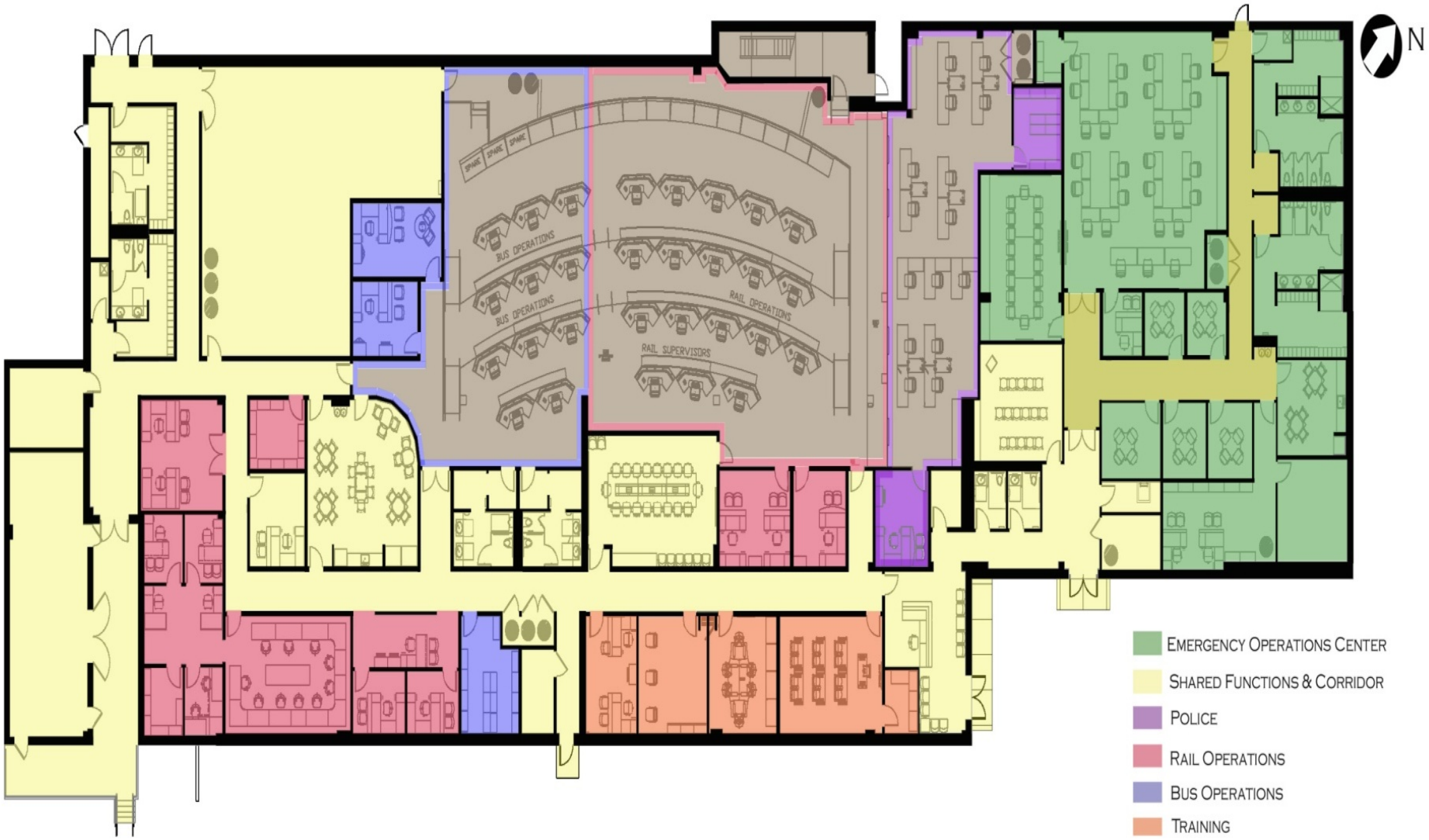
1) IFB for the Integrated Operations Center (IOC)

2) RFP for Train Control & SCADA Upgrade (TCSU)



