JOINT TRANSPORTATION
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INDIANA DEPARTMENT OF TRANSPORTATION
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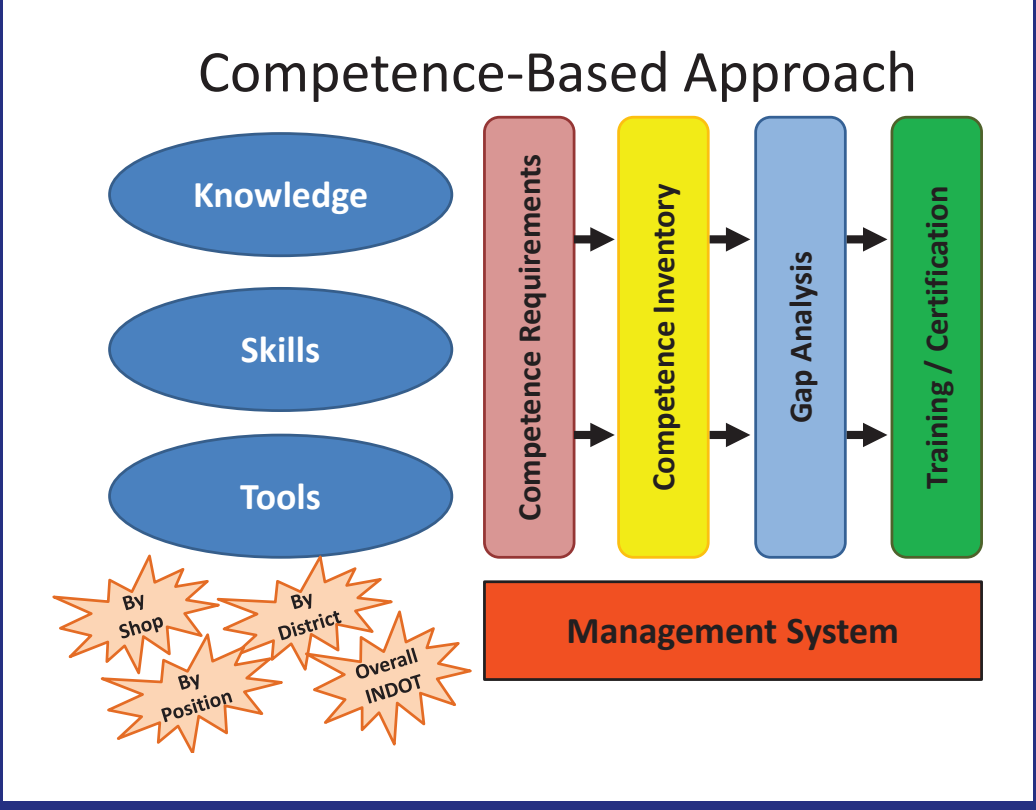
Mechanic/Maintenance Training and Certification Program



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JOINT TRANSPORTATION RESEARCH PROGRAM

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16. Abstract

The Indiana Department of Transportation (INDOT) is divided into six districts, with district offices located in La Porte, Fort Wayne, Crawfordsville, Greenfield, Vincennes, and Seymour. Each district includes multiple vehicle maintenance shops (totaling 32 shops at the launch of this project). Each maintenance shop has multiple mechanics (totaling 151 mechanics at the launch of this project). The mission of these shops and mechanics is to maintain INDOT's fleet of vehicles, including snow removal equipment, mowing equipment, paint striping equipment, transportation vehicles, and various other equipment.

At the time of the launch of this project, it was recognized that there was a need to improve the training process for maintenance mechanics. It was believed that this would result in improved performance (effectiveness and efficiency), as well as contribute to improved retention of mechanics (which was also recognized as an issue).

This research project was chartered to support improvement of the maintenance mechanics training process by accomplishing the following deliverables:

1. A review of maintenance/mechanic training programs at other DOTs and other industries for best practices.
2. Analyze data and other information to recommend work to be done in-house and the skills required.
3. Review current skills of INDOT maintenance/mechanic people and compare to skills needed.
4. Develop plan for maintenance manpower, skill levels needed and training curriculum costs to effectively maintain and sustain INDOT equipment.

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EXECUTIVE SUMMARY

MECHANIC/MAINTENANCE TRAINING AND CERTIFICATION PROGRAM

Introduction

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4. Develop plan for maintenance manpower, skill levels needed, and training curriculum costs to effectively maintain and sustain INDOT equipment.

Findings

Deliverable #1

Best Practices

- Structured training programs, with defined modules by topic, including multiple skill/training levels within topics (e.g., hydraulics, electrical, etc.) (8 of 17 DOTs reviewed)
- Training programs developed based on the architecture of the ASE certification program (Ivy Tech Community College and multiple DOTs)
- ASE certifications (used by 9 of 17 DOTs reviewed)
- Compensation for certifications (2 DOTs) (e.g., $30/pay period per ASE certification)
- Guidelines for in-house work vs. "escalation" to outsource (National Guard)
- "Virtual" training (e.g., Cummins Virtual College, Meritor) (1 DOT)
- Central resource to support training program (multiple DOTs and National Guard)
- "The [organization] should reimburse technicians for ASE test costs upon proof of certification or certification renewal" (Car Care Professionals Network, 2015)
- "The [organization] should increase pay or pay a bonus to those earning ASE certifications" (Car Care Professionals Network, 2015)
- "Shops have found that online training works for teaching basic theory and basic technical training modules, and that onsite/classroom/hands-on training works for advanced hands-on training for technical instruction and general and specific applications" (Car Care Professionals Network, 2015)
- "Shops should partner with local technical schools which may have information on new technology and provide an avenue for new technicians" (Car Care Professionals Network, 2015)

Lessons Learned

- In-house training with DOT expert trainers on staff works well (3 DOTs having success), but risky if can't retain expert staff (1 DOT abandoned due to losing both trainers)
- Once per year group training sessions are not successful/sufficient (2 DOTs)

Staffing Levels

- Multiple job levels/grades of mechanics (typically 3) (9 of 9 DOTs reviewed, plus National Guard)
- Staffing model/tool (Excel) based on projected repair hours per vehicle (National Guard)

Out-of-Scope Learnings

- Battery maintenance program big success at National Guard
- Secondary repairables rebuild and swap-out program (e.g., starters, alternators) big success at National Guard

Deliverable #2

Based on data analysis and benchmarking information, it is recommended that work done in-house generally be "head and out" (i.e., not include maintenance repairs within the engine block). Skills required to support this scope were identified as being closely aligned with the "Automotive Service Excellence" (ASE) certification program elements.

Deliverable #3

Assessment of the current skills of INDOT maintenance/mechanic people, as compared to skills needed (as detailed in Deliverable #2), showed that all districts lacked necessary skills, including nearly all sub-district maintenance shops. Of particular significance were shortcomings relating to diesel engines and electrical systems/diagnostics.

Deliverable #4

A plan was developed for maintenance manpower, skill levels needed, and training curriculum costs. An Excel model was developed, based on the recommendations summarized below, to enable analysis of costs against variable program parameters such as number of trainees, type of training (online vs. hands-on), and training program development costs.

Recommendations

1. Pursue a 3-level progression of job grades for fleet maintenance mechanics (currently all INDOT mechanics are the same job grade).
2. Consider tying progression and pay to ASE certifications.
3. Implement a structured training program to support each of the three levels of progression, based on the architecture of the ASE certification program, with three levels of training.
4. Consider a 2- to 3-year implementation program.

5. Consider either online training or hands-on workshop training for the first level of training.
6. Consider outsourcing the development and provision of the training (e.g., to a technical college).
7. Do *not* develop in-house training expertise (as several other DOTs have done), because issues with retention of expertise in maintenance mechanics is considered prohibitive for this approach.
8. Consider providing central staffing to support coordination of the maintenance mechanic training program.
9. Rectify staffing shortcomings in particular districts and subdistricts to provide lower equipment-to-mechanic ratios.

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1. INTRODUCTION

The Indiana Department of Transportation (INDOT) is divided into six districts, with district offices located in La Porte, Fort Wayne, Crawfordsville, Greenfield, Vincennes, and Seymour. Each district includes multiple vehicle maintenance shops (totaling 32 shops at the launch of this project). Each maintenance shop has multiple mechanics (totaling 151 mechanics at the launch of this project). The mission of these shops and mechanics is to maintain INDOT's fleet of vehicles, including snow removal equipment, mowing equipment, paint striping equipment, transportation vehicles, and various other equipment.

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1. A review of maintenance/mechanic training programs at other DOTs and other industries for best practices.
2. Analyze data and other information to recommend work to be done in-house and the skills required.
3. Review current skills of INDOT maintenance/mechanic people and compare to skills needed.
4. Develop plan for maintenance manpower, skill levels needed and training curriculum costs to effectively maintain and sustain INDOT equipment.

2. METHODOLOGY

The first step was to assess and understand the current state regarding INDOT's fleet, its maintenance mechanic staffing, and the types of work required of the mechanics. This assessment was accomplished by analyzing data from INDOT's Work Management System (WMS) (database for tracking maintenance work orders and activities), and by interviewing INDOT District Fleet Managers and other staff.

The decision was made at the first Study Advisory Committee (SAC) meeting to focus on the snow fleet vehicles, since they are the largest component of the overall fleet, and are critical to the INDOT districts' operations and mission.

Next, each of the deliverables was approached as follows:

1. A review of maintenance/mechanic training programs at other DOTs and other industries for best practices.
    - Interview staff from other DOTs
    - Review information available from other DOTs
    - Interview technical college mechanic training staff
    - Interview National Guard fleet mechanic management staff
    - Conduct literature search/review
2. Analyze data and other information to recommend work to be done in-house and the skills required.
    - Understand current practices (via interviews, data)
    - Use benchmarking information/results
3. Review current skills of INDOT maintenance/mechanic people and compare to skills needed.
    - Conduct skill/knowledge assessments of current INDOT maintenance mechanics
    - Identify skills needed (via INDOT interviews, benchmarking)
    - Assess organization structure and compare to benchmarks
    - Identify gaps
4. Develop plan for maintenance manpower, skill levels needed and training curriculum costs to effectively maintain and sustain INDOT equipment.
    - Summarize Current State (including staffing levels, position levels, and ratios)
    - Develop plan for manpower/staffing/structure (based on benchmarking)
    - Develop high level training approach (based on benchmarking)
    - Develop high level training curriculum (based on skill gaps and benchmarking)
    - Obtain cost estimates for high level training curriculum

3. RESULTS/ACTIVITY SUMMARY

3.1 Current State

3.1.1 Fleet Information

In the initial stage of this project (November 2015–January 2016), data from INDOT's M5 maintenance database was analyzed to understand the INDOT fleet vehicles.

The total number of units of equipment was identified and sorted according to INDOT District and Sub-District maintenance shops (see Figure 3.1). As expected, shops covering larger population areas (e.g., Indianapolis, Fort Wayne) have larger numbers of units. In some cases, sub-districts located at/near the district office also have larger fleets (e.g., Crawfordsville, Vincennes). The Seymour District has the most balanced numbers of equipment among its sub-districts.

The number of units of snow fleet equipment was identified and sorted according to INDOT district and sub-district maintenance shops (see Figure 3.2). Again, higher population areas (e.g., Indianapolis, Fort Wayne, Evansville) have larger snow fleets. Also, sub-districts in the northern portion of the state, which receive more snow on average, have larger snow fleets (e.g., Gary, Wabash, La Porte, and Rensselaer). Note also that the snow fleet of Angola is included with Fort Wayne's fleet.

