Identifying Optimal Transition Careers for Drivers Displaced due to Autonomous Vehicles

Jenna A. Van Fossen[1], Chu-Hsiang Chang[1], J. Kevin Ford[1], Elizabeth A. Mack[2], Shelia R. Cotten[3]

[1] Michigan State University Department of Psychology, [2] Michigan State University Department of Geography, [3] Clemson University Department of Sociology, Anthropology, and Criminal Justice and Department of Communication

Table of Contents

Executive Summary

The increased adoption of technology within organizations will result in a reduced number of jobs for different occupational sectors. Driving jobs, including taxi driving and long-distance trucking, are both projected to decline due to the introduction of autonomous vehicles. In response, we draw upon the 24.2 Occupational Information Network (O*NET) Database to identify potential transition occupations for displaced workers. O*NET is the foremost source for information on different occupations in the U.S., and includes data on the necessary skills, abilities, work activities, and other work characteristics for over 900 occupations. We describe the process of identifying transition careers so that it may be replicated by career agencies, organizations, and workers to address skill obsolescence or job displacement due to the changing nature of work.

We generated and compared three sets of possible transition occupations for both taxi driving and long-distance trucking. The first list of transition jobs we identified via O*NET's skills search function, in which the important skills for a given job may be entered into a search to identify other jobs that share these skills. We generated the second list by searching for jobs that share similar work activities and are in the same industry/career cluster/job family. We created a third unique set of jobs that share skills as well as work/industry based on the occupations identified in both the skills search and shared work/industry search. We statistically compared these three sets of jobs based on the number of knowledge topics, skills, interests and values that they share (or do not share) with their focal driving job. We also compared the different job lists on average income and the average level of preparation that they require.

Our results indicate that in general the set of occupations generated from the skills search have more knowledge, skills, values, and interests shared with the driving jobs than do the set of

shared work/industry jobs, as well as a greater average median income. However, the jobs derived from the skills search also have a greater amount of knowledge topics and skills that are not deemed important for driving jobs. Drivers may therefore need to learn these knowledge and skills in order to successfully transition into these alternative jobs. The list of shared skills and work/industry occupations, identified in both the skills and shared work/industry searches, display the greatest match between shared job factors (and a lesser amount of unique or dissimilar factors) with the driving jobs, and may therefore be the best option for developing a list of likely transition careers for displaced workers. We demonstrate an additional practical application by incorporating our occupation data into a prototype of a decision aid for displaced drivers.

Project Purpose, Background on Data Source, and Overview

Rapid technological development is changing all aspects of work. Machines can perform many tasks more quickly, efficiently, safely, and cheaply than human labor. Although this will result in economic benefits, greater adoption of technology is also forecasted to render lower skilled jobs obsolete (Brynjolfsson, & McAfee, 2014; Ford, 2015; Pierce, Lawhon, & McCreary, 2019). We focus on taxi/rideshare driving and long-distance trucking, which are both expected to be phased out as increasingly more sophisticated technology (specifically, vehicle automation) becomes more widely used.

This reality challenges organizations employing workers whose jobs are at risk of obsolescence, as well as career planning agencies and policy makers, to ready themselves to help workers facing the threat of displacement. Given that their occupations will cease to exist, these individuals will need to transition into a new career. A critical point at which agencies may be

able to help displaced workers, as well as streamline the workforce disruption, is by identifying alternate potential jobs for transitioning these workers.

This project leveraged data and classifications generated by the Occupational Information Network (O*NET) 24.2 Database to compare potential transition occupations for taxi drivers and long-distance truckers based upon their important knowledge areas, skills, values and interests, as well as level of preparation required and income. O*NET is the preeminent repository for descriptive occupational information in the U.S., and has served as a resource for vocational counselors, human resource professionals, and job seekers for years. The database is also supported by the U.S. Department of Labor/Employment and Training Administration (USDOL/ETA). O*NET conducts large-scale job analyses and draws upon job incumbents and trained job analysts to classify the knowledge topics, skills, abilities, work activities, interests, work styles, and work values that are important for a total of 974 occupations. More information about the O*NET Database can be accessed through the following link (https://www.onetcenter.org/overview.html).

By conducting separate skill searches for occupations that share the same knowledge and skills as taxi and truck drivers, as well as searching for occupations that share similar taskwork and are in the same industry, we compiled lists of related occupations for taxi drivers and long-distance truck drivers. These lists of possible transition careers all require similar levels of preparation to the driving jobs (i.e., do not require a bachelor's degree).

To gain a sense of fit between each driving job and these related occupations, we focused on several of the characteristics that O*NET classifies and that are especially relevant to consider for workers looking to switch between jobs. Specifically, we concern ourselves with tracking the occupational interests, work values, job zone, annual income, knowledge, and skills for the

related jobs that we identified. Occupational interests represent preferences for work

environments (e.g., the "realistic" interest applies to jobs suited for those who prefer practical,

hands-on, work). Work values refer to the aspects of work relevant to worker satisfaction (e.g.,

occupations that satisfy the value for "working conditions" are characterized by desirable

conditions such as job security and task variety). The job zone that an occupation falls into

represents the degree of preparation required to enter the occupation. Job zones range from 1-5,

although we evaluated only occupations that belong in job zones 1 (little or no preparation

needed), 2 (some preparation, e.g., high school diploma), and 3 (medium preparation, e.g.,

associate's degree or vocational training). Job zones 4 (considerable training, e.g., bachelor's

degree) and 5 (extensive preparation, e.g., graduate degree) demand greater amounts of

preparation than what drivers may be interested in pursuing. Both driving jobs fall in job zone 2.

We also considered worker requirements that are important for a job. The knowledge category

catalogs general areas of understanding needed to perform an occupation, and skills refer to the

capacities that facilitate work performance.

We extracted all knowledge areas, skills, and other factors (KSAOs) deemed important

for each of the potential transition occupations. We further coded whether each KSAO, for each

transition occupation, was shared with the focal driving job or was instead unique. That is, our

shared coding captured the KSAOs that are deemed important for both a transition job as well as

the focal driving job. By contrast, our unique code logs the KSAOs that are judged to be

important for transition jobs, but not for the driving job that they were identified for. These

"unique" KSAOs may be characteristics that drivers must also hold, or acquire, in order to be

able to perform the alternate job successfully. For every potential transition occupation we thus

compared the knowledge topics, skills, work interests, and work values that drivers have in

common with a different job, as well as what other KSAOs they may need to gain in order to enter into the new occupation successfully.

We present an avenue for identifying potential occupations, as well as the specific KSAOs relevant for considering whether to transition into them, for sectors of the workforce facing the threat of displacement. We demonstrate the value of this project with a preliminary prototype of a career transition decision aid in the form of a decision tree incorporating data on work values, work interests, level of preparation, and salary, in order to help workers at risk of job loss select viable alternative careers. In this way, our work with O*NET data can be of clear use for placement programs and career services for drivers. Although we focused on driving occupations, this paper outlines the steps that we took so that O*NET information can similarly be leveraged to curate and easily compare a set of likely transition careers for workers in any occupation at risk of displacement.