Single Platform for Integrated Systems

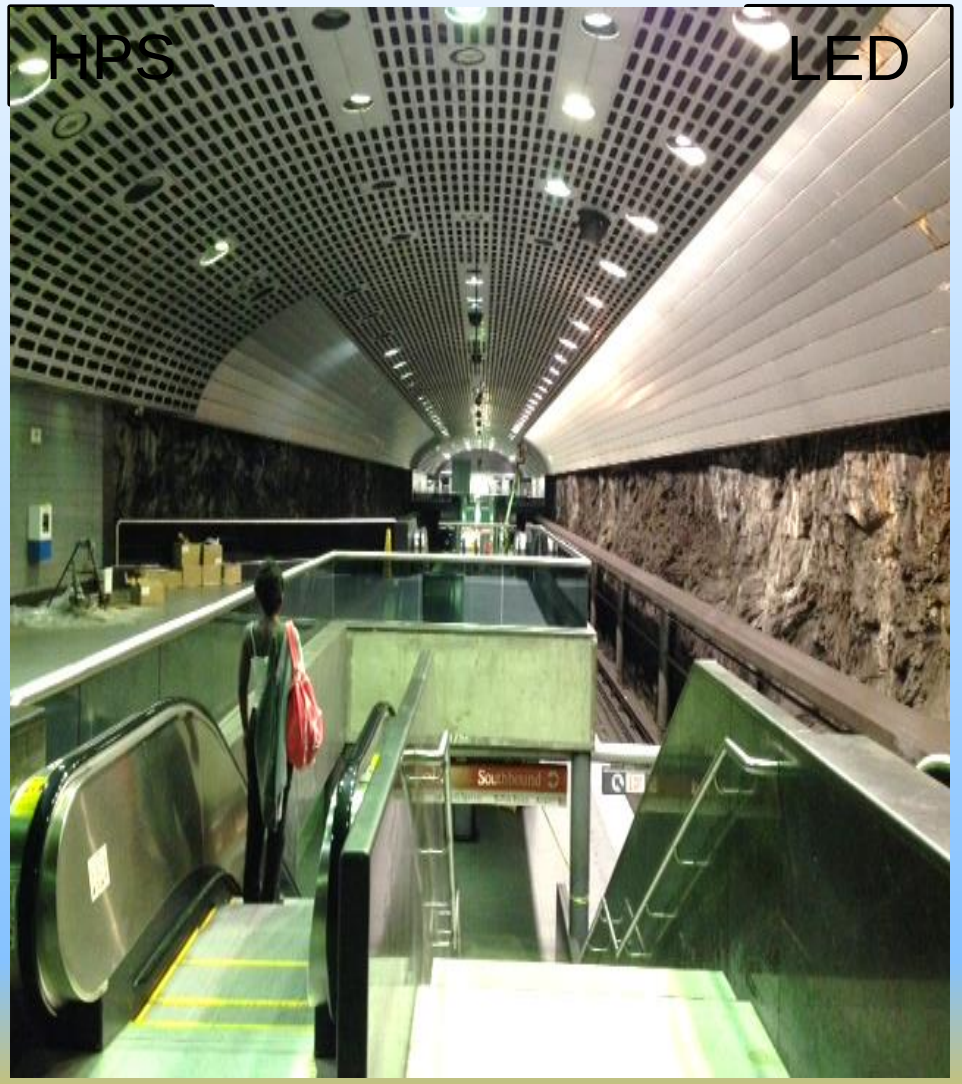



N
SPARE
SPARE
SPARE
BUS OPERATIONS
BUS OPERATIONS
RAIL OPERATIONS
RAIL SUPERVISORS
EMERGENCY OPERATIONS CENTER
SHARED FUNCTIONS & CORRIDOR
POLICE
RAIL OPERATIONS
BUS OPERATIONS
TRAINING