The number of Lane Miles per Truck (snow fleet) was identified (from INDOT's Work Management System (WMS)) and sorted according to INDOT District and Sub-District maintenance shops (see

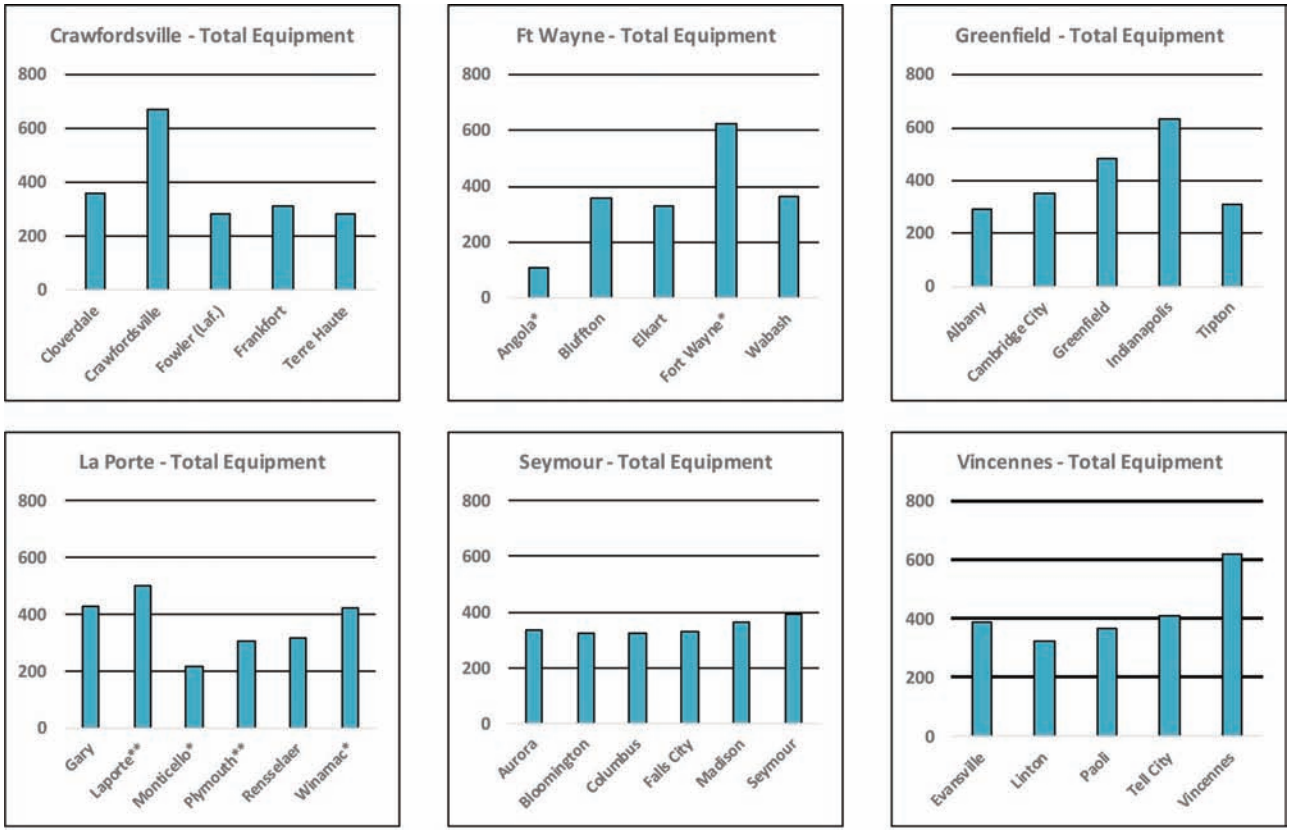

Figure 3.1 Total INDOT equipment by district and sub-district maintenance shop.

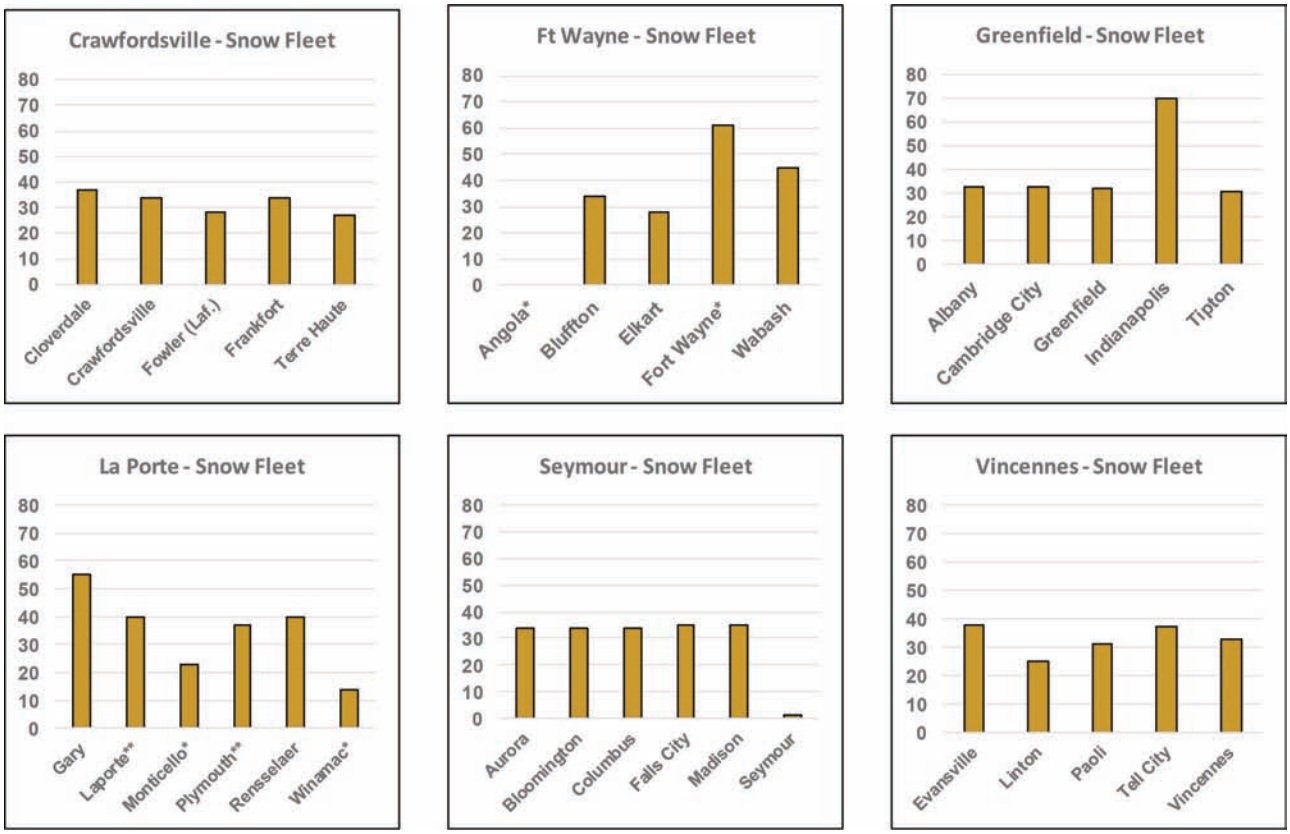

Figure 3.2 INDOT snow fleet by district and sub-district maintenance shop.

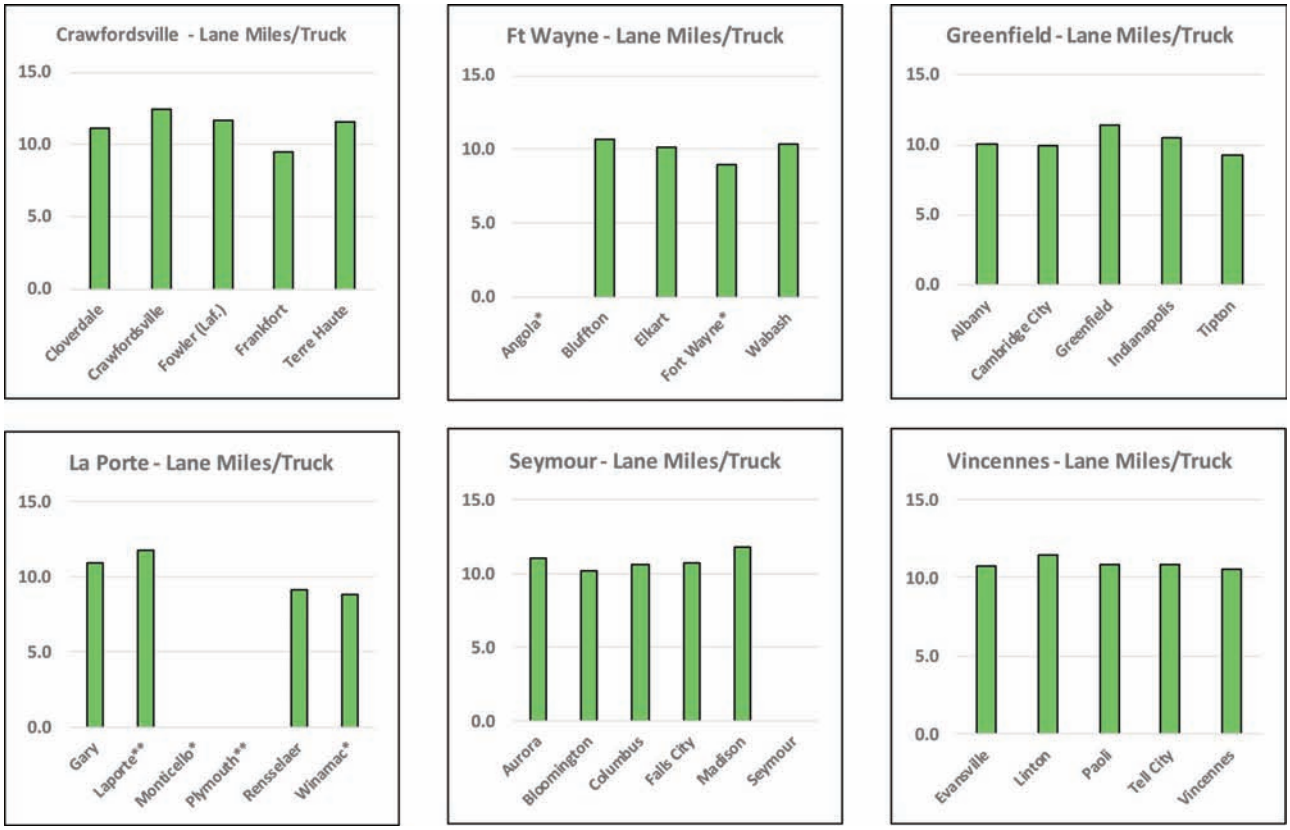

Figure 3.3 INDOT lane miles per truck by district and sub-district shop.

