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Andrew Robinson

Job Growth in Freight Operations: The Role of Technology

Faculty Sponsor
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Abstract

This report reviews the potential change in freight transportation jobs due to technology advances within the United States. Research was conducted by examining multiple scholarly and newspaper articles discussing changes in technology within the freight transportation industry. Through an analysis of Bureau of Labor Statistics Employment Projections, along with the research conducted, a qualitative projection of job growth due to technology was developed.

Introduction

Freight transportation is central to the United States economy. It is important that freight be reliably moved from one point to another. This would not be possible without the men and women in charge of transporting these commodities. For decades, these men and women have worked day and night to ensure that freight is delivered on time. With recent changes in technology, the way freight is shipped has been transformed. With ever-changing technology on the horizon, the future of freight operation jobs is uncertain. Past trends in job growth cannot accurately predict future growth with the possibility of the entire landscape of the industry changing, particularly with the potential disruption due to autonomous and connected vehicles and infrastructure. Instead, employment projections must be analyzed along with predicted changes in the industry to develop an estimate of future growth.

By analyzing employment projections created by the Bureau of Labor Statistics, and breaking these down regionally, a better understanding of employment trends, as well as the impact technology will have on specific regions within the United States, can be obtained. To regionally analyze the data, the United States must first be broken into regions. For this research project, the regional delineations of the National Network for the Transportation Workforce (NNTW) are used. The NNTW breaks the states, the District of Columbia, and Puerto Rico into five regions: Midwest, Northeast, Southeast, Southwest, and West (National Network for the Transportation Workforce 2018) (See Table 1).

By using employment data from the Bureau of Labor Statistics for each state, regional values for freight operations jobs were calculated. From these values, regional projections were made using the same percent change predicted by the Bureau of Labor Statistics employment projections. Although the future regional job growth cannot be expected to be the same across the five regions, applying the percent change predicted by the employment projections allow insight into the effect job growth will have on each region. By breaking the data down regionally, it is possible to see the areas of the country that would be impacted the most by jobs changing with technology.

Midwest	Northeast	Southeast	Southwest	West
Illinois	Conneticut	Alabama	Arizona	Alaska
Indiana	Delaware	Arkansas	California	Hawaii
Iowa	Dist. of Columbia	Florida	Colorado	Idaho
Kansas	Maine	Georgia	Nevada	Montana
Michigan	Maryland	Kentucky	New Mexico	Nebraska
Minnesota	Massachusetts	Louisiana	Oklahoma	N. Dakota
Missouri	New Hampshire	Mississippi	Texas	Oregon
Ohio	New Jearsey	N. Carolina	Utah	S. Dakota
Wisconson	New York	Puerto Rico		Washington
	Pennsylvania	S. Carolina		Wyoming
	Rhode Island	Tennessee		
	Vermont	Virginia		
		W. Virginia		

Table 1. NNTW Regions

Trucking Industry Workforce

The U.S. Department of Transportation predicts a 44% increase in the tonnage of freight shipped by truck by the year 2045 (Bureau of Transportation Statistics 2016). It is reasonable to think that the employment of truck drivers would proportionately increase as well. However, the Bureau of Labor Statistics only predicted a 6.1% increase in the Heavy and Tractor-Trailer Truck Driver employment category through the year 2026 (Bureau of Labor Statistics 2016). Comparing the predicted change in tonnage of freight carried by trucks by 2045 to the employment projections through 2026 reveals an interesting fact. Even if the predicted tonnage increase is

not linear per year, the employment projection appears low, and a significant gap may occur. This is consistent with what many in the transportation industry already know: there is a major driver shortage within the trucking industry. The American Trucking Association (ATA) suggests that the industry is short approximately 48,000 drivers (2017). Several causes have been proposed for this job shortage, but the fact remains that the current trucking workforce is aging and retiring (Mulero 2017a). In order for trucking to continue to be a competitive freight transportation option, the industry must evolve to adapt to the increasing driver shortage.

Before the potential changes in technology can be discussed, the Bureau of Labor Statistics data must first be analyzed regionally to determine where the greatest changes should be expected. The employment projections are shown in Table 2.