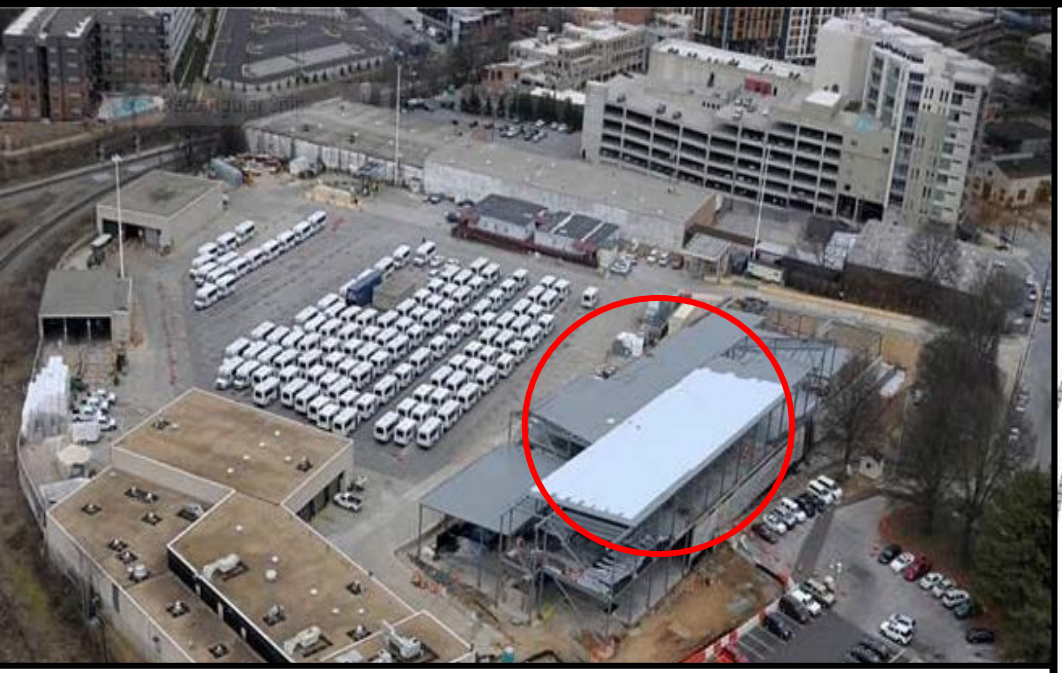
Tunnel & Station Lighting

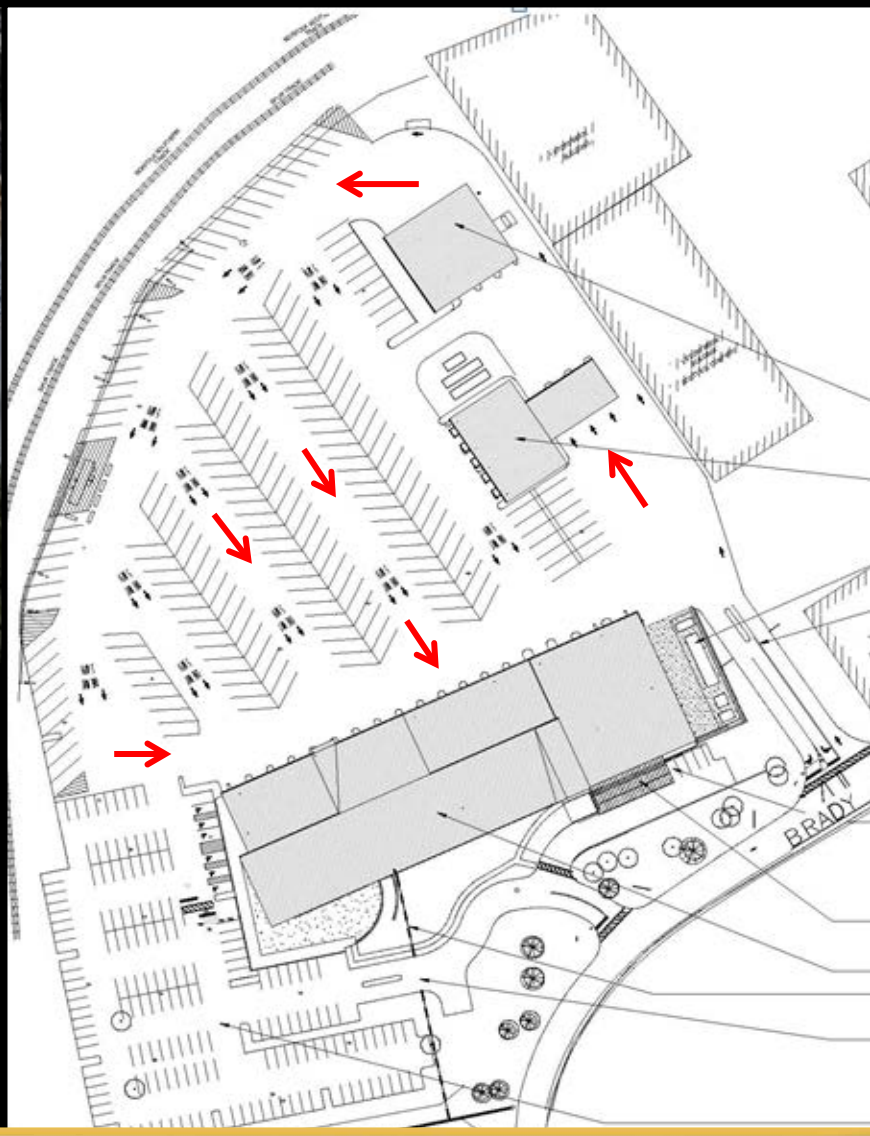
Before

After



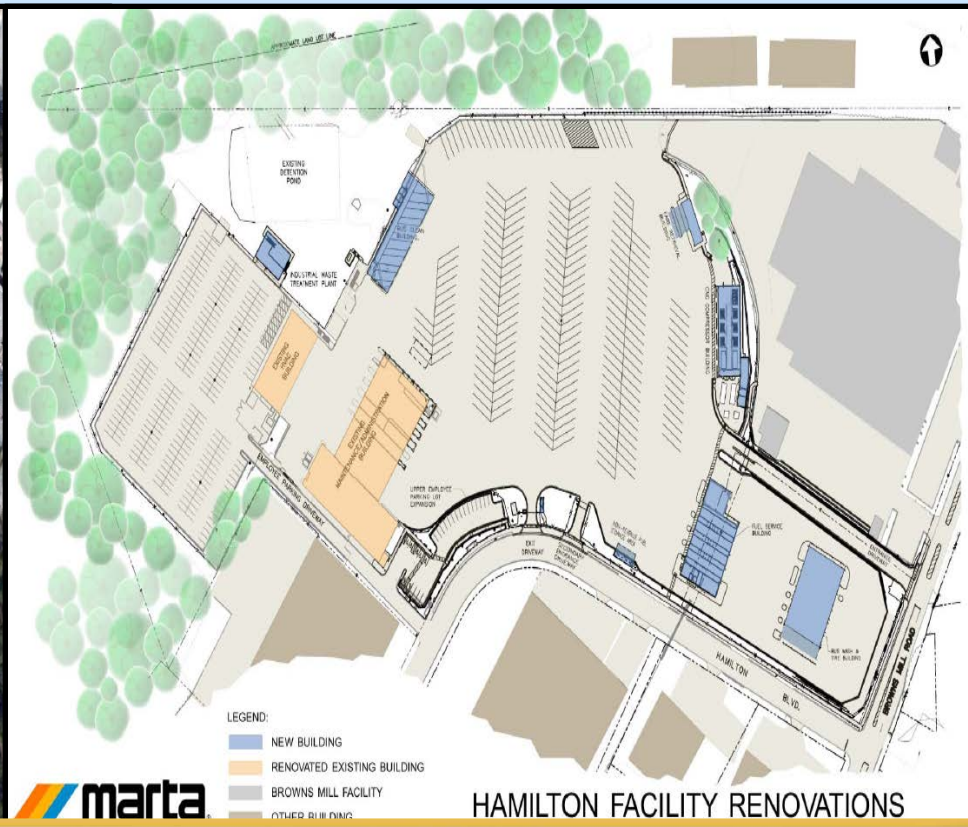
Brady Mobility Facility Renovation





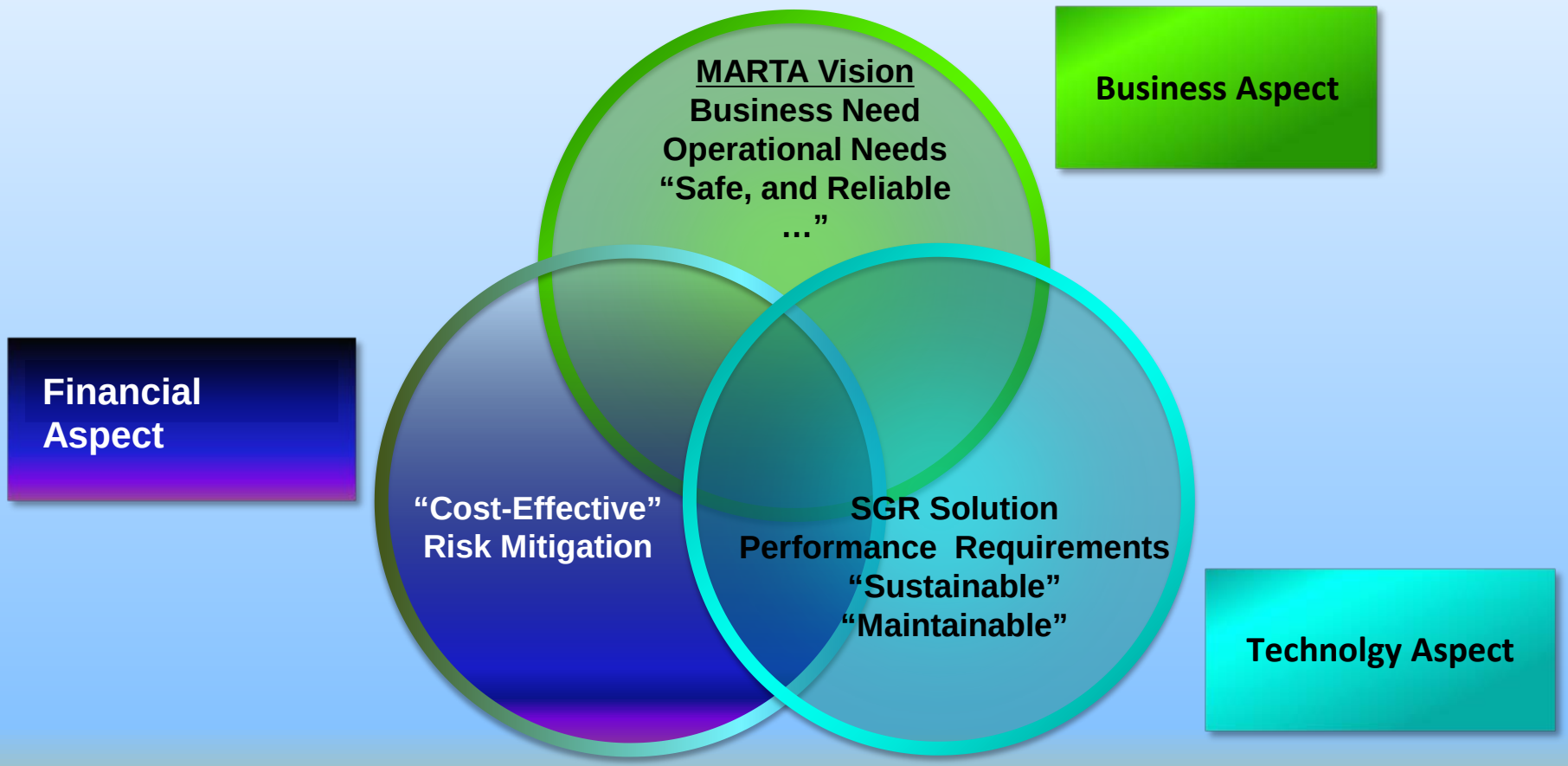
