MARTA’s Integrated Systems Approach
Train Control & SCADA Upgrade

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History and Background

• While still in a state of good repair, systems are becoming increasingly difficult to upgrade & maintain
• Systems are becoming unstable & unreliable leading to potential service delivery & operational inefficiencies
• Outdated business processes inhibit productivity due to manually intensive processes
Authority Commitment

• MARTA gives safety critical and operational critical systems & infrastructure projects highest prioritization within their Capital Improvement Plan.

  Safe - Secure - Sustainable ($S^3$)

• The Train Control and SCADA Systems Upgrade (TCSU) project demonstrates MARTA’s commitment to modernize as an agency and to serve the greater Atlanta region.
Vision for Transformation

**TODAY:**
- Manual Processes
- Stand Alone
- Unstable
- Paper Driven
- Legacy Systems
- Reactive Response
- Multiple Data Entries
- Fragmented Training

**FUTURE:**
- Automated Processes
- Integrated
- Safe & Reliable
- Electronic
- New Technologies
- Proactive Monitoring & Response
- Single Data Entry
- Integrated Training
Establishing a Vision

Bus - Rail - Police Communications Center

Integrated Operations Center (IOC)
Defining the IOC

Integrated Operations Center

Rail Operations

Bus Operations

Police Operations

Future Needs & Expansion: MARTA and Region
Challenges with Projects

Why Projects Fail:

42% Leadership
27% Organizational & Cultural Issues
23% People Issues
4% Technology Issues
Other 4%

Source: Organization Dynamics, Jim Markowsky
Guiding Principles

- Develop a **Vision** and Integrated **Scope**
- Implement a **Governance Structure**
- Involve **Leadership** and **Stakeholders**
- Establish an experienced **Project Management Team**
- Leverage and learn from **Industry** and **Peers**
- Select the **Right Partner**
- Implement **Change Management**
- Use a **Whole Life Cycle (Systems) Approach**
Unique Approach

• Comprehensive stakeholder and user driven requirements
• Multi-step & detailed procurement and negotiation methods
• Single, Collaborative Project Office: MARTA, Vendor and Consultant staff
• Highly focused on Organizational Change Management, Business Process Re-engineering, and Training
• 5 Yr. & 10 Yr. hardware and software refresh cycles
Organizational Readiness

“Classically under-estimated”

- Who does new technology impact?
- What is driving the change?
- What is the extent of the change?
- How do we change behaviors?
- Who should be trained at what level?
- What is the training content?
- How will effectiveness be measured?
- What are the delivery channels?
- What processes will change?
- How will they change?
- Who is impacted?
- How will transition be executed?
- Who are the stakeholders (internal & external)?
- How can we effectively communicate with stakeholders?
- How will the relationships with stakeholders be managed?
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Integrated Approach

- Know Your End Game
- Establish Scope & Expectations
- Users as Sponsors/Drivers
- Inclusion Brings “Buy-In”
- Provides Needed Expertise
- Not A Technology Problem
- Change People’s Behavior
- Establishes Accountability
- Partner with Unions
- Right Partner
- Right Solution
- Sustainability & Support
- Change Management
- Select the Right Vendor
- Learn from Peers & Industry
- Program Definition
- Program Management
- Leadership & Stakeholders
- Strategy and Roadmap
- Team Structure and Leadership
- Risks Management
- Higher Quality Product
- Lessons Learned
- Methodology Options
- What to Expect
- Right Partner
- Right Solution
- Sustainability & Support
Further Defining the IOC?