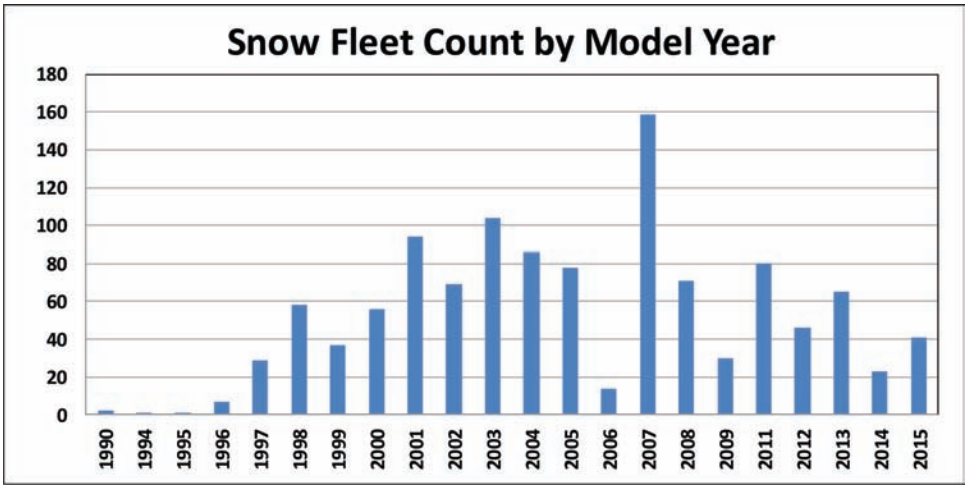

Figure 3.4 INDOT snow fleet vehicle count by model year.

Figure 3.3). Lane miles per truck numbers are reasonably consistent among all sub-districts, ranging from a high of 12.5 (Crawfordsville) to a low of 8.8 (Winamac), with all others between 9 and 11.8. Note that the snow fleet of Angola is included with Fort Wayne's fleet, Monticello is included in Winamac's fleet, and Plymouth is included in La Porte's fleet.

The age of snow fleet vehicles across the INDOT fleet was identified (see Figure 3.4). The average age of snow fleet vehicles is 10.6 years. Over half of the fleet is at least 10 years old, and 69% of the fleet is at least 9 years old.

The snow fleet truck brands in the INDOT fleet were identified (see Figure 3.5). The fleet is diverse, with five different brands prevalent throughout the fleet. Nearly half of the trucks were manufactured by Sterling, and nearly 75% were manufactured by either Sterling or International.

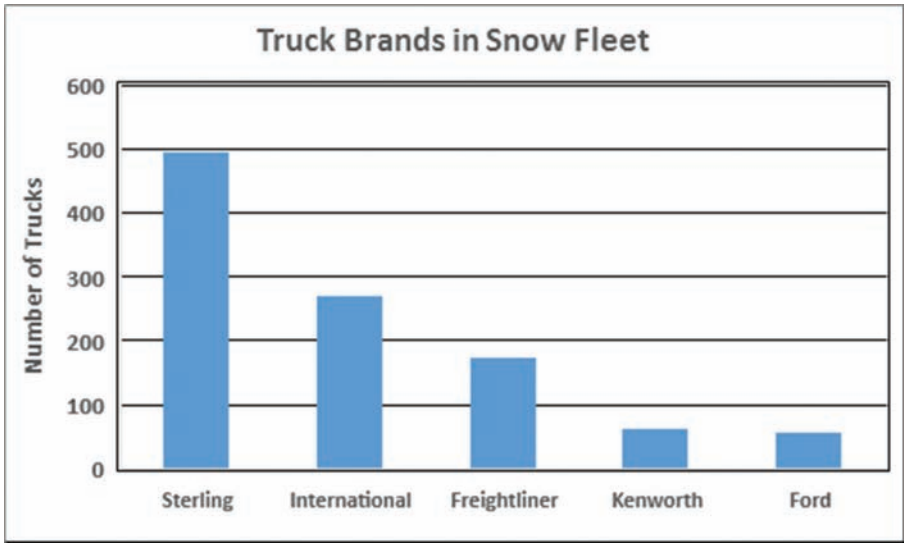

Figure 3.5 INDOT snow fleet vehicle count by brand.

3.1.2 Staffing Information

In the initial stage of this project (November 2015–January 2016), data regarding INDOT's staffing was analyzed to understand the INDOT maintenance mechanic staffing and structure. Note that organization structures may have changed since this analysis was conducted.

The staffing of INDOT's Maintenance Mechanics is summarized in Figures 3.6 and 3.7.

INDOT's six districts have varying organization structures relative to the maintenance shops (see Appendix A, "INDOT District Organization Charts"). In all cases, the maintenance mechanics report to the shop foremen. Crawfordsville, Fort Wayne, and Greenfield are similar, in that the shop foremen report sub-district operations manager, who reports to the district highway maintenance director. In La Porte, Seymour, and Vincennes, the shop foremen report to the district fleet manager, who reports to the highway maintenance director.

Relevant information regarding maintenance mechanics includes:

- At the launch of this project, there were 151 maintenance mechanics across the 32 sub-district maintenance shops.
- In all sub-district maintenance shops, all of the maintenance mechanics are the same job grade.
- Turnover among maintenance mechanics is high (30% per year, per data provided by INDOT fleet analyst); this varies significantly by district and by sub-district shop.
- The job market for qualified fleet mechanics is competitive, since there is a very high demand throughout the transportation/logistics industry.
    - This is particularly an issue in certain sub-districts, where local competition is high (e.g., Indianapolis, Fort Wayne, Gary, Evansville, Falls Cities).

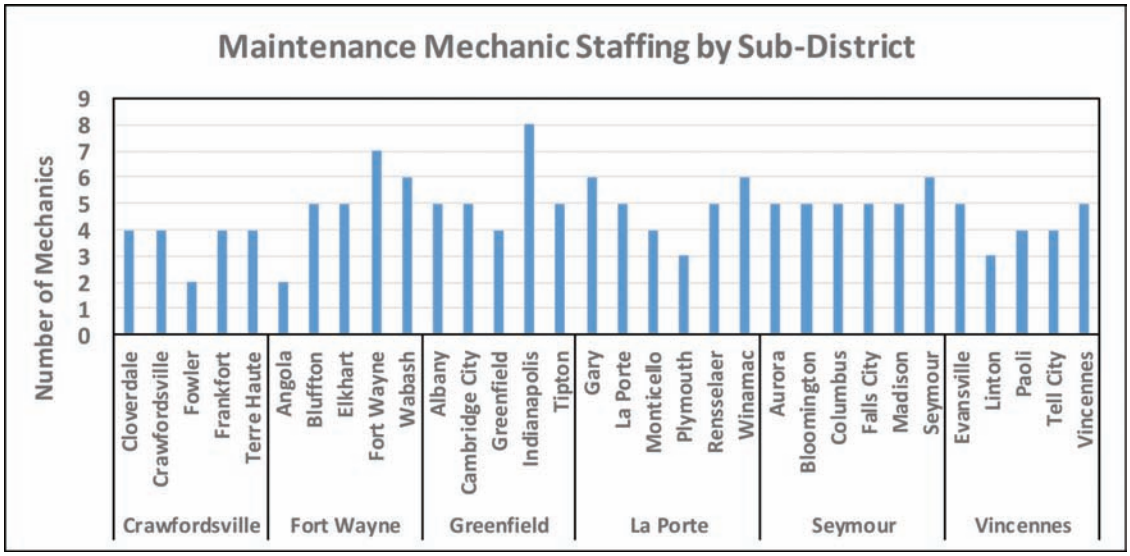

Figure 3.6 INDOT maintenance mechanic staffing by sub-district.

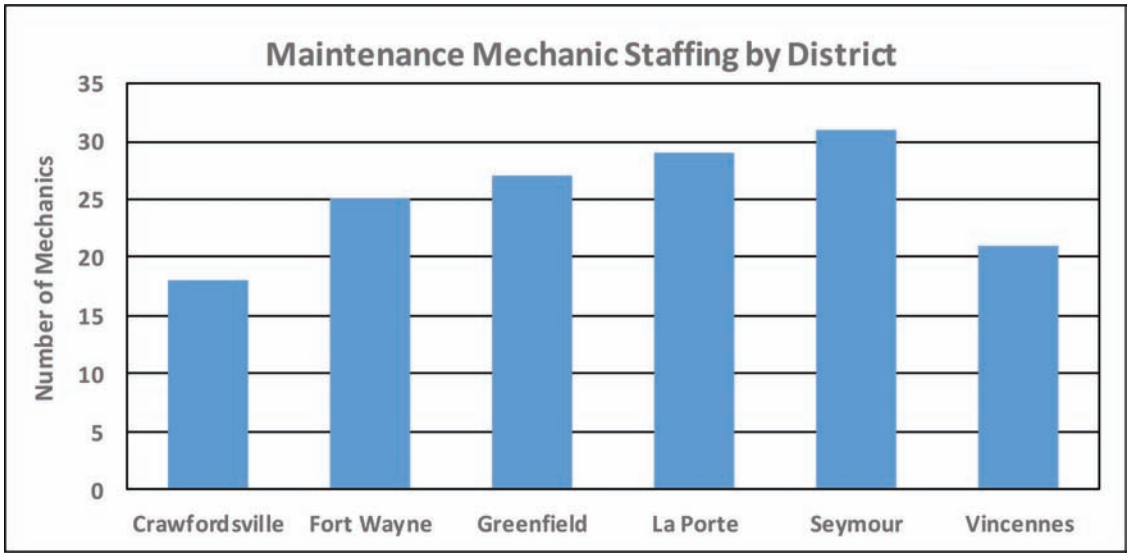

Figure 3.7 INDOT maintenance mechanic staffing by district.

- Pay scales for the INDOT maintenance mechanics is considered low relative to industry ($14.67/hr. to $23.17/hr., per data provided by INDOT fleet analyst).
- INDOT does not want a formal certification program for maintenance mechanics (e.g., "Automotive Service Excellence" (ASE) certification) because past experience has been that mechanics who achieve such certifications leave INDOT to earn higher income elsewhere.

3.1.3 Staff Loading

In the initial stage of this project (November 2015–January 2016), data from the Work Management System (WMS) database and INDOT's staffing were analyzed to understand the ratio of Snow Fleet Equipment to maintenance mechanics (see Figures 3.8 and 3.9). Ratios of total equipment to maintenance mechanics were also determined (see Figures 3.10 and 3.11). The color-coding is based on threshold levels expressed by INDOT statewide fleet management.

3.2 Deliverables

3.2.1 Deliverable #1: Benchmarking Other DOTs and Other Industries

"A review of maintenance/mechanic training programs at other DOTs and other industries for best practices."

- Conducted interviews/discussions with staff from six DOTs and reviewed available information from 17 DOTs (18 total DOTs included) (see Table 3.1).
- Interviewed National Guard fleet mechanic management staff.
- Interviewed community college mechanic training staff (Ivy Tech).

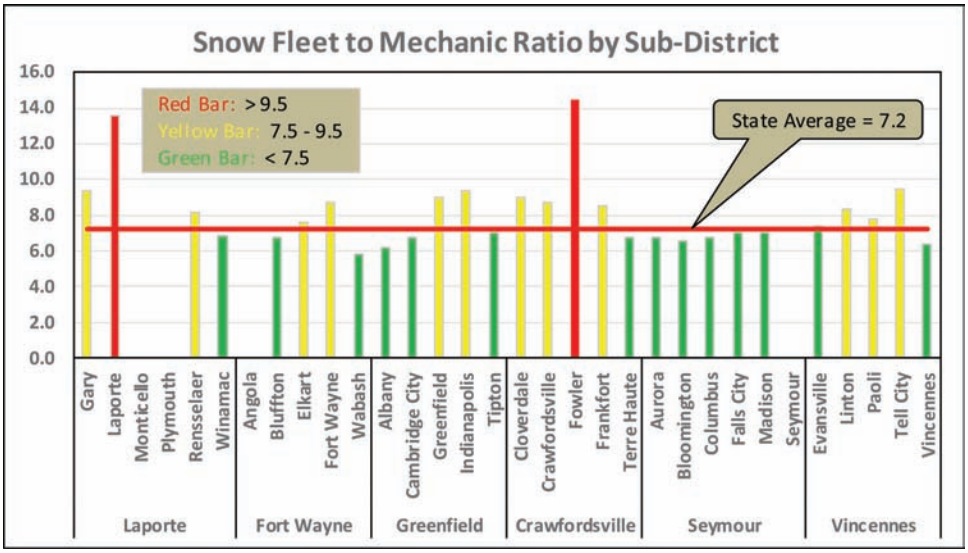

Figure 3.8 INDOT maintenance mechanic staffing (snow fleet) by sub-district.