Hamilton Bus Facility Expansion

"Leveraging Existing Assets and Seeking New Opportunities"

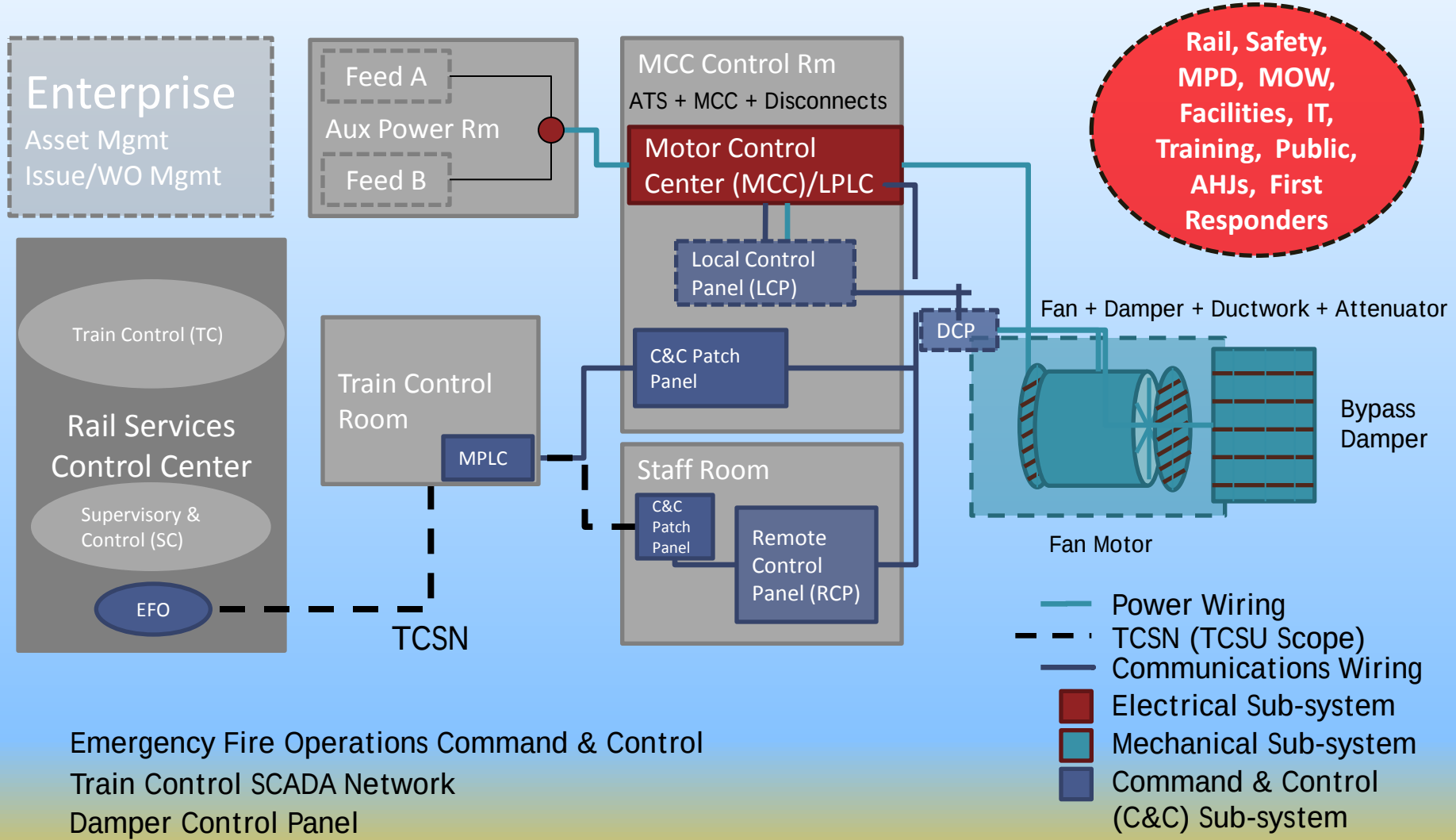


Tunnel Ventilation System

Lifecycle Considerations (approx. $200M investment)



