Working Paper #3

Workforce Deployment – Changes and Provisions of Future Policy and Contracts

To the

National Highway Cooperative Research Program (NCHRP)

On project

20-102 (02): Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations

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Acknowledgements

Throughout the NCHRP 20-102(02) project work, a group of transit industry stakeholders has assisted in the development of thought on the topic of AV applications to public transit. Several workshops have been held, and review and comment on draft documentation has been provided by this ad hoc group. The following individuals have provided specific guidance and input to the content of this working paper.

> Louis Sanders – Chief Engineer, American Public Transportation Association (APTA)
> Brian Sherlock – Amalgamated Transit Union

Other Transit Industry stakeholder workshop participants are listed in **Appendix A**.

These contributors are greatly appreciated. It should be noted that the inclusion of their names herein does not necessarily indicate that they are in complete agreement with the contents of this working paper.

Foreword

This working paper uses the following terminology and focus of its content in a manner consistent with all the associated working papers of the NCHRP 20-102(02) project.

Definition of Automated Vehicle (AV) Transit – The "system" comprising AV Transit includes:

1) Driving automation system(s) and technology per SAE J3016[1];
   a) Other vehicle systems and components which provide driver assistance such as lane departure warning when a human driver is performing the dynamic driving task (DDT) from inside the vehicle or from a remote location; and
2) Other monitoring, supervisory control and passenger safety systems, technologies and facilities necessary for public transit service, such as precision docking, automated door operation, and dispatch functions.

Definition of Transit Vehicle Operator – The typical term used to identify the person operating a transit vehicle is the "vehicle operator". However, under SAE J3016 definitions and terminology, a human "driver" is the person who manually exercises in-vehicle braking, accelerating, steering, and transmission gear selection input devices to operate a vehicle. Considering the SAE standard's intent to define terms for driving automation systems only, the term vehicle driver is specified. In the working papers, the terms vehicle driver and vehicle operator may be used interchangeably, depending on the context and point of emphasis. Likewise, the terms "remote driver" (per SAE J3016) and "remote operator" will likewise be used interchangeably.

Definition of Transit Operating Agency — Transit operating agencies can be any type of public, governmental or non-profit entity, such as transit authorities created with certain governmental responsibilities; municipal, county and state government public transportation departments; medical/educational institutions; and local management authorities/districts.

Focused Nature of the Working Papers – Each working paper has a focused purpose and is not intended to provide a comprehensive set of steps, actions or preparations encompassing the full evolution of AV Transit technology applications in public transit service. Some aspects of this project's research have focused more on the ultimate operating conditions when AV technology is fully mature to understand the long term, ultimate state of automated transit technology, policy and regulations.

Conclusions on AV Transit in the Final Report – The Final Report will address information on the probable benefits and impacts of AV Transit, as well as articulate a roadmap of further research activities that technology, policy and regulations should follow over the next few decades.

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[1] SAE J3016 is the Society of Automotive Engineers Standard titled – Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles; revised September 30, 2016.

1. Introduction

Technological changes within any industry mean uncertainty to the agencies and employees. Technology change in the transit industry is no exception. When companies implement new technology, most changes are viewed as positives which will result in increased efficiencies and lower costs. The short-term negatives sometimes involve higher expenses on new equipment and reduction of the workforce. Employees sometimes view technological changes as negatives because job roles and responsibilities change and jobs that are no longer necessary are sometimes eliminated. Salaries may be affected and additional skills may be required. Management of expectations, anxieties, and uncertainty is an important aspect of technology introduction.

This working paper examines how the implementation of AV technology will impact transit employees. Below is a brief explanation of how this paper fits into the larger scope of the project.

Purpose and Organization of the NCHRP 20-102(02) Study

This project identifies a roadmap of activities to be performed by industry groups, legislatures, the federal government, and others that will facilitate automated roadway transit operations. The project is focused on the potential barriers imposed by operating authority policies, agency regulations, and governmental laws relative to the transit environment. Without adjustment, the combination of new technology with old rules could result in undue delays and restrictions to deployment, which reduces the cumulative societal benefits that could have accrued if automated systems technology was implemented earlier.