Method

Identifying Transition Occupations

There were three major steps in our process of identifying sets of possible transition careers for drivers. The first step was to develop lists of potential transition careers for taxi drivers and long-distance truckers. We generated sets of possible alternate careers through two approaches. First, we used the "Skills Search" function on O*NET Online. A total of 8 skills are deemed important for fulfilling the job of a long-distance truck driver: operation and control, operation monitoring, time management, critical thinking, monitoring, reading comprehension, speaking, and troubleshooting. Likewise, there are 8 important skills for the job of taxi driver: active listening, operation and control, monitoring, operation monitoring, service orientation, social perceptiveness, speaking, and time management. We searched for occupations that shared

many of these same skills. This resulted in a list of 196 shared skillset (SS) (i.e., with 6 or more

skills in common) jobs for truck drivers and 168 for taxi drivers.
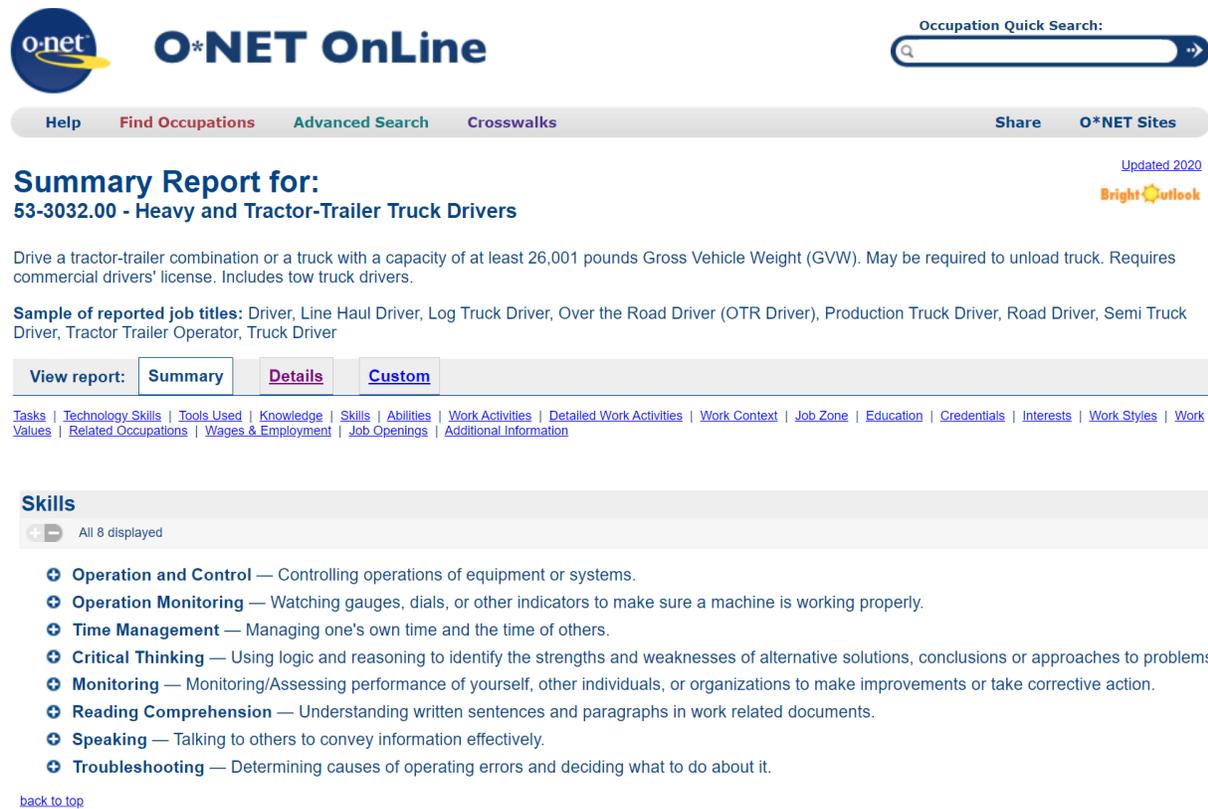
O*NET OnLine

Occupation Quick Search:

Help | Find Occupations | Advanced Search | Crosswalks | Share | O*NET Sites

Summary Report for:

Updated 2020
Bright Outlook

53-3032.00 - Heavy and Tractor-Trailer Truck Drivers

Drive a tractor-trailer combination or a truck with a capacity of at least 26,001 pounds Gross Vehicle Weight (GVW). May be required to unload truck. Requires commercial drivers' license. Includes tow truck drivers.

Sample of reported job titles: Driver, Line Haul Driver, Log Truck Driver, Over the Road Driver (OTR Driver), Production Truck Driver, Road Driver, Semi Truck Driver, Tractor Trailer Operator, Truck Driver

View report: | Summary | Details | Custom

Tasks | Technology Skills | Tools Used | Knowledge | Skills | Abilities | Work Activities | Detailed Work Activities | Work Context | Job Zone | Education | Credentials | Interests | Work Styles | Work Values | Related Occupations | Wages & Employment | Job Openings | Additional Information

Skills

All 8 displayed

- ⊕ **Operation and Control** — Controlling operations of equipment or systems.
- ⊕ **Operation Monitoring** — Watching gauges, dials, or other indicators to make sure a machine is working properly.
- ⊕ **Time Management** — Managing one's own time and the time of others.
- ⊕ **Critical Thinking** — Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
- ⊕ **Monitoring** — Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.
- ⊕ **Reading Comprehension** — Understanding written sentences and paragraphs in work related documents.
- ⊕ **Speaking** — Talking to others to convey information effectively.
- ⊕ **Troubleshooting** — Determining causes of operating errors and deciding what to do about it.

back to top

Next, we also searched for jobs that were similar in nature to the driving jobs, regardless

of their particular skills, with a series of smaller steps for several occupation searches. We first

searched for jobs that had related tasks and related detailed work activities, which yielded 17

jobs for truck drivers and 20 for taxi drivers. To bolster this list of shared work/industry (WI)

jobs we also completed ancillary searches for jobs in the same career cluster (Transportation,

Distribution, & Logistics), industry (Transportation and Warehousing), and job family

(Transportation and Material Moving) as the driving jobs.

In the final step, we pulled shared skills and work/industry (SSWI) jobs (i.e., jobs

identified in both the skills search and shared work/industry search) into their own separate list.