Tunnel Ventilation System
(People, Process & Technology)



Emergency Fire Operations Command & Control
Train Control SCADA Network
Damper Control Panel

Field	Field Format/Length	Example
Model Year	4 Digits	2013
Manufacturer ID	15 Characters	MECHANICAL INC.
Model ID	15 Characters	55-555555555555
Equipment Description	40 Characters	FAN-MIDTUNNEL
Serial Number	50 Characters	B-123-45678-QRS-123456789123456-4
Physical Location	Should be one of predefined locations already in the system	2 digit location codes to be provided upon contract award
Estimated Useful Life	6 Characters	30
In-Service Date	mm/dd/yyyy	06/06/2016
Original Cost	10 digits before decimal, 2 digits after decimal	60,000
Estimated Replacement Date	mm/dd/yyyy	12/31/2017 (may not be same as in service date +estimated useful life)
Equipment Type	30 Characters	Fan, mid tunnel
From Marker	20 Characters	1400
From Segment	10 Characters	NE
From Offset	18 Characters	47.000
To Marker	20 Characters / 10 Characters	2800
To Segment	10 Characters	SYD
To Offset	18 Characters	-111.0000
Latitude	25 Characters	304.xxx
Longitude	25 Characters	-84.xxx

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 SYSTEMS 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 1
10.3.12 TUNNEL VENTILATION SYSTEM SIMULATOR 1
10.4 SUPPORT SERVICES 1
10.4.1 SYSTEM DATA ENTRY INTO ASSET MANAGEMENT SYSTEM 1
10.4.2 SYSTEM SETUP 1
10.4.3 INSTALLATION AND START-UP 1
10.4.4 TECHNICAL SUPPORT 1
10.4.5 CHANGE NOTIFICATION SERVICE 1
10.4.6 MARTA PROCESS AND PROCEDURE REVIEW 1
10.5 **SYSTEM MAINTENANCE** 1
10.5.1 MAINTENANCE RECORDS 1
10.5.2 MAINTENANCE DURING INSTALLATION, FIELD TESTS, AND THROUGH FINAL ACCEPTANCE 1
10.5.3 WARRANTY SUPPORT 1
10.5.4 POST-WARRANTY SYSTEM MAINTENANCE SERVICES 1
10.5.5 EXTENDED LONG-TERM MAINTENANCE ALTERNATIVE – OPTION 1 1
10.5.5.1 COMPUTER AND PERIPHERAL EQUIPMENT MAINTENANCE CONTRACT(S) 1
10.5.6 TVS HARDWARE REFRESH – OPTION 2 1
10.5.7 TVS EXTENDED OPERATIONS AND MAINTENANCE – OPTION 3 1
10.6 MAINTENANCE SUPPORT EQUIPMENT 1
10.6.1 INITIAL PRODUCT PROVISIONS 1
10.6.2 RECOMMENDED SPARE PARTS LIST 1
10.6.3 SPECIAL TOOLS AND SPECIAL TEST EQUIPMENT 1
10.7 **TVS LIFE SPAN** 1

Upcoming APTA Recommended Practice

"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

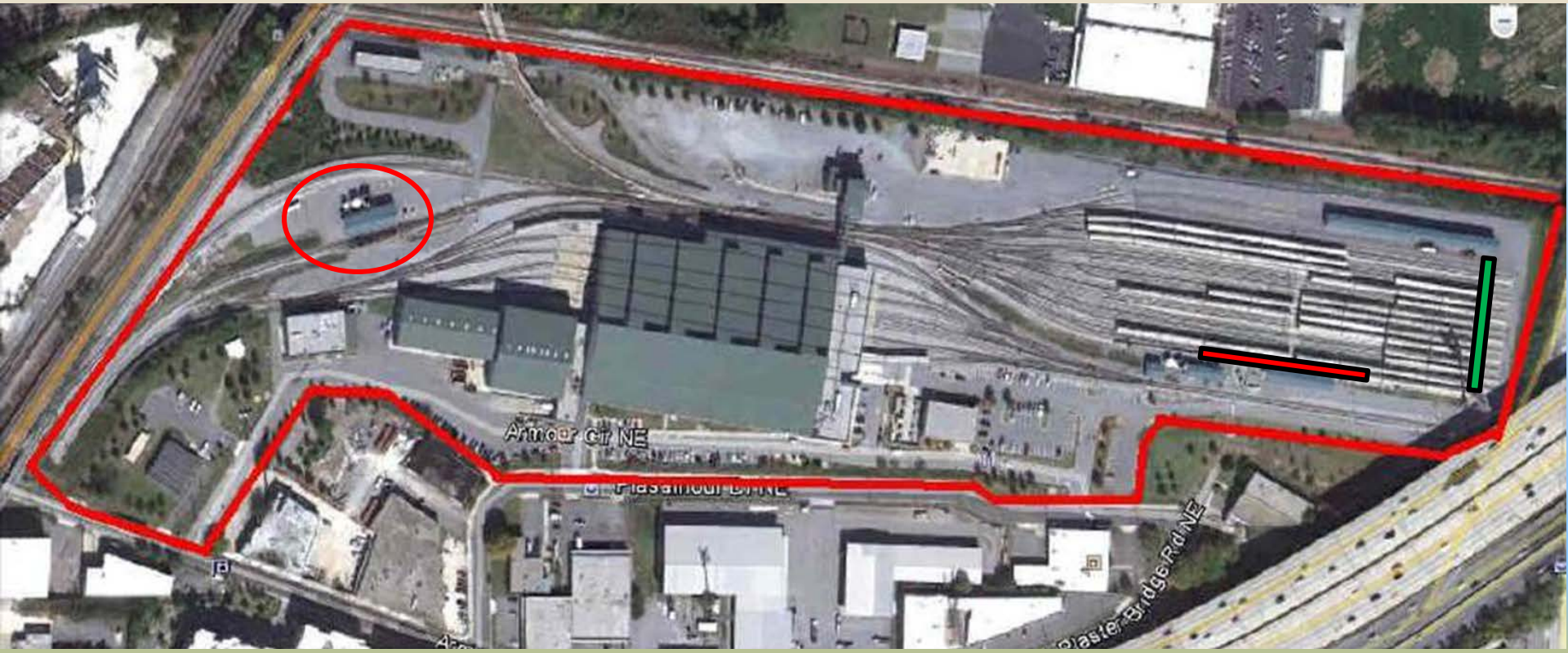
Limited SE Approach Used: Lack of Stakeholder Input