The project consists of five tasks:

1. Development of a technology baseline for the current state of the practice in AV transit
2. Identification of issues and impacts on transit vehicle driver and associated staff

The levels of automation referenced herein are taken from the NHTSA policy document released in September 2016, as given below. These are in turn based on definitions by Society of Automotive Engineers (SAE).

- **Level 0** – the human driver does everything.
- **Level 1** – an automated system on the vehicle can *sometimes assist* the human driver conduct *some parts of* the driving task.
- **Level 2** – an automated system on the vehicle can conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task.
- **Level 3** – an automated system can both conduct some parts of the driving task and monitor the driving environment *in some instances*, but the human driver must be ready to take back control when the automated system requests.
- **Level 4** – an automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions.
- **Level 5** – the automated system can perform all driving tasks, under all conditions that a human driver could perform them.

NOTE: These levels of driving automation will be referred to in this document as **L1**, **L2**, **L3**, **L4** and **L5**. Refer to Working Paper #1, Chapter 3 for a more complete discussion.

3. Identification of government regulations and laws impacting AV adoption in transit
4. Development of an implementation plan to address challenges identified in Tasks 1-3
5. Preparation of a final report consolidating Tasks 1-4

We have organized the five tasks to produce six working papers, and an implementation roadmap for transit automation in the final report. The Working Paper #1 provides an overview of the deployment scenarios for AV technology in transit applications.

Working paper #2 provides a foundation of technical information concerning safety from which subsequent considerations of operating agency policy and governmental safety regulations can be addressed.

Working Papers #3 Workforce Deployment and #4 Operating Agency Policy address the implications of automating roadway transit vehicles with respect to local operating agency issues, including labor relations and training, broad operating planning and policy, and response to governmental laws and regulations.

Working Paper #5 addresses issues and possible changes to the federal and state governmental laws and regulations over public transit that should be researched, as well as issues and possible changes that may be required in vehicle designs to effectively comply with regulations. Finally, Working Paper #6 addresses the preliminary timeline for deployment of progressive transit automation in overall consideration of technology, policy and regulatory changes that will be required.

Then in the final report for the project, an assessment is discussed of the overall benefits and impacts of AV technology on public transit and a proposed "roadmap" for further research.

Working Paper #3 Contents

The content of this paper primarily discusses the gradual changes to the role of employees as AV transit technology is progressively deployed. This paper draws primarily from the issues and questions considered during this project's Transit Industry Stakeholder Workshop #2, held at the September 2016 APTA conference in Los Angeles. The first point of discussion considers the readiness of the industry in general for the coming transformation that automation will bring. These considerations involve the historical relationship between unions and employers (e.g. transit agencies) in the form of collective bargaining agreements. Next the discussion shifts to operator contracts that will be impacted for bus operations and maintenance. The third point of discussion centers on employee training/retraining for workers displaced by AV transit technology. This discussion includes aspects of governmental regulations and related employee considerations. Finally, the last section discusses issues related to the potential for workforce downsizing.

2. Transit Industry Readiness for AV Technology

During the September 2016 APTA Conference in Los Angeles, California, Stakeholder Workshop #2 was held to gain insight regarding transit industry readiness for AV technology deployment. This was the second of three Stakeholder Workshops, with the first being held in conjunction with the TRB/AUVSI Automated Vehicles Symposium in July 2016. The second workshop addressed a variety of major discussion components, including:

- Is the Industry Ready for AV Transit?
    - Safety and ADA Regulations (discussed further in Working Paper #2 and #5)
    - Operating Policy (discussed further in Working Paper #4)
    - Employee Transition & Training (addressed in this Working Paper #3)

AV Transit Workshop Themes

Several themes emerged during the workshop discussion, with topics of high interest including:

- Unions and Labor – Will workers (primarily bus operators) be eliminated with AV transit systems? As AV transit technology advances, unions are indicating their concern regarding the timing of the implementation, the displacement of workers, and the need to be actively involved at the earliest stages when AV transit technology is first being considered.
- Human drivers/operators versus trusting in AV technology –Will the public feel comfortable riding in unmanned AV transit vehicles?
- Operational benefits of AV Transit applications – Can automated transit systems be more reliable than human-driven systems? Non-automated, manually driven vehicles sometimes experience problems staying on schedule, due to variance in bus driver performance. Automation may improve scheduled operations through tighter coordination with traffic signal systems and supervisory systems that may be continually optimizing operations over the entire line.