Our final tallies therefore consist of 158 skills search (SS) jobs, 49 shared work/industry (WI)

jobs, and 38 shared skills and work/industry (SSWI) jobs for truckers. For taxi driver jobs, the results indicated 140 SS jobs, 60 WI jobs, and 27 SSWI for taxi drivers. These numbers reflect a unique set of jobs in each list; no jobs occur in more than one of these lists, as the sets of jobs identified in both methods (the SSWI occupations) were separated into their own group. The lists of jobs that we generated purposefully do not include occupations in job zones 4 or 5. The overwhelming majority of identified occupations fall into either job zone 2 or 3.

Developing a list of likely transition careers in this manner is easily reproducible for any occupation on O*NET online. This is done by searching for the focal occupation in the occupation search bar on O*NET's website and noting which skills are listed as important for the job in the skills tab on the summary report page for the job. These skills may then be entered into the skills search function to generate a list of occupations with a matching skillset.

O*NET OnLine

Help   Find Occupations   Advanced Search   Crosswalks   Share   O*NET Sites

Skills Search

Select **skills** from one or more of the six skill groups below. Start by selecting as many skills as you have or plan to acquire. (See Skills Search for more details.)

Basic Skills | Complex Problem Solving Skills | Resource Management Skills | Social Skills | Systems Skills | Technical Skills

Basic Skills

Developed capacities that facilitate learning or the more rapid acquisition of knowledge

☐ **Active Learning** — Understanding the implications of new information for both current and future problem-solving and decision-making.

☐ **Active Listening** — Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

☐ **Critical Thinking** — Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

☐ **Learning Strategies** — Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things.

☐ **Mathematics** — Using mathematics to solve problems.

☐ **Monitoring** — Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.

☐ **Reading Comprehension** — Understanding written sentences and paragraphs in work related documents.

☐ **Science** — Using scientific rules and methods to solve problems.

☐ **Speaking** — Talking to others to convey information effectively.

☐ **Writing** — Communicating effectively in writing as appropriate for the needs of the audience.

Complex Problem Solving Skills

Developed capacities used to solve novel, ill-defined problems in complex, real-world settings

☐ **Complex Problem Solving** — Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

Resource Management Skills

Developed capacities used to allocate resources efficiently

☐ **Management of Financial Resources** — Determining how money will be spent to get the work done, and accounting for these expenditures.

☐ **Management of Material Resources** — Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.

☐ **Management of Personnel Resources** — Motivating, developing, and directing people as they work, identifying the best people for the job.

☐ **Time Management** — Managing one's own time and the time of others.

Social Skills

Developed capacities used to work with people to achieve goals

☐ **Coordination** — Adjusting actions in relation to others' actions.

☐ **Instructing** — Teaching others how to do something.

☐ **Negotiation** — Bringing others together and trying to reconcile differences.

☐ **Persuasion** — Persuading others to change their minds or behavior.

☐ **Service Orientation** — Actively looking for ways to help people.

☐ **Social Perceptiveness** — Being aware of others' reactions and understanding why they react as they do.

Systems Skills

Developed capacities used to understand, monitor, and improve socio-technical systems

The skills search page is located under the Advanced Search tab, as are the Detailed Work Activities and Related Task Search functions. Similar occupations can also be identified

with the Career Cluster, Industry, and Job Family search functions, all of which are located under the Find Occupations tab.

Comparing Sets of Transition Occupations

Our goal was to gain a deeper understanding of the areas of fit (and misfit) between taxi and truck driving and their possible transition jobs. To do so, we set out to systematically compare and contrast the KSAOs held by workers in each driving job to the KSAOs needed for each of their possible alternate occupations. To do this we downloaded O*NET datafiles on KSAOs (knowledge, skills, interests, etc.) from the O*NET Resource Center (accessible from O*NET online via the O*NET Sites tab). These data files include ratings by trained job analysts and/or job incumbents that determine whether a particular KSAO is important for each job.

Because we were only interested in KSAOs deemed important for a job, we calculated standardized scores for each KSAO using O*NET's formula, $S=((O-L)/(H - L))*100$. O represents the raw data value, L represents the lowest scale point, and H represents the highest scale point. For example, if ratings of the importance of knowledge topics were made on a 1-5 scale, L equals 1 and H equals 5. After calculating standardized scores of importance for each KSAO we excised all KSAOs that scored lower than 50 for all jobs (based on O*NET's cutoff for designating importance), rendering data files that included only the important KSAOs for all occupations. This corresponds to the information displayed on the summary report for occupations listed on O*NET online. These standardized KSAO datafiles are available upon request from the research team.

From these data files, we then compared each important KSAO for the job of taxi driver and trucker to the KSAOs judged as important for each of their potential transition jobs. For example, the knowledge areas that are important for taxi driving are transportation, customer and personal service, public safety and security, English language, and law and government. All five of these topics are also important for manufactured building and mobile home installers, an occupation identified through the skills search. However, there are also eight "unique" knowledge domains that are important for this occupation that are not shared with taxi drivers (building and construction, design, engineering and technology, etc.).

O*NET OnLine

Help | Find Occupations | Advanced Search | Crosswalks | Share | O*NET Sites

Updated 2020

Summary Report for:
49-9095.00 - Manufactured Building and Mobile Home Installers

Move or install mobile homes or prefabricated buildings.

Sample of reported job titles: Delivery Crew Worker, Mobile Home Installer, Mobile Home Laborer, Mobile Home Set-Up Person, Modular Set Crew Member, Set Up Technician

View report: Summary | Details | Custom

Tasks | Technology Skills | Tools Used | Knowledge | Skills | Abilities | Work Activities | Detailed Work Activities | Work Context | Job Zone | Education | Credentials | Interests | Work Styles | Work Values | Related Occupations | Wages & Employment | Job Openings | Additional Information

Knowledge

All 12 displayed

- **Building and Construction** — Knowledge of materials, methods, and the tools involved in the construction or repair of houses, buildings, or other structures such as highways and roads.
- **Public Safety and Security** — Knowledge of relevant equipment, policies, procedures, and strategies to promote effective local, state, or national security operations for the protection of people, data, property, and institutions.
- **Customer and Personal Service** — Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
- **Design** — Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.
- **Transportation** — Knowledge of principles and methods for moving people or goods by air, rail, sea, or road, including the relative costs and benefits.
- **Engineering and Technology** — Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- **Mathematics** — Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- **Mechanical** — Knowledge of machines and tools, including their designs, uses, repair, and maintenance.
- **Law and Government** — Knowledge of laws, legal codes, court procedures, precedents, government regulations, executive orders, agency rules, and the democratic political process.
- **English Language** — Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.
- **Education and Training** — Knowledge of principles and methods for curriculum and training design, teaching and instruction for individuals and groups, and the measurement of training effects.
- **Production and Processing** — Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.

back to top

For each occupation in our lists, we noted the number of shared versus unique knowledge areas, skills, interests, and values between taxi and truck drivers and each of their possible transition careers. We likewise noted what specific knowledge topics and skills were shared and unique between them. We also noted other relevant information about our lists of occupations, including median annual salary and job zone. Information on salaries comes from the Occupational Employment Statistics (OES) program, within the U.S. Bureau of Labor Statistics.

