The Evolving Surface Transportation Maintenance and Operations Workforce Part II: Developing a More Versatile Work-Force Through Enhanced Training and Technology

AHD15 Maintenance and Operations Personnel Committee
and ABG20 Transportation Education and Training Committee
Transportation Research Board
April 6, 2017
The Evolving Surface Transportation Operations and Maintenance Workforce Part II: Developing a More Versatile Work-Force Through Enhanced Training and Technology

Speakers:

• **Xinge Wang**, Deputy Director, International Transportation Learning Center
  Overview of Surface Transportation Workforce Demographics
  Making Headway: Public Transportation Training and Apprenticeship models

• **Nancy Laffey**, Marketing Outreach Team Leader, Applied Pavement Technology, Inc.
  Synopsis of the Maintenance Training and Certification and Leveraging Technology Syntheses

• **Diana Clonch**, Principal, DW Clonch, LLC
  Recruitment and Retention of the Maintenance Work Force - Agency Examples

**Victoria F. Beale**, JD, SPHR, SHRM-SCP; Ohio LTAP Center Director
  Smartphone Applications development by the Ohio LTAP Center

• Moderator: Dave Bergner, Monte Vista Associates, LLC; Chair AHD15
Making Headway:
Public Transportation Training and Apprenticeship

TRB Webinar | April 7, 2017
Xinge Wang
Deputy Director
Transportation Learning Center
Overview

I. About the Transportation Learning Center
II. Workforce Challenge and Opportunity
III. Industry-wide Solutions
IV. National Training Consortia
V. Registered Apprenticeship in Transit
VI. Impact
VII. Integrated Career Pathways
The Transportation Learning Center

The Transportation Learning Center is a nonprofit organization dedicated to improving public transportation at the national level and within communities. To accomplish this mission, the Center builds labor-management training and apprenticeship partnerships that improve organizational performance, expand workforce knowledge, skills and abilities, and promote career advancement.
Transit has the highest percentage of older workers among all transportation sectors

<table>
<thead>
<tr>
<th>Industry</th>
<th>&lt;25</th>
<th>25-44</th>
<th>45-54</th>
<th>55-64</th>
<th>&gt;65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>5%</td>
<td>40%</td>
<td>29%</td>
<td>19%</td>
<td>5%</td>
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<tr>
<td>Trucking</td>
<td>5%</td>
<td>41%</td>
<td>30%</td>
<td>19%</td>
<td>5%</td>
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<tr>
<td>Transit</td>
<td>4%</td>
<td>33%</td>
<td>28%</td>
<td>23%</td>
<td>12%</td>
</tr>
<tr>
<td>Air</td>
<td>6%</td>
<td>41%</td>
<td>32%</td>
<td>18%</td>
<td>3%</td>
</tr>
<tr>
<td>Highway</td>
<td>8%</td>
<td>44%</td>
<td>28%</td>
<td>16%</td>
<td>4%</td>
</tr>
<tr>
<td>Rail</td>
<td>5%</td>
<td>38%</td>
<td>27%</td>
<td>26%</td>
<td>3%</td>
</tr>
<tr>
<td>Maritime</td>
<td>7%</td>
<td>44%</td>
<td>27%</td>
<td>18%</td>
<td>4%</td>
</tr>
<tr>
<td>All US Industries</td>
<td>13%</td>
<td>43%</td>
<td>22%</td>
<td>17%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: Data Report on Transportation Workforce Needs by the U.S. Departments of Education, Transportation and Labor.
126 Percent of Today’s Transit Workforce Will Have to Be Hired and Trained in the Next 10 Years; 90 percent are frontline workers

Source: TLC Analysis of BLS and NTD data.

Diagram:
- Transit Jobs Today: 400k
- 10-Year Transit Job Openings: 500k +
Women under-represented, esp. in technical positions

Source: Data Report on Transportation Workforce Needs by the U.S. Departments of Education, Transportation and Labor.
African-Americans and Hispanics underrepresented in higher paid and skilled transit & transportation jobs (1)

2014 Employment in Transportation Jobs by Race (Annual Averages)

- **Aircraft pilots**
  - Black or African American: 2%
  - White: 97%
  - Asian: 1%
  - Other Racial Categories: 1%

- **Aircraft mechanics**
  - Black or African American: 9%
  - White: 81%
  - Asian: 7%
  - Other Racial Categories: 3%