• Integrated where all “systems” are accessible?
• Integrated operations for “MARTA’s business units”?
• Integrated operations for “MARTA and local peer agencies”?
• Integrated operations for “MARTA and potential future partners”?
• Something else?
Key Criteria Considered

• Overall
  – General site requirements
  – Accessibility from MARTA HQ
  – Central to Region

• Spatial
  – Operations theater space
  – Display wall space and ceilings heights
  – Operational, support, and ancillary spaces

• Facility
  – Safety & security
  – Environmental systems
  – Emergency operations
  – Communications (Radio, Phone, Fiber, Etc.)
  – Sustainability

• Future Expansion
  – MARTA operations
  – Regional operations
Ex: Structured Approach to **Change**

- **As Is Business Processes**
  - Training Strategy/Planning
  - Organization Assessment/Impacts
- **To Be Business Processes**
  - System Design, Build, Configure and Test
  - Organizational Design (Structure, Roles, Skill Requirements)
- **System Design, Build, Configure and Test**
  - Update Job Descriptions, Desk Procedures
  - Training Development & Delivery
- **Role-Based Training**
  - Stakeholder Mapping & Transition Planning
- **Communication Strategy, Plan, & Delivery**
  - Security and Controls - Planning & implementation
- **Implementation of Process, Technology and People Changes (“Go Live”)**
Industry and Peer Involvement

- MARTA
- Intueor
- BART
- ARINC
- Toronto Transit
- Montreal Metro
- Siemens
- Alstom
- US&S
- Thales
- GE
- ARINC
- Intueor
- BART

Denotes Program Team Members
Denotes Peer Agencies Visited and Providing Expert Advice
Denotes Potential Vendors Offering TCSU Solutions
How MARTA defines Systems Engineering

“Systems engineering is an inter-disciplinary approach to managing large-scale complex projects that meet the business requirements of stakeholders and customers, increase the likelihood of success, mitigate risk, reduce life-cycle costs and increase asset sustainability.”
Designed for Growth and Regional Opportunities

- Single, fully integrated control center (IOC) housing Rail, Bus and Police control and communications staff
- IOC site includes a new Emergency Operations Center (EOC)
- Located along MARTA’s north rail line at Chamblee Station
- Scalable theatre design, universal work stations, customizable display boards, fiber optic connectivity, training center and room for expansion
- Regional opportunity – potential to add other regional partners (heavy rail, light rail, BRT etc.)
Committed Costs vs. Lifecycle

The chart illustrates the cumulative percentage of life cycle cost over time. It shows that committed costs increase significantly as the project progresses, with a notable increase in the cost to extract defects during development. By the time of disposal, the costs are significantly higher, demonstrating the importance of managing costs throughout the lifecycle.
Requirements Gathering

- Requirements driven by “users” and not by “technology”
- Assemble the “right team” to “ask the right questions” to “the right stakeholders”
- Tackle each sub-system then system
- Understand business processes to ensure technology is “solving business problems”
- Detailed requirements development and user reviews
- Develop a detailed Requirements Traceability Matrix (RTM) to capture ALL requirements
The Right Requirements

Robust **Procurement** Process

- Written Evaluations with formal scoring by Technical Evaluation Team (TET)
- Oral Evaluations with formal scoring based on demonstration with actual proposed products
- Visited other peer agencies where the proposed or similar systems were already installed and in operation
- Best and Final Offers with formal scoring by TET for technical elements and SEC for price elements

**Robust Contract Requirements**

- Local PMO co-located with MARTA team
- Identified key personnel with penalties for changes in key personnel
- Key contractual milestones to establish progress check-points
- Liquidated damages to mitigate missing key milestones
- Six-month error free (99.99%) ‘Demonstration Period’ - mandatory condition for acceptance
- Maintenance of equipment by vendor until total system acceptance
- No-cost changes through design if in the base system
Pricing - What does it Include?