# of Employees in 2016 (Thousands)	Projected # of Employees in 2026 (Thousands)	Change in # of Employees (Thousands)	Percent Change
1,871.7	1,985.5	113.8	6.1%

Table 2. Heavy and Tractor-Trailer Truck Driver Employment Projection 2016-2026

Source: BLS Employment Projections
https://data.bls.gov/projections/occupationProj

The category of Heavy and Tractor-Trailer Truck Drivers encompasses the following job titles (Bureau of Labor Statistics 2016):

- Auto Carrier Driver
- Cement Truck Driver
- Concrete Mixer Driver
- Concrete Mixer Truck Driver
- Fuel Truck Driver
- Garbage Truck Driver
- Line Haul Driver
- Logging Truck Driver
- Moving Van Driver

- Over-the-Road Driver
- Semi-Truck Driver
- Tanker Driver
- Tow Truck Operator

Because of the broadness of the categories the Bureau of Labor Statistics places truck drivers in, not all of these jobs would potentially be affected by technology, at least not yet. For jobs such as garbage truck drivers, concrete mixer drivers, and tow truck operators, the threat of technology replacing workers is not immediately looming over the horizon. Instead, the threat is more applicable to long-haul truck driver jobs, though as newer technology becomes a reality, smaller 'across-town' truck driver jobs may eventually be affected. By using specific occupational data from each state and using the percent change in Table 2, regional values for the change in truck driver jobs were calculated. These values are shown in Table 3.

Occupation	Region	# of Employees in 2016 (Thousands)	Projected # of Employees in 2026 (Thousands)	Change in # of Employees (Thousands)
Heavy and Tractor-Trailer Truck Drivers	Midwest	426.5	452.5	26.0
	Northeast	266.8	283.1	16.3
	Southeast	469.5	498.1	28.6
	Southwest	419.3	444.9	25.6
	West	130.6	138.6	8.0

Table 3. Regional Values for Predicted Change in Truck Driver Employment

Source: BLS State Employment Statistics
https://www.bls.gov/oes/current/oessrcst.htm

By graphically analyzing the predicted change in employment from 2016-2026, it becomes possible to see which regions will be affected the most by potential technology changes. From the graph in Figure 1, it is apparent that the largest increase in employment will be seen within the Southwest and the Southeast. From the graph, it appears that the West will see the lowest number of drivers added to the workforce. However, this is due to the fact that there are fewer people employed in freight operations jobs in the West. Since the magnitude of change is directly proportional to

the number of people already employed in the region, it is safe to say that if truck driver jobs change with technology, the Southeast and Southwest regions will be the most dramatically impacted.

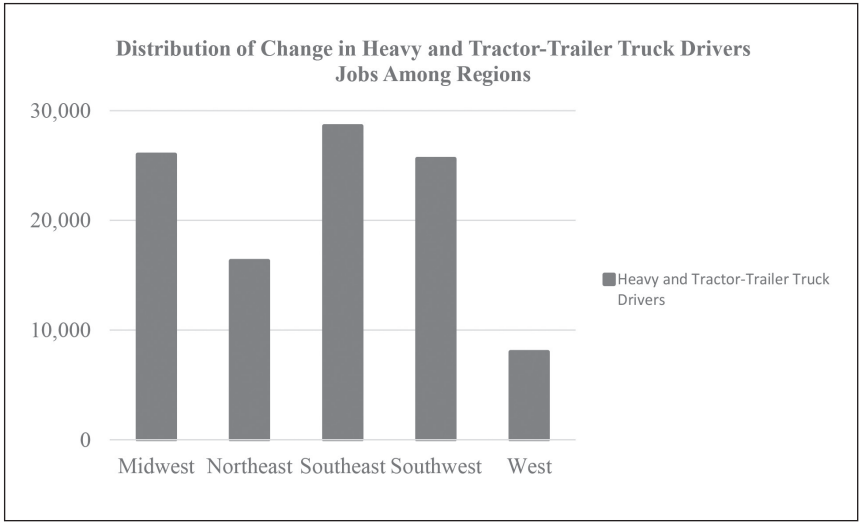

Figure 1. Distribution of Change in Heavy and Tractor-Trailer Truck Driver Jobs Among Regions