- **Bus and truck mechanics**
  - Black or African American: 8%
  - White: 89%
  - Asian: 1%
  - Other Racial Categories: 3%

- **Truck drivers**
  - Black or African American: 16%
  - White: 79%
  - Asian: 3%
  - Other Racial Categories: 3%

- **Bus drivers**
  - Black or African American: 26%
  - White: 68%
  - Asian: 3%
  - Other Racial Categories: 4%

- **Laborers**
  - Black or African American: 16%
  - White: 77%
  - Asian: 3%
  - Other Racial Categories: 4%

- **Vehicles cleaners**
  - Black or African American: 23%
  - White: 71%
  - Asian: 2%
  - Other Racial Categories: 4%

- **All US Occupations**
  - Black or African American: 11%
  - White: 80%
  - Asian: 6%
  - Other Racial Categories: 3%

Source: Data Report on Transportation Workforce Needs by the U.S. Department of Education, Transportation and labor.
### Workforce Challenge and Opportunity

**African-Americans and Hispanics underrepresented in higher paid and skilled transit & transportation jobs (2)**

#### 2014 Employment in Transportation Jobs by Ethnicity (Annual Averages)

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Hispanic or Latino</th>
<th>Non-Hispanic or Latino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft pilots</td>
<td>3%</td>
<td>97%</td>
</tr>
<tr>
<td>Aircraft mechanics</td>
<td>13%</td>
<td>87%</td>
</tr>
<tr>
<td>Bus and truck mechanics</td>
<td>16%</td>
<td>84%</td>
</tr>
<tr>
<td>Truck drivers</td>
<td>21%</td>
<td>80%</td>
</tr>
<tr>
<td>Bus drivers</td>
<td>13%</td>
<td>87%</td>
</tr>
<tr>
<td>Laborers</td>
<td>24%</td>
<td>76%</td>
</tr>
<tr>
<td>Vehicles cleaners</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>All US Occupations</td>
<td>16%</td>
<td>84%</td>
</tr>
</tbody>
</table>

- **Generally Higher Wages, Skills and Career Potential**
  - Aircraft pilots
  - Aircraft mechanics
  - Truck drivers
  - Bus drivers
- **Generally Lower Wages, Skills and Career Potential**
  - Laborers
  - Vehicles cleaners

Source: Data Report on Transportation Workforce Needs by the U.S. Department of Education, Transportation and labor.
Projected annual job openings are 68% larger than annual completions of related education programs across selected transportation job groups.

Source: Data Report on Transportation Workforce Needs by the U.S. Department of Education, Transportation and labor.
Industry-wide Solutions

- National Training Consortia
- Registered Apprenticeships
- Local Career Pathways and Ladders Programs, and CTE Connections
National Training Consortia

- Transit Maintenance Occupations
  - Elevator/Escalator; Signals Maintenance; Rail Car Maintenance
- Agency contribution matched by FTA
- Joint Development by Local SMEs and Center ISDs
- Instruction-ready course materials, safety integrated
- Train-the-Trainer courses

“One of the big problems that we’ve had is that when new cars come on the property, the employees that are there at that time get a lot of training—and the cars may be on the property for 20-30 sometimes even 40 years... Over time those resources disappear, and so as people retire the knowledge leaves. So in working with the other authorities around the country in this Consortium, we're really able to rebuild a library of training material to be able to deliver to our employees.”

Doug MacElhiney -- Maintenance Instructor -- MBTA, Boston
## Rail Consortium Member Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Union Code</th>
<th>Team</th>
<th>IBEW 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bay Area Rapid Transit</td>
<td>SEIU 1021</td>
<td>SFMTA (MUNI)</td>
<td>IBEW 6</td>
</tr>
<tr>
<td>MBTA (Boston)</td>
<td>ATU 589</td>
<td>SEPTA</td>
<td>TWU 234</td>
</tr>
<tr>
<td>Denver RTD</td>
<td>ATU 1001</td>
<td>LA Metro</td>
<td>ATU 1277</td>
</tr>
<tr>
<td>Greater Cleveland RTA</td>
<td>ATU 268</td>
<td>Charlotte Area Transit System</td>
<td>PATCO</td>
</tr>
<tr>
<td>DART (Dallas)</td>
<td>ATU 1338</td>
<td>San Diego MTS</td>
<td>VTA and ATU 265 (Pending)</td>
</tr>
<tr>
<td>Maryland MTA</td>
<td>ATU 1300</td>
<td>NFTA</td>
<td>ATU 1342</td>
</tr>
<tr>
<td>WMATA</td>
<td>ATU 689</td>
<td>CTA</td>
<td>ATU 308</td>
</tr>
</tbody>
</table>

