Innovative Transportation Solutions: Uber for Freight

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Abstract

As part of standard business cycles, new technologies continue to emerge that disrupt industries and capture market share from stagnant incumbents. In the trucking industry, Uber for Freight (UFF) is one of these innovative business models. Loosely defined as platforms which seek to more efficiently match shippers' loads with truck drivers, these companies are seeking to 'uberize' freight transport through algorithm-based applications. By eliminating the middleman of a carrier or broker, these startups' value proposition is cost savings and increased efficiency gained through a frictionless interface. While process automation has its upsides, many industry veterans have questioned the potential success of this business model. Furthermore, experts have expressed uncertainty regarding the operational mechanics of an UFF company as well as the true distinction between UFF and a traditional broker. This research seeks to address these questions about the UFF model by first developing a clear description of its players and processes, compiled based on interviews with existing companies in this space. Secondly, this research determines that UFF is best classified as a subdivision of brokers, providing similar services through a different business model that eliminates some degree of human intervention. More than simply automation, UFF provides additional benefits through its rating system and efficient payment processes. As a case study, this research then investigates the applicability of UFF within a specific company. The sponsor company, a large, multinational chemical company, maintains an extensive product offering that reaches customers across almost all industries. These products vary widely in format, hazardous material classification and service level requirements. Based on interviews with sponsor company representatives across functions and geographies, this research examines the challenges and benefits of incorporating UFF into a company's transportation strategy. From these learnings, it was recommended that UFF be implemented gradually, starting on a U.S. lane that transports non-hazardous products with lower service level requirements. If safety and service levels prove satisfactory, the sponsor company can scale accordingly to more complex products or lanes. While UFF has clear benefits and disruptive potential, it must be utilized with the appropriate products and customers; it is not a one-size-fits-all solution.

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From both of us

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1. Introduction

In recent years the sharing economy has proliferated into many different markets. Companies such as Uber Inc. (A U.S. based app-based ride-sharing service) recently redefined the taxi industry with new business models and methods of communication. Now startups are venturing into different markets, such as trucking, with similar business models; Uber for Freight (UFF) is one type of business model attempting to penetrate the trucking industry. Although UFF will be discussed in greater detail throughout Chapter 4, UFF companies are seeking to more efficiently match shippers' loads with drivers and trucks through application-based algorithms. Many of these businesses are promising reduced costs and increased efficiency through the elimination of carrier dispatch operations or brokers (among other services). The company sponsoring this project is a leading chemical manufacturer that supplies a wide range of products on a global scale involving a multitude of customers across geographies. This diversity in product and customer requirements requires the sponsor company to develop unique transport solutions for each type of load. Considering that the sponsor company conducts between 80-90% of its North American and European shipments, respectively, via truck, this new UFF business model could have major impacts on their operations.

Currently, there are over a dozen companies in the UFF industry vying to gain market share and compete with traditional brokers and carriers. In addition to the large quantity of competitors, regionally variable regulations increase the complexity of integrating UFF within the sponsor company. Furthermore, the potential consequences inherent in transporting hazardous materials elevate the risk of participating in this new business model. Therefore, a comprehensive understanding of both the sponsor company and the relatively nascent UFF business model is required to evaluate UFF's applicability. To better classify the UFF model, it is also important to analyze the differences between 3PLs, brokers and carriers, ultimately determining where UFF fits. This understanding will help determine how an UFF company can be implemented within a hazardous materials (hereafter referred to as "hazmat") transportation environment.

To determine the future of the UFF business model and its potential use within the sponsor company, the following concerns must be addressed:

1. What are the critical elements of an UFF business model? How does this differ from the business models of a broker or a 3PL?
2. How is value created in the UFF business model? What are the benefits and costs associated with UFF?
3. What are the different regulations and requirements for shipping hazardous materials by truck?
4. How will the UFF model be integrated into the sponsor company's logistics operations?
5. What will be the best segments to test the UFF business model in the sponsor company?

In this thesis, we answer these questions through (1) a review of the relevant literature, (2) development of the UFF model through interviews with currently operating UFF companies, and (3) interviews with supply chain managers with varying experience from different regions within the sponsor company. A summary of the literature is provided in Chapter 2 and an outline of our methodology is presented in Chapter 3.

To understand how UFF could be implemented in the sponsor company, the researchers developed a definition of the UFF model based on principal agent theory as described in Chapter 4. Chapter 5 conducts an operational analysis of the sponsor company by region based on interviews with sponsor company representatives. This analysis establishes the foundation for the integration of UFF within the sponsor company. Subsequently, the research focuses on how and where UFF should be implemented in the sponsor company's operations in Chapter 7.

After a synthesis of the sponsor company and UFF companies' operations, the research discusses UFF's potential solutions, benefits, and challenges in relation to the sponsor company. In this discussion, the research dissects the different reasons that the use of UFF for hazardous materials might be exceedingly complex and risky at this point in time. However, it highlights other potential products and business units as candidates for implementation and the steps required to do so.

To date, very little research exists that describes UFF and thus there is confusion among industry professionals. A primary accomplishment of this research is the written elaboration of UFF's definition and how the business model will fit into the current landscape of the trucking industry. This includes a comparison to the current broker model as well as UFF's value proposition and differentiation. Also, this research will provide supply chain managers with the knowledge required to analyze UFF's application within their business and the potential benefits. Most importantly, it will illustrate that UFF is not a one-size-fits-all solution. Shippers must evaluate each scenario's unique requirements in terms of customer service, regulations and information exchange to ensure successful implementation of UFF.

2. Literature review

This literature review establishes the foundation for analyzing the applicability of innovative transport concepts, specifically UFF to hazardous goods. Although the model will be explained in detail as part of Chapter 4, a simplified definition of UFF is as follows: business models in which companies match shippers directly with carriers, typically through application-based algorithms that optimize routing and cost for both parties (Aoaeh, 2016). The use of the word 'Uber' does not imply the involvement of the company, Uber Inc., but rather that the operators of these business models will 'uberize' the freight industry, much like Uber Inc.'s application disrupted the taxi industry through the efficient connection of drivers and riders (Carson, 2016). Although the sponsor company's current logistics system is very efficient compared to its peers, this new business model has the potential to disrupt the industry; if successfully implemented, UFF could resolve industry-wide issues such as underutilization, lack of shipment visibility and poor information-sharing between partners.

Irrespective of industry, most companies are constantly seeking ways to improve the efficiency of their transportation operations. Although some aspects can be optimized internally, many organizations utilize third-party providers of carrier, brokerage and other logistics support services; these companies must work closely with their logistics partners. In terms of innovation, the transportation industry has been comparatively stagnant over the last few decades but the transportation startup landscape has recently begun to expand; entrepreneurs are targeting the industry due to its size, known inefficiencies, room for technological enablement and high level of fragmentation (Aoaeh, 2016). Based on market research performed in support of this thesis, very few of these businesses have extended their offerings to the chemical industry due to the complexity of the products, regulations and shipping requirements.

The literature review will begin with an overview of the transportation industry in general (including detailed summaries of the carrier and broker models) and the additional intricacies involved in chemical logistics; this will be critical in understanding the opportunities and potential challenges of transferring these business models to hazardous goods. The chapter will then survey literature relating to the uberization

of the taxi industry as a comparison to UFF. Lastly, the review will summarize other innovative transportation concepts and analyze the venture capital landscape and current players in the UFF space. Although the available literature adequately describes the current state of the logistics industry, it was anticipated that only a small body of research would exist relating to the UFF model. This literature review confirms that hypothesis and the subsequent research in Chapters 3-7 will address that gap through the development of a theoretical UFF model and a case study analysis involving the shipment of hazardous materials within the sponsor company.

2.1 The freight industry

The freight industry, specifically the trucking industry as depicted in Figure 1, is comprised of four basic elements: the carrier, the broker (or 3PL / 4PL), the shipper and the receiver. The shipper is typically a company or manufacturer that needs to transport some type of products. The receiver is the recipient of these products and may or may not be the end user; this entity could be a distributor, wholesaler, retailer or consumer but is most typically one of the first three. Carriers usually own and operate the trucks that will transport the products between the shipper's facility (origin) and receiver's location (destination). Lastly, a broker or 3PL could be used as a third party to arrange and orchestrate the interaction between the shipper, carrier and receiver. As each of these elements are typically not contained within one company, many challenges arise in coordinating all four parties. In 2011, the American Trucking Association reported that of the over 400,000 carriers in the United States, over 90% operated fewer than 7 trucks (ATA, 2013). Considering there were over 3 million truck drivers in 2010 alone, this data shows that the trucking industry is severely fragmented (ATA, 2013). Since each carrier operates with its own standards and business rules, it can be difficult for shippers to fully develop and understand every relationship. This can be particularly problematic for shippers "who don't want to build new interfaces for each new carrier." (MIT Center for Transportation and Logistics, 2016)

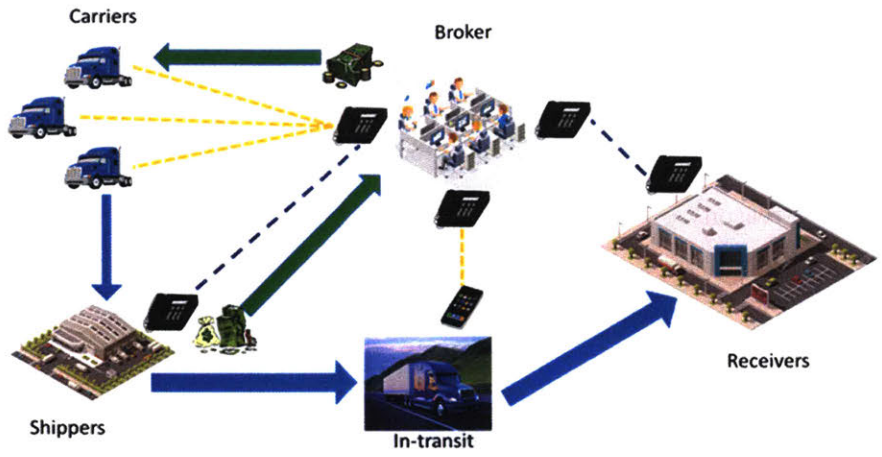

Figure 1: Simplified model of the freight industry

While each carrier is unique in its operations, this is true for shippers as well. As an example, some shippers such as the sponsor company need to transport hazardous materials that require carriers to maintain special qualifications (MIT Center for Transportation and Logistics, 2016). Similarly, some freight requires special handling due to "fragility, high-value, food safety, or temperature tolerances" (MIT Center for Transportation and Logistics, 2016). Matching a shipper's freight with the right carrier can become an arduous task due to this wide variety in load requirements. Also, each shipper can have separate standards for different types of loads. Since each carrier has varying levels of service and abilities, there is the opportunity for significant mismatches between service and freight.

As industry-wide standards (in terms of business rules) do not really exist, various business practices are set up amongst carriers, brokers and shippers. Due to the additional requirements and risk, some shippers will avoid the use of brokers when handling high-risk or high-value items. Working directly with a carrier has its benefits and shippers could choose this type of relationship over a broker for several reasons (MIT Center for Transportation and Logistics, 2016). At the 2016 MIT Roundtable on Innovations in Transportation (MIT Center for Transportation and Logistics, 2016), it was discussed that the auditability of suppliers by shippers is viewed as a clear advantage. When working through a broker, shippers often do not have this level of control or visibility into the carriers that the broker assigns to their loads. Another discussed benefit is the long-term development of trust and confidence in a carrier based on past

performance. Performance is a crucial metric, especially for shippers of hazardous materials, because of the severe consequences of an incident or misstep. The ability to develop and directly manage the performance of their carriers (without a broker as an intermediary) is important to many shippers of more complex loads for these reasons.

At the roundtable, UFF was covered in brief but the discussion was based primarily on trying to understand the definition, operations and players involved in UFF rather than its benefits and challenges. Another point of debate for the roundtable participants was which type of party would serve as the 'Uber' in UFF. Would it be a new start-up within the industry (e.g. Uber), an industry giant (e.g. DHL, FedEx), a shipper with industry knowledge (e.g. the sponsor company) or perhaps even a broker (e.g. C.H. Robinson)? Smaller players (brokers, shippers and carriers alike) expressed sentiments that they were too small to initiate this type of model and are waiting for larger shippers, brokers or a new player to lead the movement. Larger brokers, carriers and freight forwarders were split in terms of viewing UFF as an opportunity for business expansion and a fad that will not gain enough traction (MIT Center for Transportation and Logistics, 2016). There is not one correct answer to which type of party should manage the UFF model but it will surely require integration from all stakeholders involved.

2.2 Chemical logistics

Although coordinating the logistics for any large, multi-national corporation is a challenging task, chemicals bear additional complexity such as varying container sizes, states of matter and hazardous classifications; the transport of these products requires more due diligence and planning than most manufactured goods. While the specifics of these intricacies are not the focus of this research, it is important to have a high-level understanding of the relevant variables that affect the decisions of chemical shippers, carriers and other involved parties.

Despite the inherent risks, the efficient transport of hazardous or dangerous goods is integral to the continuing operations of chemical manufacturers, their customers and end-user consumers. Especially in

the chemical industry, logistics are of critical importance due to the geographical separation of production and consumption locations (Deloitte & Cefic, 2011). Although this is not the case for all companies, chemical manufacturing facilities typically cluster close to infrastructure such as ports, roads and rail terminals; the cost benefits of these location choices usually outweigh the costs attributed to increased distances to customers (Deloitte & Cefic, 2011). While the design and requirements of each chemical supply chain vary, the majority rely on many of the following stakeholder groups to champion safety, security and the minimization of incidents: logistics service providers, shippers, chemical manufacturers, chemical distributors, carriers, transportation managers, safety, security and risk professionals, regulators, insurers and industry associations. Through improvements to regulations, standard operating procedures, individual firm efforts, training and technology, the frequency and gravity of incidents has decreased over time. Nevertheless, the transportation of hazardous materials remains extremely complex due to the following non-exhaustive list of factors: number of regulated materials, varying regulations, storage and additional service requirements, equipment requirements, packaging types, different transportation modes, supply chain complexity, driver and carrier requirements and transport routing (Center for Chemical Process Safety of the American Institute of Chemical Engineers, 2008).

Number of regulated materials: The number of regulated materials is substantial; the U.S. Department of Transportation currently classifies 3726 different materials under 9 different classes and 3 packing groups as hazardous and subject to regulations under the Hazardous Materials Transportation Act (HMTA) (e-CFR, n.d.-a). The European Union classifies a similar number of materials under 13 classes regulated by the European Agreement concerning the International Carriage of Dangerous Goods by Road (United Nations Economic Commission for Europe, n.d.).