- That price quote includes *everything*!
- What about taxes, shipping, cables, carts, software, memory upgrades, maintenance and insurance?
- Has anyone ever called you needy?
Negotiating at the Right Level

• Developed agency estimates with both top-down and bottom-up approaches
• Carefully selected negotiating team to analyze proposals
• Developed a price landscape - baseline price vs. proposal price
• Identified high risk items and cost drivers
• Negotiated at a detailed level (systems and even sub-systems)
• Used analysis to strike a balance between budgetary constraints and high-priority scope items without introducing excessive risk (i.e.; no science projects)
Scope Overview

• A multi-phase program to acquire technology components & professional services to implement upgrades to five (5) major systems and the business processes that drive them:

  1. Train Control (TC) System
  2. SCADA System
  3. Rail Yard / Tower Systems
  4. Rail Cars
  5. Train-Wayside Communication

• Integrate all legacy head-end systems into the IOC and manage integration of concurrent system wide upgrade projects.
• Upgrade communication technology from RS32 to Ethernet-IP
• Physically move and transition into another facility
• Establish a Back-Up facility
More Detailed Scope

- Install 97 SCADA Field Units in traction power rooms
- Install Two-Way Train-Wayside Communication System
  - 318 Rail Vehicles (314 to be upgraded, 4 Long Term Out of Service)
  - 57 Wayside Locations
- Install 51 Train Control Field Units (TCFU) in train control rooms
- Upgrade 3 Yards – South Yard, Armour Yard, Avondale Yard
- Install and Integrate new Train Control and SCADA System at new IOC
- Update Business Processes, Manage Change, Deliver Formal Training
Team Composition

Steering Committee (10 Members)
• Directors of
  – Rail Operations
  – Rail Maintenance
  – Facility Maintenance
  – Engineering
  – Technology – Infrastructure
  – Technology - Applications
  – Safety
  – Training
  – Program & Contracts Management
  – C&P & Legal

Core Team (~25 Members)
• Managers and SMEs from
  – Rail Operations
  – Rail Maintenance
  – Facilities Maintenance
  – Engineering
  – Technology – Infrastructure
  – Technology - Applications
  – Safety
  – Training
  – Program & Contracts Management
  – C&P & Legal
## Program Benefits

<table>
<thead>
<tr>
<th>Safety &amp; Security</th>
<th>Operations</th>
<th>Customer Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improved monitoring and alarm capability</td>
<td>• Real-time car health data</td>
<td>• Improved on-time performance</td>
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<tr>
<td>• Improved communication interface</td>
<td>• Reduced maintenance costs</td>
<td>• Real-time information</td>
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<td>• Reduced response time</td>
<td>• Increased operational capacity</td>
<td>• Improved vehicle and station communication</td>
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<td>• Improved incident management</td>
<td>• More efficiently managed resources</td>
<td>• Increased reliability of systems</td>
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<tr>
<td>• Integrated system playback capability</td>
<td>• Foundation for growth</td>
<td>• Service adjustment flexibility</td>
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Renovate vs. Build

- Evaluated options
  - Renovate:
    - Existing MARTA buildings
    - Spaces that could be leased/rented
  - Build:
    - Prelim location analysis based on MARTA properties
    - Extended location analysis based on properties that could be acquired
## Conducting Comparative Analysis

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>OPTION 1 Renovate Existing RSCC</th>
<th>OPTION 2 Renovate Another MARTA Facility</th>
<th>OPTION 3 Build A New Facility On an Open Lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Flooring</td>
<td>✷</td>
<td>✷</td>
<td>✷</td>
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<td>Security (Structure)</td>
<td>✷</td>
<td>✷</td>
<td>✷</td>
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<tr>
<td>Security (Location)</td>
<td></td>
<td>✷</td>
<td>✷</td>
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<tr>
<td>Emergency Power</td>
<td>✷</td>
<td>✷</td>
<td>✷</td>
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<tr>
<td>Mechanical Systems</td>
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<td>✷</td>
<td>✷</td>
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<tr>
<td>Field Systems and Enterprise Communications</td>
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<tr>
<td>Cutover/Transition Requirements - Personnel</td>
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<tr>
<td>Operational Challenges During Construction</td>
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<tr>
<td>Esthetics</td>
<td>✷</td>
<td>✷</td>
<td>✷</td>
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<tr>
<td>Available Parking</td>
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<td>✷</td>
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<tr>
<td>Backup RCC</td>
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<td>✷</td>
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<tr>
<td>Estimated Cost</td>
<td>$6.60M</td>
<td>$11.85M</td>
<td>$14.85M</td>
</tr>
</tbody>
</table>
Design – Overall Goals