### Cost Sharing

- **3%**
- Individual Agency’s Share of Cost

### Local Unions

- **15%**
- Agencies being recruited
- **10%**
- Member agencies

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Development of Instructional Videos

LRV Batteries  Inspection
Cleaning  Filling

Ray J.
MBTA HVAC Technician

Turn the unit on.
Registered Apprenticeships in Transit

Standards-Based Training and Apprenticeship System for Transit Frontline Occupations
Transit Apprenticeship Initiative

- A program overseen by US DOL that connects job seekers looking to learn new skills with employers looking for qualified workers
- Combine/alternate work-based with school-based learning; classroom and structured OJT
- Prevalent in European countries
- US Goal - doubling the number of Americans in registered apprenticeship
- Transit’s unique position to expand apprenticeship to address future workforce needs
- College Credit
Registered Apprenticeships in Transit: Four Frontline Occupations Approved by US DOL, One More Currently Under Development
Local Implementation

- 25 transit agencies and their unions partnering under the national program
- Local Joint Apprenticeship and Training Committees
- Partnership with schools and workforce systems
- Outreach to underrepresented populations – women, minorities and veterans
- Mentor Training and Train-the-Trainer
- Classroom and structured OJT (mentorship)
- Courseware available to Signals, Rail Car and El/Es Training consortium members
- Apprenticeship Readiness using the Transit Core Competencies Curriculum (TC3)
Registered Apprenticeship in Transit

Greater Cleveland RTA Rail Technician Apprenticeship
Training Pays for itself Many Times Over

Return on Training Investment Found to be 745%

- **Training Investment**
- **Middle Estimate on Savings from Training**
WMATA Escalator Availability Improves

- 2011: 84%
- 2012: 90%
- 2013: 92%
- Today: 94%

Source: WMATA Escalator Status Report
Consortium Cultivates In-house Expertise and Saves El/Es Maintenance Costs

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>External Contractors (2 person crew)</th>
<th>In-house Specialists (2 person crew)</th>
<th>Hourly Savings (2 person crew)</th>
<th>Annual Savings (based on 20 F/T technicians)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agency A</strong></td>
<td>Low</td>
<td>$380</td>
<td>$136</td>
<td>$217</td>
<td>$4,336,000</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>$558</td>
<td>$163</td>
<td>$422</td>
<td>$8,440,000</td>
</tr>
<tr>
<td><strong>Agency B</strong></td>
<td>Low</td>
<td>$400</td>
<td>$130</td>
<td>$270</td>
<td>$5,400,000</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>$550</td>
<td>$130</td>
<td>$420</td>
<td>$8,400,000</td>
</tr>
</tbody>
</table>

Source: TLC preliminary analysis based on raw data from two El/Es consortium member organizations
Integrated Career Pathways through Apprenticeship: Linking School-Based and Work-Based Learning

- **Transportation/Transit Core Knowledge**
  - **Personal Effectiveness Competencies**
  - **Academic Competencies**

- **Early Education**
  - **Personal Effectiveness Competencies**
  - **Academic Competencies**

- **Transit/Transportation Career Awareness**

**Workplace Learning (Standards-based Apprenticeship)**
- **Operations**
  - Supervisor/Instructor
  - Experienced Operator Dispatcher
  - Operator
  - (Bus & Rail) Apprentice Operator

**Community College (Credits)**
- **Maintenance**
  - Lead/Instructor
  - Master Technician
  - Journeyperson
  - Apprentice/Trainee

**Classroom & On-the-Job Learning**
- **Train-the-Trainer or Equipment-specific**
  - 300 LEVEL: Standards-based Apprenticeship
  - 200 LEVEL: Standards-based Apprenticeship
  - 100 LEVEL AND PRE-100 LEVEL: Pre-Apprenticeship

**High School**


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Questions? Comments?