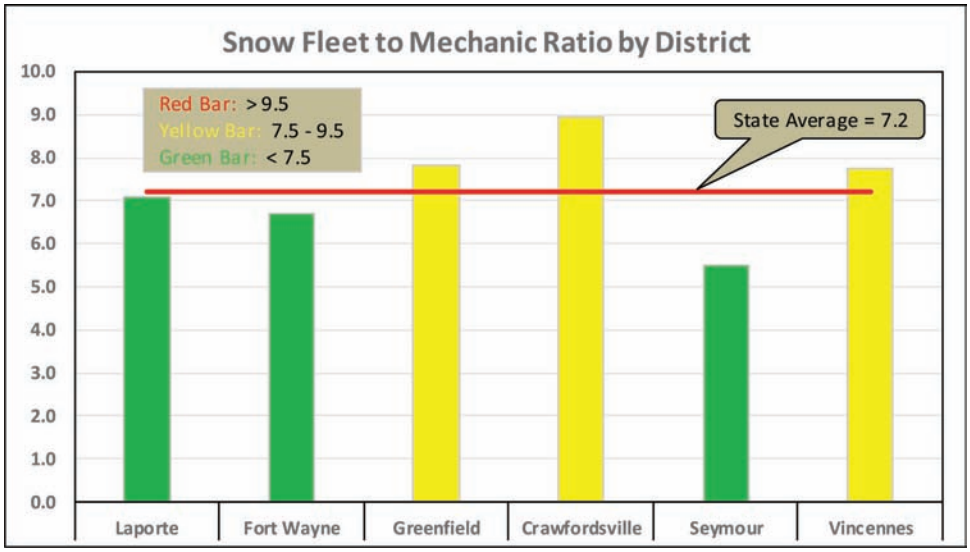

Figure 3.9 INDOT Maintenance mechanic staffing (snow fleet) by district.

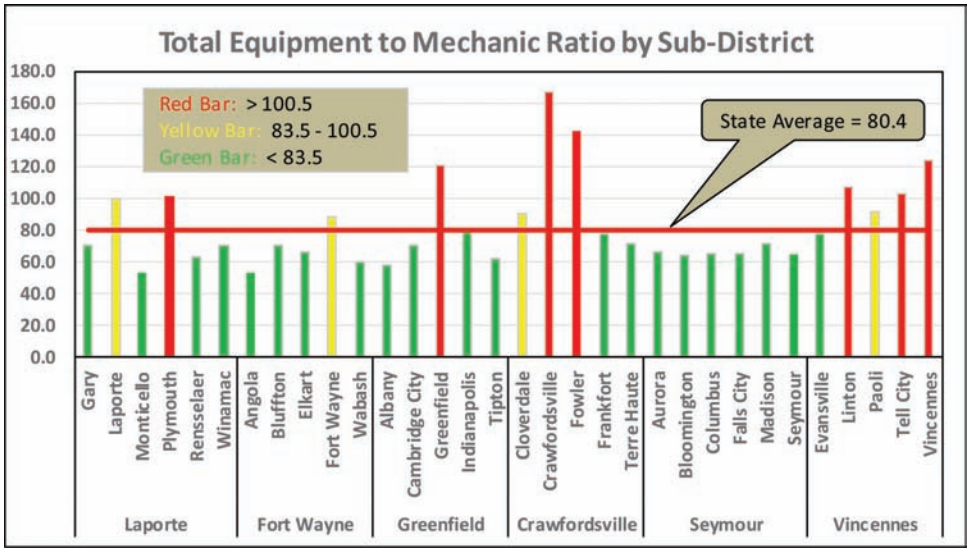

Figure 3.10 INDOT maintenance mechanic staffing (total equip) by sub-district.

- Conducted literature search/review: Identified relevant information in "Recommended Training Best Practices 2015" prepared by Car Care Professionals Network (2015).

Learnings (including best practices, lessons learned, staffing levels, and other noteworthy information) derived from the benchmarking activities are summarized in Table 3.2. (See also Appendix B, "Benchmarking Summary Data.")

3.2.2 Deliverable #2: Work to Be Done In-house and Required Skills

"Analyze data and other information to recommend work to be done in-house and the skills required."

The conceptual model shown in Figure 3.12 was developed to depict the "competence-based" approach used in this project. Deliverable #2 involves the bracketed block of the model, "competence requirements."

To determine competency requirements (including knowledge, skills, and tools), interviews were conducted with three district fleet managers, two statewide fleet staff member, and a district logistics director. A meeting was also conducted with these same individuals (less one fleet manager) to discuss current skills and brainstorm skills required for in-house work. Multiple maintenance shops were also toured, and discussions were conducted with three shop foremen.Based on these sessions, the following results were obtained:

- Current practice at INDOT Shops is to do as much in-house work as possible, then outsource work that is either (a) beyond skills/capabilities to complete, or (b) beyond shop capacity to complete in a timely fashion.

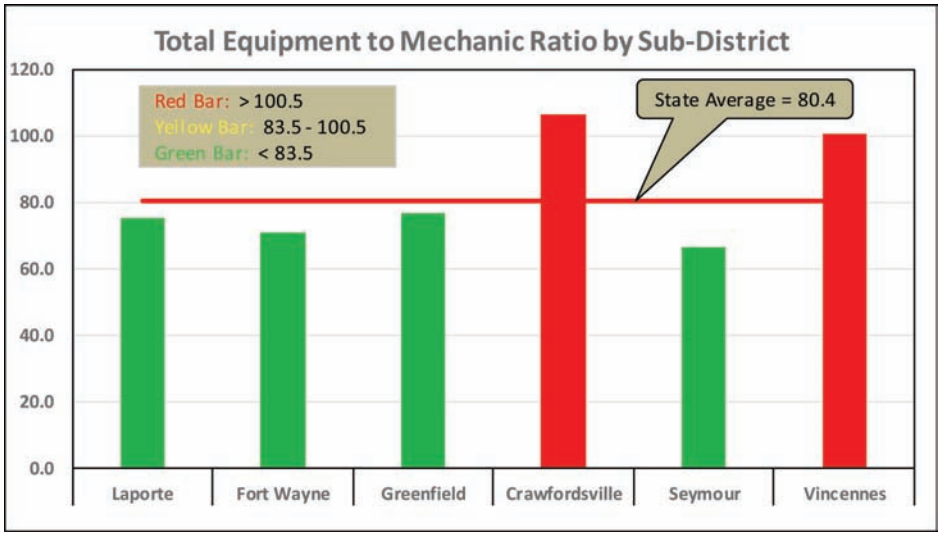

Figure 3.11 INDOT maintenance mechanic staffing (total equipment) by district.

TABLE 3.1
State DOTs Benchmarked

State DOT	Interview/Discussion	Obtained Data/Information
Colorado		X
Kansas		X
Kentucky		X
Louisiana	X	
Michigan	X	
Missouri	X	
New Hampshire		X
New Jersey	X	X
North Carolina	X	
North Dakota		X
Ohio	X	
Oregon		X
Pennsylvania		X
South Carolina		X
Texas		X
Utah		X
Virginia		X
Wyoming		X

- It was agreed that in-house work should generally include only work "from the head out" (i.e., not internal to the engine/block).
- A list of skill categories was developed that would be required to support this level of in-house work.
- Data from benchmarking was used to refine this list (see Table 3.3).

3.2.3 Deliverable #3: Current Skills and Gap Assessment

"Review current skills of INDOT maintenance/mechanic people and compare to skills needed."

Deliverable #3 involves the bracketed block of the competence-based approach model shown in Figure 3.13.

The ideal approach to the competence inventory would be very detailed, evaluating each of the 151 mechanics across all listed skills, using a framework such as that depicted in Figure 3.14 (shown for one district, but could be applied to all). However, the time and effort involved in this endeavor was not within the scope of this project. In lieu of this detailed approach, a survey assessment tool was administered to obtain a reasonable competence inventory (see Figure 3.15).

The result of the competency inventory indicated a significant competence gap across the state, including all districts and nearly all sub-districts, and across nearly all skill categories. Particular competence shortcomings appear evident in diesel engine repair. The survey approach was not able to include evaluation of skills in electrical/diagnostics, but this is commonly considered a key competence shortcoming (based on interviews).

3.2.4 Deliverable #4: Manpower and Training Plan

"Develop plan for maintenance manpower, skill levels needed and training curriculum costs to effectively maintain and sustain INDOT equipment."

Deliverable #4 involves the bracketed block of the competence-based approach model shown in Figure 3.16.

Based on the benchmarking results from Deliverable #1, the competence requirements from Deliverable #2, and the competence inventory from Deliverable #3, the following recommendations were used to develop the plan for Deliverable #4:

1. Pursue a 3-level progression of job grades for fleet maintenance mechanics.
2. Consider tying progression and pay to ASE certifications.
3. Implement a structured training program to support each of the three levels of progression, based on the architecture of the ASE certification program, with three levels of training.

TABLE 3.2
Learnings from Benchmarking

Best Practices	**Relevant to INDOT?**
Structured training programs, with defined modules by topic, including multiple skill/training levels within topics (e.g., hydraulics, electrical, etc.) (8 or 17 DOTs reviewed)	Yes
Training programs developed based on the architecture of the ASE certification program (Ivy Tech Community College and multiple DOTs)	Yes
ASE certifications (used by 9 of 17 DOTs reviewed)	Yes
Compensation for certifications (2 DOTs) (e.g., $30/pay period per ASE certification)	Perhaps
Guidelines for in-house work vs. "escalation" to outsource (National Guard)	Perhaps
"Virtual" training (e.g., Cummins Virtual College, Meritor) (1 DOT)	No
Central resource to support training program (multiple DOTs and National Guard)	Perhaps
"The [organization] should reimburse technicians for ASE test costs upon proof of certification or certification renewal" (Car Care Professionals Network, 2015)	Perhaps
"The [organization] should increase pay or pay a bonus to those earning ASE certifications" (Car Care Professionals Network, 2015)	Perhaps
"Shops have found that online training works for teaching basic theory and basic technical training modules, and that onsite/classroom/hands-on training works for advanced hands-on training for technical instruction and general and specific applications" (Car Care Professionals Network, 2015)	Yes
"Shops should partner with local technical schools which may have information on new technology and provide an avenue for new technicians" (Car Care Professionals Network, 2015)	Yes
Lessons Learned	**Relevant to INDOT?**
In-house training with DOT expert trainers on staff works well (3 DOTs having success), but risky if can't retain expert staff. (1 DOT abandoned due to losing both trainers.)	Yes
Once/year group training sessions are not successful/sufficient. (2 DOTs)	Yes
Staffing Levels	**Relevant to INDOT?**
Multiple job levels/grades of mechanics (typically 3) (9 of 9 DOTs reviewed, plus National Guard)	Yes
Staffing model/tool (Excel) based on projected repair hours per vehicle (National Guard)	Perhaps
Out-of-Scope Learnings	**Relevant to INDOT?**
Battery maintenance program big success at National Guard	Perhaps
Secondary repairables rebuild and swap-out program (e.g., starters, alternators) big success at National Guard	Perhaps