Results

The average numbers of shared and unique KSAOs between truck driving and its set of alternate careers are depicted in Table 1; comparison KSAOs for taxi driving are in Table 2. For interpretation, both truck and taxi drivers have 5 important knowledge topics and 8 important skills. The range for the values of shared knowledge and shared skills for each with their transition occupations is thus 0 to 5, and 0 to 8, respectively. The range of shared work interests is 0 to 2, and 0 to 3 for shared work values (as both driving jobs have 2 work interests and 3 work values).

Table 1

KSAO Comparisons Between Alternate Career Occupations and Truck Driving

	Job Zone	Income	Knowledge		Skills		Interests		Values	
			S	U	S	U	S	U	S	U
SS *M*	2.60	$51,835	2.63	4.80	6.85	8.39	1.59	.63	1.99	1.11
SS *SD*	.49	$15,600	1.09	2.93	.75	4.17	.49	.67	.88	1.02
WI *M*	2.09	$40,005	2.98	3.16	3.96	5.24	.82	.27	1.44	.91
WI *SD*	.42	$11,378	1.15	2.77	1.51	4.06	.39	.50	.89	.79
SSWI *M*	2.47	$60,040	3.47	2.71	6.97	7.47	1.61	.60	2.11	1.00

	Job Zone	Income								
SSWI *SD*	.51	$16,791	1.20	2.37	.79	3.03	.50	.10	.80	1.09

Note. SS, WI, and SSWI refer to the sets of skills search, shared work/industry, and shared skills and work/industry job sets, respectively. Income=the average annual median income. S=the shared KSAOs between truck drivers and the set of transition occupations. U=the unique KSAOs between truck drivers and the set of transition occupations (i.e., KSAOs deemed important for the transition occupation, but not for truck driving).

Table 2

KSAO Comparisons Between Alternate Career Occupations and Taxi Driving

	Job Zone	Income	Knowledge		Skills		Interests		Values	
			S	U	S	U	S	U	S	U
SS *M*	2.70	$53,726	2.49	5.51	6.36	10.33	1.15	1.30	2.17	1.69
SS *SD*	.46	$18,576	1.06	2.85	.75	3.18	.45	.70	.85	.99
WI *M*	2.20	$46,455	2.57	3.34	4.62	5.11	.73	.40	1.47	.84
WI *SD*	.49	$17,879	1.25	2.75	1.50	3.64	.45	.56	.84	.83
SSWI *M*	2.41	$53,994	3.44	3.67	6.59	9.37	1.30	.81	2.26	1.19
SSWI *SD*	.50	$14,690	1.42	2.09	.80	2.84	.47	.56	.86	1.11

Note. SS, WI, and SSWI refer to the sets of skills search, shared work/industry, and shared skills and work/industry job sets, respectively. Income=the average annual median income. S=the shared KSAOs between taxi drivers and the set of transition occupations. U=the unique KSAOs between taxi drivers and the set of transition occupations (i.e., KSAOs deemed important for the transition occupation, but not for taxi driving).

Job Zone, Work Interests, and Work Values

We statistically analyzed the amount of shared and unique KSAOs between each set of possible transition careers for taxi drivers and truckers. Figure 1 depicts the average job zone and shared and unique interests and work values for the sets of alternate occupations for truck drivers, and Figure 2 displays these values for the sets of taxi drivers' occupations. First, one-way ANOVA results indicate that for truck drivers, the three sets of occupations significantly differed in their average job zone, $F(2,240)=19.91$, $p<.01$. Specifically, the sets of SS and SSWI occupations have a higher mean job zone than the set of WI jobs ($p<.01$). These jobs, on average, require more preparation than the WI jobs. There were also differences in job zones for the set of taxi drivers' occupations, $F(2,221)=23.41$, $p<.01$. But instead, the SS occupations for taxi drivers have a significantly higher average job zone compared to the WI and SSWI job lists ($ps<.05$), which did not significantly differ from one another ($p=.15$).

Next, there were differences in the sets of occupations when it comes to the amount of shared $F(2,240)=48.65$, $p<.01$, as well as unique $F(2,240)=6.90$, $p<.01$, work interests that they have with truck driving. The sets of SS and SSWI occupations have significantly more interests in common with truck driving than the WI occupations ($ps<.01$). The SS jobs also have significantly more *unique* interests with taxi driving compared to the WI jobs, however ($p<.01$). Again, there were also significant differences in shared, $F(2,221)=21.53$, $p<.01$, and unique, $F(2,219)=38.72$, $p<.01$, interests between the sets of potential transition occupations for taxi drivers. As with the truck driving jobs, the SS and SSWI occupations have a greater match with taxi drivers' interests than the WI occupations ($ps<.01$). In a greater departure, the three sets of jobs all significantly differed from each other in the amount of unique work interests with taxi driving ($ps<.05$). The SS jobs have the greatest amount of different interests, yet the SSWI occupations still have a greater amount of unique interests than do the WI jobs.

We now consider work values. The truck driving occupation lists differed from one another in the amount of values that they shared, on average, with truck driving, $F(2,240)=8.15$, $p<.01$, yet they did not significantly differ in the amount of unique values, $F(2,240)=.81$, $p=.45$. According to a post hoc Tukey HSD analysis, the SS and SSWI occupations share significantly more values in common with truck drivers than do the set of WI jobs ($ps<.01$). Both the degree of shared, $F(2,219)=14.72$, $p<.01$, and unique, $F(2,219)=16.10$, $p<.01$, values differed between the sets of transition careers for taxi drivers. Similarly, SS and SSWI occupations display greater values congruence with taxi driving compared to WI occupations ($ps<.01$). However, SS jobs also have significantly more *unique* values compared to taxi driving than the SSWI and WI job sets ($ps<.05$).
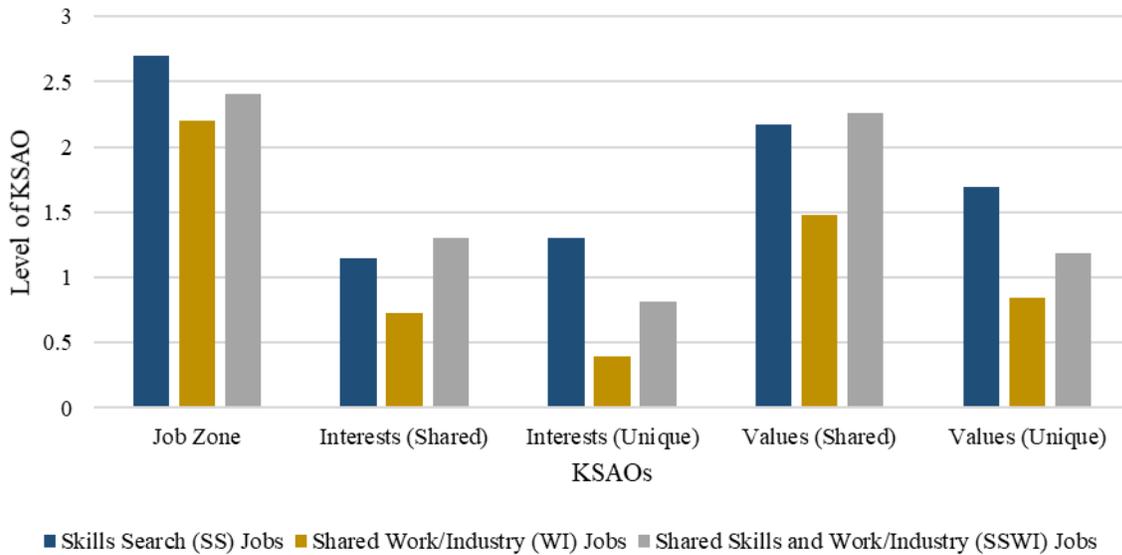
Figure 1