Varying regulations: While regulatory statutes clearly state requirements for shippers and carriers relating to classifications, permits, penalties, documentation, labeling, placarding, emergency response planning, packaging, regulations, these rules often vary by mode, country and product; this complexity can be difficult to manage for new industry participants. All parties, but especially

those involved in multinational transportation, must be aware of and abide by the governing regulations which are constantly evolving (Center for Chemical Process Safety of the American Institute of Chemical Engineers, 2008) (e-CFR, n.d.-b, sec. Part 173—Shippers—General Requirements for Shipments and Packagings).

Storage & additional service requirements: Depending on the product and shipper requirements, the load may require services in addition to the actual transport. As an example, Alfred Talke Logistics, a US-based third-party logistics provider (3PL), offers drumming, re-drumming and packing, drying and moisturizing, grinding/mixing/sieving, sample shipping, temperature-controlled transport or tank cleaning as add-on services. Shippers must coordinate with their third parties to arrange the appropriate combination of services for the product and transportation requirements.

Equipment requirements: In a similar manner, each product requires specific equipment based on its state of matter, hazmat classification and other factors. In terms of road equipment, Alfred Talke logistics offers a wide range including tank and slo trailers, semi-trailers, dry bulk trucks, multi-chamber equipment, tipper chassis, pressurized and unpressurised, gas deplacement lines, thermos equipment, vacuum equipment and more. Chemical products can be transported via tractor trailers or tank trucks. In the United States, these tank trucks can carry anywhere from a few hundred gallons to a maximum of ten thousand gallons. There are seven main types of tank trucks: gasoline tank trucks, chemical haulers, corrosive tankers, pressurized tankers, cryogenic tankers, tube trailers and dry bulk tanks ("UFRA - Hazardous Materials Awareness," n.d.). In addition to the vehicle/tractor, carriers and shippers must ensure availability of the required safety and loading/unloading equipment.

Packaging types: Based on the product, hazmat classification, size and other variables, chemicals can be packaged in many different formats including drums, intermediate bulk containers (IBCs), bottles, boxes and tanks. These containers come in varying volumes, materials (cardboard, metal,

glass, plastic etc.) and many types must be certified and/or tested for durability and integrity ("Using UN Packaging," n.d.). While optimizing cost and utilization, shippers must ensure that the selected packaging meets regulatory and customer requirements.

Different transportation modes: While this research will deal primarily with road transportation, shippers and carriers must balance cost, speed and safety with other factors when choosing between road, rail, ocean, pipeline, air and intermodal as mode options (Center for Chemical Process Safety of the American Institute of Chemical Engineers, 2008).

Supply chain complexity: Many different stakeholder groups are involved in the complete chemical transportation supply chain. Due to the multitude of parties, it can be complicated to clearly distinguish changes of custody and responsibility in transit, especially in the case of an incident or liability. These concerns must be clearly managed through contractual terms.

Driver and carrier requirements: In most jurisdictions, the regulatory landscape is constantly changing and typically increasing in rigor. For example, in the United States, carrier and driver requirements depend on the transported product and destination. In the past, hazmat drivers were solely obligated to maintain a hazardous material endorsement to their commercial driver's license which involved special training and testing. Due to increased security risk, the Transportation Safety Administration (TSA) has put in additional requirements to prevent terrorists from accessing dangerous materials. Depending on the load, some drivers now require a Transportation Worker Identification Card a Security Identification Display Area badge. These additional compliance requirements are bolstering administration and insurance costs which are not only passed on to the carrier but are also producing a driver shortage; fewer operators and drivers want to deal with this complexity and fees. This reduces the available capacity on the market (Mongelluzzo, 2010). While this case is specific to the United States, similar capacity constraints and shortages are occurring in other markets.

Transport routing: Shippers and carriers must pay particular attention to transportation routing for chemical shipments; while parties must ensure that routes are designed in compliance with restrictions (e.g. certain classes of hazmat materials are not allowed on specified roads, bridges or tunnels), companies are also proactively optimizing the risk profile of the selected routes. A substantial body of academic research exists that analyzes network design and routing problems relating to hazmat transportation. In Yilmaz's survey of literature relating to the topic, 88 scholarly papers exist up until 2014, including studies on risk assessment, network design, accident analysis, routing and scheduling (Yılmaz, Erol, & Aplak, 2016). Based on their operational needs and priorities, companies should leverage the existing body of research to optimize safety, costs efficiency.

As a last note on chemical logistics, several studies and surveys have been performed to analyze the trends and future of this subsector. Spend is growing globally with "shipment values set to exceed $1 trillion by 2018, up from $789 billion in 2013" (Logichem, 2016) and a compound annual growth rate of 11.97% through 2020, according to Sandler Research. Sandler cites expanding demand for chemicals and increased U.S. shale gas output (an input for the production of many chemicals) as drivers (Sandler Research, 2016). With this expected growth, shippers are becoming increasingly cognizant of capacity constraints as well as other drivers affecting the hazmat trucking market. Concurrently, senior managers and the executive suite are beginning to recognize chemical logistics as a strategic opportunity. As chemicals are becoming increasingly commoditized due to the globalization of customers and suppliers, companies are leveraging logistics costs and service levels to gain a competitive advantage (Knowler, 2015).

Deloitte & Cefic's Chemical Logistics Vision 2020 report identifies several other interesting trends, impacts and solutions. The study predicts evolving product flows, the growing importance of developing markets, constrained capacity due to insufficient infrastructure and an increased focus on safety, security and the environment to be key trends through 2020. As a result, the industry can expect to see increased supply chain complexity, higher logistics costs, a shift in power from shippers to logistics service providers,

additional regulation and customer-led demand for sustainability. Based on these findings, Deloitte & Cefic recommend the following approaches as solutions: horizontal and vertical integration between supply chain partners, a focus on sustainability and continuous improvement in safety and security (2011). From the shipper's perspective, price, reliability, speed of delivery and visibility are the primary considerations of their customers; Deloitte & Cefic's recommended focus on sustainability is gaining speed but is not a priority yet.

In LogiChem's 2016 global survey of logistics leaders in the chemical industry, only 37% of respondents reported supply chain sustainability as important to their customers. 55% say it is of interest, but not critical and 8% say that it is not a major concern at all. In contrast, LogiChem's respondents align with the Deloitte study on the importance of integration: 90% of those surveyed believe that the pooling of resources across the industry will help eliminate inefficiencies and reduce logistics costs; within this polling group, 52% believe not enough is being done in this area and 38% think that there is already evidence of this in practice (Logichem, 2016). These positive sentiments regarding integration, predictive demand analytics and shipment visibility will be critical to enabling widespread acceptance of any innovative transportation concept and specifically the UFF model.

2.3 Carriers

The use of carriers as briefly introduced in Chapter 2.1 can be further dissected based on the many different freight options. For clarification purposes, carriers are formally defined as "firms that provide transportation services, typically owning and operating transportation equipment" (Universal Cargo, 2016). The first way to segment carrier operations is based on the two different sizes of the cargo: Truckload (TL) and Less-Than-Truckload (LTL). As the names imply, TL are the loads from one shipper that fill the entire container and LTL is anything less than that (composed of multiple shippers' loads). LTL shipments can be carried via parcel carriers (loads less than 150 pounds) and dry van freight (larger loads) (Aoaeh, 2016). The loads that the carriers ship (via LTL or TL) can be divided into two more categories: general and specialized as defined in Aoaeh's words below.

General: This form of freight trucking involves the movement of any merchandise that does not require specialized equipment.

Specialized: This form of freight trucking requires specialized equipment to move merchandise. Some examples include flatbed trucks, tankers, refrigerated trucks, and hazmat trucks.

This research will focus primarily on specialized freight as this categorization is more typical of the sponsor company's case study. Lastly, loads can be classified by distance. These shipments can be segmented further based on whether the destination falls within a 250-mile radius from the carrier's operating base (Aoaeh, 2016).

Carriers are typically paid based on how the load was contracted. If the load was contracted through the broker, the shipper pays the broker and then the broker will pay the carrier minus a margin that varies in size. If the load is contracted with the shipper, then the shipper will pay the carrier directly. Regardless of the method, the payment is negotiable and varies due to the numerous components (e.g. fuel prices, weight, distance, type of freight, demand, etc.) in freight pricing. With payments from brokers or shippers, carriers will pay their drivers based on the cost and other factors. Typically, they are paid a rate and benefits based on their experience, the type of load and the route that they are driving (Kilcar, 2016). In 2016, specialty drivers, for instance hazardous materials drivers, were more likely to receive increases in their rates compared to their general freight counterparts (Cassidy, 2016). Thus, pay throughout the industry is manipulated by many levers, and the levers of hazardous freight tend to drive it up more.

In addition to driver pay, carriers must cover numerous other operating expenses, which leave the majority of carriers earning margins of only about 5% (Aoaeh, 2016). Table 1 below shows the average breakdown of major cost drivers that carriers reported in 2015.

Cost Driver	2015 Proportion of Total Costs per Mile
Fuel costs	25%
Truck / trailer lease or purchase payments	14%
Repair and maintenance	10%
Truck insurance premiums	6%
Permits and licenses	1%
Tires	3%
Tolls	1%
Driver wages	31%
Driver benefits	8%

Table 1: Cost drivers for carriers (Torrey & Murray, 2016).

2.4 Brokers and third-party logistics providers (3PLs)

The broker model's fundamentals are relatively simple; brokers connect shippers with carriers in exchange for a commission, but how they cater to their customers is rapidly changing. The broker market is currently growing at a much faster pace compared to the freight industry in general (Berman, 2016). As global logistics become more complex, many companies are beginning to strategically outsource to third-party logistics providers (3PLs) (Aimi, 2016). The definition of a 3PL is somewhat ambiguous as the term can be used for a wide variety of services. While the U.S. government legislation defines 3PLs as "A person who solely receives, holds, or otherwise transports a consumer product in the ordinary course of business but who does not take title to the product," these companies can provide freight-forwarding, warehousing, distribution, freight consolidation, transport management, brokerage and/or technology services (Robinson, 2014). Therefore, a broker is essentially a type of 3PL where brokers focus primarily on the freight-matching services and 3PLs provide additional services beyond just brokering. To clarify a shipper's freight transport options, Figure 2 below depicts the categorization of the parties described thus far. UFF's classification will be discussed in detail throughout Chapter 4.

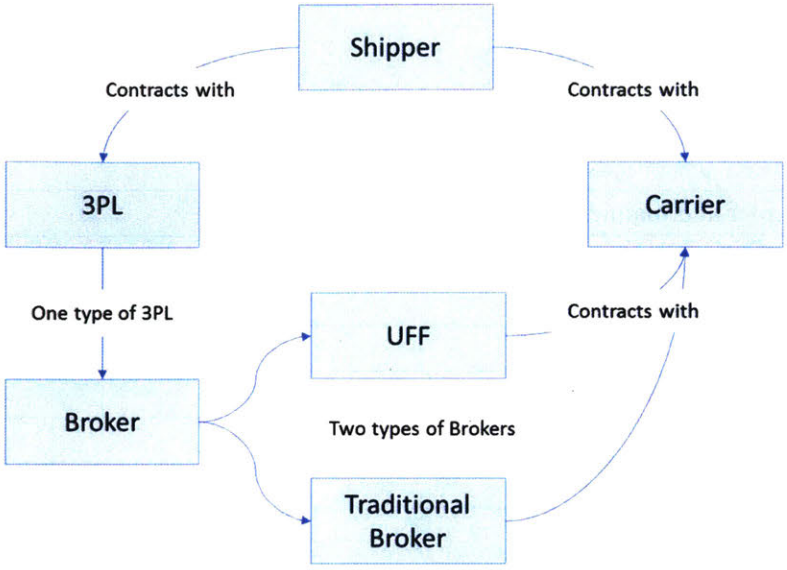

Figure 2: Shipper interactions with 3PLs and/or carriers

The increase in outsourcing to 3PLs is awarded to specific partners based on their quality and scope of service, which businesses depend on (Aimi, 2016). More specifically, the majority of the 3PL growth is driven by shippers wanting more "data on rates and capacity availability" (Berman, 2016) . As a response, 3PLs will continue to integrate technology in a rapid manner due to this desire for more data and value-added services (Burnson, 2016). Inherently, 3PLs and brokers are no longer only responsible for connecting shippers with carriers. Now brokers have value added services such as "transportation procurement, network design … shipment consolidation, and project logistics" (Burnson, 2016). Therefore, there is now a distinction between a broker and a 3PL. A broker focuses on connecting carriers and shippers, while a 3PL typically provides other services. As shippers continue to increase their dependence on 3PLs, carriers must also work with 3PLs to obtain loads; the network between all types of players is constantly expanding. Hazardous freight shippers are also likely to rely on 3PLs with specialized services and expertise, thus causing carriers with hazmat capabilities to agree to the commissions that 3PLs take.

2.5 Taxi vs. ride-sharing

To better understand the direction of UFF, similarities will be drawn from the taxi industry and how Uber Inc. disrupted it. The taxi industry, like the trucking industry, is segmented with different markets serving

a wide range of customers. Although it was possible for a normal person (not a taxi driver) to offer to pick up people off the street, there was no communication platform to connect potential drivers with potential riders; before the Uber Inc. platform emerged, the average person would not typically not trust a random driver enough to engage in this behavior. Therefore, passengers and drivers relied on the taxi model to facilitate matching. In the taxi model there are a limited number of medallions (taxi licenses) for a given municipality (Spotlight Report: Driven to the Edge, 2013). Due to the small supply, taxi businesses who own these medallions thrived because they were involved in price-setting for taxis (Spotlight Report: Driven to the Edge, 2013)In turn, the drivers pay a lot of money to utilize a taxi (due to the medallion and asset costs), but barely walk away with a living wage. Consequently, taxi fares are continuously increasing, causing more money to be lost from the passengers' pockets. These pricing problems are analogous to freight where 3PLs or brokers are partaking in the same role as the taxi businesses; they act as the sole source of tendering loads and control prices and commissions.

While new technologies allow 3PLs to proliferate, this same technology can be utilized by drivers which will allow them to take back control, an analogous situation to Uber Inc. disrupting the taxi industry. Uber Inc. is a platform that connects the average driver with passengers via a smartphone application. Since Uber Inc. drivers do not have to pay the costs of medallions and other fees to taxi companies then they can charge lower fares to customers (Gabel, 2016). Other benefits of the proliferation of ride-sharing platforms include fewer trips, modal shift, distance reduction, and increased efficiency (Gabel, 2016). These benefits partially stem from Uber Inc. drivers not being restricted to picking up passengers in their own municipality. To illustrate this further, if a Boston taxi picks up a passenger in Boston and drives them to nearby Cambridge, then they are contractually required to return to Boston to pick up their next passenger (Spotlight Report: Driven to the Edge, 2013). The trucking industry experiences similar inefficiencies by trucks having to return to their base of operations usually without a load, also referred to as empty backhauls. This is an area where an application could help drive down some of the inefficiencies inherent to the trucking industry.