A clear theme from the discussions was the requirement to involve representatives of the labor force in the early considerations of AV transit deployment. This could involve focus groups, workshops, employee meetings, and direct participation in AV transit demonstration projects and evaluations of technology benefits. Each agency should integrate this employee involvement in their policy-driven planning and it should involve front-line employees directly in the process. For example, currently Santa Clara Valley Transit Authority (VTA) is operating buses with a video-based collision avoidance system. The bus operators will be part of the evaluation of this technology during the demonstration project.

Another clear theme from the discussions was that management and organization structures will probably need modification as AV transit technology is deployed over time. The labor force may shift away from being dominated by operators and mechanics and towards remote monitors, recovery operators, and maintenance personnel with higher levels of technology skill. Organizational models may need new divisions such as a technology operations division.

Employee Roles in Compliance with Federal Regulations

During the workshop, the participants discussed regulatory aspects of safety and ADA compliance in the context of AV transit. Passenger access to platforms, assistance with boarding vehicles and docking/securing patrons in wheelchairs are all significant challenges of AV transit. When no driver is onboard a public transit vehicle, how will these things be accomplished? Depending upon the disability, additional technology solutions (auto-energized ramps, auto-securing tie-downs, etc.) may be required to perform these functions without human assistance. It may be challenging to envision these additional functions with today's technology, but perhaps by the time that "all" buses are capable of driverless operations such features will be proven as well. In the interim, however, it is difficult to imagine a driverless BRT line without such functions. While the self-driving technology may enable a BRT operation on dedicated transitways today, attendants will still be needed for ADA compliance for the foreseeable future.

Employee Transition and Training

AV transit implementation could mean significant changes to the way transit employees function. These changes range from revising roles/duties, normalizing work schedules and perhaps decreasing total staff over time. Existing employees will likely require education and training to modify their roles. Additional issues discussed in the workshop include:

- Man vs machine – Who will be responsible for the vehicle during progression from higher levels of automation back to manual control? A gradual and well-timed transition from machine control to human control is critical for success. While the opposite scenario is also important (driver handing over control to the machine), the release of the vehicle from automated operation back to the driver is a critical safety event.

- Role of current drivers – About 40% of the operator's time is spent on passenger related issues (e.g. fares, loading and unloading) and 60% spent driving. How will passenger issues be addressed when the operator is completely removed from the transit vehicle?

- Driver hours and salary changes – Most operators work 10-12 hours daily. Currently the work hours occasionally increase to 16 hours a day when the transit agency experiences staffing shortages (so the same drivers may work at both the AM and PM peak periods). Some industry representatives believe that AV transit implementation will normalize operators' work day and potentially shrink their schedules to 8 hours daily and 40 hours weekly. If these factors do in fact result in total fewer hours than transit vehicle operators currently work, it will translate into less take home pay.

3. Unions and Collective Bargaining

For decades, unions have represented hundreds of thousands of transit workers and have brokered contract terms, working conditions, wages, and benefits. These negotiations are conducted with the intent to ensure the fair treatment of employees while providing the transit agency with quality employees to meet the agency's service goals. This Chapter examines the traditional role of unions and collective bargaining and the potential for new roles for the union with AV transit deployment. The discussion draws from the Stakeholder workshops and review of example contracts (e.g. Teamsters Union Local 683 and Veolia Transportation Services).

Traditional Bargaining Items

Typically, unions help determine the working conditions, (hours, days, duration) for transit workers. Issues about wages, rates, and compensation rest at the heart of most agreements. Rules about the frequency of work and overtime situations are also contained in the contract. Unions also intervene, on behalf of the employee, when disputes with the agency occur. Unions frequently serve as a "checks and balances" system when agencies make workforce decisions, e.g. promotions and layoffs. Unions also assist in protecting workers from safety risks and unsafe working conditions.