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

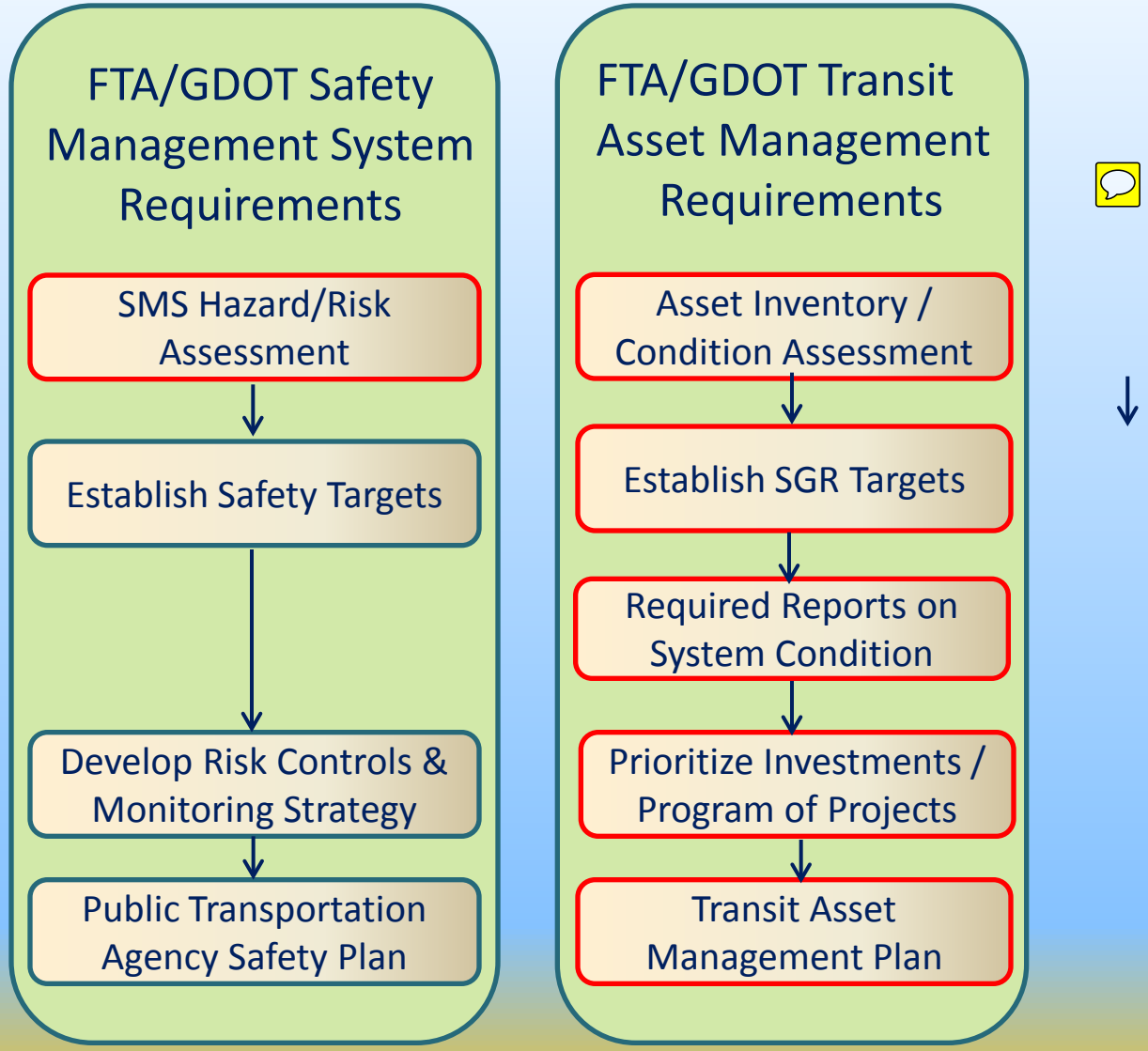
Report to the NTD data on asset inventories and condition assessments

Technical assistance from FTA

U.S. Department of Transportation
Federal Transit Administration

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

Change in approach to safety oversight

FTA
FEDERAL TRANSIT ADMINISTRATION

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?

