

Workforce development in the trucking industry: A comprehensive analysis of truck driver training entities

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ABSTRACT

The transformation of transportation technologies, economic structures, and social lifestyles is changing the truck-driving workforce. Recognizing the trends and challenges of the job is essential for proactive planning to address potential disruptions in the trucking industry and the broader economy. Despite the importance of truck drivers, the research community has little information about the entities involved in training truck drivers. These entities are critical in creating a pipeline of drivers to address the driver shortage issue and respond to the changing requirements of drivers. To address this knowledge gap, we utilize institutional theory as a framework to disentangle the factors that affect entities' considerations behind the design and delivery of driver training programs. Using explanatory sequential mixed methods, we collect and analyze multiple sources of data about driver training, including information about the entities providing training, as well as information about funding and federal regulations. In-depth interviews with these entities provide additional insights into the process of training drivers and how it varies between different types of training entities. Analytical results indicate that regulatory changes have impacted the number and types of entities providing driver training. A qualitative analysis of the interviews reveals different business models for training drivers, as well as the advantages and disadvantages of these models in terms of cost to the trainee, time to completion, and coordination costs. Finally, we discuss the implications of our findings for policymaking, including workforce development, transportation safety, and preparation for technological change.

Introduction

In the U.S., 72 % of all freight is transported by trucks [1]. Over two million people worked as heavy truck drivers in 2023 [2]. The truck-driving workforce is experiencing significant transformations [3]. While demand for truck drivers has increased due to global economic growth and the rise of e-commerce [4,5], the profession faces numerous challenges. Emerging technologies like automation and driving

assistants are altering skill requirements for drivers [6]. Although the industry expects the adoption of automated driving technologies in trucking to mitigate the driver shortage in the long run, the demand for drivers will not decrease in the foreseeable future, and technological changes may lower the retention rate of older truckers [7]. Additionally, rising costs of fuel, trucks, and maintenance—due to increasing diesel and auto parts prices—along with reduced miles, have undermined the revenue and net income of owner-operators, who have had to cover all

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costs themselves since the COVID-19 pandemic [8]. More critically, the industry is experiencing a severe driver shortage, with a shortfall of 80,000 drivers in 2021 projected to rise to 160,000 by 2030 [9].

One essential aspect of the truck driving workforce is driver training. Issues in driver training range from insufficient training programs that produce graduates in less time [10] to potential workforce disruptions related to the adoption of new technologies [11,12]. Unfortunately, the research community lacks a comprehensive understanding of current trends, formats, and influencing factors in truck driver training. This gap in knowledge hinders policymakers and planners from making informed decisions about workforce development, transportation safety, and technological adaptation in the trucking industry and related economic sectors.

Understanding truck driver training requires investigating the diverse entities providing these programs. Despite their importance, there is limited information on how these entities deliver training and the considerations behind program design. Analyzing the broader sociopolitical context and the challenges and opportunities these entities face can help create a supportive environment and policies for better driver training. This is important not only to generate more drivers but also to increase retention rates and enhance the worker's well-being for the occupation. The objectives of this paper are to fill knowledge gaps in understanding the evolution and business models of truck driver training entities, the factors shaping trends among these entities, and the considerations behind the design and delivery of their training programs. The study aims to answer three research questions: (1) What is the overall trend of truck driver training in the U.S.? (2) What models of truck driver training programs are offered by various entities? (3) What factors influence the design and delivery of truck driver training? To answer these questions, we conducted an explanatory sequential mixed-method study to analyze both the quantitative and qualitative data about truck driver training entities.

The trucking industry is highly institutionalized by government regulations, industry standards, unions and associations, and various societal factors [13], truck driver training is likely to be affected by institutional rules, norms, and changes. We use institutional theory, which has been widely applied to examine the impact of institutional rules and norms on organizational practices [14], as a framework to understand the factors influencing entities' decisions in the design and delivery of truck driver training programs. Multiple data sources were collected and analyzed, including information about training entities, funding, and federal regulations. In-depth interviews with seven public or private training entities were conducted and qualitatively analyzed. Additional data provided insights into the training process and variations among different types of training entities.

The contributions of this study are threefold. First, the study revealed trends in the number of training entities across regions and periods. Second, interviews indicated four training models: trucking school model, college course model, outsourcing model, and transition model. Third, we discussed the factors and forces that have shaped truck driver training offered by different entities.

Working context of truck drivers and issues of workforce development

Here, we first present historical data about the employment and wages of truck drivers and then summarize the relevant literature. We review the information from the Bureau of Labor Statistics (BLS) Occupational Employment and Wage Statistics (OEWS) program and from the Current Population Survey (CPS) of the U.S. Census Bureau. Fig. 1 illustrates that the total employment of heavy and tractor-trailer truck drivers increased from 1.55 million in 2001 to 1.86 million in 2019. Truck drivers represent about 1.2 % of all U.S. employment, with some fluctuations over time. Overall, the growing employment of truck drivers indicates that the demand for entry-level driver training has increased over the years.

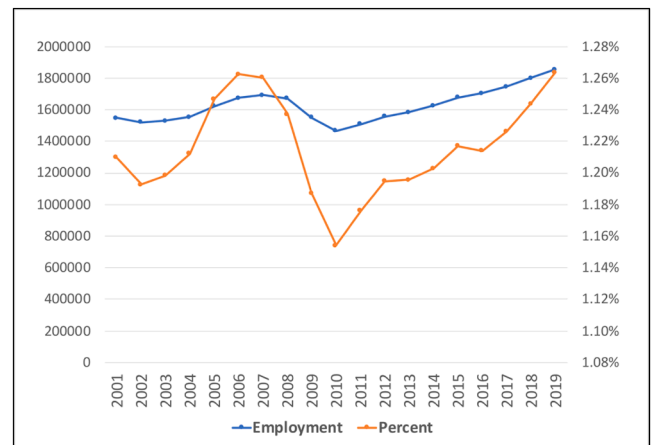


Fig. 1. The Employment of Truck Drivers and Its Percentage of Total U.S. Employment.

Source: Occupational Employment and Wage Statistics (OEWS), U.S. Bureau of Labor Statistics (BLS)

Although the demands for truck drivers continued to grow, the same cannot be said for wages. Fig. 2 displays the boxplot of truck drivers' annual wage income between 2001 and 2019. Wages decreased from a high of \$50,872 in 2001 to \$49,193 in 2019. Wages declined from their peak in 2001 until the beginning of the Great Recession, where wages reached another peak in 2009. After 2009, wages declined again until 2012, when they flattened out until 2015, when they began to rise again. That said, wages in 2019 are lower than their high in 2001.

Fig. 3 presents the trends of truck drivers' wage from 2001 to 2019 by four census regions (i.e., South, West, Northeast, and Midwest). The Northeast has the highest wage, and the South has the lowest wages. All four regions display similar trends over time, which is a steady decline over 19 years. Of the four regions, the Midwest had the largest percent reduction in wages (-6 %). A potential reason for this trend may be differences in economic vitality between U.S. regions; compared to the rest of the country, the Midwest has the slowest wage growth [15]. This may exacerbate the driver shortage in this region.

