Training for Maintainers in Advance of Railcar Procurements

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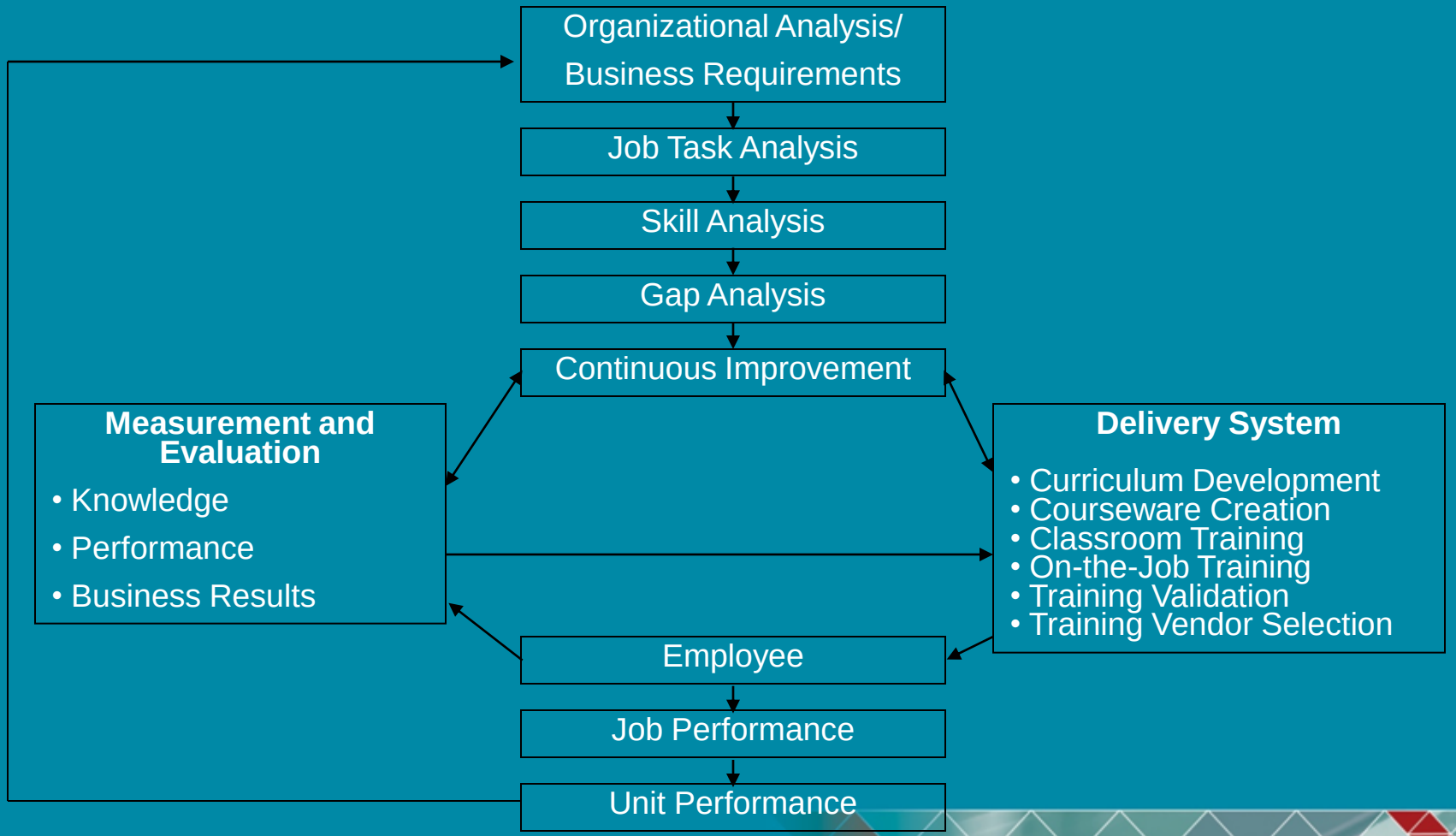
Case Studies