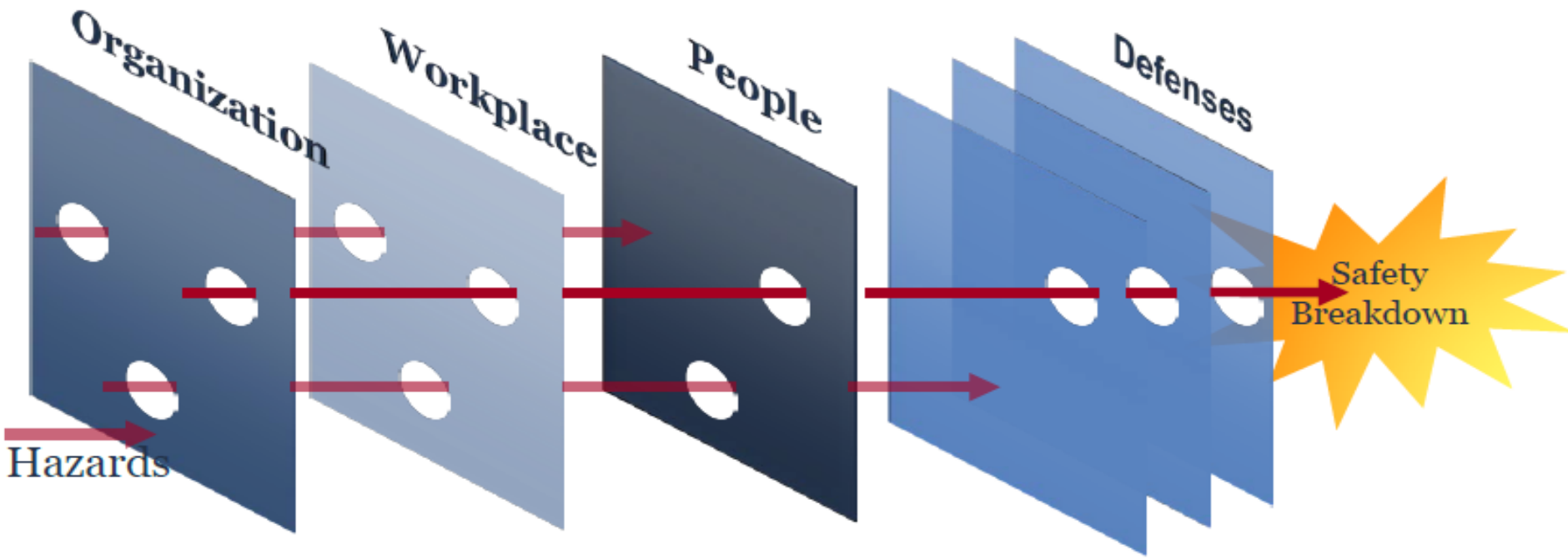
*…and importantly…how do we **know** what we are doing is working?*

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

Systems Approach – People, Process and Technology

Organizational Accidents



Some holes due to latent conditions

Some holes due to active failures

FTA

MAP-21 ISO55000

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

ISO55000 Certification Process Roadmap

June/Sept 2014	Sept 2014/April 2015	May/Dec. 2015	Jan. 2016/March 2016
• 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

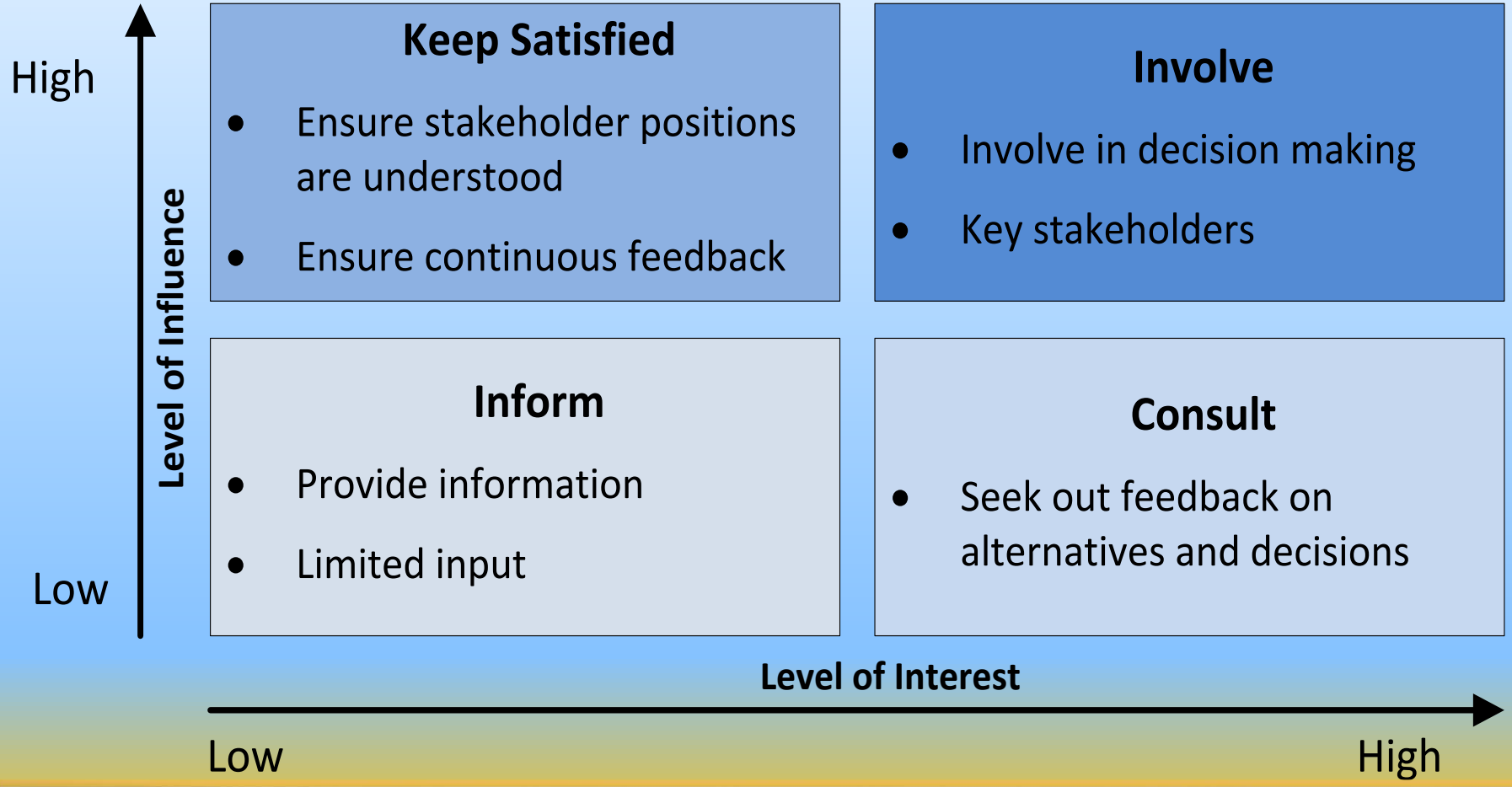
Integration of Asset Management across MARTA