With the recent advances in technology, the trucking industry has been experimenting with autonomous (self-driving) trucks (Mulero 2017b). One particular example that is currently being examined is truck platooning, a caravan of several trucks that are autonomously connected to a pilot truck (Sanctis 2017). As of now, every truck includes a driver. However, if this technology is implemented, the next step could be to remove the drivers from the trucks. However, this next step would require a major shift in the public's perception of safety, which is the biggest issue with removing drivers altogether from trucks (Sanctis 2017). Instead, it is predicted that the role of a truck driver will change into a technical role like that of an airline pilot (Sanctis 2017). Future drivers would need to be trained as technicians who could operate and maintain the new technology (Keen 2017). These technicians may also need to perform repairs to the trucks. Thus it is safe to assume that the need for truck drivers will not decrease due to technology in the short term, but rather the required skill-sets for driving candidates will shift to reflect the changing environment.

Autonomous technology may help fill a void that already exists due to an aging workforce and lack of replacements. In fact, it is speculated that the new technology may attract younger people who enjoy today's modern technology (Mulero 2017c). With this knowledge, the projected 6.1% increase in truck driver jobs over the next 9 years may be reasonable, but the job definition of a truck driver will morph into a more of technical role within the cab.

All the speculation regarding the effects of technology on truck driver jobs is dependent on the legality of operating autonomous vehicles among the states. As of 2014, the legality of autonomous vehicle operations was largely up to interpretation since most state laws were not written with these types of vehicles in mind, leaving loopholes in which "autonomous vehicles are probably legal" (Smith 2014). However, the primary legal barriers to automated truck technology, specifically truck platooning, are following-too-close (FTC) laws (Kramer 2017). Many states have laws which set a minimum following distance that must be observed between vehicles, which is often larger than the maximum distance required for a truck platoon to be effective. These laws are in place to allow trailing drivers enough reaction time in the event the vehicles ahead have a sudden issue. However, with truck platooning, all trucks are connected to the same system, allowing each trailing vehicle to stop roughly at the same time as the lead vehicle. Removing operational control from the drivers from the trailing trucks removes the need for extra reaction time. For this reason, many states have been amending their FTC laws to allow a provision for truck platooning, some even encouraging pilot programs for testing on public roads. As of 2017, the following states (outlined in Table 3) have addressed the legality of truck platooning:

State	Provisions Made for Truck Platooning
Arkansas	Platoon testing allowed[a]
California	Platoon testing allowed[b]
Florida	Platoon testing allowed. Pilot program in place[c]
Georgia	Platoons exempt from FTC laws[a]
Michigan	Platooning allowed[d]
Missouri	Pilot testing program vetoed by State Governor[e]

Nevada	Truck Platooning allowed on highways[a]
North Carolina	Exempts platoons from FTC laws as long as approved by state DOT[f]
Oregon	Platoon testing permitted on public roads[g]
South Carolina	Exempts platoons from FTC laws[f]
Tennessee	Platoon testing allowed[h]
Texas	Redefined 'braking system' to allow provision for truck platoons[a]
Utah	Platoon testing allowed. Pilot program in place[c]

Table 4. States Which Have Addressed Truck Platooning

Sources: [a]National Conference of State Legislatures 2018, [b]California Department of Transportation 2017, [c]Kramer 2017, [e]Elfin 2016, [f]Goble 2017, [g]White 2017, [h]Tennessee Department of Transportation 2017

From Table 4, it can be seen that, with the exception of Missouri, states are warming up to the idea of truck platooning. In particular, states within the Southeast region show greater acceptance of truck platooning, while states in the Northeast region have yet to address the issue as of 2017. The Southwest also shows greater acceptance as compared to the West and Midwest regions. With the trend in states authorizing truck platooning, it is reasonable to assume that more states will follow suit within the next few years. Even states such as Missouri, whose Governor originally vetoed a bill allowing for pilot testing due to concerns for safety (Elfin 2016), may eventually legalize platoons as their safe operation is demonstrated.

Rail Industry Workforce

The largest competitor to the trucking industry is the railroad industry, which the Department of Transportation predicts will increase its freight tonnage by 24% by the year 2045 (Bureau of Transportation Statistics 2016). However, the Bureau of Labor Statistics predicted a drop in rail operations jobs by the year 2026. Railroad engineer, conductor, and brakemen/switchmen jobs are predicted to decrease by 2.8%, 2.1%, and 1.6% respectively. These values are shown in Table 5 (Bureau of Labor Statistics 2016).