While the UFF concept increases efficiency, these gains may come with reductions in service and/or safety, which are critical variables to shippers, especially those transporting hazardous freight.

2.6 Innovative transportation concepts and venture capital

After several decades of growth and increased fragmentation in the transportation industry, entrepreneurs and investors are beginning to leverage technology to minimize bottlenecks and inefficiencies. Not surprisingly, the amount of capital and quantity of startups is increasing noticeably; In terms of investments, "funding for transportation-focused ventures quadrupled in 2014 to $7 billion and doubled to $14 billion in 2015 according to Volvo Group Venture Capital" (Hutchins, 2016). A well-known startup directory, AngelList, lists 149 ventures and 522 investors under "trucking startups" with most based in the United States but locations spread throughout the EU, Middle East and South America as well (Aoaeh, 2016). While CBInsights utilizes a narrower definition of transportation startups, Figure 3 below graphitizes the growth in number and total value of deals over the last few years. 2016 data is expected to grow even further as the year closes out.

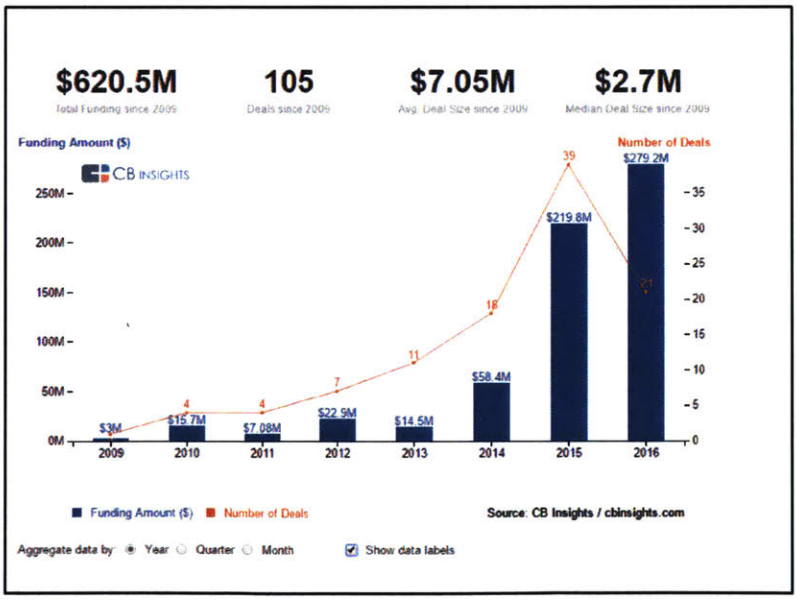

Figure 3: Venture capital landscape of freight logistics related startups (Aoaeh, 2016)

Interested investors range from public to private, including the United States Energy Department's Advanced Research Projects Agency (ARPA-E), Google Ventures, Goldman Sachs, BlackRock and many

more (Aoaeh, 2016). Aoeah with KEC Ventures classifies transportation startups into the following 5 broad categorizations:

On-demand commercial trucking services: Also referred to as digital-freight matching or UFF, this business model will be the primary focus of this research. The fundamental goal of most ventures in this category is to reduce inefficiencies in the freight brokerage market through app-based platforms; the reduction of transaction time, cost and errors involved in human interaction (inherent to the broker model) are the main value propositions of these startups.

Freight tracking and fleet management: These startups offer visibility and location solutions to fleet operators through software and hardware. Through a monthly subscription, firms promise that telematics equipment and associated services can improve operational efficiency.

Compliance and safety: Similarly, these startups offer a hardware/software subscription package designed to help truck operators comply with state and federal regulatory bodies such as the Federal Motor Carrier Safety Administration (U.S.) and the European Commission (E.U.). While discovered non-compliances carry fines and penalties, regulatory bodies can also ground an entire fleet until the operator resolves the issue. These models minimize breaches by creating electronic records of safety and compliance for audit purposes. With complex and changing regulations, these services also help operators stay current.

Delivery platforms & last-mile parcel delivery: These startups serve businesses of varying sizes by offering shipping price comparison services and/or on-demand pick-up and delivery of products to end users. Many of these last-mile delivery services are based on advanced algorithms and analytics built to optimize routing and reduce costs (Hau L. Lee, Yiwen Chen, Barchi Gillai, & Sonali Rammohan, 2016).

Autonomous vehicle (AV) platforms: With lowered costs, improved safety and increased productivity as potential outcomes, AV startups are developing self-driving systems for the

trucking industry. Due to the high proportion of trucking costs attributed to the driver (about 40%), these solutions, if scalable, could save money in the long-run. (Aoaeh, 2016).

In addition to the above classifications by Aoeah, several other theories and in particular, the physical internet, have been analyzed in the academic realm but have yet to be implemented practically on a large scale. The physical internet initiative aims to reduce logistics inefficiency and unsustainability by redesigning the way physical objects are moved, stored and used. Based on data packets of the digital internet, the physical internet proposes standardized encapsulation of goods (in so-called "pi" containers) and the use of protocols and interfaces. By minimizing space waste and increasing interconnectivity, the physical internet initiative aims to reduce environmental impact, increase economic efficiency and improve quality of life for society (Montreuil, 2012). The potential benefits and logistical application of the theory are discussed in detail in Montreuil's paper titled Toward a Physical Internet: meeting the global logistics sustainability grand challenge. While the concepts have been enumerated substantially in a theoretical context, engineering projects, studies, simulation, pilots and prototypes will be required to realistically implement physical internet infrastructure (Montreuil, 2011). While Venkatadri et al.'s paper bolsters the academic efforts to cost-model the effects of the physical internet, significant research will be necessary before we see tangible impacts (Venkatadri, Krishna, & Ülkü, 2016).

Many of these innovative transportation concepts are met with skepticism by the trucking industry and investors. In order to prove their value proposition, startups must demonstrate that their offerings are a revolutionary necessity, rather than just a "nice-to-have". Most of these solutions require set-up costs, training and employee buy-in to be successful; startups must be able to promise an efficient and substantial return on investment for their customers. Another hurdle to overcome will be gaining the trust of shippers and carriers alike. Due to the frequent communication involved in the brokerage and freight set-ups, the 150-year old trucking industry is built on relationships and partnerships. Startups will need to appease both "risk-averse shippers and technology-averse truckers" and still provide (or mimic) the personal feel and familiarity of a broker relationship (Aoaeh, 2016; Nicas & Stevens, 2015). Another challenge will be selling

these disruptive technologies in a soft freight market with excess capacity and low rates; it will be difficult for newcomers to contend in such a competitive environment. Without reduced rates, investors and industry incumbents are skeptical to how these models differ from a traditional brokerage and whether they are truly adding value (Cassidy, 2016). While the market opportunity is undeniably large, startups must recognize and address the challenges before we will see substantial disruption to the transportation industry.

2.7 Uber for freight (UFF)

Expanding on Aoeah's description of on-demand commercial trucking services from above, this section of the research aims to establish the current state of this business model and identify major players; a deeper analysis of this model including challenges and barriers to entry will be included in the body of the thesis. According to Armstrong & Associates, there are currently 27 digital freight matching companies that publish smartphone and/or web-based apps to match shippers and carriers (Rocheleau, n.d.). While information is not readily available on all players, Table 2 below summarizes the majority of the current businesses to the best of our knowledge. With such an extensive number of players, it will be critical for startups to differentiate their services amongst the competition and gain density in the fragmented transportation market.

Company	Established	Funding	Notes	Origin
10-4 Systems	2012	$13.9m	GlobalTranz spin-off July 2016. Truckload shipping, Freight portal and marketplace	Colorado, USA
Cargo Chief	2012	$10m	500k+ trucks, 500+ shippers, instant LTL quotes, 30min FTL quotes, partnership with TruckerLine to assist with driver paperwork and profiles	California, USA
Cargomatic	2013	$20.8m	Local truck shipments within 150-mile radius of LA, cash issues, layoffs, pivoting to broker model	California, USA
Convoy	2015	$18.5m	Investors include Bezos, Benioff and Omidyar, inked 4-year deal with Unilever, aiming for highest CSL trucking company globally	Washington, USA
DashHaul	2014	N/A	Instant rate, or shipper's custom-set rates, includes rating system, pre-screen/qualification of carriers	Illinois, USA

DAT Solutions	1978	N/A	Owned by Roper Industries, replaced load boards with smart phone app under TruckersEdge interface	Oregon, USA
Flexport	2013	≥65m	International freight arrangement for small and midsize companies, balance of software automation and relationships, focus on visibility	California, USA
Go by Truck	N/A	N/A	More people/relationship focus, focus on smaller trucking companies	Missouri, USA
Keychain Logistics	2012	≥2.5m	Automated brokerage, 10,000 drivers use shipment app, 10-20 new active movements/day, uses trucker's schedules and commonly traveled routes to match carriers with loads, 6-10% profit margin	California, USA
Kontainers	2014	N/A	Product of Newcastle's Ignite technology accelerator, operates in U.K.	U.K.
LaneHoney	2012	N/A	Began in big-data technology, Building business, but still growing. Cloud-based platform for trucking, charges transaction fee, spot-market player	New York, USA
Roadie	2015	≥$25m	"Neighbor-to-neighbor" shipping network, connects people with freight already heading in that direction. Local and long haul, includes ratings/reviews for drivers, 250K downloads	Georgia, USA
Schlep	N/A	N/A	B2B, B2C & Consumer (mostly consumer), only 30-mile radius of Chicago or Milwaukee	Illinois, USA
Transfix	2013	$57.8m	Smartphone based brokerage, full truckload only currently, boasts smaller margins, lower load setup time, etc. over traditional broker	New York, USA
TransLGX	2015	N/A	Trucking directory with over 500,000 trucking companies	California, USA
Trucker Path	2014	$20m	140,000 active users, 20% monthly growth, 30,000 truckloads/day, 2,500 carriers, 21.5M June 2016, focus on long-haul, not local	California, USA
TugForce	2015	N/A	Platform launch in May 2016, Beta version live now, on-demand carrier/load matching service	Delaware, USA
UberFreight	2016	N/A	Announced October 2016, leverage existing technology, incorporate AV through Otto acquisition, failed UberCargo run in Hong Kong	California, USA

uShip	2001 (LTL launched 2014)	≥$28m	Noncommercial, algorithmic pricing, targets the mid-sized LTL segment, 3.5m customers, 5.7m listings, 788k service providers, LTL marketplace growing triple digits, includes 30 LTL trucking companies and the 5 largest carriers	Texas, USA

Table 2: Current players in UFF or similar concepts (Aoaeh, 2016; Cassidy, 2016a, 2016b, Commendatore, 2015a, 2015b; Dills, 2015; FleetOwner, 2012; John Bendel, 2015; Metropolitan Corporae Counsel, 2015; Ramsay, 2016; Whelan, 2015, 2016; Company Websites)

2.8 Literature review conclusion

As with most industries, many complex factors are at play in the freight business that determine prices, process rules and how entities interact with each other. As the UFF model gains popularity, the ride-sharing industry can be utilized as a foundation for the potential evolution of the UFF model. Although a significant body of literature exists regarding the operational nature of brokers and 3PLs, the UFF concept has only been described in nonacademic news releases about new companies in this space. Furthermore, there has not been full agreement amongst these articles in defining the UFF business model, its value proposition and how UFF differs from a broker's service offering. Because UFF startups have kept many operational aspects private to maintain competitive advantage, most descriptions of the service are broad at best. Based on the available information and interviews, this research develops a theoretical UFF model and then tailors it to the sponsor company's case involving the shipment of hazardous materials. This case study can be used as an example to determine UFF's benefits, shortcomings and most importantly, if it will work as it pertains to the hazardous chemical industry.

3. Methodology

3.1 General research design

This section presents the operational context and approaches to investigating opportunities and challenges of innovative transportation solutions such as UFF. The methods described in Figure 4 are designed to determine how UFF will fit into the sponsor company's logistics. The company sponsoring the research is a global chemical manufacturer and therefore our research is tailored to their specific environment. One of the primary focus areas is to analyze whether or not the UFF concept will work with shipping hazardous materials. Hazmat is an interesting problem due to the rigorous standards and potential consequences in this specialized industry. However, even if the UFF business model is deemed too challenging for hazardous chemicals, the sponsor company and other shippers transport other less hazardous chemicals for which this model could be a game-changer.

This research also explores different models in the "sharing economy" and adjusts them to the shipping of hazardous chemicals via trucks. This research will be combined with intimate knowledge of the sponsor's company that will be obtained through interviews. Additionally, interviews were conducted with third-party companies pioneering the UFF concept. Lastly, the research and interviews will be synthesized to refine the model and make recommendations about the potential application of the UFF model within the sponsor company. Figure 4 below illustrates an overview of our methodology.

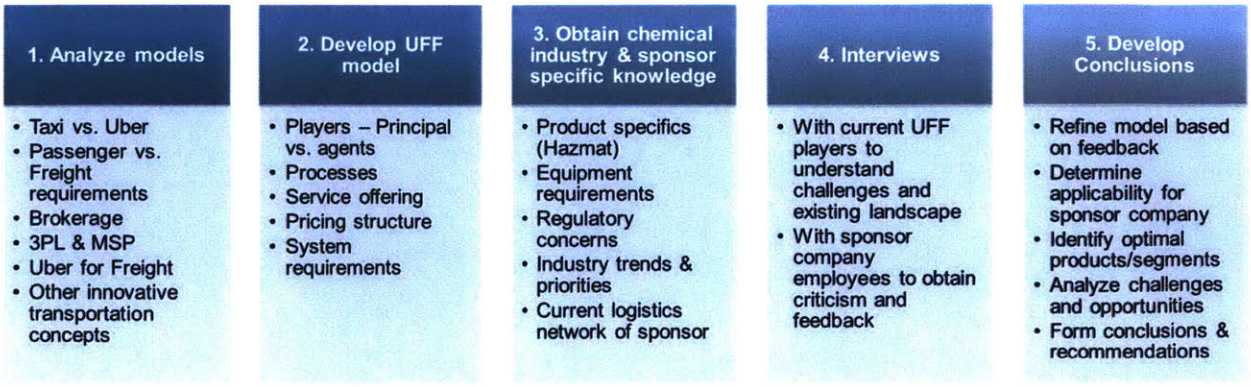

Figure 4: Overview of UFF methodology

3.2 Model analysis

As the UFF model is still fairly primitive within the industry despite increasing interest, a theoretical model will need to be generated based on existing business models in the "sharing" and trucking industry. Therefore, answering the following questions regarding business models in general will be helpful in developing the UFF model:

1. What perceived needs can be satisfied through the new model design?
2. What novel activities are needed to satisfy these perceived needs? (business model *content* innovation)
3. How could the required activities be linked to each other in novel ways? (business model *structure* innovation)
4. Who should perform each of the activities that are part of the business model? Should it be the company? A partner? The customer? What novel governance arrangements could enable this structure? (business model *governance* innovation)
5. How is value created through the novel business model for each of the participants?