ISO Elements	Executive Management	Balanced Scorecard Team	Risk Management Team	Asset Management Staff	Asset Management Committee	Asset Owners	Project Managers	Engineering	Maintenance	Maintenance Planners	Quality Assurance	Safety	Finance	Union Rep./Other Stakeholders	Environmental Health & Safety	Corporate Communications	Regulatory Affairs	Contracts & Procurement	Information Technology	Human Resources	Training	Legal	Audit	Emergency Management
Asset management planning	x			x	x	x	x	x					x												x
Contingency planning	x			x	x	x	x		x																x
Asset management activities outsourcing			x		x	x	x		x	x			x	x	x				x						
Training, awareness and competence			x	x		x	x	x	x	x	x										x				
Consultation/participation/communication	x		x	x	x		x	x		x			x												
Asset Management Program documentation				x	x		x																		
Information management/distribution				x		x	x	x	x	x		x								x					
Risk management process(es)			x																						
Risk management methodology			x																						
Risk identification and assessment			x	x		x		x							x										x
Asset risk management information use/maintenance			x			x							x												
Legal and other requirements	x		x	x		x		x				x										x	x		
Management of change				x		x							x												
Life-cycle activities				x	x																				
- creation, acquisition or enhancement of assets				x	x	x		x		x			x						x	x					
- utilization of assets						x		x	x																
- maintenance of assets						x			x	x	x														
- decommissioning and/or disposal of assets				x		x		x		x									x						
Performance and condition monitoring		x	x	x		x		x		x															
Investigation of asset-related failures, incidents, nonconformities			x			x		x				x			x										
Evaluation of compliance		x	x	x							x							x					x	x	
Audit		x		x	x	x						x	x	x										x	
Corrective and preventative action			x			x						x			x										
Continual improvement			x	x	x	x																	x		
Records				x	x	x	x			x			x					x		x				x	

DON'T PUT SLIDES UP THAT PEOPLE CAN'T READ!

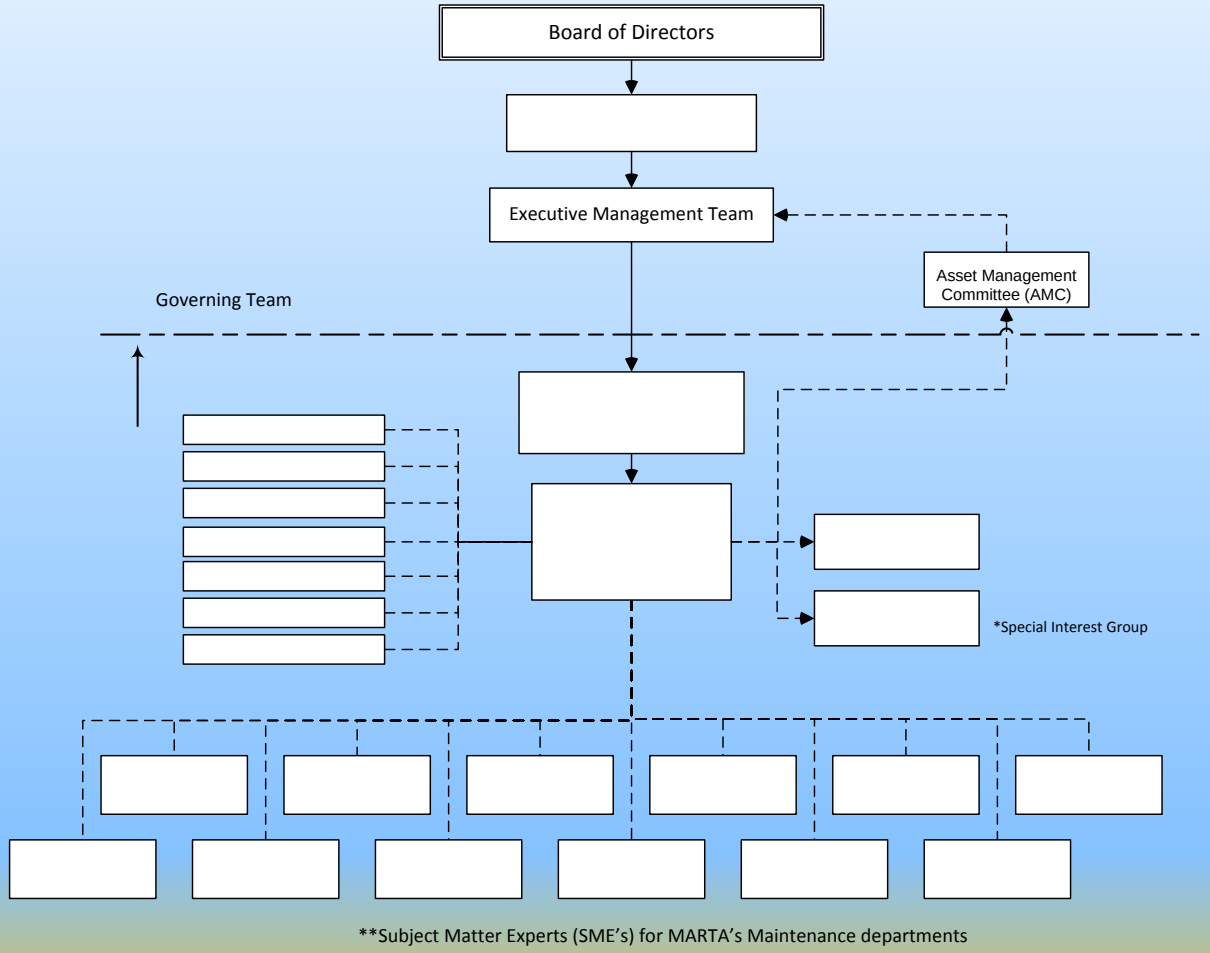
Stakeholder Participation

- 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.



Asset Management Transcends the Agency

"Everyone has a Role to Play"



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 o**rganizational 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

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