Occupation	# of Employees in 2016 (Thousands)	Projected # of Employees in 2026 (Thousands)	Change in # of Employees (Thousands)	Percent Change
Locomotive Engineers	38.8	37.7	-1.1	-2.8%
Railroad Conductors and Yardmasters	41.8	41.0	-0.9	-2.1%
Railroad Brake, Signal, and Switch Operators	19.3	19.0	-0.3	-1.6%

Table 5. Railroad Operations Employment Projections 2016-2026

Source: BLS Employment Projections https://data.bls.gov/projections/

The categories of Locomotive Engineers, Railroad Conductors and Yardmasters, and Railroad Brake, Signal, and Switch Operators encompass the following job titles (Bureau of Labor Statistics 2016).

Locomotive Engineers

- Freight Engineer
- Railroad Engineer
- Railway Engineer
- Train Engineer

Railroad Conductors and Yardmasters

- Freight Conductor
- Passenger-Car Conductor
- Train Conductor
- Yard Conductor

Railroad Brake, Signal, and Switch Operators

- Freight Brake Operator
- Locomotive Switch Operator
- Railroad Brake Operator

- Railway Switch Operator
- Switch Coupler
- Train Brake Operator

Breaking the employment projections down regionally reveals the following data (Table 6).

Occupation	Region	# of Employees in 2016 (Thousands)	Projected # of Employees in 2026 (Thousands)	Change in # of Employees (Thousands)
Locomotive Engineers	Midwest	9.4	9.1	-0.3
	Northeast	4.4	4.3	-0.1
	Southeast	6.9	6.7	-0.2
	Southwest	5.9	5.7	-0.2
	West	1.6	1.6	-0.05
Railroad Conductors and Yardmasters	Midwest	7.1	7.0	-0.2
	Northeast	8.5	8.3	-0.2
	Southeast	7.1	7.0	-0.2
	Southwest	6.7	6.6	-0.1
	West	2.7	2.7	-0.1
Railroad Brake, Signal, and Switch Operators	Midwest	3.7	3.6	-0.1
	Northeast	2.1	2.1	-0.03
	Southeast	2.9	2.8	-0.04
	Southwest	3.6	3.6	-0.1
	West	0.9	0.9	-0.01

Table 6. Regional Values for Predicted Change in Railroad Operations Employment 2016-2026

Source: BLS State Employment Statistics
https://www.bls.gov/oes/current/oessrcst.htm

In all three of the railroad operations categories, it was found that the Bureau of Labor Statistics was missing data for numerous states. However, enough data was present to perform an analysis. By graphing the value of the change in employment in Figure 2, the regions which will be affected the most by changing employment can be seen.

From the data available, it appears that the Midwest will see the most impact with changes in locomotive engineers and railroad brake, signal, and switch operators, while the impact of any change in railroad conductors and yardmasters is roughly felt the same across the Northeast, Southeast, and Southwest. Nonetheless, railroad operations jobs are decreasing across the nation.