During the Transit Industry Stakeholder Meeting #2, participants noted that the most significant concern of unions is the displacement of workers due to AV transit deployment. This concern may also be expressed by agency advisory boards and elected officials. Currently, few agreements mention the impact of technology on workers' jobs. However, as the transit industry incorporates AV transit, unions may decide to include language in contracts that specifically addresses new changes that workers may face because of AV transit deployment. The Teamsters Union Local 683 agreement (for example) specifically addresses technology regarding the safe operation of the vehicle, passenger safety, and employee investigations.

> *The Company may employ new technology, including video systems, GPS, mobile data terminals/computers and other present or future technologies for the transit industry, in order to help ensure the safety of the driver and passengers, and compliance with all Federal, State, and local driving rules and regulations by both the driver and the motoring or pedestrian public (Teamsters Union Local 683 Contract, p. 6).*

In the future, negotiations may expand and include clauses aimed at workforce retraining, reassignment, and guidance on downsizing. In the Teamsters Union Local 683 contract, for example, the following indicates that unions realize that new technologies may be introduced and the negotiators want to know how and what the effects will be to the employees once the technologies are implemented.

> *The Company shall meet with the Union before implementation of new technology, on an advise and confer basis, in order to explain and clarify the use and effects of said technology. The Union maintains all rights to the grievance procedure contained in this agreement in the case of disagreement concerning any implementation of new technology as stated in this Section (Teamsters Union Local 683 Contract, p. 7).*

Stakeholder participants also expressed concern regarding lawsuits filed by unions to protect operators' jobs. Many cited the Federal Transit Act 13 C Federal Rule, which provides transit labor protection so that jobs cannot be taken away from public employees (see further discussion in Chapter 5).

4. Employee Training and Retraining

As new technology works its way into public transit over the next few decades, employees, unions, and transit agencies must begin the process of identifying the new positions that emerge and how to incorporate current workers into these positions. In some instances, employees will need retraining and/or additional education to understand how to operate (or maintain/repair, as appropriate) the technology and systems. The early periods of transition from L0 to L3 automation will be especially important as the operators will require special training for the transition of control from manual to automated and more importantly from automated driving back to manual control. Some have argued that the risks induced by L3 driving systems may be too significant to allow on transit vehicles, particularly in mixed-traffic environments. Regardless, training and re-training will be a significant component of introducing AV technology into transit operations as the man/machine interface becomes integrally involved in the driving tasks.

The most obvious positions impacted by AV transit implementation at L4 levels are those of vehicle operators. Finding new roles for vehicle operators means examining their current roles and duties. Typically, operators are responsible for driving, for ensuring safety (in and around the bus and patron safety), and for addressing passenger issues. With AV transit, former drivers, dispatchers, and street supervisors will probably convert to operational roles as staff in the Operations Control Center (OCC) or as roving "operations response" personnel. A key element of the new roles will be direct interaction one-on-one with patrons, via remote video phone and/or intercom systems. In addition, the eventual deployment of L4 automation will likely also involve a significant number of vehicle operators who remotely take control of vehicles from the OCC when necessary. Such situations may include driving the vehicles to operational recovery or maintenance and repair locations, maneuvering the vehicle around an unexpected obstacle or extracting the vehicle from unusual circumstances such as a software failure.

When AV transit technology eventually reaches L4 operations, former vehicle operators may then serve as ambassadors to patrons. These duties include assisting persons with disabilities in the boarding and alighting process, ticketing and various services at the station, and securing wheelchairs onboard the vehicle.

In the last decade, U.S. transit agencies implemented "See something – Say something" policies, and trained bus drivers how to identify terroristic threats, strange items left onboard, and other potentially dangerous situations. Former drivers in the role of roving operations personnel will certainly use these skills and focus on observation of potential terroristic threats in and around the bus and platform. Duties would also include preventing suspicious persons from boarding the bus and loitering on the bus. These activities may improve the overall perception of safety for patrons.

Frequently, monitoring passenger activity and maintaining control on the bus also fell into the realm of the driver's duties. With AV transit deployment, former drivers acting in the roving operations response role would monitor the bus and its surroundings at the OCC or a subregional operations service center, where an intercom/video phone system on the bus may be the means of communicating with passengers. A two-way intercom has been shown in

automated guideway transit applications to help patrons feel more secure while using transit. In addition, newly retrained operators could be first responders to bus failure conditions, either driving the bus manually to a desired location, or requesting street supervisors and maintenance to assist when AV buses experience serious mechanical problems.

