Applying Systems Engineering to ITS Projects: Advancing Beyond “Federal Rule 940”

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Outline

1) NYCT Systems Engineering (SE) Approach to Project Delivery
2) NYCT’s Ongoing ITS Projects
3) Comparison of NYCT’s & Federal Rule 940 Processes and Practices
4) SE at NYCT Benefits/Challenges
NYCT’s SE Approach to Project Delivery

Capital Project Process Model: A Systems-Engineering Approach to Project Delivery

1/23/2015
Why is NYCT is adopting SE Practices?

• To reduce risk caused by project complexity
• multiple stakeholder groups (both Operating and Maintenance) with different needs and requirements
• extreme NYCT environment with systems in constant operation 24/7/365
• multiple installation locations
• integration challenges with ever increasing number of systems
• integrating new technologies with older systems
• limited time and funding for a Full Scale Development (FSD) effort to ensure concept/need can be properly implemented efficiently
SE Technical & Project Processes for ITS Projects

- Stakeholder Requirement Definition (including: stakeholder management, defining stakeholder needs & business requirements – ConOps)
- Alternative Analysis (Procurement & Deployment)
- Architectural Design
- Interface Management
- Configuration & Change Management
- Verification & Validation
- System Integration
- SE Specialties (RAMS, Human Factors, Organizational Change Management – OCM)
Ongoing ITS Projects at the MTA and NYCT

- New Fare Payment Collection (NFPC) System
- Subway Traction Power SCADA System
- Public Assistance and Customer Information Screens (PA/CIS)
- Integrated Service Information and Management: Division B (ISIM-B) Project
Public Assistance and Customer Information System
Rail Control Center – Integrated Service Management System
Application of SE Processes on the ISIM-B Project

- Project Planning Phase
  - **Stakeholder Management** – Identification and Engagement
  - **Concept of Operations** – Development of ConOps document that defined; i) the business objectives and stakeholder needs, ii) the proposed Operational Concept for the new system; and iii) identified the various groups within the organization that would be impacted with the new system.
  - **Alternative Analysis** – Evaluated both technical and procurement options for the development and deployment of the new system.
  - **System Requirements Management** - Development of system requirements including, traceability to business objectives and stakeholder needs and operational concepts.
Application of SE Processes on the ISIM-B Project (cont’d)

- Development (Preliminary Design) Phase
  - **Sub-system Requirements Management** - Development of sub-system requirements; functional and non-functional (including requirements for all the “ilities” – life-cycle support, usability analysis/human – system integration and organizational / business change requirements).
  - **Verification & Validation** - Development of the System & Sub-system Verification and Validation Plan.
# NYCT SE versus Federal Rule 940 - Compliance Matrix

<table>
<thead>
<tr>
<th>NYCT-SE Processes</th>
<th>Stakeholder Requirement Definition (ConOps)</th>
<th>Alternatives Analysis (Procurement &amp; Deployment Strategies)</th>
<th>Requirements Management</th>
<th>Architectural Design</th>
<th>Interface Management</th>
<th>Configuration &amp; Change Management</th>
<th>Verification &amp; Validation</th>
<th>System Integration</th>
<th>SE Specialties (RAMS, HF, OCM)</th>
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Explanation of Federal Rule 940 activities

Development of the Regional ITS Architecture and the use of the National ITS Architecture as a resource for its development.

- NYCT is compliant with the provisions of 940
- Regional ITS Architecture Implementation is project dependent. Regional architecture for a particular project may currently be in development or not fully deployed.

Additional NYCT Processes that go beyond Federal Rule 940:

- Configuration and Change Management
- SE Specialties (RAMS, HF and OCM)
Federal Rule 940 – Strengths & Weaknesses:

- **Architecture Design Focused** - Extremely important process for the planning phase to ensure consistency with the transportation planning process and improvement of system integration on major ITS projects.

- **Stakeholder Requirement Definition** – Similar to other Systems Engineering “best practices”, requires the need to develop the operational concept (ConOps document), to ensure:
  
  i. **Roles and responsibilities are defined** “… of participating agencies and stakeholder in the operation and implementation of the systems included in the regional ITS architecture”. - ref: Federal Rule 940, section 940.9.d.3

  ii. **Any agreements (existing or new) required for operations** “… including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the ITS regional architecture.” – ref: Federal Rule 940, section 940.9.d.4
Federal Rule 940 – Opportunities & Threats:

- **Continual Outreach with FTA and INCOSE** - The need for the INCOSE community of SE practitioners to work with the FTA to ensure that the System Engineering practices are applied throughout the life-cycle stages for all systems. – and not just the planning and design stages.

- **Governing policies for SE practices** - Concerns with Federal policies being institutionalized without a full understanding of System Engineering practices.
Systems Engineering at NYCT

Benefits / Challenges

**Benefits of SE at NYCT**

- **Better Project Stakeholder Agreements** with alignment of Stakeholders Needs and Business Objectives to system requirements. Engagement of the stakeholders during all the life-cycle stages of the project not just at acceptance testing.
- **Systems Engineering Processes** provides basis for the development and implementation methodology to improve the delivery of complex projects.
- **Better Verification and System Integration** through complete testing and traceability to source requirements.

**Challenges of SE at NYCT**

- **Maturity of the Transportation sector vendors** as opposed to Military (DoD) sector
- **Complexity of deploying the proper Agreement Processes** (Acquisition and Supply) that extends past the traditional agreements used in the Transportation (“brick & mortar”) sector. – Needs to extend past the system delivery stage into the Utilization, Support and Retirement stages.
- **Evolving Senior Management knowledge** on the importance of applying SE practices/processes on complex projects. – The need to provide more effort and project time in the planning and development stages of the project. Organizational and Cultural changes take time to implement and be accepted.