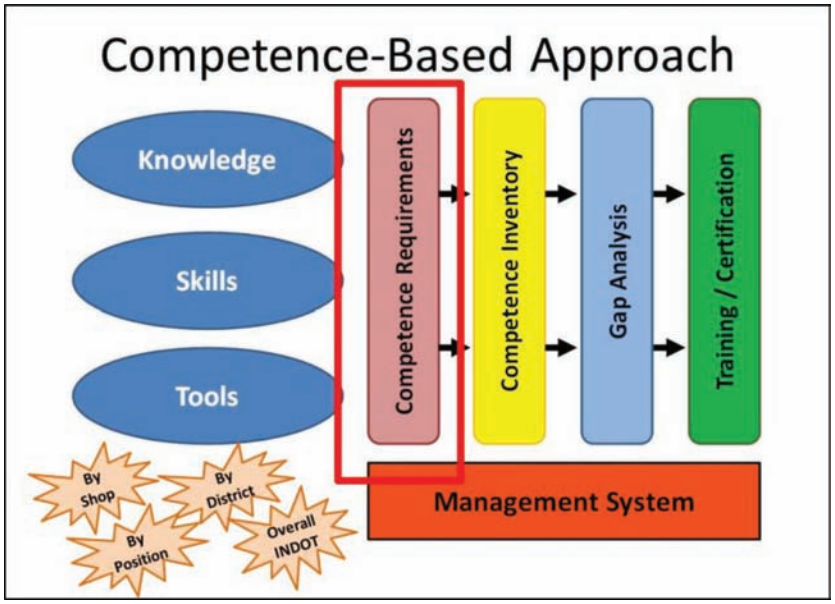

Figure 3.12 Competence-based approach model—Step 1.

TABLE 3.3
INDOT Fleet Maintenance Mechanics Skill Requirements

Group Code (APWA and Navistar)	Category	Competence Requirement	Mechanic
02	Brakes	Air Brakes	R
		Mechanical Brakes	R
03	Steering	Steering	R
04	Driveline	Driveline	R
	Transmission	Transmission	R
05	Electrical	Electrical: Electrician / Wiring	R
		Electrical: Diagnostics	R
06	Engine	Diesel Engines	R
		Engines—Top End	R
		Engines—Bottom End	R
07	Cab and Body (APWA uses "cab and mounted equipment")	Cab and Body	R
08	Hydraulic	Hydraulics—Muncie	R
		Hydraulics—Certified	R
		Hydraulics—Force America	R
09	PM Service	PM—Oil and Filter	S
		PM—General Inspections	P
		PM—Brake Inspections	P
		PM—Hydraulic Inspections	P
10	Tires/Wheels/Rims (sub-category of Driveline?)	Tires/Wheels/Rims	R
	Fuel Systems	Fuel Systems	R
	Coolant Systems	Coolant Systems	R
	Exhaust Systems	Exhaust Systems	R
	HVAC	HVAC	R
	Snow Plow Systems	Snow Plow Systems	R
	Diagnostics	Basic Diagnostics	P
		Advanced Diagnostics	P
	Welding	Welding	P
	Cylinders	Cylinders	S
	Recovery / Towing	Recovery / Towing	P
	Computer Skills	M5	P

S = service; K = knowledge; R = repair; P = proficiency.

4. Consider a 2- to 3-year implementation program.
5. Consider either online training or hands-on workshop training for the first level of training.
6. Consider outsourcing the development and provision of the training (e.g., to a technical college).
7. Do *not* develop in-house training expertise (as several other DOTs have done), because issues with retention of expertise in maintenance mechanics is considered prohibitive for this approach.
8. Consider providing central staffing to support coordination of the maintenance mechanic training program.
9. Rectify staffing shortcomings in particular districts (e.g., Crawfordsville and Vincennes) and sub-districts to provide lower equipment-to-mechanic ratios.

Based on these recommendations the training program models depicted in Figures 3.17 and 3.18 was developed. Cost estimates are based on quotations from technical colleges as shown. Figure 3.17 depicts a program with online training in Year 1, while Figure 3.18 depicts a program with hands-on training workshops in Year 1.

Note that these programs were derived using an Excel model (provided to INDOT), with input variables such as number of people, development costs, and tuition costs. These factors can be varied in the model to allow analysis of alternatives. The magnitude of the impact of these recommendations will depend on the alternatives implemented.

3.3 Additional Considerations

3.3.1 Competence Management Systems

In the competence-based approach model (see Figure 3.19), the "management system" block was considered out of scope for this project. However, it was recognized during the project (in interviews with the director of talent management) that INDOT does not have an organization-wide system for tracking and managing employee competencies (i.e., competence management system). Without such a system for infrastructure, the ability to sustain any maintenance mechanic training

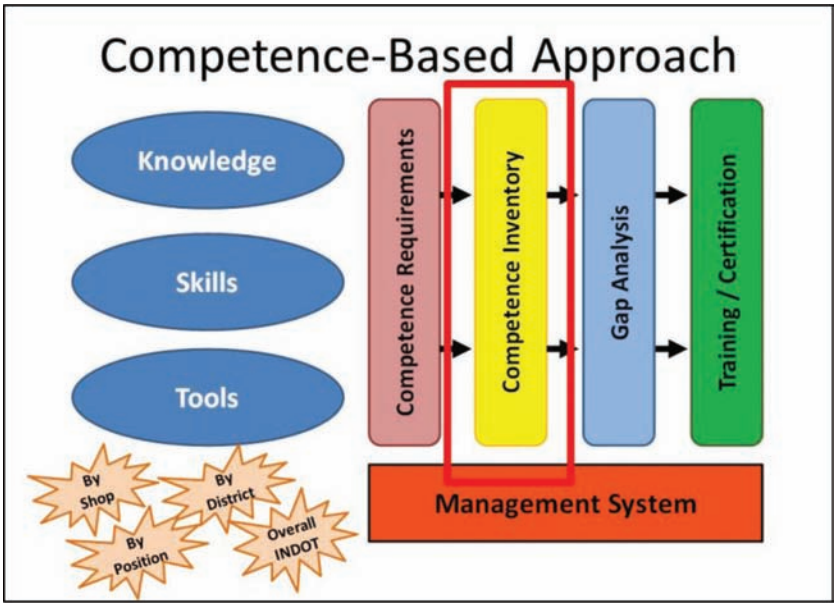

Figure 3.13 Competence-based approach model—Step 2.

Group Code	Competence	La Porte District																							
		Gary						La Porte					Monticello				Plymouth			Rensselaer					Winamac					
		Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 1	Person 2	Person 3	Person 4	Person 5	Person 1	Person 2	Person 3	Person 4	Person 1	Person 2	Person 3	Person 1	Person 2	Person 3	Person 4	Person 5	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6
02	Air Brakes																													
	Mechanical Brakes																													
03	Steering																													
04	Driveline																													
	Transmission																													
05	Electrical: Electrician / Wiring																													
	Electrical: Diagnostics																													
06	Diesel Engines																													
	Engines - Top End																													
	Engines - Bottom End																													
07	Cab and Body																													
08	Hydraulics - Muncie																													
	Hydraulics - Certified																													
	Hydraulics - Force America																													
09	PM - Oil & Filter																													
	PM - General Inspections																													
	PM - Brake Inspections																													
	PM - Hydraulic Inspections																													
10	Tires/Wheels/Rims																													
	Fuel Systems																													
	Coolant Systems																													
	Exhaust Systems																													
	HVAC																													
	Snow Plow Systems																													
	Basic Diagnostics																													
	Advanced Diagnostics																													
	Welding																													
	Cylinders																													
	Body - Repair/Prep																													
	Body - Paint																													
	Recovery / Towing																													
	M5																													

S = Service K = Knowledge
R = Repair P = Proficiency

Figure 3.14 Detailed competence inventory approach.

and certification program will be hindered, and will require manual tracking by process owners.

Similarly, learning management systems (LMS) (software application that automates the administration, tracking, and reporting of training events) were out of scope of this project. One advantage of utilizing a technical or community college to develop and administer the training program (see recommendation #6 in section 3.2.4 above) is that they typically use a sound LMS for the program.

	Mechanic Avg.	Diesel Engine Repair	Brakes/Axles /Tires	Electrical	CNG/ Propane
State	79	60	75	84	97
Crawfordsville District	87	66	83	100	100
Fowler	87	66	83	100	100
Fort Wayne District	77	63	66	81	96
Bluffton	81	66	86	73	100
Elkhart	67	50	50	66	100
Fort Wayne	76	71	61	85	85
Wabash	83	66	66	100	100
Greenfield District	73	49	75	82	87
Albany	72	40	73	73	100
Cambridge City	60	53	53	73	60
Greenfield	88	53	100	100	100
La Porte District	79	63	78	78	97
Gary	78	50	72	88	100
La Porte	92	91	100	75	100
Monticello	64	33	66	58	100
Plymouth	83	83	75	75	100
Rensselear	65	46	60	73	80
Winamac	93	77	94	100	100
Seymour District	78	59	67	84	100
Aurora	73	66	41	83	100
Bloomington	81	66	75	83	100
Columbus	67	40	53	73	100
Falls City	92	66	100	100	100
Madison	76	46	66	93	100
Seymour	78	72	66	72	100
Vincennes District	79	57	84	76	100
Evansville	75	33	100	66	100
Linton	83	77	88	66	100
Paoli	83	66	75	91	100
Tell City	79	58	75	83	100
Vincennes	77	50	83	75	100

Figure 3.15 Survey assessment tool for competence inventory.

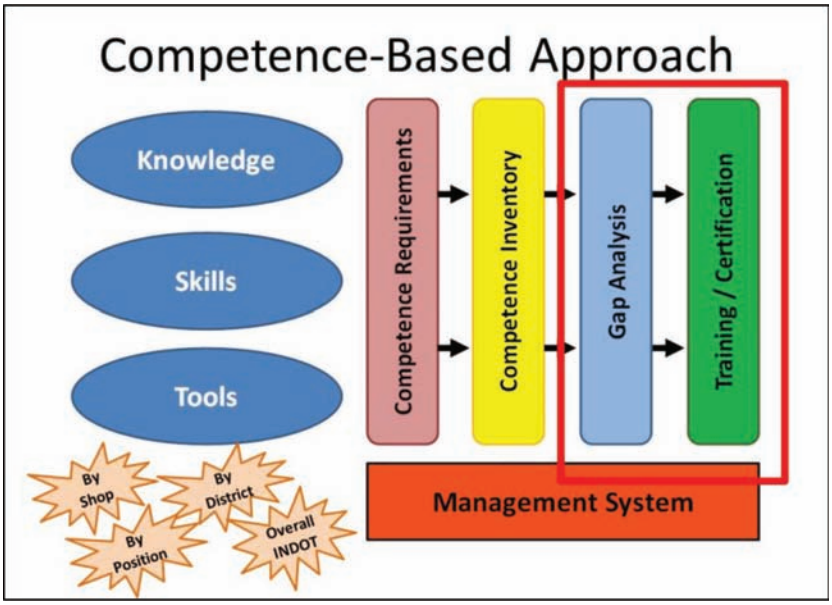

Figure 3.16 Competence-based approach model—Steps 3 and 4.