Imagining and preparing for the type of jobs needed over the long term because of AV transit implementation is not just the role of the transit agency, but also should also be undertaken by the unions and drivers themselves. Cooperation between all parties would ensure a better understanding of who will be directly impacted by the technology and to what extent. Such cooperation will lead to new work opportunities, e.g. cross training and promotions as well as additional training/education for employees.

Unions could also gather information from other unions and transit agencies around the world to see what jobs and skill sets are needed when automation is brought into the operations in order to ensure that workers receive the training to compete for these new positions. Employees will be able to embrace the new technologies and avail themselves of training for new positions within the agency.

Although the precise result of workforce redeployment is impossible to predict now, it has been observed in other parts of the world when rail transit lines are automated that a larger percentage of the workforce has been needed in the maintenance department – some as roving personnel who for example may be dispatched to recover vehicles that have been removed from service due to failures in the automated control system. These types of changes should begin to be evaluated, and retraining programs considered.

Workforce redeployment will be affected differently by automation of different types of transit service, such as L4 automation of first-mile/last-mile shuttle systems in urban districts, line-haul BRT lines in high density corridors, or long distance commuter bus lines operating in dedicated HOV lanes, As these very different types of service are progressively converted to L4 operations over the next several decades, the transit operating fleet will likely see a greater diversity of vehicle types and sizes. This transition in service types may also be affected by changes to the fleet mix operating more total vehicles which are smaller and more flexible in their daily deployment. This increase of the fleet size will likely also shift the percentage of workers dedicated to maintenance responsibilities, and the percentage dedicated to operational support roles.

The deployment of AV transit also means that transit agencies must budget for retraining and re-educating drivers, dispatchers, and maintenance workers. At each stage of implementation, transit employees must be equipped with the training and skills to detect problems and identify solutions to ensure the successful operation of the service. Transit agencies may also consider working cooperatively with local community colleges to create curriculum, certifications, and associate degrees for persons interested in AV transit technology.

5. Resizing the Workforce

Little to no research on cost-benefit evaluation of the introduction of AV to transit systems has been done to date. Given that the current cost of transit operations is dominated by the cost of the driver (25%-40% of the cost), automated driving systems can provide lower-cost services – based on the premise that AV transit technology can be shown to be as safe as human driving and able to navigate the wide range of operational scenarios that humans can currently handle when the drivers are removed. The amount of reduction in workforce cannot be accurately identified without a detailed identification of the operating paradigm (such as how many vehicles a remote operator can monitor reliably).

Changes resulting from the implementation of AV transit will likely mean considering changes to the job descriptions, titles, skills and number of employees. As discussed above, transit operating agencies must give the utmost concern and sensitivity as to how these changes will occur. Initially, FTE positions could be eliminated via attrition. As workers retire, transit agencies may make decisions not to fill these positions because the work can be spread across fewer employees in their new roles. This approach allows for a natural and progressive shrinkage of the number of employees.

The previous chapter discussed the employee training and retraining and the new roles and responsibilities that displaced drivers, dispatchers, and maintenance workers may take in the transit industry. As a matter of last recourse, transit agencies may be forced to realize that workers that cannot be retrained or reassigned will be released from employment as the total workforce is right-sized. Working with employees and unions will help lessen the impact over the years of transition during which AV transit technology is progressively coming on-line.

Section 13c of the Federal Transit Act

Equally important are the potential changes to federal law that may be required to be made. This major issue for public transit authorities concerns 13 C Federal Rule, which specifically states that jobs cannot be taken away from public transit employees. Refer to 49 U.S.C. 5333(b), also known as "Section 13(c)" of the Federal Transit Act[2].

The statute reads in part:

> As a condition of financial assistance … the interests of employees affected by the assistance shall be protected under arrangements the Secretary of Labor concludes are fair and equitable.