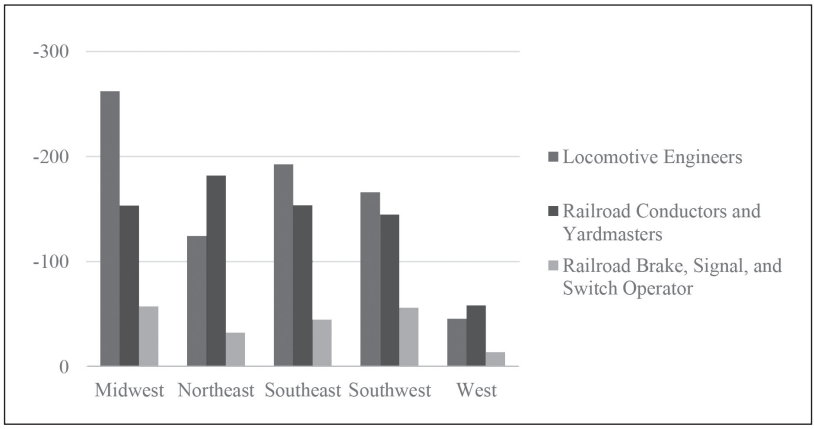

Figure 2. Distribution of Change in Railroad Operations Employment Among Regions

Could this predicted decrease in employment be due to changing technology? With the coming of Positive Train Control (PTC), the path towards automated trains is a little clearer. PTC is a new GPS technology federally mandated for all railroads which monitors the locomotive's performance and track conditions (Bizjak 2017). With PTC, the early steps of automation are there. It would not take much to fully implement automation, or at the very least reduce crews to one person. However, if history is a good prediction, a reduction of train crews will not be well-received. When railroads moved from steam to diesel locomotives, several operations jobs, such as the role of the locomotive fireman to shovel the coal and maintain the steam locomotive, were no longer needed. However, because of labor unions, a fireman was included with each road crew up until the 1980s, when the job was finally dissolved by a presidential mandate (United Press International 1985). Labor unions representing railroad conductors and engineers still have a firm hold on the industry today. It is this hold that has in part allowed the Federal Railroad Administration (FRA) to create a federal mandate which requires two-man crews on every

train (Black 2016). This mandate has created a lot of controversy and leads many in the rail industry to worry about the future competitiveness of the industry with trucks. Because of the power the labor unions hold on the industy, it is unlikely that crew sizes will be reduced due to autonomous technology, even though one person can safely operate and maintain a train today (Black 2016).

This still does not explain the projected decrease in railroad operations jobs. Instead, this can be explained by a reduction in railroad freight traffic, specifically coal traffic. With the recent push towards cleaner energy, the demand for coal has decreased, which has historically been big business for railroads. Because of a decreased demand, the amount of unit coal trains has also decreased, sidelining both engineers and conductors. In addition, even though the Bureau of Transportation Statistics predicts a rise in freight tonnage, the actual tonnage carried by rail has been decreasing over the past several years (Ashe 2017). This decrease seems to contradict the 24% increase predicted by the Department of Transportation (Bureau of Transportation Statistics 2016). However, the 24% increase is a long-term prediction which may be due to population growth and could potentially be drawn from previous long-term growth. From now until 2045, it is expected that growth will occur within the rail industry, even if it is less than other freight industries (Bureau of Transportation Statistics 2016). Because the projections created by the Bureau of Labor Statistics are through the year 2026, they reflect short-term changes, which show a decrease in rail freight tonnage. With the future demand for coal uncertain, however, along with the decreasing amount of freight carried by rail, it is reasonable to assume that the demand for railroad operations jobs will not increase over the next 9 years.

Warehouse and Distribution Center Workforce

The technology change has perhaps had the greatest impact within warehouses and distribution centers, where robotics and automation are quickly becoming the norm (Bearth 2017). With the popularity of online retailers such as Amazon, distribution centers are popping up and expanding across the country (Baddour 2017). With this boom has also come new automation technology, of which Amazon has been a big promoter (Fletcher 2017). What used to be dozens of people scanning, sorting, picking, packing, and moving materials around a warehouse, is now a series of robots automating almost every step. This automation removes the need

for multiple people to touch each item in scanning and sorting, thus reducing the possibility of error. While this does remove a lot of the traditional warehouse roles, most of these jobs have transformed into technical roles assisting and overseeing the automation, as well as more data analysis roles analyzing data collected by robots on the warehouse floor (Chew 2017). These machines are not designed specifically to replace humans, but rather to assist humans in the warehouse sorting process by automating processes, freeing up people to serve in other roles. In some instances, these robots are being used to assist in transporting materials across the warehouse floor as well as picking out the correct materials (Smith 2017).

With a large need for distribution centers and the push for automation, it is difficult to predict how technology will affect job growth. With the need for more warehouses comes the need for more employees to oversee and operate them. However, if these centers become automated, it would not only reduce the number of workers needed to operate such a facility, but also dramatically shift the skillsets required to do so. Thus there seems to be a trade-off with the increase of centers and automation. It is predicted that eventually automation will be implemented in almost every major transportation distribution center, reducing the number of warehouse employees needed to operate such a facility. However, because of the expanse of online retailers such as Amazon, there is an increased need for more distribution centers. Thus it can be predicted that employment in this market will remain fairly steady, with new jobs in new facilities created to replace those taken by automation. The Bureau of Labor Statistics shows a similar prediction, with an 8.5% increase in warehouse supervisors and a 6.7% increase in transportation and distribution managers. However, the Bureau also predicted a 5% increase in stock clerk and order-filler jobs (Bureau of Labor Statistics 2016), which seems high considering the evolving changes in distribution technology. These values are displayed in Table 7.