Figure 5: Questions for developing business models applied to UFF (Amit & Zott , 2016)

3.3 Freight industry analysis

To answer the "perceived needs question," research needs to be performed on the freight industry as a whole. Understanding the freight industry is crucial because it will determine its inefficiencies and how UFF will evolve to eventually address those needs. A crucial foundation to the research was the "Innovations in Transportation Roundtable: Impact of New Technologies", hosted by MIT CTL in the Fall of 2016. At this event, "shippers, carriers, brokers, and technology firms engaged in a highly interactive roundtable" (MIT Center for Transportation and Logistics, 2016). This day-long seminar was helpful in obtaining an insider's perspective into the logistics industry and the current problems that participant companies are facing. Also, it was an opportunity to learn about the possible advantages of an UFF business model from people pioneering freight technology.

The next crucial piece was a deep dive into the literature that surrounds the industry. This in-depth research provided a thorough understanding of how business dynamics and policies shaped the market into its current state. This research exposed current market inefficiencies such as visibility, under-utilized loads, non-transparent shipping rates and key players. Understanding these inefficiencies will help determine the problems that an UFF business concept would solve. As a result, the business model can be described utilizing these concepts and marrying them to the "sharing" economy model that is proliferating in numerous industries.

3.4 Uber for Freight (UFF)'s evolution

To answer the question of what UFF will evolve into, this research needs to answer what "novel activities are needed" to fix the problems in the freight industry (Amit & Zott , 2016). The best way to determine these "novel activities" is to look at very similar industries and the new consumer "sharing" models. Therefore, researching the taxi industry and how ride-sharing services have grown exponentially will be used as a starting point.

The Uber Inc. (the US-based ride-sharing company) versus taxi case is utilized due to its similarities to the freight industry. Instead of transporting cargo, drivers are transporting passengers. Additionally, there are low barriers to entry for the Uber Inc. concept as it allowed anyone with a car to become a "taxi" driver. Understanding the taxi industry requires defining the principals and agents in the taxi model and how they were redefined by the Uber Inc. model. As discussed in the literature review, the trucking industry in the US was deregulated, which created very low barriers to entry. Therefore, the research uses the principal-agent model depicted in Figure 6 below to create the UFF model.

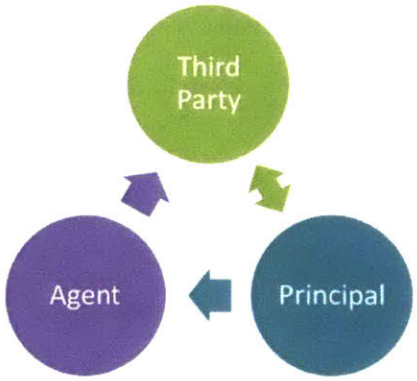

Figure 6: Principal-agent model

The model shows, a principal (e.g., a buyer) and an agent (e.g., a supplier) in addition to the third party that orchestrates the transaction. This model establishes the roles of shippers and carriers in the UFF model based on how principal-agents evolved in the taxi versus Uber Inc. model. This research specifically focuses on how the third party is transforming the roles and responsibilities of each party in the model.

After researching the taxi and ride-sharing industries, the novel concepts in Uber Inc. were identified by analyzing the differences between pre-uberization and post-uberization states. The biggest transformation after ride sharing services such as Uber Inc. became established was increased ownership for drivers and passengers in the decisions they make when utilizing a ride service. This is done through an application on smart-phones and is completely automated. Using this same "novel" concept and applying it to the freight industry would now define the capabilities and limitations of the UFF model. Specifically, the biggest operational advantages are the introduction of a rapid payment system, increased transparency to all parties involved, and removal of the need for a 3PL or broker. The illustration of the principal, agents and third party are incorporated into the UFF model as depicted below in Figure 7.

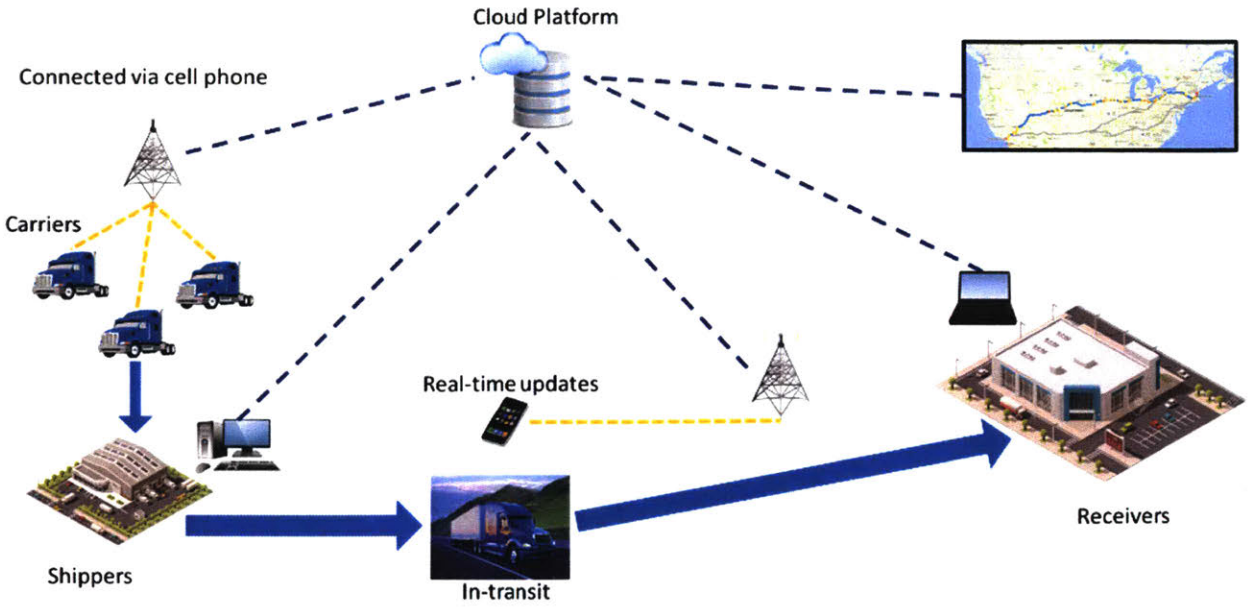

Figure 7: Simplified operational illustration of Uber for Freight (UFF)

Fundamentally, the shippers (the principal) contract a carrier or driver (the agent) through a more sophisticated third party (UFF). This sophistication and expertise stem from UFF's visibility into real-time data of the spot-market and transparency in the shipping process. This is different from Figure 1 where the third party was the broker who could not provide simultaneous load updates and live spot market prices to all parties; there was always a delay, however small, due to the broker model's inherent requirement for human intervention. While shippers, receivers and carriers can call brokers to receive load locations and real-time spot market prices, it is a somewhat inefficient process. This is comparable to the taxi model where passengers had to call dispatchers to request taxis or prices to understand their options. Other items such as certifications, ratings, and flow of information were developed in a very similar manner utilizing the principal-agent model for UFF and will be illustrated in the UFF model.

Developing and understanding how the UFF model will work in the logistics industry is one of the crucial parts of this research. As a result, it answers the last two key questions from Figure 5 in developing innovative business models. It defines who the participants are and their roles in addition to where "value

is created" (Amit & Zott , 2016). These two concepts are important as the UFF model will be explained to sponsor company interviewees to obtain their perspectives on how hazmat will be managed.

3.5 Chemical industry research

After analysis and formalization of the UFF model, the next step was to develop a foundational knowledge of the chemical industry and its specific requirements, especially pertaining to logistics and transportation. This step was a prerequisite to understanding how and where the model could be applied to chemical shipments and was incorporated into the literature review. This portion of the research relied on the following two sources of data:

Scholarly articles and peer-reviewed publications: Respected publications detailing the current state and history of the chemical industry were reviewed. These sources covered the following topics:

- Industry size, growth projections and competitors
- Types of products, hazardous classifications, etc.
- Portfolio and priorities of major players
- Containerization and packaging materials
- Transportation landscape and typical modes
- Driver, carrier and equipment requirements
- Storage and additional services (including loading/unloading procedures)
- Safety, security and risk considerations
- Regulatory environment
- Relevant stakeholders

Unstructured interviews with industry participants: In addition to formal academic research, three informal interviews were conducted with industry participants external to the sponsor company. Details of the research were not shared; the context of the engagement was explained as improving

the researchers' basic understanding of the industry for writing a chemical-related thesis. The intent of these interviews was to better understand real-life challenges associated with chemical transport and ask follow-on questions from the academic research. The interviewees were employees of chemical or chemical logistics companies.

The knowledge gained from these two sources was combined before evaluating the applications of UFF to the chemical industry and the sponsor company.

3.6 Qualitative research methods: interviewing

Due to the novelty of the UFF concept, this thesis is exploratory in nature and does not involve detailed numeric or quantitative analysis; there is limited data available from existing players in this space or within the sponsor company. In discussions with the sponsor company and advisor, it was determined that the feasibility and applications of UFF should be analyzed through a qualitative lens. When designing this research's qualitative methodology, the following major components as recommended by Bryan & Bell were considered and incorporated:

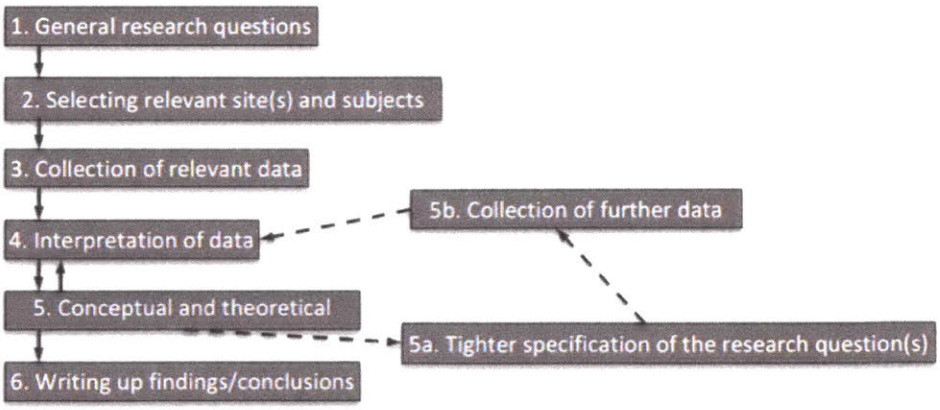

Figure 8: Bryan & Bell's components of a qualitative research methodology

Although alternate qualitative research methods exist such as questionnaires and participant observation, the interview method was chosen as the most feasible and effective approach for this topic. Questionnaires are useful for obtaining deductive feedback based on existing theory which does not currently exist yet due to the novelty of UFF. Participant observation could have been utilized to better understand the sponsor

company's processes but was not possible due to geographic and budgetary limitations. The interview method helped to build a better understanding of the problem for the researchers as well as allowed crowd-sourcing of improvements to the UFF model, constructive feedback and criticism.

In terms of interview mode, many choices are available but as compared to questionnaires or surveys administered electronically, phone interviews were chosen to support a more natural flow of discourse. Additionally, live interviewing allowed the interviewers to steer and adjust the conversation to better address the research goals. Interview guides were developed and sent to interviewees in advance of the meetings to improve response quality and encourage preparation. Two types of interviews were conducted with separate interview guides (see Appendix A for an example interview guide – versions with slight modifications were shared with interviewees prior to the meeting):

UFF Current Players: These interviews were conducted first with select startups and operating businesses utilizing the UFF or a similar model. The primary objective was to understand the UFF model, its challenges and the current state of the industry. Interview requests were sent to 8 companies, and 4 responded agreeing to participate. The names of participating companies will not be disclosed due to confidentiality and competition concerns. Due to the relatively small number of interviews, information on other companies was gathered through researching publicly-available data online.

Sponsor Company Representatives: After the first set of external interviews, 8 interviews were conducted with various representatives within the sponsor company that were chosen by the thesis point of contacts. The selection process of the company representatives was done with a balanced view in mind, blending different regions, functional groups and levels within the company to obtain diverse responses and points of view (See Table 3 for interviewee positions and functions). The purpose of these interviews was to first explain the UFF model and then to gather feedback regarding the model's benefits, pitfalls and potential application within the sponsor company. These interviews also served as the main basis for the researchers' understanding of the sponsor

company's logistics network and current processes. An eighth interview was also conducted with the company's third-party logistics provider (3PL) to understand their involvement in the company's logistics decisions and how UFF could be integrated into their systems. The following table lists the positions of the sponsor company interviewees:

Interviewee	Position	Function
1	Director Transportation Services	Transport Management Surface
2	Executive Assistant	European Site Logistics Operations
3	Global Leading Functional Expert	Site Logistics Operations Bulk Storage & Transport
4	Global Functional Expert	Site Logistics Operations Bulk Storage & Transport
5	Senior Vice President	European Site Logistics Operations
6	Vice President	Regional Supply Chain Services Europe
7	Senior Vice President – Chief Supply Chain Officer	Global Supply Chain Strategy & Performance
8	Group Manager	Domestic Transportation Procurement

Table 3: Interview list of sponsor company representatives

One limitation or constraint of these interviewing choices is that sampling bias is inherent in the interviewee selection process. Because the representatives were not selected at random but based on relevance to thesis topic, relationship with thesis points of contact and past level of support, this research's selection process exhibits qualities of purposeful and convenience sampling. Due to the specificity of the thesis topic and the experience or knowledge required to provide relevant insight on the UFF model, a less biased approach such as random or probability based stratified sampling was not considered fruitful, as the subject of the study required in-depth insights into logistics operations. Furthermore, due to the short timeline and limited availability of interviewees, the number of interviewees could not be increased although a larger sample size would be ideal (Bryman & Bell, 2011). Following the lines of Fawcett and Waller's thinking that theory and practice should be confronted in a straightforward and systematic manner that is of value for both academics and practitioners, the researchers and the sponsor company reached agreement that the proposed methodology was sufficiently detailed and unbiased for the sponsor company's purposes while also adhering to academic standards (Fawcett & Waller, 2011).

3.7 Interview guide development

Weiss' guidance was utilized in developing the interview guide (Weiss, 1994). In terms of length and appointment scheduling, each interview should last no longer than one hour to maintain focus and engagement. The guide should include placement questions (to get to know the respondent and understand context regarding their current role and their past experiences), open questions (designed to obtain impartial feedback without influencing or directing responses) and semi-open questions (to revisit interesting topics or probe deeper into previous answers) (Weiss, 1994). In addition to the question types and wording, per Bryman & Bell's recommendation, a concerted effort was made to follow a logical structure and use comprehensible language (especially since some of the interviewees were not native English speakers) (Bryman & Bell, 2011).