Summary of relevant work

Although there is a lack of studies on truck training providers and programs, the literature has recorded several critical issues in truck-driving workforce development. Particularly, scholars have

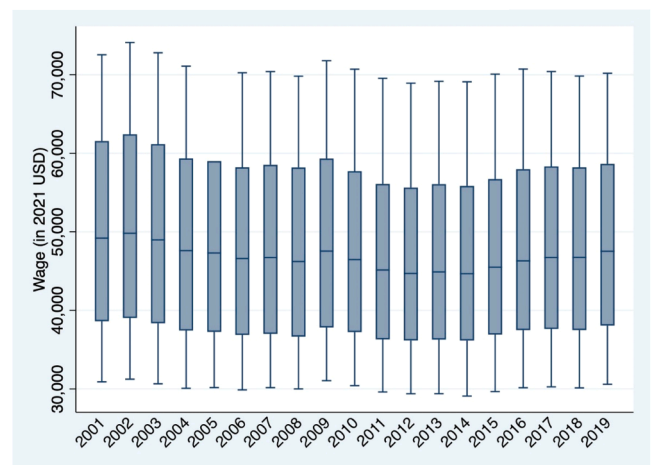


Fig. 2. Boxplot of Wage of Truck Drivers between 2001 and 2019. Source: Current Population Survey (CPS), IPUMS CPS database

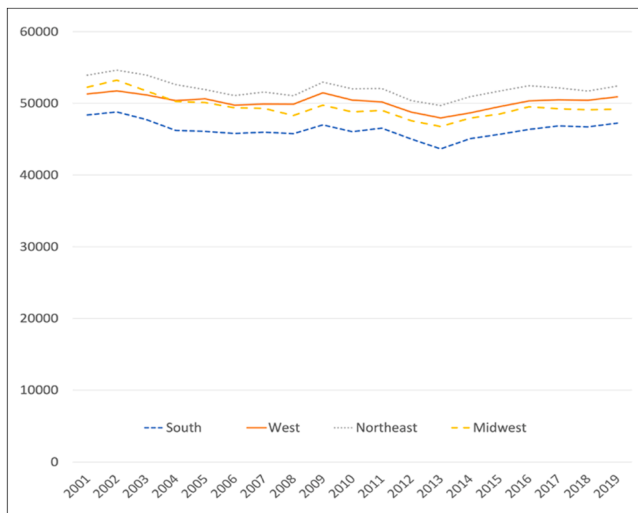


Fig. 3. Trend of Annual Mean Wage of Truck Drivers between 2001 and 2019 by Census Region.

Source: Occupational Employment and Wage Statistics (OEWS), Bureau of Labor Statistics (BLS)

investigated the reasons for the shortage [16–18], factors associated with the increasing average age and low retention rate [19,20], safety, health, and well-being of drivers [21,22], training and retraining [23, 24], and the impact of new technologies [7,25]. These issues are often interrelated. For example, the increasingly aging workforce is one of the reasons for the driver shortage, as fewer younger workers enter the industry when older drivers retire [16]. Older drivers have difficulty learning and using new driving assistance or safety technologies [19]. Those who did not receive formal training early in their careers are more likely to experience accidents [23]. Skill requirements for the new generation of truck drivers have been reshaped by the contemporary logistics industry, which demands more sophisticated skills in technology use, navigation, communication, and customer service [5].

Despite these prior explorations and discussions, researchers have ignored a critical aspect of the truck driver workforce – entities providing truck-driving training. Evidence from other industries (e.g., healthcare) indicates that professional training entities and programs play an essential role in promoting workforce sustainability [26,27]. The unbalanced geographic distribution of training entities determines the disparities in the workforce [28]. All issues noted above in the truck-driving workforce, from driver shortages to technological change, are highly related to how entities design and provide training programs. Given the importance of truck drivers in the economy, we dedicate this paper to a comprehensive understanding of the formats of truck driver training entities and their considerations behind the design and delivery of training programs.

The institutional theory

We used institutional theory as a conceptual framework to analyze the evolution and formats of truck-driving training provided by entities. This framework is a valuable lens for analyzing driver training because of the range of institutions that influence the trucking industry, including government regulations, industry standards, unions and associations, and societal factors [13]. Institutional theory emphasizes the impacts of institutions and the process of institutionalization on organizations' decision-making and changes [14]. A central concept of institutional theory is "isomorphism," which refers to the tendency of organizations within a field to evolve toward similar features (i.e., homogenization) [29]. There are three types of isomorphism: coercive (organizations adapt to external pressures, such as laws or regulations),

mimetic (organizations imitate successful models or competitors), and normative (organizations are affected by professional norms and standards through educational systems and professional networks). A common isomorphism process in a highly institutionalized field comprises phases of emergence, diffusion, and adaptation [30]. Emergence involves introducing new practices, diffusion refers to how these practices spread across entities, and adaptation occurs when entities modify and integrate these practices into their organizational routines [31]. Institutional theory often interrelates with several other social science theories, such as structuration theory (which explores the relationship between structure and agency), resource dependence theory (which emphasizes organizations' acquisition of critical resources), organizational ecology (which examines environmental factors such as competition and selection), and social network theory (which focuses on relationships and networks between organizations).

Institutional theory has been adopted in previous studies to understand social and governmental forces that influence professional education and workforce development [32,33]. In this study, the institutional theory is effective in disentangling coercive, normative, and mimetic isomorphism [34] to explain the mechanisms behind the development of training programs offered by entities. This framework enabled us to understand internal and external pressures affecting the design, delivery, structure, and process of professional training [33]. For truck driver training entities, the coercive effect comes from government authorities and regulations (e.g., training provider registration, drug test); the normative effect comes from society and the economic environment (e.g., technological change, pandemic); and the mimetic effect comes from their peer entities in both the public and private sectors.

Methodology and data

We used explanatory sequential mixed methods to integrate quantitative and qualitative analyses of multiple datasets. The explanatory sequential design [35] allows us to conduct a quantitative analysis to understand the overall trend and common types of truck driver training, then implement a generic qualitative approach to further investigate different training models offered by different entities.

First, we analyzed two national datasets to provide a comprehensive examination of the formats, structures, and characteristics of truck training entities. Next, we reviewed the timeline of federal regulations relevant to truck driver training to understand the coercive pressure. Finally, we conducted a generic qualitative analysis of semi-structured interviews with seven training entities to gain in-depth knowledge of factors associated with the design and delivery of training programs.

The first phase was the quantitative analysis of the Integrated Post-secondary Education Data System (IPEDS) and Training Provider Registry (TPR) data. IPEDS collects data on an annual basis for every college, university, and technical and vocational institution that participates in federal student financial aid programs [36]. For each institution, the database lists all programs offered and provides institutional information about enrollment, graduation rates, faculty and staff, finances, institutional costs, and student financial aid; it also includes program-level information, such as the number of completions [36]. However, the program-level information is relatively coarse because IPEDS does not contain detailed program-level information about enrollments, tuition and financial aid. Thus, much of the detailed data are available only at the institutional level. From IPEDS, we obtained a list of 412 entities that offer Truck and Bus Driver/Commercial Vehicle Operator training. For this paper, information about the location of the institution, institution type (e.g., public, private, for-profit, non-profit), and program duration was also extracted from IPEDS.