Occupation	# of Employees in 2016 (Thousands)	Projected # of Employees in 2026 (Thousands)	Change in # of Employees (Thousands)	Percent Change
First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand	184.4	200.1	15.7	8.5%
Transportation, Storage, and Distribution Managers	115.5	123.3	7.7	6.7%
Stock Clerks and Order Fillers	2,008.6	2,109.9	101.3	5.0%

Table 7. Warehouse Operations Employment Projections 2016-2026

Source: BLS Employment Projections https://data.bls.gov/projections/occupationProj

The categories of First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand; Transportation, Storage, and Distribution Managers; and Stock Clerks and Order Fillers encompass the following job titles (Bureau of Labor Statistics 2016):

First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand

- Material Handling Crew Supervisor
- Warehouse Supervisor

Transportation, Storage, and Distribution Managers

- Airport Manager
- Cold Storage Supervisor
- Distribution Center Manager
- Logistics Manager
- Logistics Supply Officer

- Marine Oil Terminal Superintendent
- Traffic Safety Administrator
- Transportation Manager
- Warehouse Manager
- Warehouse Operations Manager

Stock Clerks and Order Fillers

- Grocery Stocker
- Inventory Control Clerk
- Inventory Taker
- Night Stocker
- Retail Stocker
- Stockroom Attendant
- Stockroom Clerk
- Store Stocker
- Supply Clerk
- Supply Room Clerk
- Tool Crib Attendant
- Warehouse Clerk
- Warehouse Stocker

Because the categories of Transportation, Storage, and Distribution Managers and Stock Clerks and Order Fillers include a broad range of job titles, not every position covered falls under the category of warehouse worker. However, because it is not possible to separate the data specifically to warehouse job titles, every job title within these categories must be included in the analysis (even though they potentially skew the data as it pertains to freight operations). For instance, because Stock Clerks and Order Fillers is such a large category containing jobs such as Grocery Stocker and Retail Stocker, the employment projection cannot be accurately used to portray changes specific to warehouse workers. This may explain why the predicted 5% increase seemed high. However, because most of the jobs within these categories are similar, potential shifts in technology could bring changes to the whole category. Even though the numbers may be skewed, the data still provides insight into potential changes due to technology.

Breaking the national projection into regional values yields the numbers shown in Table 8.

Occupation	Region	# of Employees in 2016 (Thousands)	Projected # of Employees in 2026 (Thousands)	Change in # of Employees (Thousands)
First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand	Midwest	38.4	41.7	3.3
	Northeast	36.2	39.3	3.1
	Southeast	52.1	56.6	4.4
	Southwest	46.6	50.5	4.0
	West	11.1	12.0	0.9
Transportation, Storage, and Distribution Managers	Midwest	27.8	29.6	1.9
	Northeast	18.8	20.0	1.3
	Southeast	25.4	27.1	1.7
	Southwest	33.7	35.9	2.2
	West	8.4	9.0	0.6
Stock Clerks and Order Fillers	Midwest	429.7	451.3	21.7
	Northeast	422.8	444.1	21.3
	Southeast	528.9	555.5	26.7
	Southwest	542.7	570.1	27.4
	West	109.2	114.7	5.5

Table 8. Regional Values for Predicted Change in Warehouse Operations Employment 2016-2026

Source: BLS State Employment Statistics https://www.bls.gov/oes/current/oessrcst.htm

Graphing the change in warehouse operations jobs yields the following two graphs, shown in Figures 3 and 4.