Training "Phase"	Topic (CONCEPT DRAFT ONLY)	Type of Training	Training Module	Duration (Hours)	Training Source/Provider	Number of People Year 1	Number of People Year 2	Cost Estimates							
								Module Development Cost	Per Person Costs - Year 1 "Tuition" Per Person Year 1	Per Person Costs - Year 1 "Tuition" Cost Year 1	Per Person Costs - Year 2 "Tuition" Per Person Year 2	Per Person Costs - Year 2 "Tuition" Cost Year 2	Total Cost Year 1 (Tuition + Develop.)	Total Cost Year 2 (Tuition)	Total 2-Year Cost
1. Basic	Gas Engine Construction & Operation	On-Line	A1	2	Tech College	100	70	$ 4,000	$ 380	$ 38,000	$ 380	$ 26,600	$ 42,000	$ 26,600	$ 68,600
	Diesel Engine Construction & Operation	On-Line	A2	2	Tech College										
	Basic Automotive Preventive Service	On-Line	A3	2	Tech College										
	Diesel Preventive Service	On-Line	A4	2	Tech College										
	Transmissions I	On-Line	A5	2	Tech College										
	Transmissions II	On-Line	A6	2	Tech College										
	Fuel Systems I	On-Line	A7	2	Tech College										
	Fuel Systems II	On-Line	A8	2	Tech College										
	Air & Hydraulic Brake Systems	On-Line	A9	2	Tech College										
	Electrical Systems I	On-Line	A10	2	Tech College										
	Electrical Systems II	On-Line	A11	2	Tech College										
	Steering & Suspension Systems	On-Line	A12	2	Tech College										
	Auxiliary Hydraulics I	On-Line	A13	2	Tech College										
	Climate Control (HVAC)	On-Line	A14	2	Tech College										
	After-treatment Systems I	On-Line	A15	2	Tech College										
	Basic Diagnostics	On-Line	A16	2	Tech College										
	Welding Familiarization	Classroom/Workshop*	A17	5	Tech College	32	32		$ 170	$ 5,440	$ 170	$ 5,440	$ 5,440	$ 5,440	$ 10,880
2. Intermediate	Electrical Systems	Classroom/Workshop*	B1	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Truck Drive Trains	Classroom/Workshop*	B2	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Truck Brake Systems	Classroom/Workshop*	B3	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Truck Steering & Suspensions	Classroom/Workshop*	B4	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Transmissions	Classroom/Workshop*	B5	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Fuel Systems	Classroom/Workshop*	B6	8	Tech College	0	30		$ 110	$ -	$ 110	$ 3,300	$ -	$ 3,300	$ 3,300
	Coolant Systems	Classroom/Workshop*	B7	8	Tech College	0	30		$ 110	$ -	$ 110	$ 3,300	$ -	$ 3,300	$ 3,300
	Exhaust Systems	Classroom/Workshop*	B8	8	Tech College	0	30		$ 110	$ -	$ 110	$ 3,300	$ -	$ 3,300	$ 3,300
	Auxiliary Hydraulics II	Classroom/Workshop*	B9	8	Vendor	0	30		$ -	$ -	$ -	$ -	$ -	$ -	$ -
	HVAC	Classroom/Workshop*	B10	8	Tech College	0	30		$ 110	$ -	$ 110	$ 3,300	$ -	$ 3,300	$ 3,300
	After-treatment Systems II	Classroom/Workshop*	B11	8	Vendor	0	30		$ -	$ -	$ -	$ -	$ -	$ -	$ -
3. Advanced	Diesel Engines	Classroom/Workshop**	C1	24	Tech College	0	6		$ 550	$ -	$ 550	$ 3,300	$ -	$ 3,300	$ 3,300
	Advanced Diagnostics	Classroom/Workshop**	C2	24	Tech College	0	6		$ 550	$ -	$ 550	$ 3,300	$ -	$ 3,300	$ 3,300
	Auxiliary Hydraulics III	Classroom/Workshop**	C3	8	Vendor	0	6		$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Advanced Diagnostics	On-Site Training	C4	8	Vendor	0	6		$ -	$ -	$ -	$ -	$ -	$ -	$ -
		* 10 people per workshop										Grand Total Costs:	$ 47,440	$ 84,840	$ 132,280
		** 6 people per workshop		Estimated									Year 1	Year 2	2-year Total
								Online cost estimates based on information obtained from Ivy Tech							
								Classroom/Workshop cost estimates based on information obtained from Lincoln Tech							

Figure 3.17 Training program syllabus with cost estimation modeling (online Year 1).

Training "Phase"	Topic (CONCEPT DRAFT ONLY)	Type of Training	Training Module	Duration (Hours)	Training Source/Provider	Number of People Year 1	Number of People Year 2	Cost Estimates							
								Module Development Cost	Per Person Costs - Year 1 "Tuition" Per Person Year 1	Per Person Costs - Year 1 "Tuition" Cost Year 1	Per Person Costs - Year 2 "Tuition" Per Person Year 2	Per Person Costs - Year 2 "Tuition" Cost Year 2	Total Cost Year 1 (Tuition + Develop.)	Total Cost Year 2 (Tuition)	Total 2-Year Cost
1. Basic	Gas Engine Construction & Operation	Classroom/Workshop*	A1	32	Tech College	100	70		440	44000	440	30800	44000	30800	74800
	Diesel Engine Construction & Operation	Classroom/Workshop*													
	Basic Automotive Preventive Service	Classroom/Workshop*													
	Diesel Preventive Service	Classroom/Workshop*													
	Transmissions I	Classroom/Workshop*													
	Transmissions II	Classroom/Workshop*													
	Fuel Systems I	Classroom/Workshop*													
	Fuel Systems II	Classroom/Workshop*													
	Air & Hydraulic Brake Systems	Classroom/Workshop*													
	Electrical Systems I	Classroom/Workshop*													
	Electrical Systems II	Classroom/Workshop*													
	Steering & Suspension Systems	Classroom/Workshop*													
	Auxiliary Hydraulics I	Classroom/Workshop*													
	Climate Control (HVAC)	Classroom/Workshop*													
	After-treatment Systems I	Classroom/Workshop*													
	Basic Diagnostics	Classroom/Workshop*													
	Welding Familiarization	Classroom/Workshop*	A2	5	Tech College	32	32		$ 170	$ 5,440	$ 170	$ 5,440	$ 5,440	$ 5,440	$ 10,880
2. Intermediate	Electrical Systems	Classroom/Workshop*	B1	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Truck Drive Trains	Classroom/Workshop*	B2	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Truck Brake Systems	Classroom/Workshop*	B3	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Truck Steering & Suspensions	Classroom/Workshop*	B4	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Transmissions	Classroom/Workshop*	B5	16	Tech College	0	30		$ 220	$ -	$ 220	$ 6,600	$ -	$ 6,600	$ 6,600
	Fuel Systems	Classroom/Workshop*	B6	8	Tech College	0	30		$ 110	$ -	$ 110	$ 3,300	$ -	$ 3,300	$ 3,300
	Coolant Systems	Classroom/Workshop*	B7	8	Tech College	0	30		$ 110	$ -	$ 110	$ 3,300	$ -	$ 3,300	$ 3,300
	Exhaust Systems	Classroom/Workshop*	B8	8	Tech College	0	30		$ 110	$ -	$ 110	$ 3,300	$ -	$ 3,300	$ 3,300
	Auxiliary Hydraulics II	Classroom/Workshop*	B9	8	Vendor	0	30		$ -	$ -	$ -	$ -	$ -	$ -	$ -
	HVAC	Classroom/Workshop*	B10	8	Tech College	0	30		$ 110	$ -	$ 110	$ 3,300	$ -	$ 3,300	$ 3,300
	After-treatment Systems II	Classroom/Workshop*	B11	8	Vendor	0	30		$ -	$ -	$ -	$ -	$ -	$ -	$ -
3. Advanced	Diesel Engines	Classroom/Workshop**	C1	24	Tech College	0	6		$ 550	$ -	$ 550	$ 3,300	$ -	$ 3,300	$ 3,300
	Advanced Diagnostics	Classroom/Workshop**	C2	24	Tech College	0	6		$ 550	$ -	$ 550	$ 3,300	$ -	$ 3,300	$ 3,300
	Auxiliary Hydraulics III	Classroom/Workshop**	C3	8	Vendor	0	6		$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Advanced Diagnostics	On-Site Training	C4	8	Vendor	0	6		$ -	$ -	$ -	$ -	$ -	$ -	$ -
		* 10 people per workshop										Grand Total Costs:	$ 49,440	$ 89,040	$ 138,480
		** 6 people per workshop		Estimated									Year 1	Year 2	2-year Total
								Online cost estimates based on information obtained from Ivy Tech							
								Classroom/Workshop cost estimates based on information obtained from Lincoln Tech							

Figure 3.18 Training program syllabus with cost estimation modeling (hands-on Year 1).

3.3.2 Mechanic Staffing Modeling Tool

As mentioned in the benchmarking summary in Table 3.2, the Indiana National Guard has implemented an Excel model/tool used to estimate maintenance staff requirements based on a fleet vehicle database. The database includes downtime estimates/projections (preventive maintenance and repairs) for each vehicle in the fleet. The database uses this information, along with staff loading and other factors, to determine how many mechanics are required for each shop/fleet. While challenging to implement, the tool has become

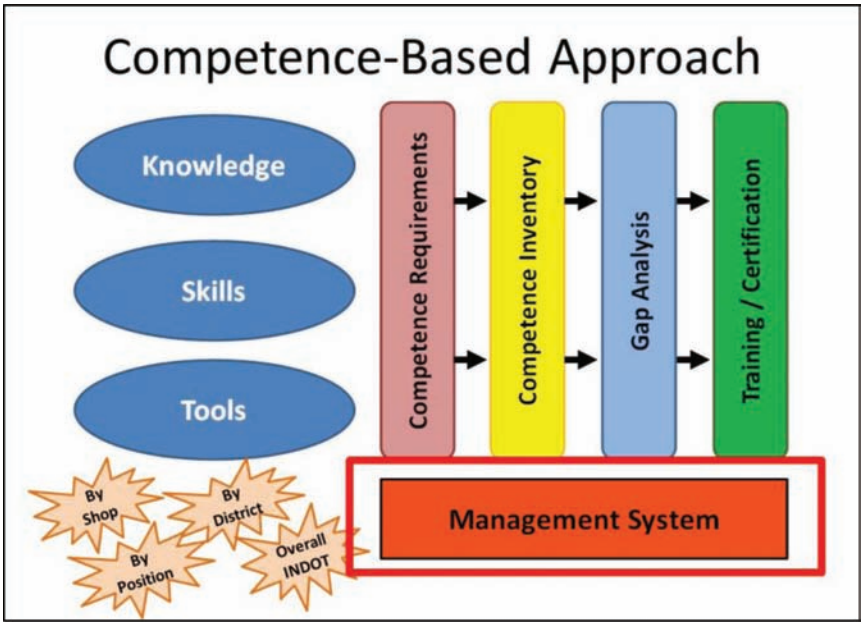

Figure 3.19 Competence-based approach model—management system.

instrumental in the management of the fleet maintenance operation.

It is recommended that INDOT consider evaluating the applicability of this best practice for its fleet maintenance management.

3.3.3 Training Modules from Other DOTs

During the benchmarking activity of Deliverable #1, it was identified that multiple state DOTs have developed training modules to support their mechanic training programs. While it was not in the scope of this project to obtain details of these modules, it is recommended that INDOT consider investigate the potential for using existing training modules to support the program implementation.