We paired information from the IPEDS database with the TPR data which offer the information about all training providers and locations registered with the Federal Motor Carrier Safety Administration (FMCSA) that offer entry-level driver training. This database provides information about the location and type of training offered by the

provider, broken down into theory and behind-the-wheel training categories [37]. The database also indicates if the training is provided in-person or online and if the provider permits private-only enrollment or not.

The second phase involved a review of federal policies relevant to truck driver training. We collected data archived on the U.S. Federal Register website (federalregister.gov), which records historical policy documents, including rules, proposals, and public notices from federal agencies. We used “truck driver training” and “commercial driver training” as the keywords, and “Federal Motor Carrier Safety Administration” and “Federal Highway Administration (FHWA)” as agency filters for the rule document search. The initial search identified 92 documents, which we then screened to extract information on the evolution of policies related to truck driver training.

In the third phase, we applied a generic qualitative approach to analyze semi-structured interviews of training entities, further exploring the factors influencing the training programs and entities. Generic qualitative research often uses inductive approaches, open codes, categories, and thematic analysis [38]. It allows flexible blending of theoretical frameworks and tools to answer specific research questions in an underexplored field [38].

Semi-structured interviews were conducted with administrative staff who were in charge of workforce development or program development (e.g., program director) at various driver training entities. The goal of these interviews was to provide additional resolution about the variety of entities providing training, including information about program development, as well as the advantages and disadvantages of programs. Information about students, enrollment numbers, and program outcomes (e.g., graduation and placement information) was also gathered.

To recruit participants, we sent emails to the contacts of driver training entities recorded in IPEDS and FMCSA data. In total, 179 community colleges and 23 truck driving schools nationwide were contacted. Eventually, we recruited seven entities: four community colleges and three truck driving schools. Interviews were conducted between January and April 2023. The institutional review board approval was obtained before the interviews. Each interview took about 1 hour to 1.5 hours. Informed consent was obtained from each participant. Two research team members facilitated each interview—one to moderate and the other to take notes. Interview recordings were transcribed using the transcription tool *Fireflies.ai* and then verified by the researchers. The transcriptions were manually coded by the researchers.

Results

Trends and geographic distribution of truck driver training entities

Fig. 4 maps the number of Title IV (i.e., postsecondary education entities eligible for federal funds) entities per 1 million people that provide driver training in 2020–2021. North Dakota (3.87), Delaware (2.99), New Mexico (2.84), Montana (2.72), Mississippi (2.71), Utah (2.70), Kentucky (2.44), and Arkansas (2.31) are the states with the most training entities. Idaho, Nevada, Wyoming, Colorado, Indiana, and New Jersey have the fewest training entities.

Fig. 5 displays information about the number of entities providing Commercial Driver’s License (CDL) training. From the academic years 2000–2001 to 2020–2021, there was a 48 % increase in the number of entities providing training. Within this time period, there are three noticeable periods of growth in the number of entities. The first peak is evident in the academic year 2006–2007, with a 7.5 % increase in the number of entities compared to the previous year. The second growth period began in 2011–2012 and reached a new peak in 2016–2017 with around a 38 % increase in the number of entities compared to 2011–2012. The third growth period began in 2020–2021. The changes in the number of entities offering driver training may largely be attributed to the changes in CDL requirements and regulations, which will be discussed later.

Fig. 6 illustrates the increase in private-for-profit entities providing CDL training. From 2000 to 2001, only 9.6 % of entities providing CDL training were private-for-profit. Between 2004 and 2005, the number of private, for-profit entities increased by about four percent to 13.5 %. There was also a noticeable increase in these entities again between 2011 and 2015. Interestingly, these trends coincide with research reports about the truck driver shortage, which has been an ongoing problem for the industry [16]. This report notes that the first documented driver shortfall was noted in 2005. The shortage diminished in the years that coincided with the Great Recession but returned anew in 2011. The latest IPEDS data indicate that in the 2020–2021 academic year, 19.4 % of entities providing CDL training were private and for-profit. Another trend in training entities is the length of programs offered; most programs provide short-term training. Over ninety percent of the training offered across all entity types lasted less than one year.

Formats of training entities

In addition to information about entities providing truck driver training, data were also obtained from the Federal Motor Carrier Safety Administration (FMCSA) registry, which contains information about the characteristics and location of certified training providers. As of March 2023, there were 32,152 training locations registered at the FMCSA, offering training for various CDL categories, including Class-A (i.e., license to operate a vehicle > 26,001 lbs. and > 10,000 lbs. of cargo) and Class-B (i.e., license to operate a vehicle > 26,001 lbs. and < 10,000 lbs. of cargo, Passenger, School Bus, and Hazardous Materials (Schneider Jobs, n.d.). After collapsing duplicates in the database for entities that provide training at multiple locations and removing providers in overseas military bases or US minor islands, there were 15,370 unique registered training providers. 7494 (~49 %) of these providers offer CDL-Class A training (either theory only or behind-the-wheel training). 2180 of the Class A training providers are open to public enrollment, which means any individual interested in training can enroll.

Fig. 7 displays the number of public-opening Class A training providers per 1 million people in each state. A few states in the northern and southern parts of the United States stand out as having the most Class A public training providers. In the northern portion of the country, North Dakota has the most training entities (27.10), followed by Montana (19.02), South Dakota (18.99), Utah (15.28), and Wyoming (12.09). In the southern portion of the country, Mississippi (15.93) and Alabama (13.89) also have several training entities. Several Midwestern and Northeastern states have few training entities. Examples of these states include Ohio (2.8) and New York (3.13). Rhode Island, which is the smallest state in terms of land area, has the fewest Class A providers (0.91) and is the only state with fewer than one provider per 1 million people.

Table 1 breaks down the types of registered providers from the FMCSA database in terms of public or private enrollment. More than 70 % of these are only open to private enrollment, which is employer-sponsored training (e.g., tuition waiver), where enrollment is restricted to students sponsored by the employer.

Table 2 summarizes the types of training offered by FMCSA-registered providers. More than 78 % of the providers offer both theory and behind-the-wheel training. About 8 % provide theory-only courses, and about 14.2 % provide behind-the-wheel training. We explored 538 providers that offer theory-only training. The majority (62 %) of theory-only programs are offered online. The rest of the theory-only providers include many state and local government agencies (e.g., New Hampshire Department of Transportation, City of Grand Prairie), public school districts, and community colleges.