3.8 Interview execution

Efforts were taken to "minimize the 'contamination' of interview data by the interviewers through both the development of an interview guide and the execution style of interviews, as this is a common concern with the interview method (Thorpe & Holt, 2008). The researchers employed a balanced interview approach; while a non-directive or unstructured style more closely mimics normal conversation and makes the respondent more at ease, the use of an interview guide provides structure and consistency (Thorpe & Holt, 2008). Out of the three interview types (structured, unstructured and semi-structured, the semi-structured approach was taken to benefit from the interview guide but still maintain some flexibility (Bryman & Bell, 2011). While the interview guide was followed for the most part, questions were skipped or adjusted to better suit the interviewee's experiences and knowledge of the subject. Additional questions were also added spontaneously based on previous responses and topics of interest. The interviews were performed via WebEx (without video), were audio-recorded (with permission) and annotated with hand-written notes to promote recall accuracy. In terms of data confidentiality, all interviewees were guaranteed anonymity in the written thesis to obtain their unbiased and truthful opinions. All interviewee statements described in this research were accurately summarized to the best ability of the researchers.

Personal interviews, although advantageous for gauging non-verbal feedback and establishing interviewer trust, were not possible due to respondents' geographical location and cost (Zikmund, 2003). Furthermore, the researchers believe that the use of in-person interviews person would not change the content or quality of overall findings. The interviews were conducted by two researchers which is believed by Bechhofer, Elliott and McCrone to be advantageous to the interview process; with two researchers, one interviewer can actively lead the interviewer while the other research assumes the role of the "passive" interviewer, taking extensive notes and making sure topics are covered appropriately. Additionally, the use of multiple interviewers typically produces a more informal atmosphere which fosters a better discussion between just two people. Some disadvantages include cost and coordination between the two interviewers but these were not pertinent issues in this research (Bechhofer, Elliott, & McCrone, 1984); conducting the interviews did not incur any costs as an internet-based telephone service platform was used and the researchers actively managed the concern of coordination by planning which researcher would manage each section of the interview guide.

3.9 Post-interview processes and research applications

After completing the interviews, the methodology design followed steps 4-6 in Figure 8, namely interpretation of data, conceptual and theoretical analysis, and writing up findings and conclusions. Although the interviews were recorded they were not manually transcribed due to time and cost constraints. Notes taken during the interview and the audio recordings were used as references to recall interview content and address any unanswered questions. Content from the interviews was synthesized by the two researchers to identify overarching trends as well as discrepancies between interviewee opinions and statements. This process of identifying categories or themes varies among researchers and ranges in formality. While it is recommended that this task be performed and/or verified by a third party to avoid bias, this process was performed by the researchers to limit costs (Creswell, 2009). Due to the sample size limitations and diversity of the interviewees (each interviewee's role reported into a different business unit, region, or function), the reduced benefits of a formal coding system did not merit the required time

investment. Based on the performed analysis, the researchers formed recommendations on potential applications of the UFF model within the sponsor company. In alignment with Wilson's recommendations for qualitative analysis, these processes can be summarized as analyzing data, generating themes and patterns, interpreting findings and developing conclusions (Wilson, 2014).

These speculative recommendations are highly dependent on the sponsor company's strategy, portfolio and the UFF industry in their current states. As the UFF marketplace develops and information regarding the profitability and performance of this business model becomes available, these conclusions should be adjusted. Specifically, pricing information, if available, would assist in quantitatively assessing the cost effectiveness of UFF. Further and more detailed research on this topic is encouraged before investment.

4. The Uber for Freight (UFF) model

4.1 Operational overview

The UFF model is a fairly new and a continuously evolving model. To help construct the model, interviews with some of the leading UFF companies were used to obtain knowledge on operational aspects of UFF. As one director of an UFF company explained, "Pricing and negotiation are done without picking up the phone." This concept (as depicted in Figure 9) illustrates the ability for a shipper and carrier to communicate with each other without the traditional means of human intervention via a 3PL or broker.

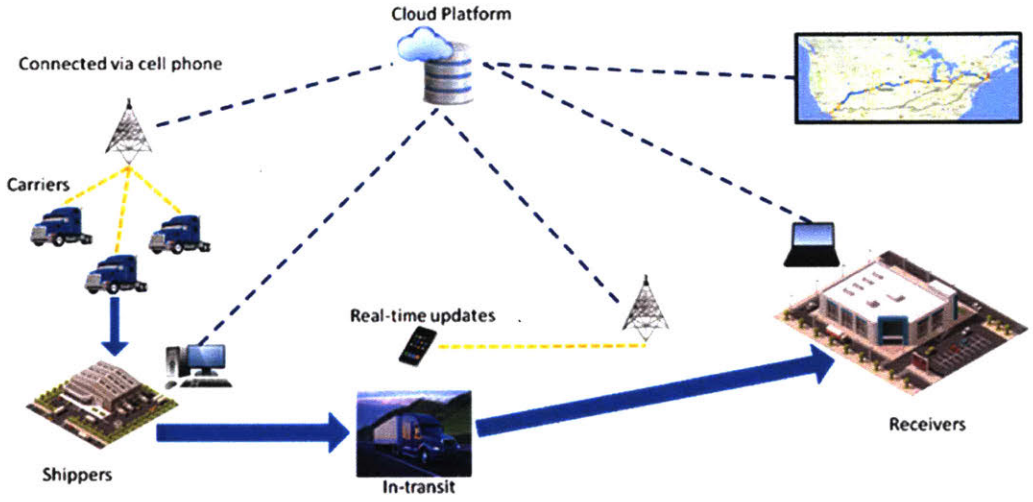

Figure 9: Simplified operational illustration of Uber for Freight (UFF)

Compared to the current method via brokers and 3PLs, this process streamlines the entire transaction and removes the need for a dispatcher, thereby decreasing throughput time and reducing cost. As illustrated in **Error! Reference source not found.**, a shipper in need of a carrier can utilize an application on a smartphone or a computer platform which provides visibility on spot market availability. In the traditional broker model, a shipper must call a dispatcher and wait to get an updated position. An algorithm calculates the spot market price by determining the number of trucks that are available locally and the current demand (taking into consideration load requirements and driver or truck capabilities). If the shipper agrees and accepts the current spot price, an algorithm will match a carrier to the shipper based on load requirements.

These load requirements can be based on size, weight, classification, destination, route, carrier qualifications and certifications to name a few variables that UFF companies will have to include. When the load is accepted by the carrier, the driver will then pick up the load at the desired time and location and deliver it to the receiver.

4.2 UFF, a Broker or a 3PL?

From the previous overview, it can be concluded that UFF's purpose is to connect shippers and carriers as a traditional broker normally would. The primary difference between the traditional broker model and UFF is how shippers and carriers will be matched. A traditional broker uses human dispatchers to match the load while UFF would use an automated algorithm. Comparing UFF to a 3PL yields several other differences. As mentioned in Chapter 2.4, 3PLs provide a vast array of services like software, data integration, and supply chain strategy. However, UFF is only supplying a platform and a means to connect shippers and receivers. While software facilitates the carrier-shipper transaction, it is unlikely to serve as a complete solution for a company. UFF in its prescribed form will not work with shippers seeking a partner to help them become more efficient, other than potentially reducing shipping costs and streamlining the dispatch process. While there is potential for 3PLs to use the data collected by UFF to help provide consulting and other value-added services to shippers, carriers and receivers, it is not currently the scope of the UFF model. As a result, UFF will be considered as a type of broker model since its main goal is to accomplish the basic task of connecting shippers and carriers.

4.3 Players & Stakeholders

To determine the players and stakeholders in UFF and the relationships between them, the principal-agent framework was applied. In the traditional broker and UFF models, the principal is the shipper. They are the entity that has a requirement – for their loads to be transported. If the shipper does not have its own private fleet or it requires additional support, then it will acquire extra shipping capacity from a carrier (agent). In the broker model, a dispatcher from a broker facilitates this transaction between shipper and carrier. The

broker will field the request from a shipper, then it will utilize its network of carriers to supply the best option to the shipper. In the UFF model, the broker is replaced by a completely automated electronic platform. As UFF gains adopters, there will be competition between the companies operating under the UFF model and those that are operating as a traditional broker or 3PL. UFF also creates competition for the proportion of carriers that work directly with shippers.

For this project, the primary concern is how the UFF model will fit into the sponsor company with regards to hazmat. Therefore, the four primary stakeholders in UFF are the receivers, shippers (sponsor company), UFF and the carriers that ultimately transport the load. In this case the receiver will handle contracting the load; this task will be completed by the sponsor company. To illustrate how the receiver is a stakeholder, here is an example of one of the difficulties that can arise with a receiver: If the load is not delivered in a timely manner, there could be significant consequences for both the receiver and the shipper. A receiver or customer, demands a certain level of service from the shipper depending on the product and contract. If this a shipment is delayed, this could have cost consequences for the receiver (e.g. plant shutdown, production delay, etc.) and contractual penalties against the shipper. Therefore, if the carrier contracted by UFF does not deliver, the two parties will need to determine the root cause. Subsequently, UFF may take some prescribed action against the carrier or driver, such as banning the driver or giving higher priority loads to other carriers. Additionally, UFF and the shipper will need to have a discussion to determine whether this was preventable and what remedies need to be put in place. As a result, the receiver is just as much of a key stakeholder in this process as the other three entities.

In this context, the receiver could be any one of the thousands of customers that the sponsor company serves. Likewise, carriers can be any of the carriers or drivers that are qualified to ship the load. The only two constants parties in this case are the sponsor company and UFF. Another important stakeholder group in the model is the drivers. They can be independent drivers and therefore act as carriers on their own, or they can be drivers that work for a carrier. The number of qualified truck drivers in a particular area will influence the spot-market price, and the quality of the driver's performance will determine the customer

service received. For UFF, the drivers that the sponsor company seeks are primarily those who are qualified to transport hazmat loads, in terms of certifications and equipment.

4.4 Benefits

The UFF business model can provide several benefits to all parties involved. One promising aspect is increased transparency of the spot-market price to the shippers and real-time load updates to all stakeholders. In terms of pricing, UFF could prove even more beneficial if it is able to provide a breakdown of the pricing components, like Uber Inc. does within the passenger context (per minute, per mile, booking fee, etc.). UFF could breakdown the load cost so that shippers know why a price is high or low (due to factors such as load complexity, distance, driver shortage, load size, etc.). Although this may not be possible or wanted by the carriers, it would be beneficial to shippers if this type of breakdown was transparent.

As long as a truck driver has cell phone service, he or she can be tracked before and after picking up the load. One of the problems with brokers is that if the shipper or receiver wanted to know exactly where the load was they would have to call the broker. Traditionally, this would require the 3PL to call the carrier or the driver to get an update on the trucks position, then it would be fed back to the shippers and receivers. The entire transaction requires three phone calls at a minimum but often more. While some 3PLs and brokers are publishing location data as part of their value-added service, with UFF this would be a standard feature for all customers. Since the flow of information is conducted via a Smartphone, the driver (and respective carrier) is automatically opting in to being tracked as part of the platform's basic capabilities. In this system, the shipper and receiver have constant, real-time visibility to the load with updates on any potential delays without requiring additional services from their 3PL or broker. Constant connectivity and real-time positioning also could be a benefit by facilitating rerouting based on hazards (e.g. traffic, accidents, extreme weather) on the current route. Consequently, UFF may achieve improved customer service through automated monitoring and updates. Based on customer demands (some customers do not need or want real-time information on their cargo) the reporting of milestones (e.g. load picked up, en route to cross-docking, on the way to final destination) may be sufficient. The researchers envision that UFF

would allow customers to customize their notification settings to meet their needs at the company, business unit, lane or individual load levels.

The transparency to spot-market pricing provides benefits to the carriers, drivers and shippers. With visibility for all, each entity has much more ownership over its individual decision-making process. A shipper has the ability to look at the price and make the decision about whether it is cost-effective for them to ship the load at the current moment. However, this could be a risk since there is no guarantee for future capacity at a lower rate. This may also affect mode decisions. Extremely high spot pricing could shift non-time-sensitive loads to rail or sea and vice versa. In a similar manner, carriers and drivers can perform the same decision-process to determine if the load is worth the resources and costs to work. As an example, drivers could be incentivized to work if capacity drops and spot market prices begin to increase. UFF companies could also consider alternative incentive mechanisms for drivers. For example, companies such as Lyft or Uber Inc. often provide small bonuses to get drivers on the road during peak or inconvenient hours. This decision-making ability empowers the driver to accept loads when he or she benefits and ideally deliver better customer service as a result. Drivers will theoretically have greater ownership of the load-acceptance process and should deliver better results in the long run, which is beneficial for the system's overall level of service.

In addition to higher levels of customer service, the cost is likely to be reduced in the long run. In a traditional broker model, the 3PL can demand up to a 30% commission for matching a carrier to a load. This cost covers the broker or 3PL's operating expenses with a built-in profit. This is not very cost effective for the shipper, carrier and driver. Therefore, the proposed value added by UFF is the ability to match these loads automatically and therefore reduce the commissions charges built into the price. This hypothetically will be attributed to the lower labor cost required to run the dispatching operations. This could possibly result in higher pay for the driver and/or a lower load price for the shipper. These cost and wage benefits will eventually encourage more shippers, carriers and drivers to join UFF. By increasing options available and the size of the system, UFF will become increasingly attractive for others to join. Therefore, a positive

reinforcing "pull" effect could be created that will cause increased membership, just as in the traditional Uber Inc. model. In summary, UFF offers many benefits and has the ability to revolutionize the trucking industry, but the system requires a certain level of density (of drivers and shippers) before it takes off.

The backbone of the UFF system is extremely efficient transactional processes powered by information technology. As depicted in Figure 9, all parties (receiver, shipper, carrier or driver) exchange money and information as part of the UFF model. As a result, a new set of functionalities and benefits can be built into the UFF model. One component could be the driver rating system, which is a pillar of transparency in the traditional Uber Inc. model. All entities in the transaction have the ability to rate each other based on their experience and level of service. A leader of an UFF company explained, "Tribal knowledge of the trucking industry" was required to know who the bad shippers, receivers and carriers were. Now with the aid of a 5-star rating system, all entities can rate each other. When the data is compiled after many transactions, trends can be discerned that improve decision-making capabilities for all parties. The data collection process has the added benefit that companies can use these trends to repair their inefficiencies and create more value for their business. Consistently poorly-rated drivers can and should be pushed out of the system to improve the overall satisfaction of all parties.

In addition to ratings, the database will contain additional information about carriers and drivers. This database will maintain the certifications, qualification and license information necessary for matching certain loads. This data will allow for an algorithm to pick the best carrier based on the load requirements so that the right truck, with the right driver is accepting each load. The algorithm will remove the possibility for human error from the transaction process that may occur within a 3PL or broker.