Contact the Transportation Learning Center

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Deputy Director
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xwang@transportcenter.org
Developing a More Versatile Workforce Through Enhanced Training and Technology: Relevant Synthesis Data

Presented by Nancy Laffey
Today’s Agenda

• What synthesis data reveals about:
  – Current training opportunities
  – Approaches to training programs, policies, and partnerships that provide career development for maintenance workers
## Synthesis Objectives

<table>
<thead>
<tr>
<th>483 Maintenance Training</th>
<th>503 Leveraging Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Document and summarize current training and certification practices for front-line highway maintenance workers</td>
<td>• Document how state and local agencies are using ICT to train their workforce</td>
</tr>
<tr>
<td>• Document the rationale behind decisions regarding training where possible</td>
<td>• Document the planning and resources required to implement and maintain a training and development program</td>
</tr>
</tbody>
</table>
Our Research Approach

- Literature review
- Survey
- Follow-up interviews

<table>
<thead>
<tr>
<th>Respondents</th>
<th>483</th>
<th>503</th>
</tr>
</thead>
<tbody>
<tr>
<td>State DOT</td>
<td>41</td>
<td>40</td>
</tr>
<tr>
<td>LTAP/TTAP</td>
<td>n/a</td>
<td>38</td>
</tr>
<tr>
<td>Canadian MOTs</td>
<td>6</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Findings from Synthesis 483
Maintenance Training and Certification
Literature Review Findings

- Training is crucial but often not adequately structured or funded
- Agencies are meeting needs through:
  - Partnering
  - Alternative delivery methods
- Efforts to tie training to performance are inconsistent but vital
What Content Is Being Taught?

- Bridge
- Highway Safety and Reliability
- Pavement
- Roadway/Roadside
- General Maintenance Skills
What Delivery Methods Are Used?

- Classroom and on-the-job training are the most widely used for front-line maintenance worker and are considered most effective.
- The use of alternate delivery methods is growing.
Training Development Approaches

How much of your training is developed in-house?

Do you develop training in-house?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>LESS THAN 50%</th>
<th>MORE THAN 50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>4</td>
<td>10</td>
<td>33</td>
</tr>
</tbody>
</table>
Is the Impact of Training Measured?

- Training is aligned with employee performance requirements in 50% of the organizations.
- Training is considered by a supervisors in 2/3 of the organizations when making promotions.
- Very few agencies measure the effectiveness of training.
Are You Measuring the Impact of Training on Workers’ Performance?

- Yes: 31
- No: 7
- Don't know: 9
Are You Measuring the Impact of Training on the Organization?

- Yes: 12
- No: 27
- Don't know: 8
Additional Training Needs
(> 10 agencies mentioned)

- Bridge preservation
- Guardrail, end treatments & median barriers
- Asphalt pavement patching
- Preservation treatment application
- Base and subbase repair
- Vegetation management
- Roadway draining systems
- Stormwater management activities
- Scheduling & planning
- Customer service
- MQA program inspections
Findings from Synthesis 503
ICT-supported Training
Literature Review Findings

- ICT-supported training is growing
- ICT can enhance learning
- Designing and delivering effective ICT-supported training requires:
  - Sound pedagogy
  - Reliable technology
# ICT Usage

<table>
<thead>
<tr>
<th>How many agencies are using ICT?</th>
<th>What is ICT used to do?</th>
</tr>
</thead>
<tbody>
<tr>
<td>34 DOTs</td>
<td>Replace more traditional delivery methods (74% DOTs, 53% LTAP/TTAPs)</td>
</tr>
<tr>
<td>17 LTAP/TTAPs</td>
<td>Create supplemental training components for existing training products (65% DOTs, 63% LTAP/TTAPs)</td>
</tr>
<tr>
<td></td>
<td>Develop new training courses (38% DOTs, 5% LTAP/TTAPs)</td>
</tr>
</tbody>
</table>
## What Types of ICT Are Used?

<table>
<thead>
<tr>
<th>Type</th>
<th>LTAP/TTAP Count</th>
<th>State DOT Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web-based training</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Computer-based training</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>Web conference training</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Video conference training</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Mobile</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>
The Most Effective Type of ICT

- Engineers **WBT**
- Regional or District Managers **CBT/WBT**
- Foreman **CBT/WBT**
- Equipment Operators **CBT**
- Inspectors **CBT/WBT**
- Technicians **WBT**
- All employees **WBT**
Why Did You Implement ICT?