Regulations governing driver training

A common theme of conversations with training entities indicated that there are coercive forces at work on the industry; federal changes to

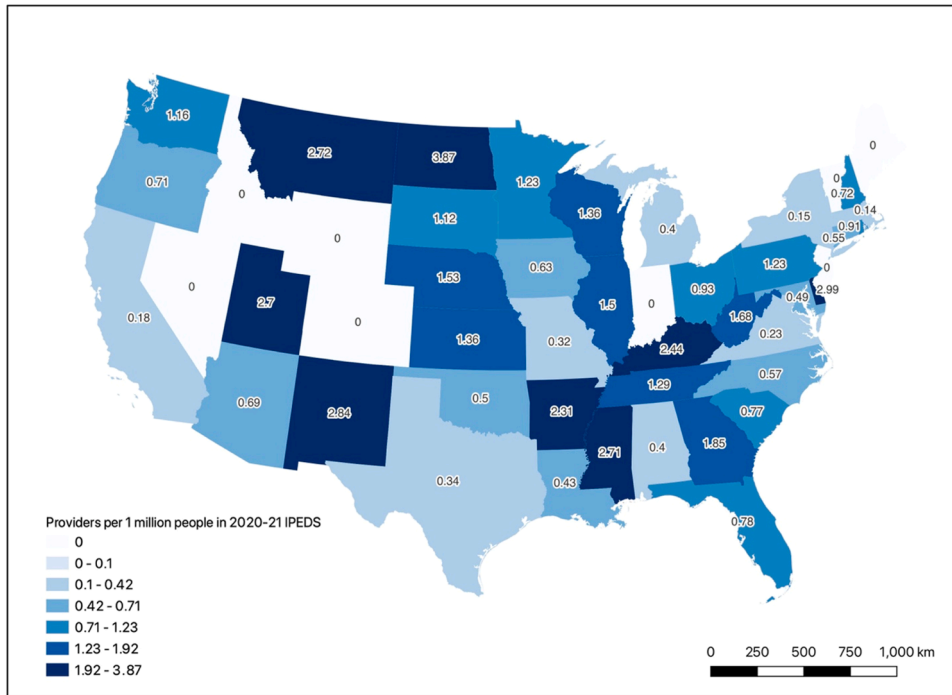


Fig. 4. Number of Title IV Entities per 1 Million People Providing Driver Training in 2020/21. Source: Integrated Postsecondary Database

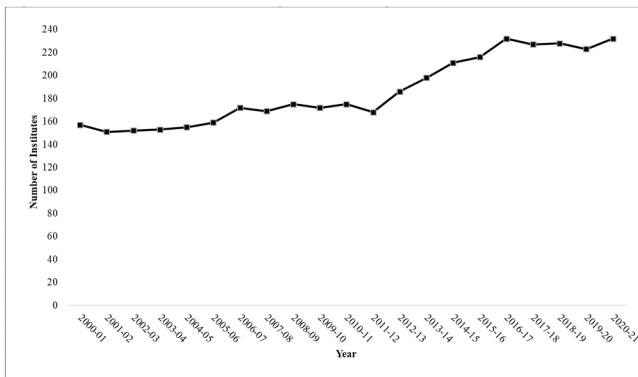


Fig. 5. Number of Entities Providing CDL Training between 2000/01 and 2020/21. Source: Integrated Postsecondary Database

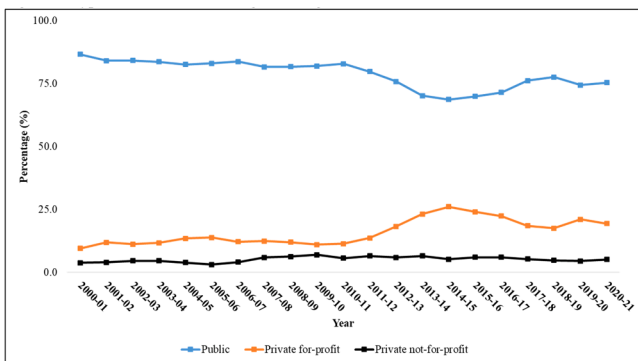


Fig. 6. Types of Entities Providing Training. Source: Integrated Postsecondary Database

CDL training regulations are shaping the number of entities involved in training truck drivers and how training is conducted. Fig. 8 outlines key regulations that have shaped training requirements for driver training (the major changes in the regulations are detailed in Appendix A). The timeline presented in this figure shows that there have been significant changes in the requirements of CDL training and qualification over the past few decades. The foci of those regulations were threefold: (1) the establishment of minimum training requirements, (2) the standardization of training curriculums, and (3) the accreditation and registration of training providers.

Truck driver training was largely unregulated in the first half of the 20th century. Instead, new drivers got training on the job. At this point, regulations were created to improve traffic safety for commercial motor vehicles (CMVs). The development of minimum requirements for entry-level drivers really started in 1970 with the establishment of minimum qualifications for truck drivers. The standardization of training curriculum began in the mid-1980s and focused on outlining a minimum number of training hours. Since then, the minimum required hours of training for drivers have changed several times. In the early 2000s, there was no minimum required number of hours, and the estimated number of training hours was very short (10.5 hours) because informal on-the-job training and observation were still popular in the trucking industry. A formal minimum hour requirement was proposed in 2007 (72 FR 73225), which established stricter requirements in terms of training contents and training providers’ accreditation [39]. This regulation specified the minimum number of hours for both classroom (76 hours) and behind-the-wheel (BTW) training (44 hours).⁶ Eventually, in the new final rule in 2022, a modified minimum number of hours for BTW experience was specified (30 hours), but the requirement for theory hours was removed [40].

Perhaps the most impactful change in driver training was the most recent FMCSA rule that was issued in 2016 and went into effect in February 2022. The new rule requires that all training providers be

⁶ All minimum hour requirements in this study were for CDL Class A training, and other types of CDLs have different requirements.

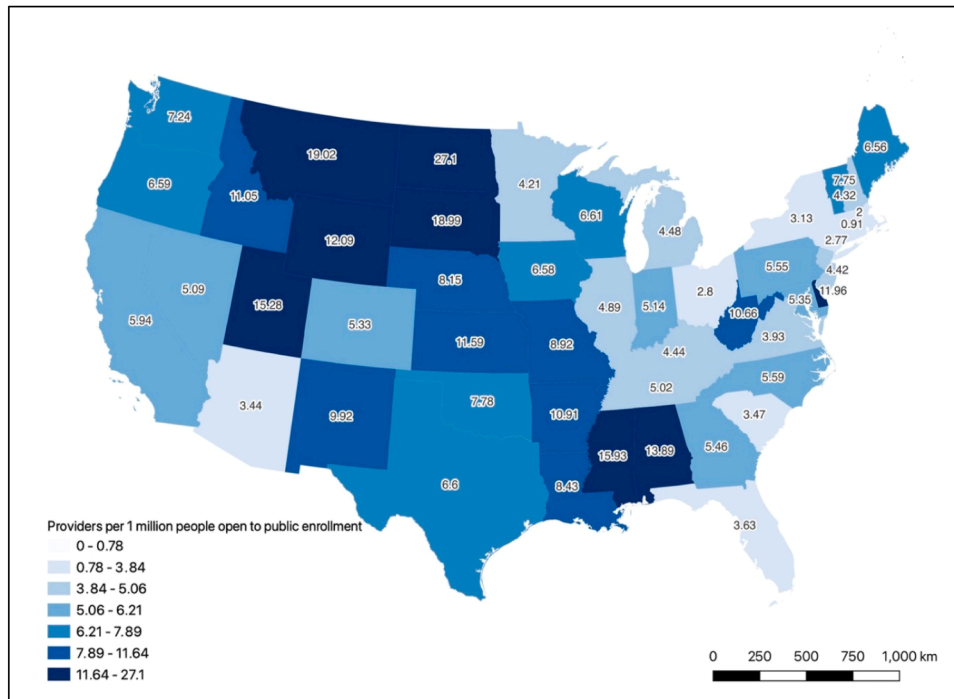


Fig. 7. Number of CDL A Training Providers per 1 Million People Open to Public Enrollment Registered at FMCSA. Source: Federal Motor Carrier Safety Administration (FMCSA) registry

Table 1
Summary statistics of private-enrollment and public-enrollment programs.