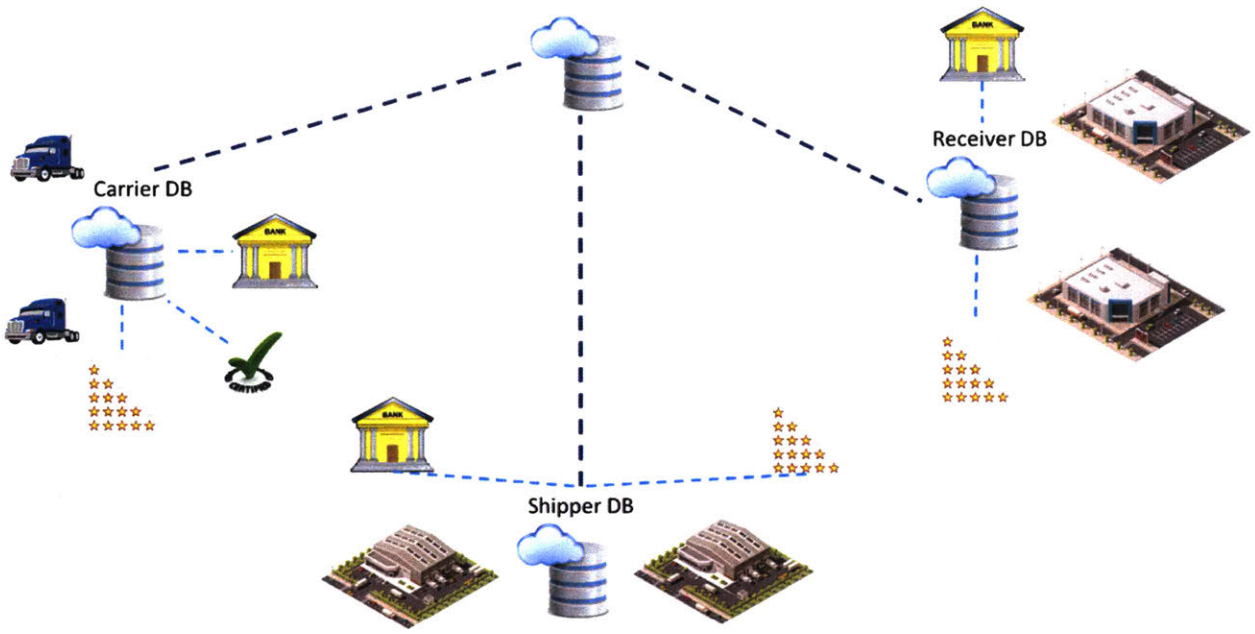

Figure 10: UFF transactions, payments and ratings

The last part of the process is the payment. As illustrated in Figure 10, UFF is the entity responsible for collecting the payment from the shipper and passing payment onto the carrier or driver. The payment will be done automatically, electronically and securely since all bank information will be stored in UFF database. Therefore, payments should theoretically happen instantaneously, giving the truckers immediate access to their money. This benefit allows truckers to receive their money earlier, potentially causing them to rely less on credit and reduce their overall costs while also reducing the risk of carrier bankruptcy due to unpaid invoices. However, payment terms could be adjusted if contracts stipulate otherwise.

4.5 Drawbacks

While UFF could dramatically change the dynamics of the trucking industry, of course there are several concerns and barriers to be mitigated. First, with the tracking of all trucks, there is a potential security concern linked to data ownership. If the information about routes and location of hazardous freight is compromised, this could give potential targets to terrorist groups. Data must also be protected from the shippers' competitors to prevent exposure of potential competitive advantages. Additionally, individual drivers are now able to compete for loads that they did not have access to previously via a broker, 3PL or

shipper. Therefore, the quality of some drivers (specifically brand new unrated drivers) may actually be worse than what a shipper previously received. This could result in problems for shippers and receivers desiring a high level of customer service. This might, however, not be relevant for hazmat handling or loads with high customer service requirements as shippers might continue to work with "trusted" drivers, regardless of cheaper alternatives in the system. Additionally, challenges may arise in the initial stages of UFF when the quantity of onboarded shippers and carriers is low. Drivers and equipment may be located geographically far away from load pick-up points. The benefits of price and services will be diminished as if there are not many carriers or shippers to choose from. Until more principals and agents join UFF, it will be hard to differentiate the clear advantages UFF can offer in the long run as this type of system's success depends on density and scale.

4.6 Challenges of implementation

While Uber Inc.'s passenger model has accomplished global scale and a high-density network of passengers and drivers in most cities (predominantly in the US and a few other selected countries), UFF has not yet achieved the same success. A major difficulty in growing density (shipper and carrier or driver base) will be the number of shippers and carriers in a given region. One of the primary reasons for Uber Inc.'s success was the influx of additional capacity into the marketplace. By easing the high barriers to entry that existed for taxi drivers (medallions, background checks, etc.), the pool of potential drivers and vehicles grew exponentially. In the UFF space, none of the interviewed UFF companies are bringing any additional capacity (drivers or assets) to the market; they are simply increasing the system efficiency used by existing shippers and receivers. While autonomous trucks will increase capacity by addressing the driver shortage, this will require several years of substantial progress in technology and policy before it becomes possible. Currently, there are multiple UFF companies operating, but they are struggling to get customers to subscribe to and utilize the model. While Uber Inc. was able to gain traction city-by-city due to the short distances and smaller range of passenger transport, this is more challenging for UFF; most lanes span hundreds of miles, especially within long haul shipping. Without the differentiation and the density to have a true price

for the spot-market, it will be hard to gain further customers. If prices are not competitive, shippers will continue to utilize a broker or 3PL to contract all of their capacity needs.

In addition to price concerns with UFF, regulatory concerns are another point of contention. 3PLs or brokers can specialize in certain segments of the trucking industry such as hazmat or refrigerated goods. Therefore, 3PLs or brokers are well suited to be the experts on the certain requirements required by industry for very specialized loads. These specific requirements can extend to special licenses, routes, permits and driver qualifications to be within regulatory bounds. The sponsor company currently works with 3PLs and brokers to approve carriers based on a proven track record and imposes additional requirements on carriers. For a company providing UFF services to reach this level, it would require extensive insider industry knowledge and development of a complex algorithm to meet the same levels of service and regulatory rigor currently provided by 3PLs and brokers. AN UFF company would need to have comprehensive understanding of the individual shipper's needs and be able to tailor their platform accordingly. Considering that there are thousands of shippers and carriers, this could become very arduous for the UFF. Layering regulatory and qualification concerns on top of the density required for success, UFF face several extremely challenging problems to solve in their early phases. Without attention to these issues, the UFF model's success will be limited to general freight applications.

5. Sponsor company operational analysis

Before analyzing the impact of integrating an UFF model, it is critical to understand the sponsor company's current operations in its major markets. This includes a basic overview of the freight-booking process as well as region-specific procedures and challenges. Although the sponsor company has global reach, this research focused primarily on the North American and European markets which combined, comprise over 70% of revenues. The company also operates in South America, Africa, the Middle East and Asia Pacific. This information was gathered through interviews with sponsor company representatives, discussions with the project champions and company-produced media.

Before addressing region-specific details, many operational processes and challenges are similar across the globe. Within the sponsor company, the logistics procurement group is responsible for selecting and approving carriers, brokers and/or other transportation service providers (referred to collectively as suppliers). Like many companies, this is done by lane but must also be separated by product type; depending on the chemistry and nature of the product, suppliers must meet certain regulatory and internal standards in terms of quality, equipment and safety. Sourcing activity is typically conducted on an annual basis and then routing guides for each product type/lane combination are created based on ranking of the received bids. Procurement must prequalify and onboard every supplier before they can begin shipping freight; suppliers are then monitored with monthly KPIs (on-time pick-up, on-time delivery and compliance to tender) and audited on an annual basis. Although sourcing processes are dependent on business unit requirements, suppliers are selected based on a combination of pricing, delivery reliability, safety and other factors. For their trucking supplier base, the sponsor company utilizes a combination of carriers and brokers. Dedicated carriers are typically used for more complex freight (hazardous, etc.) but some brokers are also capable in this realm. Brokers are typically used for low frequency lanes with less than fifteen loads per year, but can be utilized for the spot market (when none of the contracted up to four to six carriers per lane can accept the load or it is a new or uncontracted lane). When the sponsor company utilizes brokers, they audit and

monitor the performance of the broker with the same metrics as carriers, not the individual carriers that the broker ultimately assigns. The sponsor company is not currently using any UFF-like providers.

The developed routing guides are then integrated into the sponsor company's transportation management systems (TMS). The TMS is operated and monitored by either a third party or the company's shared services organization. When various business units submit delivery notices, the TMS is utilized (either manually or automatically) to conduct the tendering process and assign the load. The TMS verifies that the appropriate carrier and equipment are assigned based on the product's specific requirements. It also is a source to monitor shipments through receipt of loading and delivery notices. The TMS is also used to collect on-time delivery, on-time pick up, claims, safety incident counts and spend by supplier (at the carrier or broker level).

It is also important to note that the sponsor company's wide product offering heavily impacts the way they manage freight. Each shipment can be unique in terms of equipment, service level and loading/unloading requirements. As an example, some business units operate in a commodity environment which makes freight costs critical to their ability to maintain competitive pricing. On the other hand, some specialty chemicals are proprietary to the sponsor company and/or have extremely high switching costs. For these products, service level is key and high transport costs are miniscule compared to the cost associated with a customer stock out. The sponsor company must develop and execute unique routing guides for each product-lane combination; a one-size-fits-all approach would not work.

The interviewees cited the following as global challenges related to chemical transport, their product mix and other operational factors:

> Company standards: Most interviewees described the sponsor company's internal standards relating to health, safety and the environment as very high, exceeding regulatory requirements in most cases. These policies require that the sponsor company's employees and suppliers operate with safety as the top priority. While this has been integral to the sponsor company's historical

success and corporate culture, these high standards reduce the number of potential suppliers that qualify and require additional monitoring efforts to ensure supplier compliance.

Organizational change: Several of those interviewed mentioned that the sponsor company historically has transitioned between a centralized (current state with a centralized shared services center used globally for freight arrangement) and decentralized (each business unit arranges its own shipments) supply chain organization. While the current centralized model is extremely efficient and takes advantage of economies of scale through load consolidations and other mechanisms, the central organization must recognize the different requirements of each business unit in terms of quality, service level and product type.

Company size: Due to the sponsor company's size and global footprint, there are many different parties (internal and external) involved in one transaction. These stakeholders may sometimes use different systems and procedures. Several interviewees mentioned that it is challenging to plan a complete solution or obtain an end-to-end planning view of the supply chain due to this complexity.

Product nuances: Although mentioned previously, the sponsor company must plan while considering the nature of the product being shipped. Numerous unique qualities of certain products were mentioned during the interviews. As an example, despite a package's small size, the weight-density of certain products would require a forklift to be loaded into a truck. Another example is that RFID tags do not signal properly in a truck full of metal drums. The sponsor company must be aware of and plan for these nuances.

Empty backhauls: A frequently cited obstacle was filling empty backhauls. Although this is a shared responsibility between the company and the supplier (carrier or broker), collectively they have had minimal success filling backhauls due to two reasons: (1) The nature of certain chemicals carried on the outbound load restricts what can be hauled afterwards and/or certain cleaning processes may be required before a new load can be taken on and/or (2) The geographical location

of company and customer sites limits the feasibility of finding return loads. Potential backhauls are not close enough to be economic.

5.1 North America

The following information was compiled based on sponsor representative interview #1 with the Director of Transportation Services for North American surface transport and an interview with a representative from North America's third-party transport management supplier. The sponsor company representative is responsible for transportation management, freight payment and management of the company's rail fleet but this interview focused primarily on over-the-road transport.

North American freight constituted over 700,000 shipments (inbound and outbound) in 2016. Figure 11 below shows the proportional split of shipments by mode; the two charts show the rough breakdown by number of shipments and by weight.

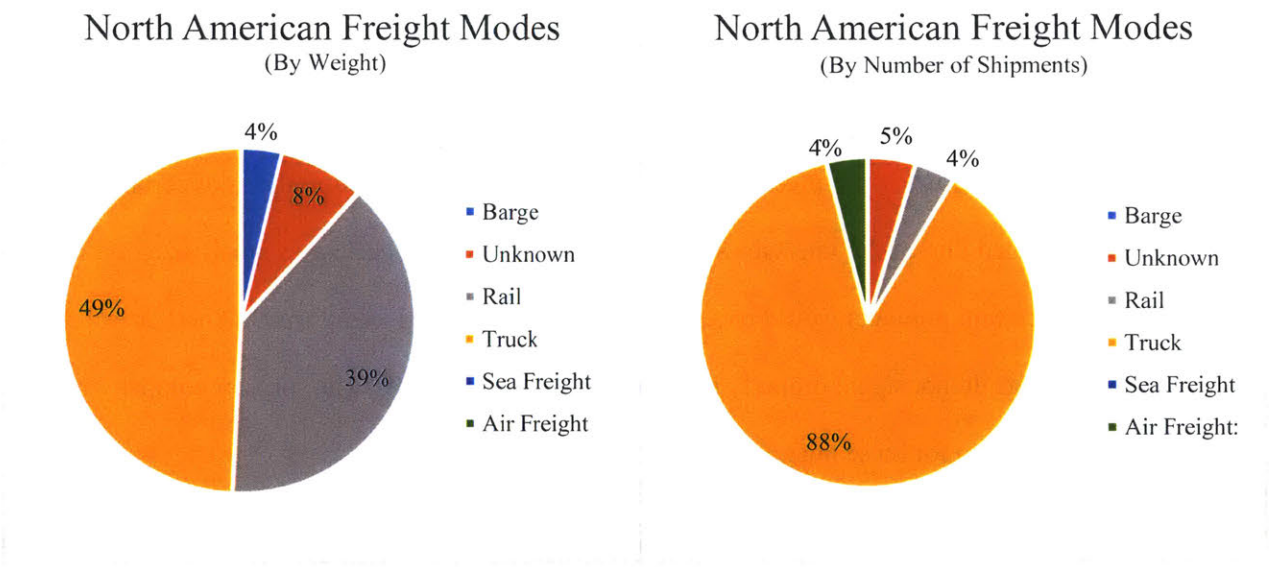

Figure 11: North America freight distribution by mode

Of the trucking component, about 75% is full truckload, less-than-truckload or package shipments and 25% is bulk chemical (by number of shipments). While the bulk providers typically have more experience with these products, the sponsor company's brokerages can handle all types of freight, including hazardous

materials. The bulk side is comprised of more regional and local carriers whereas most of standard carriers are well-known companies that operate nation-wide. Although detailed information was not available, interviewee #1 estimated that 40-50% of North American shipments are hazmat. As the sub-classifications within hazmat vary based on the risk profile of the product, only about 10-15% of these shipments would fall within the highest risk category. The interviewee noted that the consequences of an accident or safety breach with these shipments are so severe that UFF or a similar model would likely be impossible.