Job Zone, Interests, and Values for Truck Driver Alternate Occupations
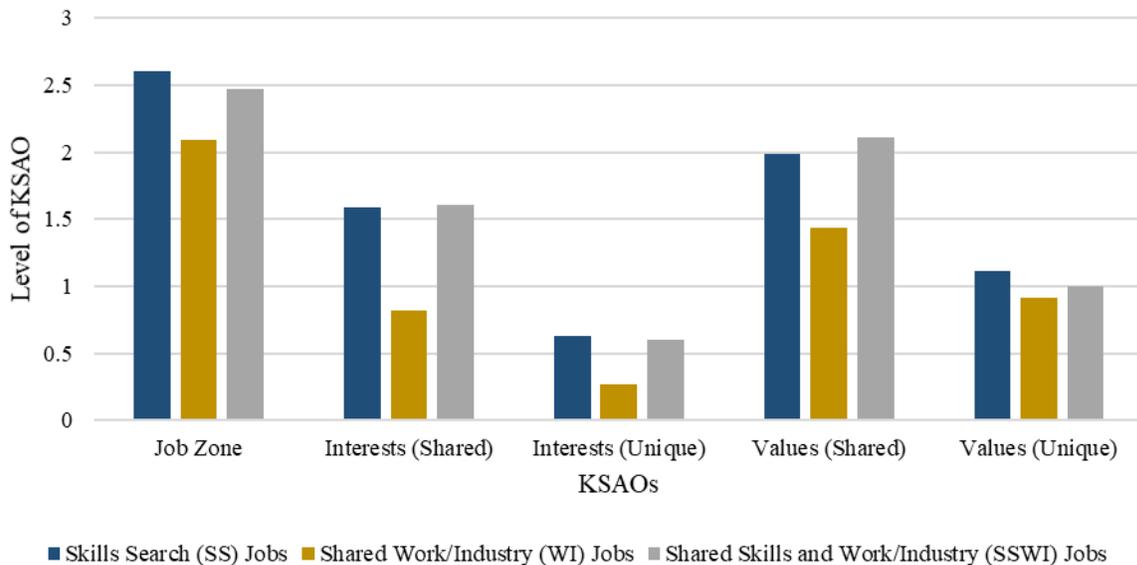
Note. The scale for Job Zone ranges from 0 to 3, the scale for shared interests is 0 to 2, and the scale for shared values is 0 to 3. There is not a preset upper bound for levels of unique KSAOs.

Figure 2

Job Zone, Interests, and Values for Taxi Driver Alternate Occupations

Note. The scale for Job Zone ranges from 0 to 3, the scale for shared interests is 0 to 2, and the scale for shared values is 0 to 3. There is not a preset upper bound for levels of unique KSAOs.

Income

Figure 3 shows the average median annual income for the sets of potential transition careers for truck drivers, and Figure 4 shows annual income for the sets of careers for taxi drivers. There were also differences in the average median annual income for the sets of jobs identified for truck drivers, $F(2,244)=20.13$, $p<.01$. Post hoc Tukey HSD tests found that the average median salary for the set of SSWI jobs was significantly greater than the salary for the other job sets (ps$<.01$), but also that the SS jobs still have a significantly higher income than the WI jobs ($p<.01$). Likewise, there were significant differences in income between the sets of taxi driver jobs, $F(2,225)=3.61$, $p=.03$; the only difference was between the SS and WI incomes ($p<.05$), however. In this instance in particular, it should be noted that the comparatively smaller

sample size for the set of SSWI jobs for taxi drivers does limit the extent to which tests may

detect meaningful differences.

Figure 3

Average Median Income for Truck Driver Alternate Occupations
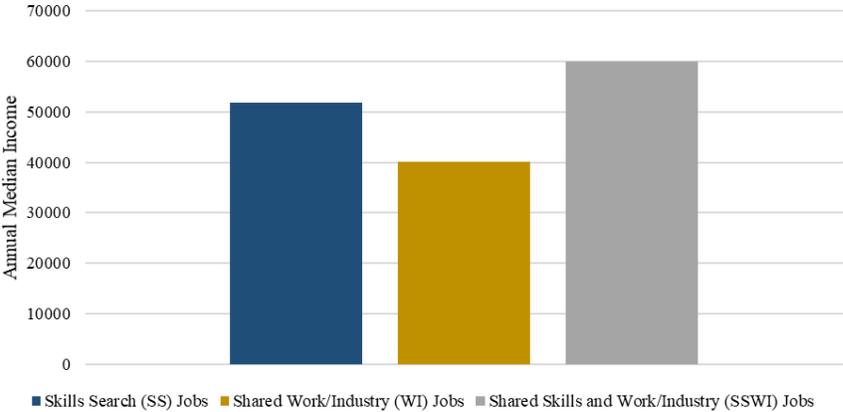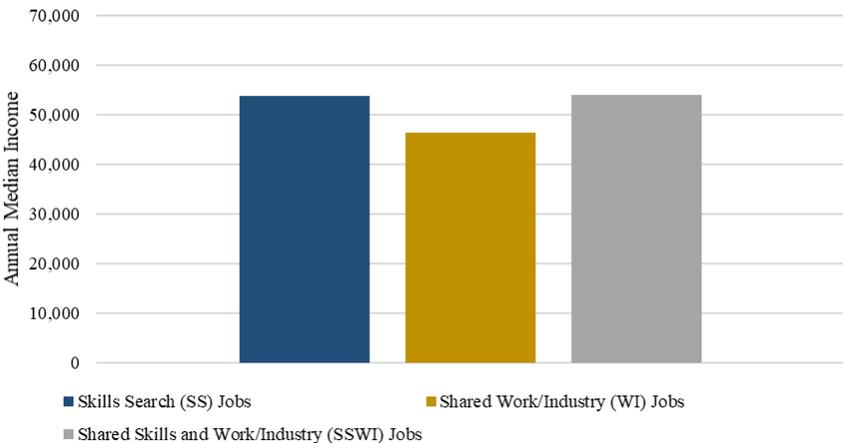