Private Enrollment Only	Number	Percentage
No	2180	29.1
Yes	5317	70.9
Total	7497	100

Source: List of ELDT Training Locations Registered with FMCSA

Table 2
Summary statistics of training contents.

Type of Training	Number	Percentage
Offer both theory and behind-the-wheel training	5894	78.6
Offer theory training only	538	7.2
Offer behind-the-wheel training only	1065	14.2
Total	7497	100

Source: List of ELDT Training Locations Registered with FMCSA

“licensed, certified, registered, or authorized to provide training in accordance with the applicable laws and regulations of any State where in-person training is provided” [41]. Moreover, all training providers must register their training location with the FMCSA’s Training Provider Registry (TPR). This change means that informal, uncertified training or on-the-job training, which were popular in the past (e.g., on-the-job training), do not meet CDL requirements anymore. Instead, all entry-level truck drivers must receive training from a registered training provider.

The evolution of formats and requirements of truck driver training demonstrates the strong coercive effect of governmental regulations on the industry. FMCSA has become an authority that regulates all aspects of training. As registered formal training is required, entities have rapidly expanded across the country, and the curricula have been standardized. Consequently, several models of training programs have been developed. We conduct interviews with entities to further understand different models and the factors associated with these models.

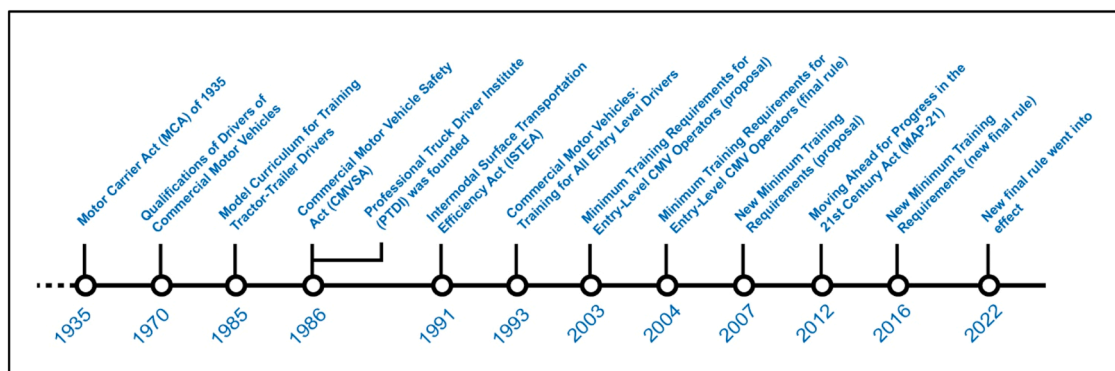


Fig. 8. Timeline of Regulations.

Four training models

To provide detailed information about the range of programs offered by the entities providing CDL training, we conducted semi-structured interviews with seven truck driver training entities: four community colleges and three private, for-profit schools. By analyzing the transcriptions of interviews, we summarize four training models.

Model 1, called the “trucking school model,” refers to training programs offered by private, for-profit companies. The three private trucking schools use this model and focus on only truck driver training. However, the owners of these entities may also engage in other businesses related to trucking, such as CDL tests or freight transportation. For example, one of the schools was started in 1996 by a truck driver. The founder saw a need for truck driver testing and started the company originally as a testing site; students trained at other schools. Today, they still have their own onsite testing, which is a unique feature of the company. It is one of three testing sites in their state.

The school has diversified beyond testing to include training as part of its business operations. Program enrollees can take classes at the main campus, or they can enroll in courses at one of the community colleges that partners with the training entity. The training company representative noted that many community colleges partner with private training programs like themselves to deliver courses to trainees. When the entity partners with a community college, they are in charge of everything and cover the training from the theory component to the actual driving training. They provide the trainers and the vehicles for the behind-the-wheel component of the course. Community colleges benefit from these partnerships because they get credit hours for offering the course, and credit hours are tied to state funding; the more credit hours offered, the higher the funding.

One participant mentioned that they are interested in recruiting women drivers because the school’s metrics showed women outperform their male counterparts when it comes to on-time delivery, fewer accidents and fewer citations. Overall, the participant indicated that this better performance stems from a higher level of conscientiousness of women drivers.

The dropout rate from the program is about 1%. The inability to finish the program is usually related to a failed drug test. The school representative noted that other schools have higher fail rates on the test because of a larger number of students per instructor. This means students have to wait in line to complete parts of the training and do not get as much hands-on time as programs with more teachers and lower teacher-to-student ratios. Less time on the road means they are not as well-prepared to take the driving test.

With the “trucking school model,” entities usually have many partners, such as truck-driving companies that send people for training. The arrangement with these partners is that they will pay for the person’s training as long as the person meets the terms of the contract. One participant noted that agreements between trainees and company partners typically state that tuition will be paid for as long as the trainee passes the program, passes the CDL driving exam, and is employed for the period specified in the contract. In the interim, the training entity holds the trainee’s driving certificate until they fulfill the terms of the contract. If the trainee does not fulfill the terms of the contract, it is possible to get the paperwork by paying the tuition cost in full. This arrangement solves one of the key barriers to work identified by the training entity’s representative, which is that most companies will not hire a driver unless they have prior work experience.

Model 2, called the “college course model,” is a normal for-credit CDL training course that is similar to other programs offered by community colleges. It is offered by a community college that participated in our study. The semester-long course was initially developed as supplementary training for its well-established utility linemen program. A requirement for utility linemen is that they have their CDL. Given this requirement, the college offered a CDL A training program as a complement to their utility linemen training program.

The program offered by the participating entity was approved in 2022; it is in-person for 16 weeks. The college is also planning to develop an independent non-credit truck driving training program that will be open to the public in the summer of 2023. All instructors are hired by the college, and all trucks for behind-the-wheel training and other facilities are owned by the college. The college decided to conduct all of the training themselves because they prefer to have control over all aspects of training. A grant enabled them to purchase two full-size manual semi-trucks. The college also purchased curriculum materials from an external firm that specialized in trucking safety and regulations. The college does not have its own testing site, but graduates of the program can complete their road test at a nearby testing site. Students participating in the program receive training to pass their CDL permit test. They also receive theory and on-the-road training. Post-graduation, they are responsible for passing the on-road CDL test. Students in the program may use school trucks to take the CDL test.