REFERENCE

Car Care Professionals Network. (2015, August 20). *Recommended training best practices 2015*. Retrieved April 23, 2016, from http://autocare.org/workarea/DownloadAsset.aspx?id=2696&gmssopc=1

APPENDIX A. INDOT DISTRICT ORGANIZATION CHARTS

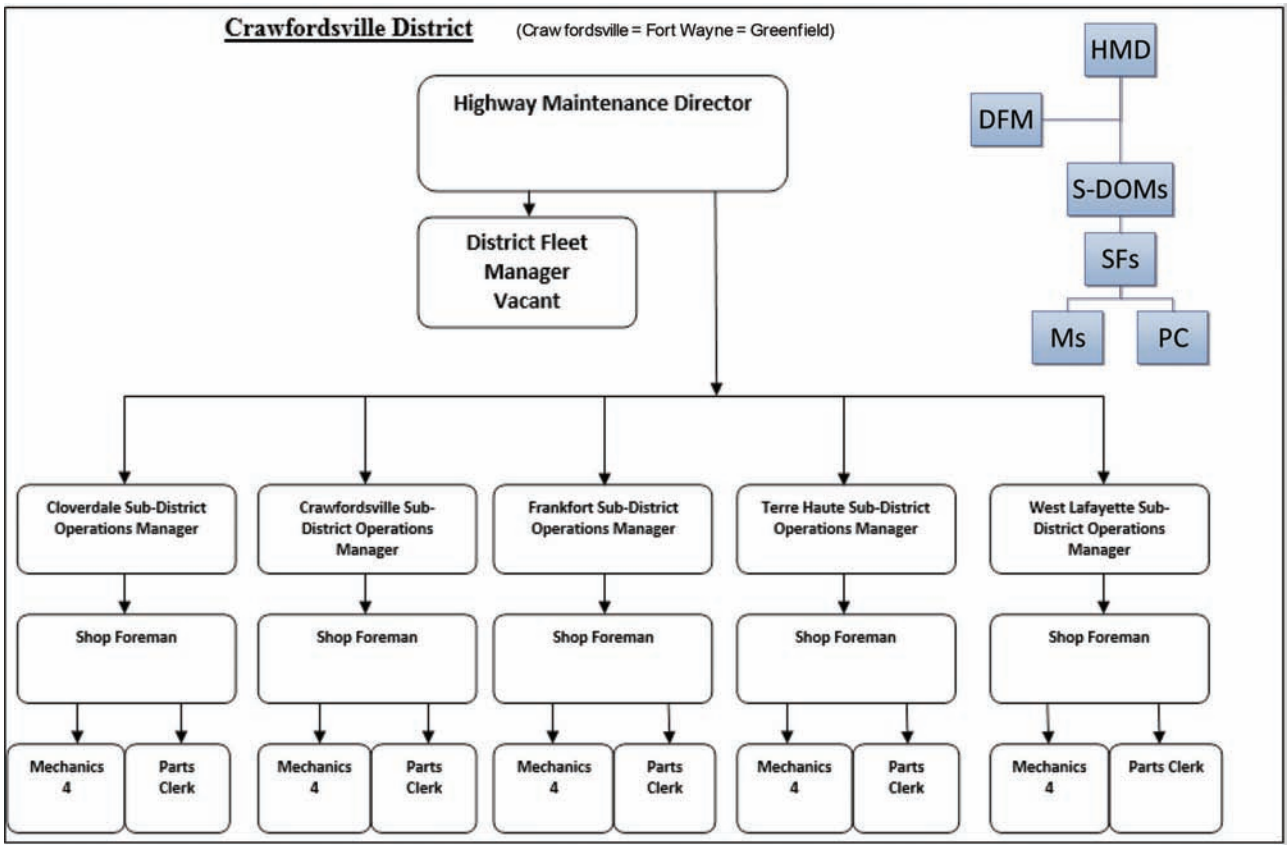

Figure A.1 INDOT Crawfordsville District organization structure.

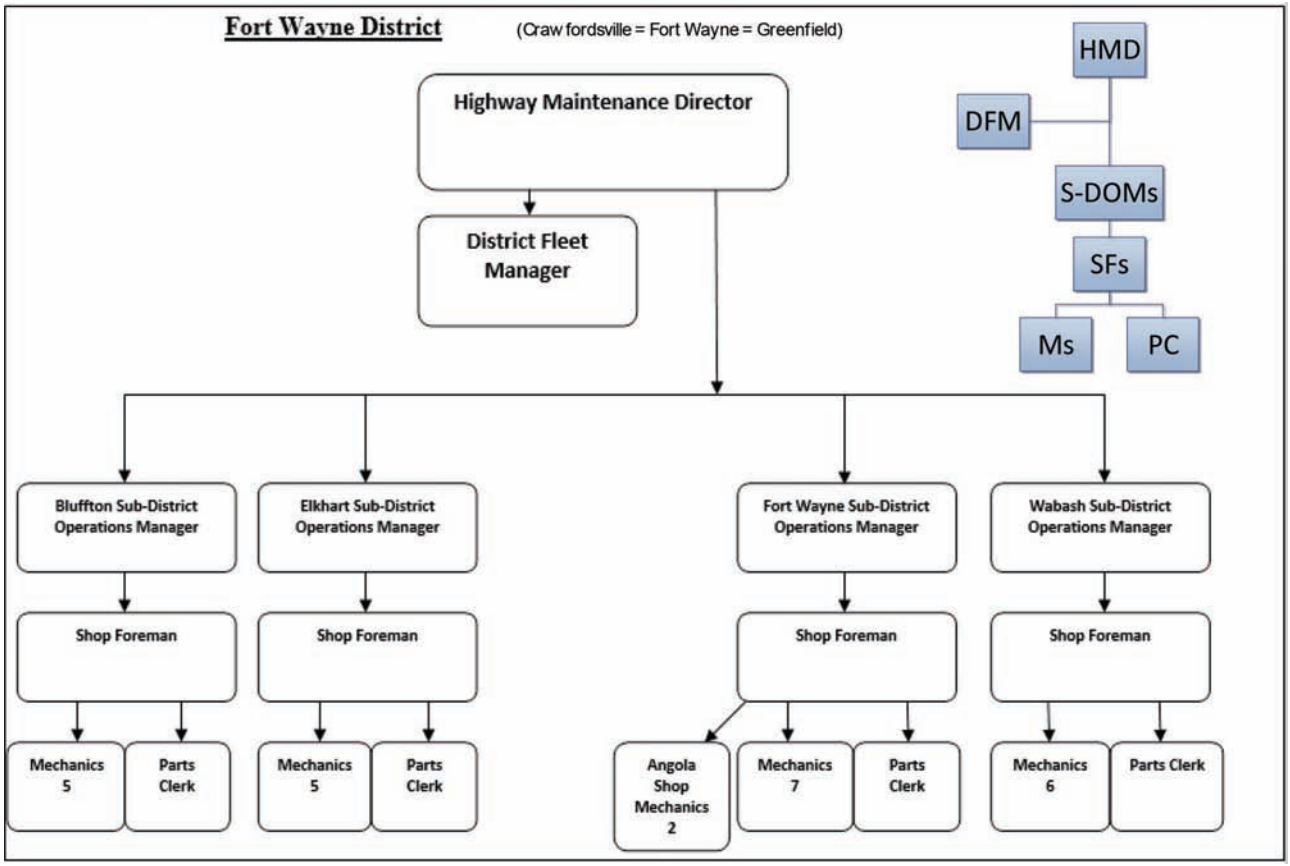

Figure A.2 INDOT Fort Wayne District organization structure.

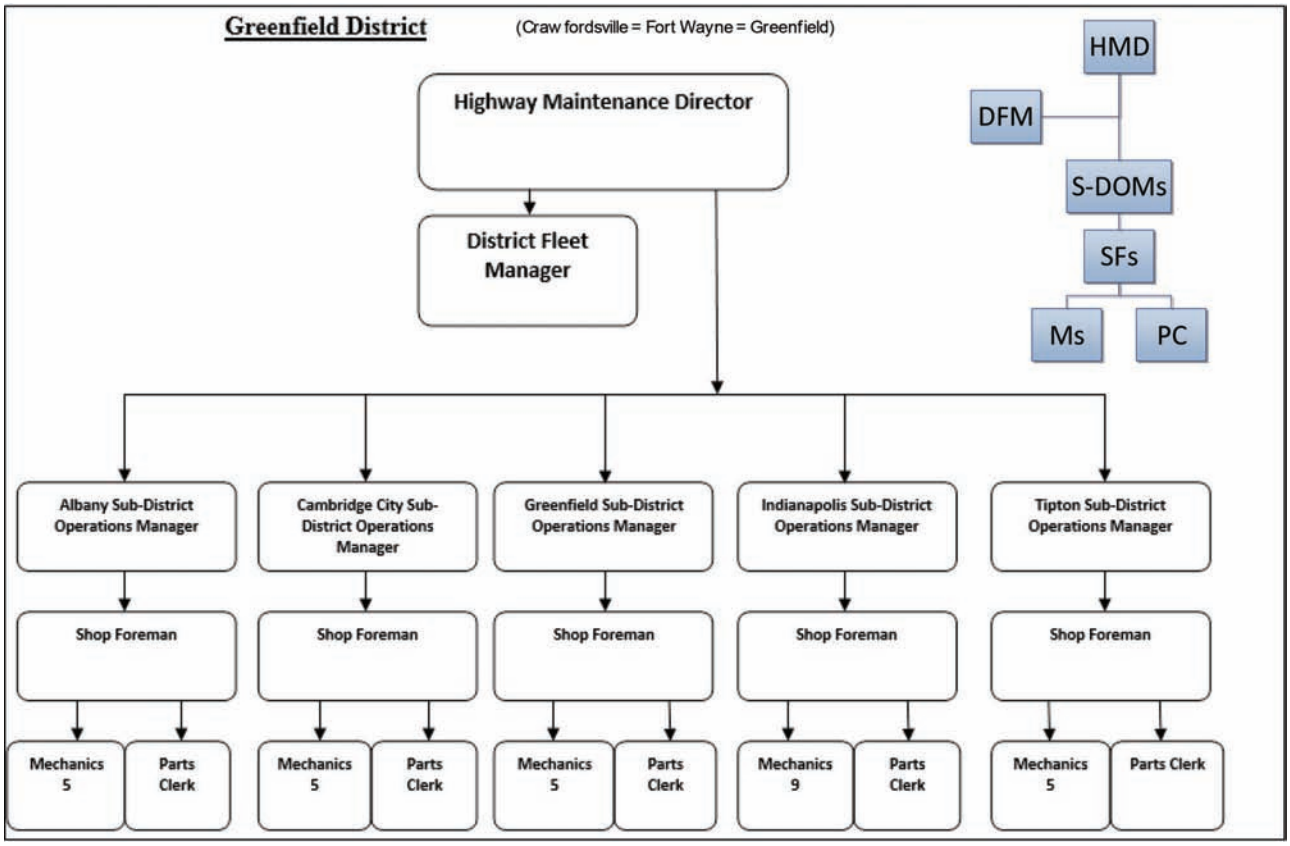

Figure A.3 INDOT Greenfield District organization structure.