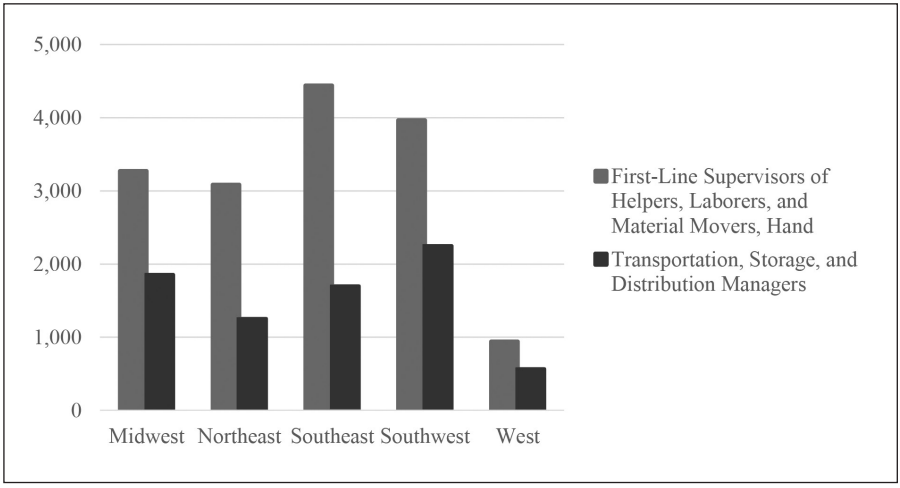

Figure 3. Distribution of Change in Warehouse Operations Employment Among Regions

From Figure 3, it can be seen that changes in supervisor employment will affect the Southeast and Southwest the most, while managerial roles will be most affected in the Southwest region. Due to the large scale of the Stock Clerks and Order Fillers category, this group was graphed separately (Figure 4). As the graph shows, the change is more evenly distributed among all the regions except for the West, with the most impact in the Southeast and Southwest.

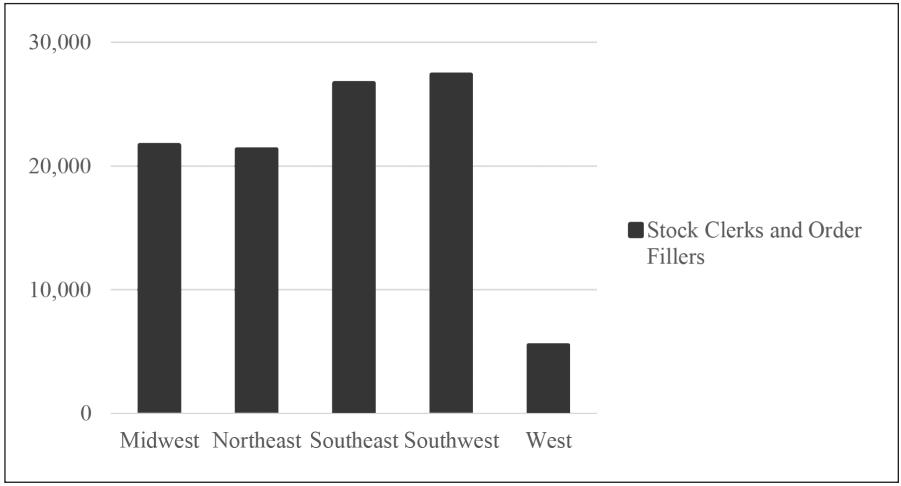

Figure 4. Distribution of Change in Stock Clerks and Order Fillers Employment Among Regions

Conclusion

It is difficult to predict the future, but through an analysis of trends and research on upcoming changes, insight can be gained. Through research of the upcoming technological changes, it can be predicted that the freight transportation industry will undergo a major change within the next few decades. With the advent of new autonomous technology, the trucking industry is rapidly moving towards driverless trucks. With the coming of PTC across all major railroads, autonomous technology may not be far behind; the major hurdle being federal regulations and labor unions. For this reason, it is predicted that railroad operations jobs will not drastically change because of technology. However, the warehouse and distribution area will drastically change within the upcoming years. With the boom in warehouses caused by online retailers and the advent of warehouse robotics self-fulfilling orders, the type of warehouse jobs will shift to technical roles and managerial positions. These few changes only provide a glimpse into the future of freight transportation. With more upcoming technological advances on the way, such as drone delivery (Behrmann 2017), the future looks bright for technical jobs. The advent of drone technology will help create a new career field within the freight transportation industry. Finally, with new logistics and technological software, transportation time is quickly becoming streamlined (Hollingsead 2017), allowing for more

freight to be shipped in the same amount of time. By regionally breaking down employment projections, it is possible to see which areas could be most impacted by the coming technological changes. Through this analysis, it was found that the Southwest and Southeast areas of the United States will see the biggest impact in freight operations employment due to technology. Through all the technological advances, one thing is certain: people will still be needed to help efficiently transport freight across the country, although their roles and responsibilities may shift significantly.

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