- **SEPTA – Proactive Gap Analysis and Training Planning**
- **NYCT – Diagnostics and Troubleshooting Workshop**
- **NYCT – Engineering Staff Training**

SEPTA – Project Goals

- Identify existing skill gaps for existing fleet maintenance
- Identify potential skill gaps for new railcar maintenance
- Provide SEPTA Technical Training Department with data to proactively address skill gaps over 18-24 months prior to roll out of new fleet

EDSI Process Model



Job Task Analysis

- **The JTA process included:**
  - **Review of current job documentation to develop draft task lists**
  - **Subject matter expert interviews (SEPTA Trainers, LTK Engineer)**
  - **Review of Silverliner V specifications and other documentation**
  - **Series of meetings with Regional Rail Training staff to review and revise task lists**
- **Developed a common task list with different skill benchmarks for existing fleet / new vehicles**
- **Identified 500+ Tasks in 30+ Responsibilities covering Electrical, Electronic, and Mechanical Maintenance and Diagnostics**

Job Tasks + Skill Benchmarks

- **For each maintenance task, the required skills for performing it on each railcar were considered:**
  - **0 – Knowledge of this task is not needed to maintain the railcar**
  - **1 – Task rarely occurs, awareness needed from some in position, expertise needed from a very few**
  - **2 – Basic knowledge of the task required of all in the position, competence from a broad number across locations and shifts**
  - **3 – Common and important tasks, ideally everyone in the position would have the skills to perform this task competently**
  - **4 – Task is common and critical, everyone in position must have competence in the task**

Job Task Analysis (short excerpt)

Responsibility Name / Task Statement	Silverliner IV Benchmark	Silverliner V Benchmark
Troubleshooting and Maintaining PLCs / Using PLCs as troubleshooting aid		
Identify the functions of the controller and its related components	1	3
Understand operation of Allen Bradley PLC devices	1	3
Interpret combinations of inputs and outputs to determine electrical faults	1	3
Interpret Fault Displays to repair systems	1	3
Relate drawings to various switches	1	3
Troubleshoot components of controller	1	3
Repair or replace I/O cards	1	3
Repair or replace various modules	1	3
Repair or replace various sensors	1	3
Repair or replace other components of controller	1	3
Create sensors and new PLCS to perform tasks from software revisions	1	3
Understand the functions of the controller and its related components	1	3
Use diagnostic software to troubleshoot equipment	1	3
Operate Windows based computer for diagnostic purposes	1	3

Skill Surveys

- **Task based skill analysis**
  - **Information from job task analysis becomes basis for *self-rated* skill survey**
  - **Rating Scale**
    - **0 – Employee is <u>not</u> aware of this type of work.**
    - **1 – Employee is aware of this type of work.**
    - **2 – Employee can perform this type of work with assistance or supervision.**
    - **3 – Employee can perform this type of work competently without supervision.**
    - **4 – Employee can instruct others in this type of work.**

- **Surveys were administered by SEPTA training staff.**
- **Meetings with unions took place beforehand to increase acceptance of process**
- **Employees who were likely to retire prior to or soon after intro of Silverliner V were not included**

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Skill Surveys + JTA Benchmarks → Gap Analysis