> Arrangements under this subsection shall include provisions that may be necessary for –
> a. the preservation of rights, privileges, and benefits (including continuation of pension rights and benefits) under existing collective bargaining agreements or otherwise;
> b. the continuation of collective bargaining rights;
> c. the protection of individual employees against a worsening of their positions related to employment;

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[2] https://www.dol.gov/olms/regs/compliance/statute-sect5333b.htm

    d. *assurances of employment to employees of acquired public transportation systems;*

    e. *assurances of priority of reemployment of employees whose employment is ended or who are laid off; and*

    f. *paid training or retraining programs.*

The reality that automation will eventually reduce the total size of the public transit system work force may be one of the most significant policy considerations that will need to be addressed within each local transit operating agency over the coming years. This matter alone may pace the rate at which AV transit technology can be implemented in many locales, resulting in a significantly longer timeframe for AV transit deployment as labor force reduction and redeployment will only be able to occur gradually without revision to Section 13c of the Federal Transit Act.

6. Findings and Recommendations on Workforce Deployment

In this and other working papers, a broad interpretation of "Policy" has been used as representing the decision-making process accomplished at the executive management and board of directors level in local transit operating agencies. Workforce impacts are one of the most important policy matters that any operating agency will face when they consider deployment of automated transit services.

Several general findings on workforce deployment that came primarily from the Transit Industry Stakeholder Workshops are as follows:

- It will be important (and as evidenced in some collective bargaining agreements, *required*) to involve employees and employee-representative unions in the planning and preparations for deployment of AV transit technology.

- Compliance with federal regulations concerning safety and ADA requirements currently require bus drivers to directly communicating with and assisting transit passengers in entering and exiting the vehicle. There are no current solutions that would allow ADA-compliant transit operations at L4 with no vehicle attendant.

- There are occasionally problems with passenger behavior that are currently addressed by the bus driver, and the way incidents are addressed in the future when no human driver is onboard is currently uncertain.

Unions and Collective Bargaining Contracts – Unions will certainly remain a chief arbiter of transit employees in the foreseeable future. New technology introduction that makes transit safer – such as will be true with L2-L3 automation – will not likely be an issue, since provisions for safety-enhancement technologies are typically in existing contracts. However, going forward in time as technology applications move into L4 automation, collective bargaining agreements should be adjusted. Contracts over the medium to long term should address the conditions during the transition phase as humans interact with the self-driving machines. The new contracts will have to include provisions for retraining and reassignment of employees as the role of the vehicle operator is transitioned into a remote monitoring and occasional remote-pilot role from the OCC.

Employee Training and Retraining – Drivers will be the employees most directly affected by AV transit technology applications, and these employees will need to be progressively retrained. Initially, the training will prepare the drivers for the semi-automated operations where portions of the driving tasks or even entire transit route operations are fully automated, while other portions are not automated. Particularly, the transfer of control from the vehicle's automated driving system back to the human driver will require significant training.

In addition, passenger assistance will gradually absorb a higher percentage of the onboard staff member's time. The monitoring of passenger activity to discern criminal or even terrorist activity will continue to be a key aspect of operations personnel, whether the employees are onboard the vehicle or monitoring the activity in other ways. These aspects of removing the human staff member from the vehicle will require careful policy considerations, and union involvement in determining these areas of responsibility will certainly be a factor.

Resizing the Workforce – Over the decades to come, all public transit operating agencies will be right-sizing their workforce, both in their allocations between operations and maintenance personnel and in total number of employees required to adequately serve the needs of transit patrons. Workforce challenges and policy restrictions will pace the timing of progress into fully automated, driverless transit vehicle operation.

In Conclusion – Despite a variety of concerns regarding AV transportation, a change in how public transit vehicle are controlled and how public transit agencies operate appears imminent. Unions and employees will consider new areas of bargaining to ensure that employees gain the knowledge required to function effectively once AV transit technology is employed. In turn, transit agencies must operate strategically in the handling of essential jobs and begin now to identify how employees will be retrained to assimilate into the new AV transit operations. All in all, the transference from "people power" to automation will require a gradual or incremental change so that the transit operating agency, transit employees, unions, and patrons can adjust to the "new" normal with minimal impacts.