Figure 4

Average Median Income for Taxi Driver Alternate Occupations
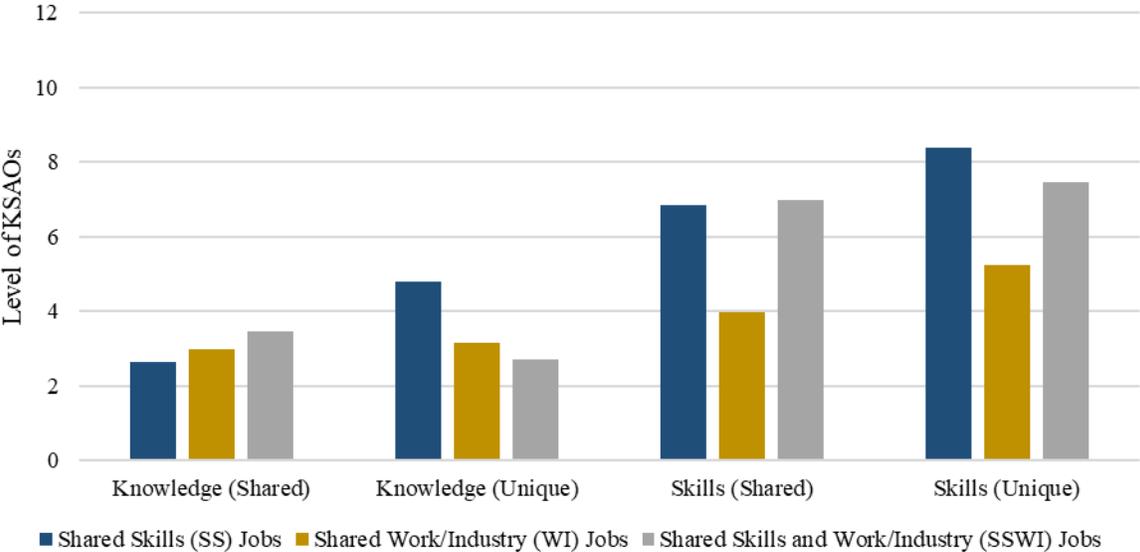

Knowledge and Skills

The amount of shared and differing knowledge areas and skills between each set of

identified alternate careers compared to truck driving are displayed in Figure 5. These KSAO

comparisons for the lists of jobs identified for taxi drivers are in Figure 6. As expected, the truck

driving occupations differed in terms of both shared, $F(2,239)=9.32$, $p<.01$, as well as unique, $F(2,240)=11.98$, $p<.01$, knowledge topics. The set of SSWI jobs have a significantly greater amount of shared knowledge topics with taxi drivers compared to the set of SS occupations ($p<.01$). Alternately, a significantly greater number of knowledge topics, unique from those held by truck drivers, are deemed important for the set of SS jobs versus the other two sets of jobs ($p<.01$). Akin to findings for truck driving, there were also differences in the job sets for taxi drivers both when it came to shared, $F(2,217)=7.84$, $p<.01$, and unique, $F(2,217)=14.48$, $p<.01$, knowledge areas. Although the SS and WI job sets do not differ from one another in the amount of knowledge topics that they have in common with taxi driving ($p=.90$), the SSWI set of jobs display significantly more knowledge areas in common with taxi driving (ps$<.01$). Moreover, the set of SS occupations have a significantly higher number of additional knowledge topics, not shared with taxi driving but deemed important for the job, compared to the WI and SSWI occupation lists (ps$<.01$).

Finally, we considered the similarities and dissimilarities in skills for each of the sets of possible transition careers in relation to their focal driving job. There were significant differences in the amount of shared, $F(2,240)=176.86$, $p<.01$, as well as unique, $F(2,240)=10.94$, $p<.01$, skills between truck drivers' sets of alternate occupations. The WI jobs have fewer skills shared with truck drivers than do the SS and SSWI jobs (ps$<.01$); however, they also have fewer unique skills than either of these job sets (ps$<.05$). For the lists of taxi drivers' alternate jobs, there were also differences in the amount of shared, $F(2,219)=65.61$, $p<.01$, and unique, $F(2,220)=50.14$, $p<.01$, skills with taxi driving. As with the truck driving jobs, WI jobs have a lesser amount of skills in common (ps$<.01$), but also a lesser amount of unique skills (ps$<.01$), different than those held by taxi drivers, compared to the other two job sets.

Figure 5

Knowledge Topics and Skills for Truck Driver Alternate Occupations

Note. The scale for shared knowledge ranges from 0 to 5 and the scale for shared skills ranges from 0 to 8. There is not a preset upper bound for levels of unique KSAOs.

Figure 6

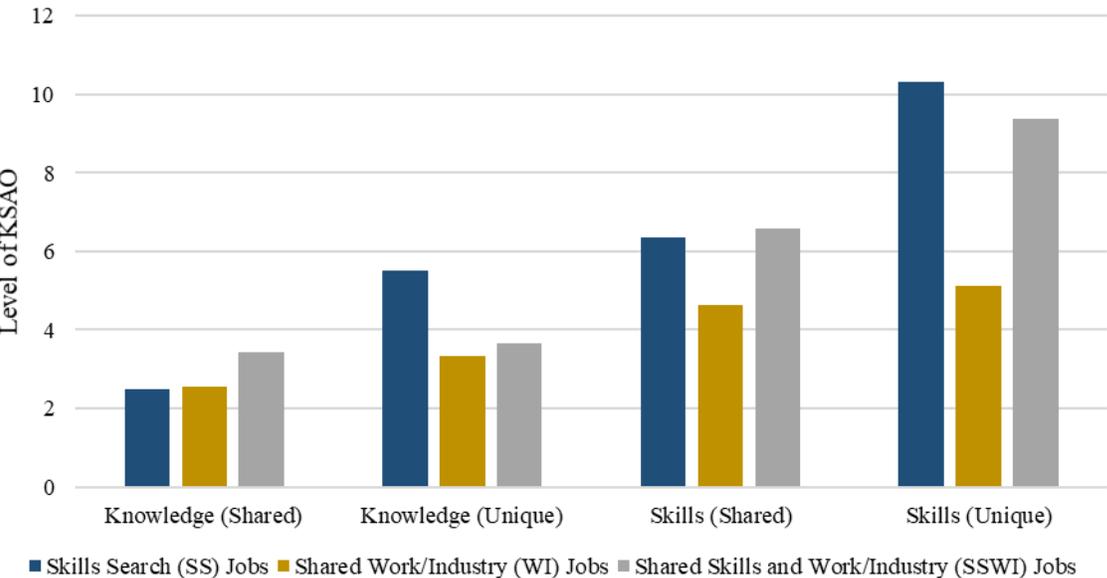*Knowledge Topics and Skills for Taxi Driver Alternate Occupations*

Note. The scale for shared knowledge ranges from 0 to 5 and the scale for shared skills ranges

from 0 to 8. There is not a preset upper bound for levels of unique KSAOs.