The program managers indicated that an advantage of obtaining a degree through a community college is the resources available on campus, including a library, exercise facility, and tutoring assistance available for students. Another advantage of pursuing a CDL at a community college is that if students decide to switch programs, they can transfer their course credits and transition into a different program at the college.

Model 3, called the “outsourcing model,” is a training format in public entities (e.g., community colleges) that partner with a third-party provider of a private truck driving school. The partner typically provides instructors and trucks for training. The third-party provider performs all the upkeep and maintenance on the trucks. Thus, the curriculum arrangement and tuition of the program are similar to those in private truck driving schools. Usually, the public entity provides the space for training and recruiting students. The entity splits the tuition paid by students with the private provider. They select their third-party trainer based on the tuition split offered by the provider. However, the partnership may be unstable. One participant mentioned that their entity was switching providers since a walkout with their current provider left them unable to offer courses for several months.

The program offered through this model is similar to the “trucking school model” and typically shorter than the “college course model.” One participating entity offers an “outsourcing” course that is three weeks and 160 hours long. Week one of the course is the theory portion of training, which prepares students to take their learner’s permit test. Students must obtain a learner’s permit before they can enroll in weeks two and three. Week two of the course is dedicated to yard and maneuver training. During this time, students also conduct observations of on-road driving. A critical benchmark at this point in the program is that they know all pre-trip inspection protocols. Week three is spent on the road with an instructor.

The participant mentioned that their entity does not have to do a lot of recruiting, particularly since the recent changes in federal requirements of certified training provided by a licensed provider. The graduation rate of students from the program since 2017 is 95%. People who have trouble with the pre-inspection or the theory aspects of the course get additional training to help them pass these segments of the course. The entity (community college) tracks the employment rates of students’ post-graduation. Most students are employed within a few weeks after graduation.

The program director saw trends in the people who had trouble making it through the program and finding jobs post-graduation. Drug screening poses a problem for people getting through the program. Although marijuana is now legal in their home state, there remains zero tolerance for this type of substance in the profession. To overcome this issue, the community college asks students to complete drug screening before enrolling in the program.

The other trend in graduates is specifically related to when and how much they are willing to work, which may reflect a shift in worker values because of the pandemic. In particular, the community college

observed that more graduates were seeking part-time rather than full-time employment. Many drivers also want to be home at night instead of being away from home for long stretches of time. Other people simply do not want to work at this time. So, a challenge for the program is finding people who want to work the hours the job requires.

Model 4, the “transition model,” is in the middle of the spectrum between the “college course model” and the “outsourcing model.” One community college participating in our study uses this model by having both a for-credit program and a non-credit program. The old for-credit program was delivered on a semester basis (15 weeks) and underwent a transition after the college conducted an economic evaluation of its programs. Due to the popularity of the non-credit program and the demand for truck drivers, the college decided to focus instructional efforts on delivering not-for-credit training. The non-profit program is an accelerated six-week program comprised of a two-week theory component and a four-week behind-the-wheel component. The program includes a total of 80 hours of student involvement in driving, and the college does not include waiting time as part of the total hours of instruction.

Aside from the length of the program, the other big difference between the for-credit and the not-for-credit program is the cost. The old 15-week program was \$1200, and the not-for-credit course cost about \$4600. The entity designs its own courses and conducts its own driver training. They also own and operate their own trucks. A unique feature of the college is that they conduct testing on their property and are a statewide testing center. The flow of students through the program is as follows. Students get a permit before enrolling in the program. Once they have a permit and pass a drug test, they take the theory part of the course and complete the behind-the-wheel segment of the course.

The estimated dropout rate of the program is low, about 1 in every 20 students. Reasons for student departure are often related to the unique lifestyle challenges associated with truck driving, such as sleeping in their truck and/or time away from home. Students might also change their minds about truck driving as an occupation because of the responsibilities associated with driving that they had not considered previously. For example, the fact that they could kill people in the course of job duties deters some students from completing the program and pursuing the occupation of truck driving.

The entity estimates that about 70 % of graduates are employed within the first year following training. They also bring employers in every month to speak to students so if someone was not employed right after they completed the program, they can participate in the networking opportunities to facilitate their job search.

For students who have trouble getting a job, it is often attributable to their age. Drivers under the age of 21 are not allowed per federal regulations to cross state lines. Another reason people may have trouble finding a job is a lack of experience. Many employers, particularly small employers, prefer to hire drivers who have at least two years of experience for insurance reasons. Larger employers will hire drivers with no experience and will partner them up with someone else and drive as a team for a while. Larger employers' insurance will cover team driving and less experienced drivers.

Coercive, normative, and mimetic pressures

From the perspective of institutional theory, the training process and entities could be changed by institutional pressures [14]. In this section, we focus on three types of pressures: coercive, normative, and mimetic isomorphism. The coercive pressure primarily comes from governmental regulations. In previous sections, we have already reviewed the timeline of federal regulations for truck driver training, unveiling the process of how coercive pressure has shaped truck driver training over decades.

The interviews enable us to understand the coercive pressure from the entities' perspectives. The results confirm that governmental regulations have constantly changed the formats and models of truck driver

training. For example, a participant mentioned that before February 2022, trucking providers and employers were allowed to train drivers themselves, and training entities had more flexibility in offering training programs. Thus, employers often send their drivers to their entities for partial training (e.g., participating in driving practice without completing full hours). However, the most recent FMCSA rule, which went into effect in February 2022, requires all drivers to complete an approved training curriculum at a registered entity. Employers can no longer self-train drivers and must send their drivers for the full-hour training program.

Another example of coercive and also normative pressures is the drug screening requirement mentioned by several participants. Zero tolerance for drugs is both a law and a professional standard based on safety concerns. Students are required to register for the national database “Drug and Alcohol Clearinghouse,” managed by the FMCSA (<https://clearinghouse.fmcsa.dot.gov/>). The Clearinghouse permanently records information about a violation of FMCSA's drug and alcohol testing program by a driver. If a driver tests positive in a test, their CDL license will be suspended or revoked, and they will be prohibited from being a truck driver for an amount of time (e.g., five years).

Participants indicated that the failure of the drug test has been a common reason for terminating students' training at entities, especially as marijuana has been increasingly legalized. Therefore, entities have put substantial efforts into reducing the risk of drug test failure. A participant said:

“I warn them, don't eat food you didn't cook. Like you have to be really careful because accidents are not allowed in this profession; it can really ruin your life. So they have to take those things seriously. Same way with prescription drugs, Aspirin, Tylenol, anything. You can't trust people to give you a pill when you're in this profession.”