- Provide employees with training flexibility: 29
- Reduce delivery costs: 29
- Provide geographically synchronous training sessions: 25
- Reduce time spent in a classroom: 24
- Other: 3
- Don’t know: 1
Who Develops ICT Training?

- **Agency partner**
  - CBT: 9
  - Mobile: 3
  - VCT: 5
  - WBT: 10
  - WCT: 1

- **Contractor or consultant**
  - CBT: 7
  - Mobile: 4
  - VCT: 5
  - WBT: 6
  - WCT: 1

- **In-house resources**
  - CBT: 20
  - Mobile: 5
  - VCT: 11
  - WBT: 7
  - WCT: 23

- **Third party/purchased**
  - CBT: 11
  - Mobile: 13
  - VCT: 9
  - WBT: 18
  - WCT: 8
What Does It Cost to Develop?

<table>
<thead>
<tr>
<th>Agency Type</th>
<th>CBT</th>
<th>Mobile</th>
<th>VCT</th>
<th>WBT</th>
<th>WCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000-$5,000</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>$5,000-$10,000</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>$10,000-$15,000</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

LTAP/TTAP

State DOT
Are You Tracking Completion and Impact of Training?

- 33 DOTs and 14 LTAP/TTAPs track
- Impact on knowledge is mainly tracked
- Impact on performance less known
How Do You Measure Impact?

<table>
<thead>
<tr>
<th>Agencies</th>
<th>LTAP/TTAP</th>
<th>State DOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online exams</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>No exams</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Printed exams</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

LTAP/TTAP vs State DOT
Future Research Needs

- Develop guidance for measuring the effectiveness of training
- Explore strategies for using new technology in training
Questions?

- Maintenance Training and Certification?
- Leveraging ICT for Training?
- Other?
Thank You

Contact me:
Nancy Laffey
Applied Pavement Technology, Inc.
nlaffey@appliedpavement.com
217-693-3297
Recruitment and Retention of the Maintenance Work Force
National, State and Local Agency Examples

No Boundaries Transportation Pooled Fund Project #TPF-5(330)

Diana Clonch
DW Clonch, LLC
No Boundaries Pooled Fund Project
#TPF-5(330), noboundaries-roadmaintenance.org

- Community of practice for Roadway Maintenance Professionals around the country
  - Identify innovative technology and practices
  - Promote through sharing, outreach and technology transfer
  - Led by Ohio DOT with 15 current members:
    CT, FL, IL, LA, MD, MI, MO, ND, NY, OH, PA, SC, VA, WA, WI
Recruitment and Retention

• Agencies across the county face common issues and concerns

• Workforce pipeline, generating and maintaining interest...
  - Among the younger generation
  - Retention after training
  - Industry competition
  - Availability of workers
State and Local Efforts

• Outreach
• Engagement
• Community awareness – Agency open house
• Summer work programs
• In-house training
• Conference sponsorships
• Scholarships
Local school outreach...
Paint the Plow

• Ohio, Indiana, Pennsylvania and Virginia DOTs

• Numerous local agencies
One Outstanding Model

- Apprenticeships
- Internships
- Youth Outreach
Apprenticeship Program

• Partner with local unions offering:
  - Masonry
  - Gardening
  - Labor/service work

• Work hand-in-hand with the DPW employees
Project Pull Internship and Youth Works

• Project Pull
  - Summer program for high schoolers and recent graduates
  - Develops talented youth who will one day serve as part of the city’s workforce

• Youth Works
  - Career oriented program for high school students matching students with department employee mentors
In-house Training

• Agency specific training academies
  - North Dakota Training Academy has been running for two years to transfer knowledge. Teaches how to use equipment, use maintenance support software (MDSS), keep better records, etc.
  - Numerous DOT programs with varying degrees of detail and advancement
Existing State DOT programs...
Recruitment and Retention of the Maintenance Work Force

National, State and Local Agency Examples
LTAP – Local Technology Assistance Program

www.ltap.org
Other Resources... National APWA

• Children’s publications

• Mascot – PW Paws
Local APWA Chapters

- Outreach by Marketing and Diversity Committees
Recruitment and Retention of the Maintenance Work Force

Public Works

Provides core public services for safety & high quality of life for Dayton residents