North American surface transport outsources most of its transport management to an external third-party supplier. In the past, command centers operated by the third party utilized the sponsor company's TMS for the freight booking process but this is transitioning currently; the sponsor company will be using the third party's more advanced TMS in the near future. This system will be cloud-based with improved freight consolidation opportunities, reporting and automated tendering. The routing guides (that include product-specific requirements) developed by procurement are programmed into the TMS. Logic tables within the TMS verify product mixability and compatibility if loads are consolidated; there are many checks and balances to ensure internal and regulatory compliance. The sponsor company's business units submit confirmed orders to the third party between six hours and six days in advance of the planned loading time but this number is more typically between three and five days. The third-party command centers then convert this into a shipment plan which triggers commencement of internal logistics operations. The ordering business unit is then charged a cost per transaction plus management fees to cover the transport arrangement.

For the tendering process, each routing guide (by product-lane) typically includes 3-5 carriers; the sponsor company's current tender compliance rate is close to full acceptance due to elevated capacity in the marketplace. The sponsor company will utilize the spot market when a tender is not accepted, sudden freight requirements emerge or a contract has not been assigned to a lane yet; this occurs for about ten percent of the sponsor company's freight requirements. Even when utilizing the spot market, the chosen supplier (carrier or broker) must be approved by procurement.

In North America, some current challenges include management of diverse customer requirements and system integration. Deployment of the third party's TMS is expected to improve integration and serve as the single source of truth for data (versus multiple reference systems currently). Additionally, the software will include best-in-class data visualization and reporting capabilities to eliminate some of the manual interventions that these activities require currently. The interviewee also recognized that although not a present issue, capacity is expected to constrict to an extent within the next few years due to driver shortages and other factors. With procurement, the North American surface transport organization will need to devise strategies to ensure the availability and affordability of transport on capacity-constrained lanes.

5.2. Europe

The proceeding information was gathered from interviewees #2-#6 who maintain different roles relating to the sponsor company's supply chain operations within Europe. The positions ranged in scope, some focusing on day-to-day operational activity and others guiding the strategic direction of the company's supply chain. Although this diversity provided a unique set of perspectives on the region's current state and challenges, none of these interviewees' roles specifically focus on trucking logistics. Thus, the researchers combined each of the interviewees' contributions to create a complete picture of the sponsor company's European logistics. Although this resulted in slightly less information on Europe than North America, the gathered data is sufficient to effectively understand the sponsor company's operations in this geography.

The sponsor company's European freight requirements are greater than those of North America with over 1.1 million shipments in 2016. Figure 12 shows the split by number of shipments and by weight. While data on outbound hazmat deliveries was not available, inbound estimates indicate that the sponsor company's main European site receives 2100 trucks a day, with about 17% carrying hazardous goods. Despite minor differences, both North America and Europe rely heavily on trucking to support inbound and outbound logistics.

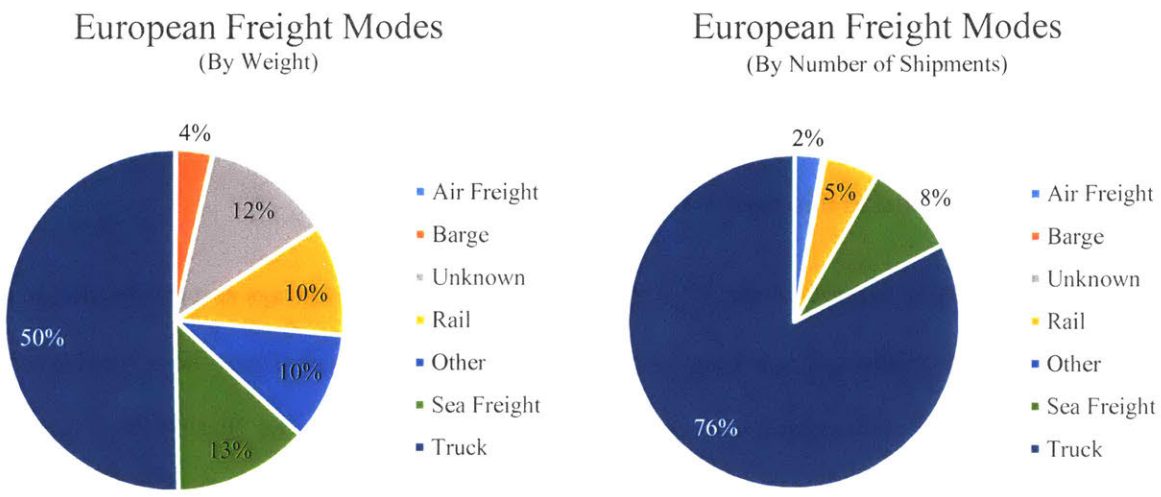

Figure 12: European freight distribution by mode

For the sponsor company's European operations, the freight-booking process is outsourced to their supply chain shared service organization rather than a third-party transport management supplier. Like in North America, business units submit their delivery requirements to the supply chain shared services organization and then the appropriate mode and carrier (or broker) are selected based on the contracts established by procurement; of course, this is dependent on the product type, lane and other factors. The cost of the supply chain shared services organization is billed back to business units via a fee per shipment.

The interviewees mentioned several region-specific challenges affecting European logistics. One difficulty mentioned was a lack of visibility into the location or status of a shipment. The sponsor company receives notifications when shipments leave the origin and arrive at the destination but sometimes do not have access to status updates in between. The interviewees' perception was that this is primarily due to reduced use of telematics in the trucking industry in Europe versus in North America. Interviewees cited that although many of their larger, more strategic suppliers have telematics capabilities, it is not guaranteed with smaller suppliers.

The variety of languages is also a region-specific issue for Europe; it is not guaranteed that drivers can speak and read in the native language of the site or destination. Two interviewees noted that this is due to

the inflow of lower cost labor from Eastern Europe. While all sponsor company sites make safety materials and briefings available in more than ten languages, the language barrier can still cause difficulties in the loading or unloading processes as the site staff may not speak the same language as the driver. Effective verbal communication makes this process safer and more efficient.

Lastly, the geography of Europe allows for increased use of barge on waterways as a transportation mode. Although this is cost-efficient, it is not necessarily reliable. The water level affects the allowable load and feasibility of shipments via waterways, sometimes reducing fillable capacity by 20-40%. This increase the price of freight significantly and companies must build flexibility into their transportation strategies to offset these costs. This is a cyclic issue for the sponsor company's European operations.

6. Analysis of Uber for Freight (UFF)'s application within the sponsor company

At the beginning of each interview, the researchers provided an identical explanation of the UFF concept to the company representatives to ensure proper understanding. Although the major players and processes were explained, some specific details of how the business model would work were left vague; this was done intentionally to obtain an unbiased view of what features the interviewees desired from the model. After explaining the general concept, the researchers asked a series of questions surrounding the potential benefits, challenges and structure of the model's application within the sponsor company. See Appendix A for a complete list of these questions.

As more interviews were conducted with sponsor company representatives, it became clear that many of the interviewees had preconceived opinions relating to the efficacy, challenges and benefits of the UFF model. While the interviews were not transcribed and quantified, the average sentiment towards the UFF model appears to be negatively biased; overall, the interviewees perceived the quantity and impact of the challenges to be greater than those of the benefits. This was somewhat expected due to the small sample size of successful UFF ventures to date. This bias could also be attributed to fact that the majority of the interviewees reside in Europe. As Uber Inc. and similar passenger models are not as prevalent in Europe, they may be less familiar with the uberization concept and therefore more skeptical of its benefits. Another possibility is that the negative sentiments stem from a concern that UFF's automation would result in a loss of local jobs (e.g. within brokers and carrier dispatching). While the intent of this thesis is not to advocate for UFF, the researchers feel that it is important to juxtapose the opinions of all parties (shippers, the researchers and UFF companies) on related issues. Although it is yet to be proven whether an UFF provider can successfully overcome these challenges, several mitigating actions are presented in response to each challenge listed in Chapter 6.1. Appendix B summarizes these perceived challenges of the interviewees (left hand column) and the researchers' or UFF companies' counterarguments and plans to address these concerns (right hand column).

6.1 Perceived challenges

Equipment requirements: As mentioned previously in Chapter 2, each chemical has different equipment requirements based on its classification and inherent qualities. For non-bulk chemicals (which could be hazardous or non-hazardous), products are shipped via standard box trucks but in different container types and sizes which may require additional equipment either within the truck or for the unloading process (straps, forklift etc.). For bulk chemicals, the product must be matched with the correct tank truck type depending on pressurization, safety and climate-control requirements. As mentioned in Chapter 0, there are seven main types of tank trucks which are available in varying sizes. Additionally, the driver must also be outfitted with certain personal protective equipment (PPE) such as steel-toed boots and a safety helmet to comply with sponsor company site policies. The interviewees expressed concern regarding how UFF would accurately match shipments to carriers with the right truck type outfitted with additional required equipment. They affirmed that shippers and carriers must be able to input their respective requirements and capabilities and be matched based on that information. UFF would have to have many input fields to account for the large variety of equipment requirements. Based on interviewees with currently operating UFF companies, this is an addressable challenge. While all of the inputs fields for this equipment or hazmat requirements may not currently be active now, this type of update would be relatively easily once an UFF company begins to offer hazmat services. Many sponsor company interviewees were concerned that even if this functionality was built into UFF, it would be difficult to ensure compliance, especially regarding the additional equipment and PPE requirements. However, it is important to note that this issue exists in the current system as well. Through the ability to provide quality feedback (through ratings) at the driver level rather than just for carriers and brokers, UFF may improve this challenge; if shippers submit poor ratings for repeatedly non-compliant drivers, they will eventually be removed from the system. Additionally, the sponsor company could consider a proactive approach by keeping spare PPE equipment at the site entrance.

This would likely be a relatively small expense in comparison to the consequent cost and delays of turning drivers away.

Driver requirements: Like equipment, certain chemical classifications require that drivers be specially trained and certified. In the United States, certain loads require drivers to obtain a hazmat (H) or tank endorsements (N) in addition to their Commercial Driver's License (CDL). These require a passing grade on a written test and a fee ("CDL Endorsements & Restrictions," 2017). Depending on the lane, drivers may also need a Transportation Worker's Identification Card (TWIC) if the site is within a port or waterway's vicinity. While the certification process is mandated and monitored by governments, carriers usually manage regular training for their drivers on hazardous material safety. Additionally, some sponsor company sites require that drivers participate in a brief training session (such as a video on location-specific safety procedures) before entering the facility. Drivers must typically renew the training process annually and this is monitored by the sponsor company. Interviewees stressed that the UFF platform must be able to verify and guarantee that driver have the correct government-mandated certifications with 100% accuracy. Similar to equipment requirements, these driver certifications would be a required input field for each driver within UFF's system. Based on the type of load, UFF would verify that it is matched to drivers with the correct certifications based on embedded logic tables in the algorithm. Regarding carrier-provided trainings, interviewees were concerned that the reduced barriers to entry in UFF (for carriers and owner-operators) may reduce the drivers' overall level of knowledge of hazardous material safety. UFF companies and the researchers argue that this assumption is somewhat unfounded. Provided that the driver has passed the respective hazardous materials classifications, they have sufficient knowledge to handle these loads per federal government standards. If the sponsor company or any shipper has additional requirements, these should be covered during site trainings or specified when requesting the load. For the site training, the interviewees supposed that use of UFF would increase the number of new drivers. This could

increase the number of sponsor-company required site-entry trainings and potentially slow-down traffic into the facility. Although this is possible, the researchers' opinion is that this is unlikely to have a significant affect. During pilot project implementation, the number of new drivers and time spent training should be recorded to monitor the effect of UFF on these metrics and develop mitigating actions.

Language barriers: The interviewees anticipated that the Europe-specific challenge of drivers speaking many languages would still exist with the UFF model. Consequently, the UFF application would need to be available in a variety of languages to accommodate the full driver and carrier population which is not seen as a major concern. The UFF platform would need to accurately translate sponsor company requirements so that drivers and carriers can understand and conform. Even a small translation error could have immense safety and compliance repercussions. UFF companies and the researchers believe that modern translation technologies can ensure accuracy of shipment requirements; additionally, the passenger models (e.g. Uber Inc. and Lyft) have already entered many, if not most of the countries UFF companies might penetrate. UFF providers can learn from and build upon the language complexities that these models have already worked through. While this can be viewed as a challenge, one interviewee believed that if executed properly, UFF could improve the current situation. As part of matching shipper requirements and carrier capabilities, the sponsor company could request drivers with certain language proficiencies. While this would not be necessary for every transaction, it could be helpful for shipments with especially complicated loading and unloading procedures; loading these products requires careful coordination between the driver and site employee to fill the tank safely and efficiently.

Safety: Above all, the sponsor company champions safety and sustainability as top priorities. To keep this promise to its customers, the environment and the general population, the company maintains extremely robust prevention and accident response procedures. In terms of prevention, one of the foremost concerns of the interviewees was whether UFF could meet the sponsor

company's high safety standards for its logistics partners. The sponsor company's current suppliers (carriers and brokers) show their commitments to safety through historical statistics and measures; in the United States, data by carrier or broker is managed and verified by the FMCSA. As many of these startups are relatively new, the interviewees questioned how an UFF company would demonstrate safety without past statistics. Even if the sponsor company made an exception to its normal supplier qualification processes to onboard an UFF provider, could they continue to pass the sponsor company's regular safety and quality assessments, once operating? Interviewee #8 from Procurement explained that while a shortage of safety history within the FMCSA would not prevent the sponsor company from hiring an UFF provider, it would require a more cautious approach. When similar situations have arisen in the past with 'younger' carriers or brokers, the sponsor company gradually built the supplier into routing guides and monitored their safety metrics closely. After building a satisfactory safety record, the sponsor company would assign more lanes to the supplier; a similar if not the same approach could be taken with an UFF supplier; the sponsor company would not have to make any exceptions to its current processes. While the sponsor company has significantly reduced the frequency of accidents, a robust response system is still critical to their commitment to safety. Interviewees were concerned about the speed and efficacy of accidence response with an UFF provider. Within their current supplier base, carriers and brokers are trained on the processes to follow if a spill or accident occurs. UFF's influx of new drivers would not have this background. These processes including the order of communication and contact information will need to be clearly communicated to each driver through the UFF platform; they will need have quick access to phone numbers for the sponsor company's emergency response management team as well as reporting bodies such as the United States Environmental Protection Agency (EPA). Although this is a valid concern, UFF might actually improve speed and traceability during accident response. In the current system, drivers likely have to reference documents in order to locate the correct contact numbers. UFF could offer this information within only a few touches through a driver's cell phone application. Additionally, the application would serve as a central

repository to maintain the accident's location and timing. After an accident is resolved, the UFF company, as well as the involved driver and carrier must agree to cooperate with the sponsor company's follow-up procedures for root-cause analysis; this stipulation should be clearly mandated in the contract for an UFF provider or any supplier.