Recommended Research Projects on AV Transit Workforce Deployment – There are significant matters to be addressed in the near to medium term regarding the redeployment of the transit operating agency's workforce as AV transit is progressively brought into passenger service and as levels of automation are progressively increased. The following key research projects are recommended for undertaking based on the considerations and findings of this working paper:

1. **AV Transit Employee Roles and Responsibilities** – A study is needed to develop preliminary job descriptions for future employee roles and responsibilities as progressively higher levels of transit automation are deployed by a "typical" small, medium and large transit operating agency, and as different types of transit service are implemented (e.g., first-mile/last-mile circulator/connector service, line-haul BRT service, arterial street corridor service, and regional long-distance commuter bus service.)

2. **Employee Involvement Guidelines** – The transit industry would greatly benefit from the preparation of a planning template of steps which frames a generic process involving employee representatives in AV transit technology investigations/demonstrations and subsequent phasing of deployment. These steps should serve to define for each phase of AV transit technology implementation the progressive redeployment of the existing workforce to new roles and responsibilities.

3. **Union Contract Guidelines** – Policy study(ies) that leads to the preparation of draft language for future union contracts would be very beneficial, in particular which specifically provide for a progressive implementation of AV transit technology and the associated transition of employee roles and responsibilities.

4. **Automation of Employee Actions in Compliance with ADA** – A technical research project that first performs an evaluation of current employee actions and responsibilities in assisting and protecting passengers with disabilities when accessing transit vehicles and the corresponding securement of wheelchairs once onboard could then produce technical guidelines for automation of these functions in design of AV transit vehicles. This research will necessarily investigate the means and methods to

accomplish these actions as higher levels of vehicle automation are achieved. Equipment functional capabilities/features, employee involvement/monitoring, and employee location (i.e., at the vehicle or remote) should be defined for each automation level and type of transit service.

APPENDIX A
Attendees at NCHRP 20-102(02) Industry Stakeholder Meetings

Attendance Roster – NCHRP 20-102(02) Transit Industry Stakeholder Meeting #1,

July 21, 2016, San Francisco CA

NAME	ORGANIZATION	PROJECT ROLE
Jerry Spears	Washington State Transit Insurance Pool	Stakeholder
Jane Schroter	Capital Metro	Stakeholder
Lou Sanders	APTA	Stakeholder
Peter Thompson	SANDAG	Stakeholder
Gary Miskell	VTA	Stakeholder
Marla Westervelt	LA Metro	Stakeholder
Brian Sherlock	Amalgamated Transit Union	Panel
Jerry Lutin	NJT	Panel
Adriano Alessandrini	University of Florence	Panel
Ray Derr	TRB	Project Team
Doug Gettman	Kimley-Horn	Project Team
J. Sam Lott	Texas Southern University	Project Team

Attendance Roster – NCHRP 20-102(02) Transit Industry Stakeholder Meeting #2

September 12, 2016 – JW Marriott LA Live, Los Angeles CA

NAME	ORGANIZATION	PROJECT ROLE
Vincent Valdes	Federal Transit Administration	
Joe Calabrese	Greater Cleveland RTA	Stakeholder
Marlene Connor	Marlene Connor Associates LLC	Stakeholder
Lou Sanders	American Public Transportation Association	Stakeholder
Art Guzzetti	American Public Transportation Association	Stakeholder
Gary Miskell	Santa Clara Valley Transportation Authority	Stakeholder
Marla Westervelt	LA Metro	Stakeholder
Brian Sherlock	Amalgamated Transit Union	Panel Member
Bill Churchill	County Connection, Concord CA	Stakeholder
Lisa Darnall	Jacksonville Transportation Authority	Stakeholder
Dave Hudson	County Connection, Concord CA	Stakeholder
James Garner	Pace Suburban Bus	Stakeholder
Rick Ramacier	County Connection, Concord CA	Stakeholder
Pete Gould	Shared Mobility Strategies	Stakeholder
Jim Hunter	Golden Empire Transit District, GETBus	Stakeholder
Doug Gettman	Kimley-Horn	Project Team
J. Sam Lott	Texas Southern University	Project Team
Gwen Goodwin	Texas Southern University	Project Team