Service Activities:
- Civil Engineering (design, construction, inspection, management)
- Street Maintenance
- Waste Collection
- Fleet Management
- Parks & Forestry
- Water (treatment & distribution)
- Waste Water treatment & sewerage

Street Maintenance

Roadway maintenance, mowing, park playgrounds and grounds maintenance, snow removal, leaf collection, street sweeping, urban forestry

Waste Collection

- Provides waste & recycling services to over 36,000 accounts
- Weekly trash, bi-weekly recycling, monthly yard waste
- Neighborhood clean-ups
- Removal of 5,000 tons of trash
- Removal of 6,000 tons of recycling
- Public Works Call Center staff logs and routes service requests

Fleet Management

Manage acquisition, maintenance and repairs for the fleet required to provide quality public works and public safety services.

$27,331 – $51,750

$36,608 – $57,658
In Closing...

• Common issues and concerns among all
  - National, state and local

• Seeking options and solutions
  - No Boundaries
Hot! Apps

On Demand Information Even Deming Would Love

Victoria F. Beale, Esq., SPHR, SHRM-SCP
Ohio LTAP Center Director
The Just-In-Time Learning Revolution
The Just-In-Time Learning Revolution (cont’d)
What do your customers need?

- Work Zone Safety
- Roadside Safety
- Pavement Preservation
- Traffic Sign Installation
Types of Apps

Informational
- Reference
- Static Content

Interactive
- Gaming
- Data collection
Developing the App
Base Information
Organization

Storyboard your App

Visualize the layout

Confirm the content

Verify the information flow
Writing the App

• Software you will need:

  • Authoring –
    • We used - Ionic Framework
    • http://ionicframework.com/

  • Compiling –
    • We used – Cordova
    • https://cordova.apache.org/
Did we need Ionic Framework?
- No, but provided the ‘framework’ of already built pieces which we just had to add our code to in order to build our apps
- Advantages:
  - Sped up the process
  - Open source
  - Works on any operating system (windows, mac, etc.)
  - Components are made to scale to any size screen
- Disadvantages:
  - Need to know angular javascript (lots of resources available to learn this)
• Did we need Cordova?
  • We needed a compiler – Cordova was our initial choice
  • Moving forward we will be using PhoneGap
  • [http://phonegap.com/](http://phonegap.com/)
• Why the change?
  • More automated features in PhoneGap
  • Don’t have to type in the phone commands to test your app
  • Only drawback is there are some situations where PhoneGap commands behave differently than Cordova commands (we will get used to it)
Testing During Development

Google Chrome Developer Tools

https://developer.chrome.com/devtools
BETA Testing

iPhone

• Must have a mac with the newest version of iOS operating system to test the app – not an iPad

• https://developer.apple.com/xcode/
BETA Testing (cont’d)

Android

• Test on any computer operating system – use google studio developer bundle

• http://developer.android.com/sdk/installing/index.html
BETA Testing (cont’d)

Or compile the app and download it directly to your phone to test it

Good idea to test it on different phone versions – iPhone 4, 5, 6
Publishing

Publishing (cont’d)

Account Costs

Android - $25 Lifetime

Apple - $99 Yearly
Search for “ODOT”

Traffic Sign Installation App

Roadside Safety Field Guide

Guidelines for Traffic Control in Work zones
Next Steps

• Market, market, market the apps!!!!

• Update apps as information is updated

• Monitor the number of downloads
Lessons Learned

• Overall tips

  • ALWAYS test on a real device before publishing.
  
  • Plan out your screens ahead of time (story boarding)
  
  • Internet is a great resource – w3schools is a good resource on html, java script, angular java script
  
  • Stack exchange – useful free tool for specific problems such as scaling issues
Lessons Learned (cont’d)

• The publishing process

  • Android process

    • Establish account – easy.

    • Harder to find where to go – just google “Google play developer consul” and login in. Not intuitive publishing process.
Lessons Learned (cont’d)

• The publishing process

  • Apple process (the most difficult)

    • Apple account more difficult to establish – used individual account vs. organizational account.

    • Apple wants to test it before it is released; must wait for approval.

    • To test an app on an apple device, you must have an apple account. Otherwise, can only test on a simulator.
Lessons Learned (cont’d)

• Developing an App doesn’t have to cost you tens of thousands of dollars

• The Boomers and the Gen Xers also appreciate having the Apps

• **Most Important:** Keep Your App Focused and Streamlined
Questions?

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