We also endeavored to gain a sense of what truck and taxi drivers may need to learn in

order to successfully transition into a new career. To do so, we documented which knowledge

topics and skills were judged to be important for each of their identified potential alternate

careers and that differed from the knowledge topics and skills judged important for the driving

jobs. These "unique" knowledge areas and skills therefore represent what drivers may need to

learn and gain expertise in to successfully adopt the alternate occupation. The top 10 most

common knowledge topics and skills across the set of SS, WI jobs, and SSWI jobs identified for

truck drivers are listed in Table 3. The most common differing knowledge topics and skills

across the sets of alternate jobs for taxi drivers may be found in Table 4.

These frequencies suggest that drivers are likely to need proficiency in knowledge areas

related to technical (e.g., mathematics) as well as interpersonal (e.g., administration and

management) areas. Skill gaps for truck drivers are mainly oriented around cognitive capabilities

and social skills. Although more social skills (specifically, social perceptiveness and service

orientation) are judged as important for taxi drivers than truckers, taxi drivers may still need to

develop competency in working with others (such as with the coordination skill), as well as other

cognitively-oriented skills. Pointedly, the overwhelming majority of the potential transition

careers for taxi drivers have critical thinking listed as important for the work—in order to move

into a new career with ease, it may be imperative that taxi drivers either develop, or maintain,

their critical thinking abilities.

Table 3

Most Common Important Knowledge Topics and Skills for Truck Driver Transition Jobs

Knowledge Topic	# of Jobs	Skill	# of Jobs
Mathematics	159 (66%)	Active Listening	195 (81%)
Computers and Electronics	105 (44%)	Judgment and Decision Making	158 (66%)
Education and Training	96 (40%)	Complex Problem Solving	148 (62%)
Engineering and Technology	82 (34%)	Coordination	134 (56%)
Administration and Management	81 (34%)	Quality Control Analysis	126 (53%)
Building and Construction	45 (19%)	Active Learning	115 (48%)
Physics	39 (16%)	Writing	96 (40%)
Clerical	37 (15%)	Social Perceptiveness	83 (35%)
Law and Government	34 (14%)	Equipment Maintenance	77 (32%)
Psychology	24 (10%)	Service Orientation	69 (29%)

Note. Knowledge topics and skills displayed are those deemed as important across all identified alternate occupations but are not listed as important for truck driving. Number of jobs=the number of jobs (SS, WI, and SSWI, combined) for which the knowledge topic/skill is listed as important.

Table 4

Most Common Important Knowledge Topics and Skills for Taxi Driver Transition Jobs

Knowledge Topic	# of Jobs	Skill	# of Jobs
Administration and Management	105 (48%)	Critical Thinking	212 (96%)
Computers and Electronics	102 (47%)	Judgment and Decision Making	183 (83%)

Mathematics	100 (46%)	Reading Comprehension	181 (82%)
Education and Training	98 (45%)	Complex Problem Solving	171 (78%)
Mechanical	97 (45%)	Coordination	168 (76%)
Clerical	77 (35%)	Active Learning	162 (74%)
Production and Processing	59 (27%)	Writing	134 (61%)
Engineering and Technology	44 (20%)	Installation	113 (51%)
Psychology	42 (19%)	Instructing	88 (40%)
Personnel and Human Resources	34 (11%)	Persuasion	79 (36%)

Note. Knowledge topics and skills displayed are those deemed as important across all identified alternate occupations but are not listed as important for taxi driving. Number of jobs=the number of jobs (SS, WI, and SSWI, combined) for which the knowledge topic/skill is listed as important.

Discussion

The future of vehicle automation presents a host of opportunities, such as enhanced mobility for vulnerable populations and increased efficiency and safety. However, it is also poised to result in a dramatic reduction in driving jobs, including taxi driving and long-distance trucking, as new technology is adopted and becomes standard across driving industries. It is therefore necessary that career planning agencies, organizations, and workers themselves are able to identify the optimal occupations that displaced workers may easily and satisfactorily adopt in order to minimize workforce disruption. With this goal in mind, we drew from the O*NET 24.2 Database to generate lists of possible transition occupations for both taxi and truck drivers through different search options. We compared the sets of occupations that we identified

based on their match with the KSAOs held by the driving jobs, and these comparisons revealed

pertinent information that may help streamline the career transition process for displaced drivers.

The findings point to a two-pronged approach, using both O*NET's skills search option

as well as searching for jobs that share tasks and are in the same industry, to identify likely

alternate careers for workers facing the threat of displacement. We conducted separate searches

for transition careers via O*NET's skills search option and based on shared work and industries,

and the set of jobs that displayed the greatest congruence in KSAOs for both driving jobs was the

unique set of jobs that arose in *both* the skills search and shared work/industry search. Although

the set of skills search occupations generally had greater alignment with drivers' skills, interests,

and values compared to shared work/industry occupations, they also had a higher job zone and

greater number of unique knowledge topics and skills. Displaced drivers who would rather not

undergo greater education and training may therefore prefer to search for a new job from the set

of occupations identified based on similarities in work/industry, as opposed to shared skills. Yet

unfortunately, although shared work/industry jobs may not necessitate the same degree of

learning, drivers will not be leveraging their existing skillsets to the same extent for these

occupations. In addition, the shared work/industry jobs also had the lowest average median

annual income out of the three identified job sets for both taxi and truck drivers.

A noteworthy insight is thus that alternate career searches may be differentially suited to

workers with different priorities. Those who prefer to utilize and build from their existing

skillset, find a match with their work interests and values, and who emphasize the importance of

earnings may be served best by considering a set of careers derived from O*NET's skills search

option. Alternately, older workers and those who prefer to minimize the degree of additional

education and training required for reemployment may be better served by searching for

occupations through shared work and industry options on O*NET. This is an especially relevant distinction to consider for drivers threatened by displacement from autonomous vehicles; workers in certain driving occupations, such as rideshare drivers, who are younger in age (Hall & Krueger, 2018; Short, 2014), may be more willing to undergo greater training compared to more established taxi drivers and long-distance truckers.

However, as noted, the list of careers that displayed the best fit with taxi and truck driving were those identified in both the skills search and the shared work/industry search. This set of shared skills and work/industry occupations generally had a greater match in knowledge, skills, values, and interests compared to the set of just shared work/industry jobs, as well as a higher salary. However, they also tended to have fewer additional, or unique, skills and knowledge topics as compared to the set of just shared skills jobs, identified via skills search. Accordingly, performing a thorough search for potential transition occupations through O*NET's skills search function, as well as combing through lists of occupations that shared work activities and are in the same industry, can yield large lists of careers for displaced workers to consider. Career agencies and workers should focus on the occupations identified through both search options for a greater likelihood of maximizing the match between workers' existing expertise and interests and minimizing the training that they will need to make a career transition.