Responsibility Name Task Statement	Average Rating	Silverliner IV Benchmark	Current Skill Gap	Silverliner V Benchmark	Future Skill Gap
Troubleshooting and Maintaining PLCs / Using PLCs as troubleshooting aid	***1.81***				
Identify the functions of the controller and its related components	1.37	1	OK	3	(1.63)
Understand operation of Allen Bradley PLC devices	1.06	1	OK	3	(1.94)
Interpret combinations of inputs and outputs to determine electrical faults	1.52	1	OK	3	(1.48)
Interpret Fault Displays to repair systems	1.62	1	OK	3	(1.38)
Relate drawings to various switches	2.11	1	OK	3	(0.89)
Troubleshoot components of controller	1.92	1	OK	3	(1.08)
Repair or replace I/O cards	2.22	1	OK	3	(0.78)
Repair or replace various modules	2.29	1	OK	3	(0.71)
Repair or replace various sensors	2.35	1	OK	3	(0.65)
Repair or replace other components of controller	2.09	1	OK	3	(0.91)
Create sensors and new PLCS to perform tasks from software revisions	1.18	1	OK	3	(1.82)
Understand the functions of the controller and its related components	1.76	1	OK	3	(1.24)
Use diagnostic software to troubleshoot equipment	1.84	1	OK	3	(1.16)
Operate Windows based computer for diagnostic purposes	2.06	1	OK	3	(0.94)

Electrician Skill Survey Results

- Taken by 79 incumbent electricians (842, 841, 840)
- The lowest rated responsibilities were related to PLCs and other new technologies that were not present on Silverliner IV but were going to be present on Silverliner V. Only between 10 and 25% indicated current competence in these areas.
- Courses in Programmable Logic fundamentals, Electronic theory and Troubleshooting techniques were recommended. Developed a plan for building on the strengths of Electronic Specialists and working closely with vendors to ease the transition into maintaining Silverliner V's.
- Provided SEPTA with more detailed analysis by job title, location and years of experience

Mechanic Skill Survey Results

- Taken by 113 Mechanics
- Although the major new troubleshooting tasks for Silverliner V fell to the Electricians, preparation in basic computer skills and familiarity with PLC functions was needed by the mechanics
- About 1/3 to 1/2 of mechanics would benefit from a Basic Computer operations course. Virtually all indicated little or no familiarity with PLCs and related tasks
- Additional pneumatics training was recommended to raise skill levels for many new air controlled SV components
- Additional data was provided to breakdown by location, job title, and years of experience

Gap Analysis → Training Strategies

- **Broad based training was delivered to bring up core skills and better prepare technicians to get value out of subsequent OEM training upon delivery of vehicles.**
- **Advanced training for a smaller group covered new technologies and diagnostics best practices. This group then worked closely with vendors upon delivery of vehicles.**
- **Advanced analysis of workforce needs was a critical component in the process**

NYCT Training Program Examples.....

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Training Programs at NYCT
Overview

Overall Objective: Two distinct Training Programs for NYCT to bridge the knowledge and expertise gap of the staff in transitioning from maintaining Legacy Cars to New Technology Cars

- **Diagnostics/Troubleshooting Program:** Classroom and hands-on workshops for personnel involved in diagnostics and repair of the rail cars

- **Engineering Training Program:** A classroom training program geared towards general vehicle engineering and understanding NYCT Technical Specification requirements

Diagnostics/Troubleshooting Program

- **Program Objective:** Effort to provide NYCT staff with training to fill knowledge gaps in the areas of vehicle systems, diagnostic and general troubleshooting techniques

- **Program Content:**
  - **Training Modules:**
    - ❑ Air Brakes
    - ❑ Communication and Passenger Information System
    - ❑ Doors
    - ❑ Event Recorder
    - ❑ HVAC
    - ❑ Networks
    - ❑ Propulsion

Diagnostics/Troubleshooting Program
Training Resources

Following resources were allocated to each session:

- **Training Lead:** maintain uniformity of training program and facilitate individual session
- **Lead Resource:** A senior technical professional responsible to the technical content of the training session and associated material
- **Supporting Resource:** Technical professionals that assist the lead in the development of the training work products
- **Trainer/Instructor:** An engineer from the relevant discipline trained to present the information in the session in an effective and intended manner

Diagnostics/Troubleshooting Program
Overview

- **Structure:** Each workshop dedicated to a specific System/Subsystem
- **Duration:** Each workshop spread over 2 days
  - **Day 1:** A full day classroom session
  - **Day 2:** A full day on-car hands-on session
- **Size of Class:** Restricted to 10-12 trainees to maximize instructor-trainee interaction