Normative pressures are also introduced in the curriculum design, such as the allocation of hours for theory learning, driving observations, and on-the-road driving. Regardless of the model an entity adopts, the first part of training is the theory class. Online theory courses have become increasingly popular recently because of their flexibility. Upon the completion of theory training, students must take a series of knowledge tests (e.g., general knowledge, air brake) and get their learner permit before they can start behind-the-wheel training. Although the length of training programs varies, entities agreed that the actual driving time in the course is essential for improving the pass rate of the CLD test. A participant indicated that they had a low student-to-teacher ratio to ensure the actual behind-the-wheel hours. Also, they usually design their program based on the model curriculum published by the Professional Truck Driver Institute (PTDI), a non-profit organization for trucking training curriculum development. A representative of a private trucking school said:

“...we had programs in 16 states, 33 permanent locations, 17 satellite locations. And so then through the years, we had just developed and continued to improve on our program, but always based on those practices that were identified in the model curriculum and by the Professional Truck Driver Institute...”

Mimetic pressures make entities follow or imitate the practices of other entities or programs. For example, they tend to adopt standardized and consistent curricula that other entities also use. One participant in Michigan said:

“... We bought curriculum from J.J. Keller, which is based out of Wisconsin, and it's one of the most common curriculums...We had a curriculum, but it wasn't as formal as the one that we [are using now]. So... we just bought it...”

Another example of mimetic pressure is the transition model identified by our interview analysis. The entity started with the traditional 'college course model' with a semester-based for-credit course but is switching to a new not-for-credit program that outsources parts of

training to private partners because this is a trend of shorter training programs.

Funding for driver training

Based on the interview information provided above, there are several differences in the training for truck drivers offered by community colleges and private truck driving schools. One of the biggest differences is the cost. Community colleges can be more affordable than private driving schools; indeed, the average annual in-state tuition and fees at a public 2-year college was \$3770 [42]. There is a range of financial aid resources for students enrolling at public community colleges. About 56 % of community college students receive some form of financial aid, including Pell Grants (a subsidy that the federal government provides to undergraduate students who display exceptional financial need), federal work-study programs, subsidized and unsubsidized federal loans, and state grants or institutional aid [42]. Many states will pay tuition for state residents. Recent information indicates that 26 of the 50 states provide free tuition in some form for students attending community colleges [43]. Some states waive tuition for eligible local students at community colleges; the eligibility requirements for free community college tuition vary across states [42]. For example, in Michigan, an applicant must be at least 25 years old, be an in-state resident for at least one year and have a high school diploma or equivalent but not a post-secondary degree (Michigan [44]).

On the other hand, private truck driving schools usually have higher tuition rates compared to public community colleges. The standard tuition for a private trucking school is typically between \$4000 and \$7000 [45]. As indicated by the interview participants, many truck driving companies will pay for CDL training. There are also a number of funding and financial aid opportunities for individuals who wish to become truck drivers and acquire CDL training. For example, a student who enrolls in a private truck driving school can apply for a Pell Grant if they have not earned a bachelor’s or higher degree. The U.S. Department of Labor’s Workforce Innovation and Opportunity Act (WIOA) provides funding for CDL training [46]. A student who has been laid off or whose household income is below 250 % of the Federal Poverty Level is qualified to apply for the WIOA fund [46]. A veteran can apply for the GI Bill to cover the costs of truck driver training [47]. Moreover, FMCSA provides a Military Skills Test Waiver Program for military service members and veterans to get their CDL by waiving some requirements [48]. The Women in Trucking Foundation offers scholarships to women receiving truck driver training [49].

Table 3 presents a summary of information about financial aid awarded to students enrolling in entities offering driver training. It describes two financial aid categories: (1) federal, state, local, institutional or other sources of grant aid and (2) Pell Grants. Public entities have a large share of awards for the former category (61 %) and the lowest share for the latter (33 %). Private for-profit entities have the highest percentage of both types of aid (68 % and 53 %, respectively). This indicates that despite higher costs, private truck driver schools do a good job of offering financial aid to students.

Table 3
Financial aid in sampled entities for the year 2020–21.

	Federal, state, local, institutional or other sources of grant aid		Pell Grants aid	
	Mean percentage of undergraduate (%)	Mean of average amount awarded to undergraduate students (\$)	Mean percentage of undergraduate (%)	Mean of average amount awarded to undergraduate students (\$)
Public	61	4478	33	4343
Private not-for-profit	58	8607	39	5357
Private for-profit	68	4842	53	4282

*Undergraduate student refers to a student enrolled in a 4- or 5-year bachelor’s degree program, an associate’s degree program, or a vocational or technical program below the baccalaureate.

Source: IPEDS, 2020–2021 Student Financial Aid component

Discussion

Truck driving is an occupation requiring a range of mental and physical skills to transport goods. Much of the goods in the U.S. are delivered by truck drivers. That said, surprisingly, little is known about this essential occupation, particularly when it comes to the training of workers. To shed some light on how drivers are trained, we analyzed data from secondary governmental sources and interviews from training entities to understand how drivers have been trained, how people funded their training, and the regulations that shape how training is conducted.

The analysis of wage and salary data offered a potential explanation for the shortfall of drivers in the industry. Recent inflation-adjusted data indicated that real wages for truck drivers are below their 2001 levels. This was particularly true after the 2008 economic crisis. Real wages have increased since 2013 but have not yet reached wage levels in the early 2000s. Paying truck drivers more could incentivize people to work in this occupation.

The analysis of the IPEDS data indicated there are three types of entities that train drivers: public, private not-for-profit, and private for-profit. It also illustrated three waves of increases in the number of both public and private training programs in the last 20 years. These surges can be associated with the change in federal regulations for CDL training and qualifications. The first surge may be related to the new proposal of minimum training requirements for entry-level commercial motor vehicle (CMV) operators issued in 2007. The second increase in the number of entities from the academic year 2021–2022 onward may be attributed to MAP-21, which required new regulations for minimum entry-level training requirements and certification of all training providers. This increased the demand for CDL training entities that provide formal, standard training programs to meet the new training requirements [50]. The third surge happened recently in 2020–2021. It may be related to the expected changes driven by the new FMCSA rule that went into effect in 2022 and may also be associated with the economic recovery after the pandemic.

Furthermore, the share of private for-profit programs has increased. Programs with shorter durations have also become more popular compared to traditional for-credit programs. Although private entities may charge higher tuitions, the student financial aid data indicates that private for-profit entities have the highest percentage of students receiving financial aid, and private, not-for-profit entities provide the largest amount of financial aid to students. More than 70 % of registered training providers with the FMCSA are only open to private enrollment, indicating that employer-sponsored, employer-based training is still dominant in the trucking industry.

Interviews collected information from community colleges and private truck-driving programs to understand how training is designed and delivered. As the trucking industry is highly institutionalized, we used institutional theory to conceptually frame our mixed-method analysis. Specifically, we examined the coercive, normative, and mimetic pressures that have shaped the design and delivery of truck driver training over the years. These pressures, which come from government

regulations, industry standards, technological change, and economic transformation, have standardized and formalized training programs across the country.

The interviews revealed four models for training truck drivers. The first is the “trucking school model” provided by private truck driver training entities. The second is a wholly contained for-credit course structure, as represented by the “college course model.” The third model, the “outsourcing model,” is a not-for-credit partnership model in which entities pair up to provide training. It is a not-for-credit program run entirely by public entities (e.g., community colleges), which is similar to training provided by private truck driving programs. With this model, the public entity partners with a private truck driving company to train drivers. The fourth model, the “transition model,” represents a combination of models two and three. They offer their own training but also partner with community colleges.