• Theater layout and design
  – User and functional needs
  – Operational relations between business units
• Standardizing the spaces
• Standardizing the furniture – consoles, offices, etc.
• Future needs – MARTA and Regional expansion
Current Rail Services Control Center
Design – Ergonomic Studies

- Detailed ergonomic studies were conducted to determine the optimal work area.
Design – Ergonomic Studies

- Ergonomic studies drove the theater and console design
- Emphasis on the universality of the design
  - Rail, Bus, Others
Design – Sight Line Analysis

• Sight-line studies were conducted to confirm there were no interferences from any area within the theater
Design – Overview Display

• Special Emphasis was placed on the Overview Display design and layout
  – Who are the users?
  – How will it fit in the theater space?
  – How will the mounting mechanics work?
  – How will it sit on the raised floor?
  – How will the cubes be powered and fed with the TCSU information?
Design – Main Theater

• Theater was based on all design elements together
  – Functions & Users
  – Ergonomics
  – Related spaces
  – Universality
  – Future Needs
Bringing It All Together!
IOC-EOC Floor Plan
The Existing Revenue Building / Warehouse
The New IOC
MARTA’s Train Control Functionality

- Rail Services Control Center (RSCC → IOC):
  - Monitoring and alarm functions

- Automatic Train Operations (ATO):
  - Regulates train start/stop and speeds

- Automatic Line Supervision (ALS):
  - Regulates dispatch, routes, and communication

- Automatic Train Protection (ATP):
  - Enforces safe operation through speed control and train separation

- Car Borne Equipment and Cab Signaling:
  - Communicates with the field and controls train operation
Overall Progress

SCADA Field Units In Service
- Installed: 98%
- In Service: 98%

Train Control Field Units In Service
- Installed: 94%
- In Service: 62%

Train Wayside Communications
- Installed: 89%
- In Service: 62%

Rail Cars Upgrades
- Installed: 100%
- In Service: 100%

IOC/EOC
- Construction: 100%
- EW Testing: 94%
- Commission Before APTA

IOC/EOC:
- Construction: 100%
- EW Testing: 94%
- Commission Before APTA
Moving Towards the Future

- Begin East-West Integration Testing
- Receive IOC Consoles and Begin Installation
- Begin East-West Transition Rail Training
- Complete Console Installations
- Conduct Integrated Level 3 Ops from IOC
- Complete East-West Transition Rail Training
- Complete EW Integration Testing
- Complete Office FAT
- Transition Ops to IOC

April

- Begin East-West Integration Testing

May

- Receive IOC Consoles and Begin Installation
- Complete Console Installations

June

- Conduct Integrated Level 3 Ops from IOC
- Complete East-West Transition Rail Training

July

- Transition Ops to IOC
- Complete EW Integration Testing
- Complete Office FAT

August

- Complete East-West Transition Rail Training

September

- Transition Ops to IOC

October

- APTA
TCSU – IOC Timeline

- NTP: February 2011
- IOC Building Complete: December 2017
- E/W Completion: August 2017
- Implementation Completion: May 2019
- Full System Beneficial Use: May 2019
- Contract Completion: December 2019
- Transition Operations to IOC: September 2017
- Beneficial Use: September 2017 – May 2019
Conclusion

MARTA’s Integrated Systems Approach validates that a collective vision and commitment at the appropriate levels coupled with a well established roadmap and approach can help agencies set strong foundations for even the most challenging and complex projects and programs.
THANK YOU

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