Diagnostics/Troubleshooting Program
Work Products

Two work products were generated in advance of each Diagnostics/Troubleshooting Workshop:

- **Classroom Presentation:** Introduction to theory of operation and specific system architecture

- **Reference Documents:** Detailed information on the specific system/sub-system including:
  - Diagnostics and trouble shooting support documentation
  - Drawings and schematics
  - System Functional Description

Diagnostics/Troubleshooting Program
Training Content

Typical Day 1: Classroom Session

- Theoretical description of the system
- Technical Specification requirements and their significance as related to reliability, diagnostics and troubleshooting
- Features of cars that aid in troubleshooting
- Tools available to aid in diagnosing route cause
- Overview of commonly encountered problems

Diagnostics/Troubleshooting Program
Training Content

Day 2: On-Car Session

Each hands-on session was divided into two parts.

Part I- Instructor Demonstration

Instructor demonstrated/discussed the following:

- Available diagnostic tools
- Accessing car fault logs
- Analysis of fault codes
- Troubleshooting techniques

Part II- Trainee hands-on time

- Each trainee participated in individual hands-on diagnostics and troubleshooting to with minimal instructor guidance

Engineering Training Program

- **Program Objective:** Effort to provide NYCT Engineering staff with training to fill knowledge gaps in the area of contemporary railcar technology in a classroom setting

- **Program Structure:**
  - **Training Modules:**
    - CBTC
    - EMI
    - Friction Brake System
    - Industry Standards
    - HVAC System
    - Implication of Buy America Act on Train Procurement
    - Introduction to Data Communications and Practical Use of Diagnostic Tools

Engineering Training Program

- **Training Modules:**
  - Introduction to Power Collection and Distribution
  - Introduction to Solid State Power Conversion
  - Introduction to Structural Analysis and Carbody Design
  - Introduction to Vehicle Dynamics
  - MDS and ERU System
  - Principles of Metallurgy and Fastening Techniques
  - Propulsion System Overview
  - Scheduling
  - Shop Management
  - Sound
  - Train Control
  - Trucks

Engineering Training Program
Overview

- **Structure:** Each session dedicated to a specific technology and/or system
- **Duration:** 2 hours
- **Size of Class:** Restricted to 25 trainees to maximize instructor-trainee interaction

Engineering Training Program
Work Products

Two work products were generated in advance of each Engineering Training Session:

- **Presentation:** **Power Point overview of material designed to compliment the handouts and solicit interaction from the participants**

- **Handouts/References:** **With detailed information on the technology/system under discussion including information from:**
  - **White paper outlining basic theory and specific NYCT application**
  - **Applicable Technical Specification sections**
  - **Any germane Carbuilder educational/seminar information**

Engineering Training Program
Course Content

Each session covered the following areas:

- **Theoretical overview of the technology/system**
- **Evolution and application of technology in the rail industry**
- **Correlation of Technical Specification and new technology incorporation in the design of NYCT cars**
- **Samples of encountered problems and problem resolution during new technology deployment**

Engineering Training Program
Resources Needed

Following resources were allocated to each session:

- **Training Lead:** maintain uniformity of training program and facilitate individual session
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Return on Investment?

- **Diagnostics Effort:** Maintainers were generally more efficient and effective in identifying the route cause of train system failures; reducing down time and repeat failures.

- **Engineering Effort:** Engineering staff had a better understanding of the Technical Specification requirements and the principle elements of contemporary rail car design.

Proactive Training Analysis + Customized Training Delivery = Prepared Workforce

Preparing a workforce for maintaining new vehicles will ideally involve:

- **Proactive analysis of current skills, and future skill requirements**
- **Broad based training as needed for fundamental new technology skills and troubleshooting best practices**
- **Specific and achievable requirements for OEM delivered training, and well-timed delivery of OEM training**
- **Supplemental in house or 3rd party training, train-the-trainer, mentoring, or other ongoing solutions**