There are advantages and disadvantages to these different models. As shown by IPEDS statistics, the share of private truck driving programs has increased in recent years, indicating several advantages of this model. First, private programs often offer more flexible and accelerated training schedules, attracting trainees who wish to start training immediately and enter the workforce quickly. Second, private schools are more accessible in terms of location and are often easier to enroll in compared to public entities. Third, private schools frequently have partnerships with trucking companies, which provide more job opportunities upon completion of training.

On the other hand, public entities, especially community or technical colleges, generally provide lower-cost education, widely acknowledged accreditation or certification, eligibility for public financial aid, and strong student support services. More specifically, an advantage of the traditional college course model is that the college has control over the program offerings and does not need to rely on other entities to provide training. The program is likely to be less expensive than a not-for-credit course. Another advantage is that there is more flexibility for students to transfer credits from the truck driving program to another program within the public education system. A disadvantage of this business model is the length of the program, which is much longer than 4–6 week courses offered by not-for-credit programs or private trainers. Another disadvantage of this model is that there can be long backlogs when enrolling in the program, which produces wait times for prospective students.

The emerging not-for-credit partnerships between public and private entities eliminate some of the disadvantages associated with the for-credit model. They are shorter and can train more students in less time. The programs are more likely to be costly for students, approaching or equating the costs of private provider training. The risk of these programs is a breakdown in the partnership. The participant with the “transition model” ran into this issue when a strike at their training provider rendered them unable to offer classes for several months. The outsourcing model provides more flexibility to training providers. It also avoids the coordination costs involved with the partner model and can train more students in shorter periods of time. Running these programs can be more costly, however, particularly the maintenance and upkeep of trucks. This model also requires considerable industry expertise from the training provider.

Aside from the types of business models implemented to train truck drivers, conversations with training providers indicated what they believe to make for successful training programs. Trainers indicated that low student-to-teacher ratios produced better learning outcomes and a higher likelihood of passing the on-road test. One of the private trucking schools believed that their high pass rate on the on-the-road test resulted from low student-to-teacher ratios. Relatedly, the participant from that private trucking school also mentioned that more time driving rather than observing produces better training outcomes and higher passing rates on the road test. The participant with the “outsourcing model” noted the importance of actual driving time compared to observation time. They mentioned that many students spend a lot of time in class but

on observation rather than actual driving. As a school, they are more interested in seeing how much time students spend behind the wheel. The “outsourcing model” participant also stated that there are limits to observation, and they noticed differences in test outcomes related to how much time is spent behind the wheel. The way their program is set up right now, there is variation in the amount of time spent behind the wheel. The “outsourcing model” entity plans to track actual drive time more closely in the future.

Conversations with training providers also revealed two key barriers to having more truck drivers on the road. The first barrier is the age threshold of 21; drivers under 21 cannot cross state lines, limiting the employment prospects of younger drivers. The representative from a private trucking school is seeing more interest by young people in driving, given the earnings potential of the occupation. They believe training high school-aged students could solve the industry driver shortage. The second barrier to driving is the inability of people to comply with the zero-substance requirement and pass drug screening. Providers noted that the legalization of marijuana in many states compounds the problem. Prospective students do not realize that marijuana is still a banned substance in the driving industry because it is now a legal substance in so many states. A third barrier to getting more drivers on the road is that many prospective drivers want to remain local and do not want to take on work that involves long-distance driving.

Conversations with training providers also revealed how regulations are shaping trucking education, particularly the most recent change in February of 2022. Study participants stated the changes are beneficial in providing curriculum guidelines and training standards. They also noted that there are significant tracking requirements associated with the new federal requirements. The “outsourcing model” entity noted that the tracking of all of the training hours for entry-level driver training (ELDT) is quite detailed. They need to document the time students spend on each task, and instructors have to scan the students to track the tasks.

The findings of this study are based on the data and people interviewed for this study. This means the conclusions derived from the available data may not be representative of all entities involved in training truck drivers. To minimize this inevitable shortcoming of the limited sample, efforts were made to interview additional entities and to have study findings reviewed by people with truck driving industry knowledge. Another limitation has to do with the information available in the IPEDS dataset which combines information about programs for truck driver training and other commercial driver training (e.g., bus drivers). This means data about programs that deliver truck driver training only are not available. To reconcile this data limitation, the analysis incorporated information from the FMCSA training database. These data indicated that truck driver training programs account for the majority of all CDL programs. Therefore, the impact of the limitation associated with the IPEDS data on the analysis presented in this paper is anticipated to be minimal. There are also questions about future trends in training that cannot be answered in this paper. However, these questions do suggest interesting avenues for future work.

One area for future work is to revisit the type of programs being offered by community colleges. In the past, and at present, it was a mix of for-credit and not-for-credit programs. The recent changes in federal training requirements, however, may make the for-credit model obsolete. Follow-on studies to this paper can evaluate the mix of program offerings at community colleges moving forward. A second area for future work is to examine how the number and types of training providers shift, given the recently enacted federal requirements for driver training, and how these requirements impact the number of drivers in the industry. A third area for future work is to examine how the number and mix of training hours between classroom and behind-the-wheel instruction evolves over time. The FMCSA 2022 regulations establish a floor for driver training, but more time may be needed, particularly for behind-the-wheel elements of training. Interview participants indicated higher success rates for trainees who spent more time behind the wheel. Thus, the number of hours of training time behind the wheel may

increase in future years, or standards may shift to mandate a higher percentage of time spent behind the wheel. Fourth, it will be interesting to assess whether changes in training and wages exacerbate or alleviate the current shortage of truck drivers in the U.S. Lastly, it is worth exploring how training providers respond to technological challenges, such as autonomous driving, that are set to transform the trucking workforce in the next few years.

Conclusion

This study provides new perspectives on trends in truck driver employment and wages, as well as the entities that train drivers. It also provided information about institutional pressures that impact driver training offered by entities. The analysis of interviews with training entities revealed different business models for training drivers, as well as the advantages and disadvantages of these models in terms of cost to the trainee, time to completion, and coordination costs. Our study contributes to both academic research and practical policymaking. From a research perspective, it fills a gap in the literature regarding the evolution and trends of truck-driving training entities, as well as the factors influencing the development of training programs, while expanding the use of institutional theory on this topic. From a policymaking perspective, it compares the advantages and disadvantages of different training models and highlights challenges for training providers and the truck driver workforce, supporting informed decision-making.

CRedit authorship contribution statement

Sicheng Wang: Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Elizabeth A. Mack:** Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Nidhi Kalani:** Writing – original draft, Visualization, Validation, Software, Investigation, Formal analysis, Data curation. **Chu-Hsiang Chang:** Writing – review & editing, Funding acquisition. **Shelia R. Cotten:** Writing – review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.team.2024.11.003](https://doi.org/10.1016/j.team.2024.11.003).

Data Availability

The quantitative data extracted from administrative data can be shared on request. The qualitative data (interviews) are confidential.

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