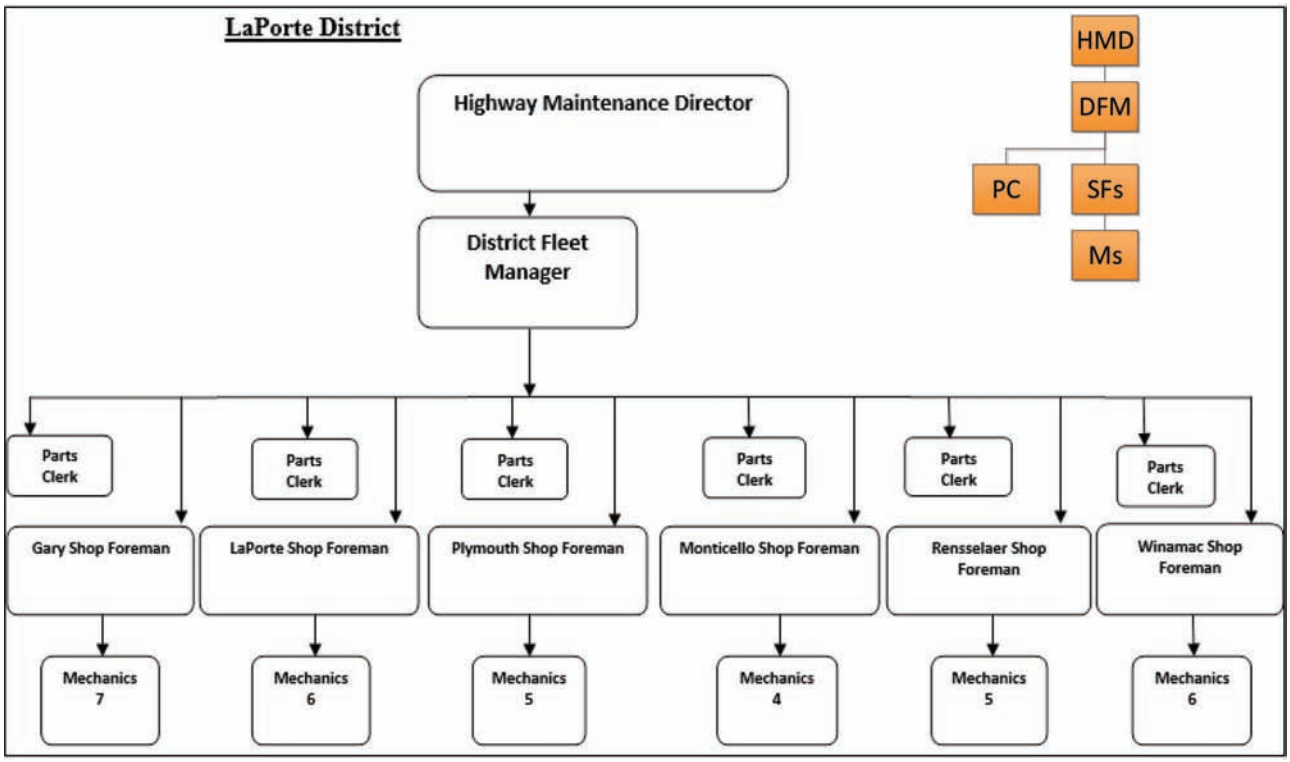

Figure A.4 INDOT La Porte District organization structure.

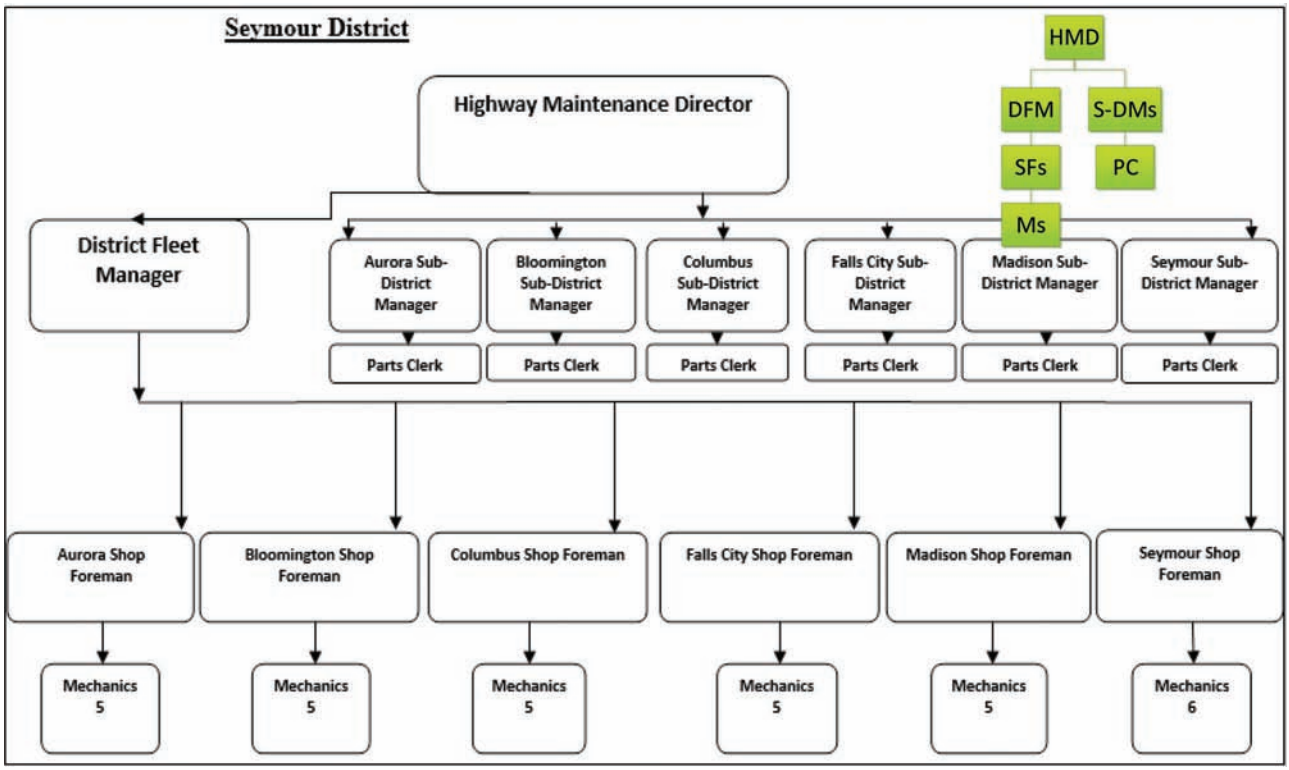

Figure A.5 INDOT Seymour District organization structure.

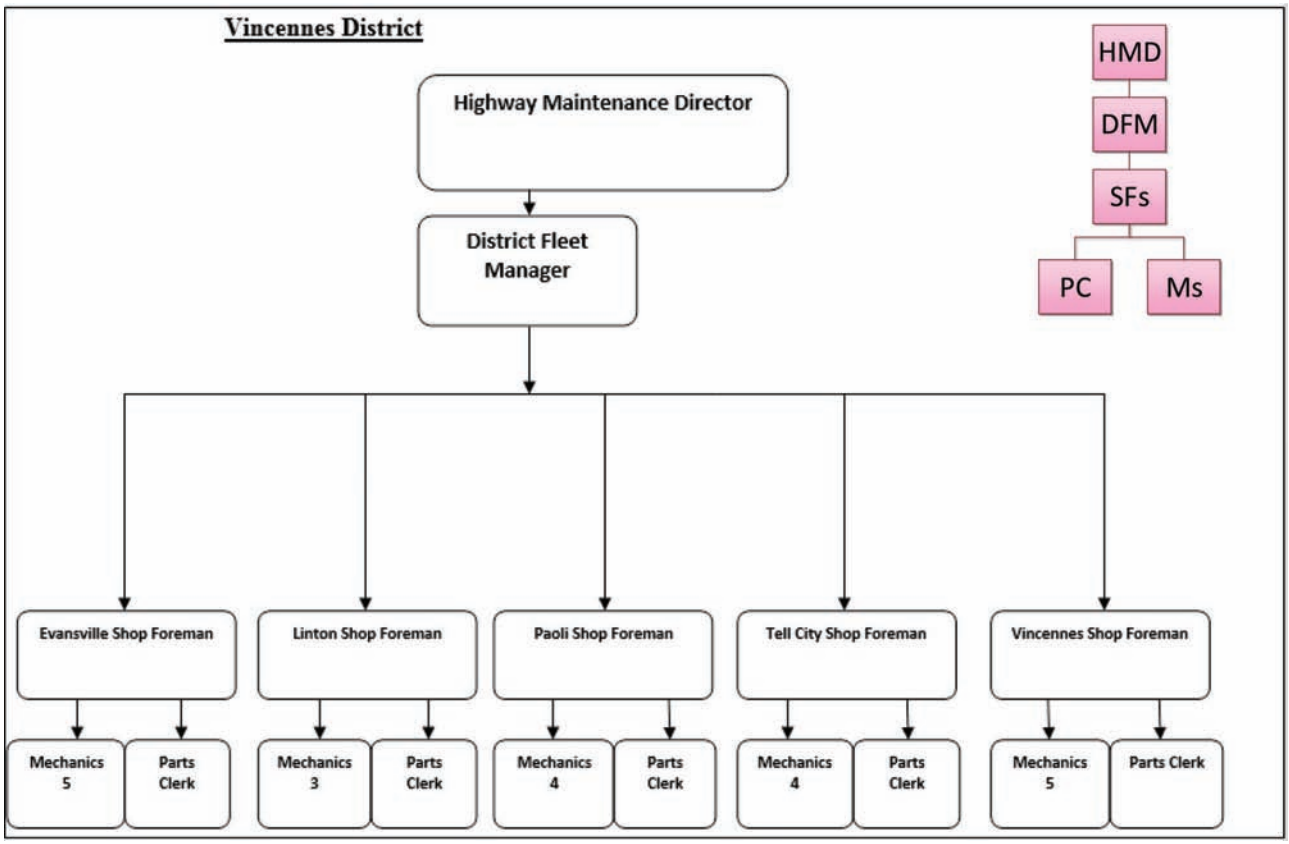

Figure A.6 INDOT Vincennes District organization structure.

APPENDIX B. BENCHMARKING SUMMARY DATA

State DOT or Other Industry	Interviewed /Discussed	Obtained data/ information	In-house training	Virtual Training	ASE Certifications	Mechanic Levels	Comments
Colorado		X	X				
Kansas		X		X			Starting Cummins VC & Meritor
Kentucky		X			X	5	
Louisiana	X	X				3	Have team formed to develop
Michigan	X	X	X				1x/yr training; Union Mechanics
Missouri	X	X	X		X	3	1X/yr training; retention issues.
New Hampshire		X			X		
New Jersey	X	X	X		X		Like Pennsylvania
North Carolina	X		X		?	3	37 modules; base + compensated
North Dakota		X			X	3	
Ohio	X	X	X		X	3	Abandoning in-house
Oregon		X				2	
Pennsylvania		X	X				5-week in-house; NJ copied
South Carolina		X			X	3	
Texas		X			X		
Utah		X			X		Pay $30/ASE Cert up to 12
Virginia		X				2 (+?)	
Wyoming		X	X				
Indiana National Guard	X		X			2	Excellent Staffing Model/Tool
MOPAR CAP Program		X					Structured training model

Figure B.1 DOT benchmarking summary data.

About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1—evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,600 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at: http://docs.lib.purdue.edu/jtrp

Further information about JTRP and its current research program is available at: http://www.purdue.edu/jtrp

About This Report

An open access version of this publication is available online. This can be most easily located using the Digital Object Identifier (doi) listed below. Pre-2011 publications that include color illustrations are available online in color but are printed only in grayscale.

The recommended citation for this publication is:

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