We have presented a replicable process for utilizing O*NET's database of job information to generate potential transition careers for workers threatened by displacement. The insights from our work can be of use to career planning organizations, organizations who desire to minimize disruption in their workforces, and drivers themselves. However, we must note reservations with our project. First, we consider only two occupations (taxi driving and long-

distance trucking). Although O*NET's resources and information should be equally useful for developing alternate careers for other jobs, there may be some obstacles or limitations in doing so that we did not encounter in our limited foray.

Second, we did not evaluate the likelihood that the alternate careers that we identified may face obsolescence due to technology as well. Given their comparatively lower levels of knowledge and skills, this may more so be the case for occupations identified in the shared work/industry search. A final consideration is that the occupational data that O*NET provides are fairly broad. Displaced workers looking to gain a sense of what exactly they may need to learn in order to make a career transition will need to seek additional resources (i.e., by examining the requirements listed in ads for specific jobs of interest) for a more concrete understanding.

Future Direction: Decision Aids for Displaced Workers

Comparing the convergence and divergence in the KSAOs of jobs held by workers at threat of displacement to the KSAOs held by those in prime transition careers can be useful for forecasting obstacles and opportunities for reentry. A possible future step building from this project may be to use comparison data to aid displaced workers in the process of selecting an optimal reentry position. From the O*NET data we created a prototype decision tree incorporating data on work values, work interests, education requirements, and salaries in order to help workers at risk of job loss select viable alternative careers. The decision tree prototype may be found in Figure 7. Viewers may select the factor that is most important to them in choosing a transition career, out of values fit, interests fit, level of education/training required, and salary. They may then identify their unique set of work interests or values. All of these options can then lead to a list of occupations that match their main priority.

A decision aid may also be incorporated into a quiz for displaced workers to use interactively. We tested this by formatting career decisions as multiple-choice questions in the free survey site Qualtrics, adapting the career decision aid to be interactive for users and tailored to displaced workers in driving professions. We used Qualtrics' decision logic to display the next decision in a sequence based on the user's previous choice, reflecting the separate branches of the decision tree. In this way, our work with O*NET data can be of clear use for placement programs and career services for drivers. The same static and survey-based decision trees may be used to help workers in any occupation, with the only necessary change being to replace the lists of suitable careers presented.

Figure 7

Prototype of Transition Career Decision Aid with O*NET Data
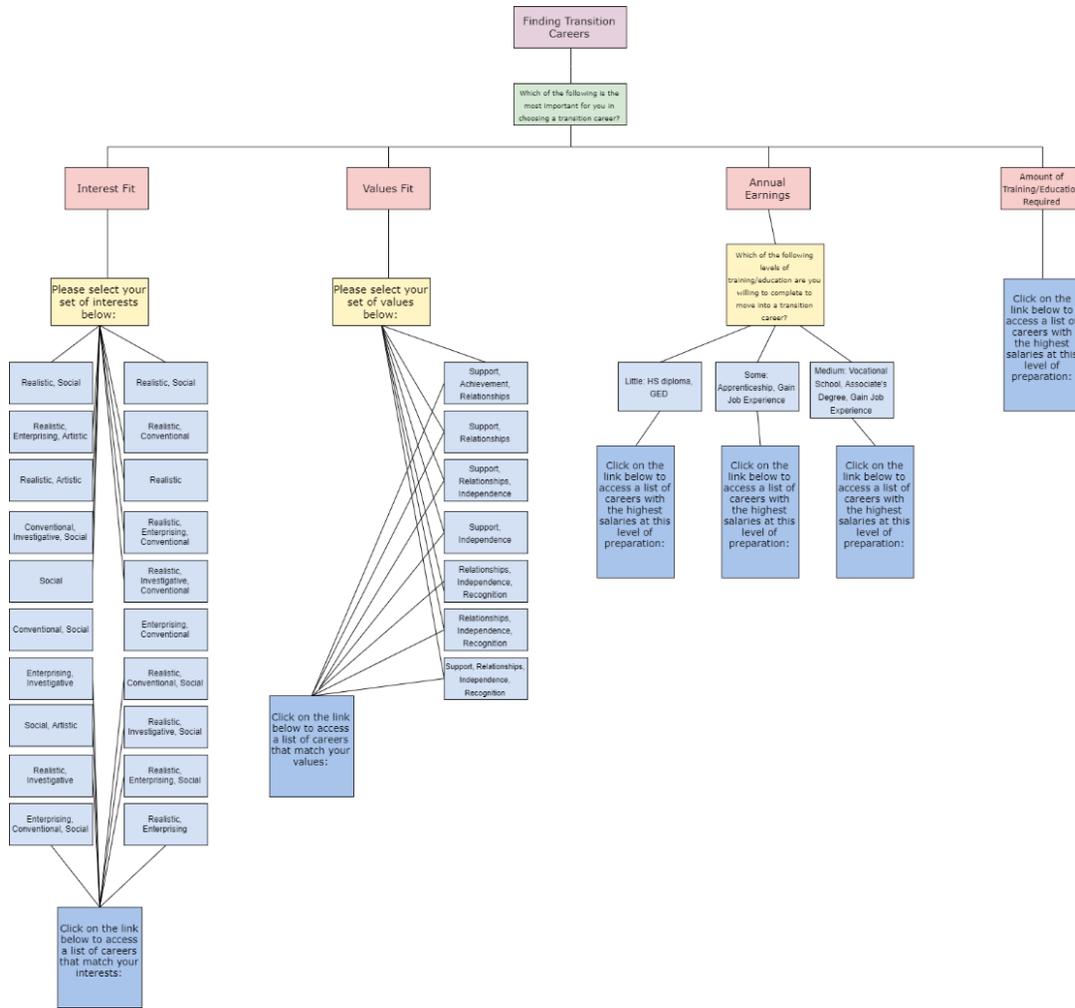
References

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and*

    prosperity in a time of brilliant technologies. New York: WW Norton & Company.

Ford, M. (2015). *The rise of the robots: Technology and the threat of mass unemployment*.

    New York: Basic Books.

Hall, J. V., & Krueger, A. B. (2018). An analysis of the labor market for Uber's driver-partners

    in the United States. *ILR Review*, *71*(3), 705-732.

Pierce, J., Lawhon, M., & McCreary, T. (2019). From precarious work to obsolete labour? Implications of technological disemployment for geographical scholarship. *Geografiska Annaler: Series B, Human Geography*, *101*(2), 84-101.

Short, J. (2014). Analysis of truck driver age demographics across two decades. https://trid.trb.org/view/1334389. Accessed June 3, 2020.