Insurance & liability: If an accident does occur, who would be held responsible? Numerous questions from the interviewees concerned the extent of an UFF provider's legal liability. Their perceptions are likely due to the grey legal area that companies like Uber Inc. and Lyft have occupied in their passenger-transport models. For example, in 2013 a driver between rides struck and killed a young girl. Uber Inc. deactivated the driver's account but denied liability as the accident "did not involve a vehicle or provider doing a trip on the Uber Inc. system." Their current insurance at that point in time did not cover drivers logged into the application between active rides (Constine, 2014; Miners, 2015). Not limited to accidents for UFF, this issue also relates to freight damages and insurance. Although these risks could be mitigated via contractual terms, it is still uncertain whether an UFF provider would compromise enough to meet the sponsor company's requirements for agreement. The sponsor company's standard requirements for insurance and liability coverage are above industry norms and relatively non-negotiable. UFF would have to verify that only carriers, brokers and owner-operators that meet this standard were matched with the sponsor company's freight. In general, it is anticipated that UFF providers and shippers will be able to negotiate through any discrepancies in liability requirements based on interviews with UFF companies as well as publically available information regarding UFF-shipper partnerships. If shippers are willing to pay for it, UFF could also consider incorporating an option for additional liability coverage into its pricing model; shippers could specify the desired amount and then this would increase the published price of the load transport. This could be beneficial for hazmat or other high risk loads; the higher risk profile of these shipments would merit higher driver pay and thus a higher transport price.

Regulatory: Although this does not relate to whether the UFF concept would work in the sponsor company's context, UFF companies must meet regulatory requirements in order to operate. While both the United States and European trucking markets are deregulated and thus UFF's legality as a business model is not in question, UFF still has other barriers to cross. As mentioned above, employment status is a complex and constantly evolving issue for Uber Inc. and other "gig-economy" companies. A brief internet search regarding Uber Inc.'s employment status debate reveals numerous class action lawsuits brought by drivers in multiple countries with differing court opinions; for example, drivers were ruled as employees in the UK but as self-employed in France in just the past few months (Osborne, 2016; Sebag, 2017). In addition to employment status, Uber Inc. and similar companies have encountered lawsuits relating to accommodation of disabled passengers and driver qualifications; Sanders and Pattinson's article provides a legal summary of Uber Inc.'s dealings with employment status and other suits for further reference (Sanders & Pattison, 2016). Interviewees were concerned that similar employment issues would arise for UFF drivers and be perhaps even more complicated due to professional driver union membership; in 2016, 18.4% of United States transportation employees (includes occupations other than truck-drivers) reported themselves as union members (U.S. Department of Labor, 2017). In the European Union, sector-specific figures are challenging to obtain as most of this data is by country and organization. One trade union, the European Transport Workers Federation, boasts over 3.5 million members (includes sectors other than road transport) from more than 230 transport unions and 41 European countries (European Transport Workers' Federation, 2015). In terms of employment status, UFF companies actually have an advantage in that they can learn from the mistakes and corrective actions of the passenger models in each country. While addressing union membership will be new territory for the UFF model, most of these concerns can be mitigated through contractual terms and relationship-building early on. Another legal complication for UFF that interviewees mentioned was the use of cell phones while driving. While hands-free interaction with an application while driving is legal for the most part in the United States, regulations in the

European Union surrounding this issue are more complex. As of 2009, Figure 13 shows a sample of the vastly different regulations by country in the European Union (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Germany, Demark, Estonia, Greece and Spain) and in general, the global trend is increased regulation, with over 32 countries that have enacted laws banning cell phone use while driving (Wallace, 2017).

Country	Legislation requires		Hand-held phone is prohibited if		Requirement to use		Hands-free required when using		Forbidden to use			Requirements concerning	
	complete ban	use of hands-free equipment	engine is running	vehicle is moving	headset/Bluetooth	additionally fixed phone	phone function	other function	texting function	all functions that involve continous handling	headphones	location of mounting	way of fixing
AT		X		X	X		X						
BE		X	X		X		X	X					
BG		X		X	X		X	X					
CY		X		X	X		X		X				
CZ		X		X	X		X	X					
DE		X	X		X		X	X	X				
DK		X	X		X		X	X					
EE		X		X	X		X						
EL		X		X		X	X	X	X				X
ES		X	X				X				X		

Country Code	Country
AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain

Figure 13: Sample of European Union member countries' cell phone regulations (Timmo Janitzek, Andreas Brenck, Samantha Jamson, Oliver Carsten, & Vojtech Eksler, 2009)

If implemented in this region, an UFF company would need to comply with all country and commission policies which would be particularly complex in cross-border transport. Even with legal use of devices, the interviewees expressed concern about the safety implications of driver

application-use, especially in the transport of hazardous materials. Again, UFF companies can build upon the learnings of passenger models within these countries; the cell phone requirements for UFF drivers should be extremely similar to those of passenger drivers. In terms of hazardous materials, UFF companies should consider whether they should impose additional restrictions upon drivers carrying these loads. While morally and technologically complex, lock-out technologies (applications or embedded software that prevent cell phone use while driving) have been considered by cellular companies and regulators to curb distracted driving (Richtel, 2016). Although this is probably not feasible in the short-term, this type of technology could be a solution in the future to ensure compliant cell phone use by drivers transporting hazardous loads.

Service level guarantees: Although there are places within the sponsor company's product line where service level is not as critical, some degree of service guarantee is typically promised in the carrier or broker's contract. As UFF is relatively new to the marketplace, it is uncertain whether these businesses will offer this degree of commitment and at what cost. The interviewees were apprehensive regarding how their customers would feel about less certainty around delivery windows. They elaborated that this type of model would be extremely challenging or possibly not feasible for their customers with very high service requirements. A late delivery (even by minutes) could cause the customer's plant to shut down. In some cases, the sponsor company's contract includes penalties and shared cost burdens for lost production caused by delivery delays. UFF may not be appropriate for these types of critical customer relationships. The issue of service level guarantees will be addressed by UFF companies through contractual terms. Based on interviews with current UFF companies, UFF providers do promise and agree to a specified service level in their contracts. While they may not be willing or able to meet the requirements of the sponsor company's most demanding customers, UFF's service level adherence should be acceptable for a significant portion of the sponsor company's business units.

Data integration: As mentioned previously, the interviewees are already inundated with numerous systems and sources of data due to the size of the sponsor company. For UFF to work, it must be seamlessly integrated into the sponsor company's existing platforms for data entry and reporting. Interviewees explained that they do not want to reference a new, additional platform to book freight, see a shipment's status or review quality metrics for UFF. A critical requirement for UFF will to support efficient and flexible integration with its enterprise partners. Discussions with UFF companies suggest that this technology is developed and already available but does require some level of set-up effort. Alerts and notifications were another area of concern for the interviewees. Although increased visibility can be extremely beneficial, the company does not have the resources to monitor nor do they want to receive automated notifications for every shipment. The interviewees suggested that UFF include programmable system rules to prioritize shipment notifications by business unit, lane, product, degree of delay and other factors. The interviewees described this as an important, but surmountable challenge to address before implementation.

6.2 Perceived benefits

Capacity gaps: Several interviewees proposed UFF as a solution for capacity-constrained lanes and areas. Although capacity is not an imminent issue in the sponsor company's major regions, interviewees expect that driver shortages (particularly for long haul routes) and increased shipping volumes are expected to tighten carrier availability in the coming years, especially in the liquid bulk area. In this environment, the company would likely experience a lower percentage of tender acceptance and have to resort to alternative means. Additionally, temporary crunches caused by weather, heightened demand or other factors still occur occasionally. The interviewees acknowledged UFF's feasibility an efficient method to quickly fill capacity gaps when all routing guide carriers or brokers reject a load. One interviewee mentioned that the sponsor company could realize indirect benefits of UFF even if they do not participate; if this business model accelerates in popularity, increased use of UFF by large companies in consumer packaged goods (CPG) (also

known as fast-moving consumer goods (FMCG)) or other benign industries could release capacity in the market for sponsor company use.

Increased flexibility: In a similar fashion to filling capacity gaps, several interviewees cited UFF's ability to facilitate quick response and action as a primary benefit. For sudden, urgent or unexpected freight requirements, finding a carrier for a new lane through UFF may be quicker than their current tendering process. These perceptions are likely due to the digital automation aspect of UFF versus working through a broker or carrier's dispatcher. For certain business units, they deliver to new customers and sites (and thus utilize new lanes) on a regular basis. This type of flexible freight booking process may be ideal in this context due to constantly evolving lanes and volumes. For the sponsor company and many other large multinationals, this may be one of the main benefits of using an UFF model. These companies typically contract primarily with the larger carriers and brokers; UFF will provide access to smaller players that large companies are not currently using which is advantageous for both parties. By increasing the potential pool of drivers, UFF will enable shippers to fill capacity requirements quickly and on short notice. The additional competition brought by an influx in supply might also place pricing pressure on the larger players which will benefit shippers such as the sponsor company.

Filling of backhauls: As backhauls were cited as a potential area of improvement for the sponsor company, many of the interviewees mentioned that this could be an opportunity area for an innovative business model like UFF. By growing the population of available shippers, receivers and carriers (and thus transactions), the UFF platform may increase the probability of matching shipments with backhauls. This would also have a cost and environmental impact as many trucks are going out of the way (~25% addition in distance) to pick-up return freight (Benoit Montreuil, 2012). The interviewees supposed that this could be executed relatively easily for less complex freight but may be difficult or impossible for a large proportion of their shipments; this is due to

the cleaning requirements or shipping restrictions for some classes of products. Nevertheless, filling even a small percentage of backhauls could bring substantial savings to the sponsor company.

Lower prices and cost: Based on interviews with current players in UFF, it is still unclear how this service's pricing will compare against incumbent carriers and brokers. One company implied that their current pricing is essentially equivalent to current market rates but that these rates were temporary to attract customers and gain density – prices eventually will rise to reflect the additional services and benefits provided by UFF. The interviewees had differing opinions about UFF as a cost reduction initiative. Once interesting observation was that this proposition might be attractive to the commodity business units, as these products compete on price more than technology or service level; they are more willing to accept a reduction in service for a reduction in price. In business units or products with high penalties for delivery delays, lower freight costs would not outweigh the risk.

Increased visibility: As mentioned previously, real-time visibility of shipments is an improvement opportunity in certain regions. Interviewees affirmed that if deployment of an UFF model increases visibility into shipment locations, this would be viewed as a benefit to the sponsor company. This would reduce back-and-forth calls with carriers and brokers to obtain ETAs and help them to provide accurate updates to customers. Their caveat regarding this benefit is that the shipment monitoring process must be automated and efficient without unnecessary clogging of feeds with system notifications.

Improvement of public infrastructure issues: Widespread use of an UFF model could create benefits beyond just the sponsor company in the environment. Data confirms that a large proportion of trucks are either empty or underutilized; globally, 42.6% of trucks are empty and only 56.8% full when not empty (Montreuil, 2012). These smaller shipment sizes increase the number of vehicles on the road, traffic congestion and environmental detriment. Interviewees projected that UFF could help to resolve these issues in two ways: (1) by increasing truck utilization through shipment

consolidation and/or (2) by increasing backhauls as mentioned previously. The interviewees explained that if executed correctly, UFF aligns with the sponsor company's sustainable vision and would be a desirable initiative. As a large, multinational company, the sponsor company's participation could result in considerable environmental impact. Additionally, proven, quantified improvements will help the sponsor company to champion UFF to its peer companies across industries.

7 Discussion of results and recommendations

7.1 General conclusions

As discussed in Chapter 6.1, the UFF model has several unresolved challenges with respect to hazardous materials. When debating whether to utilize this service for more complex freight, the question becomes: What value does the sponsor company place on visibility, hypothetically lower prices, and on-demand access to capacity? How do these potential benefits compare to the potential for additional risk and reduced service levels? The sponsor company prides itself on customer service and a commitment to safety. At least for the most hazardous materials, the benefits of UFF might not outweigh the uncertainties at this point in time. For these products, cost reductions and additional transparency do not warrant the potential consequences of utilizing an unproven business process; maintaining safety and compliance is a non-negotiable priority. The potential environmental, health, and business costs of a major accident could be astronomical. It is recommended that the sponsor company wait to incorporate UFF for the highest levels of hazardous materials, at least in the near term; once UFF companies establish themselves through an extended period of safe operations and expand their competencies to properly accommodate hazmat loads, this recommendation should be reevaluated.

While UFF for hazmat may not currently be the best option for a pilot project, it does not mean the sponsor company should not experiment with the model in other capacities; UFF can be integrated into non or low hazmat business units within the sponsor company. Both interviewees #1 and #5 agreed that it should be first tested in a business unit that ships non-hazardous freight. One category of ideal products could be commoditized items where business units are willing to sacrifice service level for cost savings. These products are relatively standardized among competitors and each company competes primarily based on price; even small cost savings could provide a competitive advantage for business units of this nature. Prospective products should have minimal risk from a safety and requirements (special equipment, procedures, etc.) standpoint. To mitigate the additional challenges and requirements of entering manufacturing sites, the UFF model could also be implemented first at regional distribution centers (RDCs).

Lanes to, from or between RDCs are a logical first test for UFF for multiple reasons. Drivers entering manufacturing sites require additional training and certifications (e.g. TWIC card) regardless of the type of freight they are picking up; this is because driving in and around RDCs does not carry as much risk as driving near manufacturing operations. Using UFF in between RDCs would eliminate these additional site-entry requirements for drivers. Certain RDCs only deal with non-hazardous materials thus the risks of implementation at RDCs are relatively low. Lanes between two sponsor company-operated RDCs would be ideal as the sponsor company would have visibility and control over the entire process and transaction. Although a delivery delay to a RDC might still have negative consequences, this is better than directly impacting an external receiver; ideally the sponsor company could mitigate the delay internally so that the end customer's shipment is on-time. As lanes involving RDCs reduce service and safety risks, they are one of the best places to pilot the integration of UFF within the sponsor company.

A summary of the broad recommendations is depicted in the matrix below. The x-axis measures ease of implementation which encompasses internal and external factors such as regulatory environment, number of UFF companies servicing these loads, and adherence with company policies. The y-axis measures risk in terms of variables such as safety, contract compliance, and customer relationships. The matrix is not intended to be prescriptive, all-inclusive or exact. The purpose is to show where generalized categories of products might fit on this spectrum. The applicability of UFF to each lane, product and customer combination should be evaluated based on its unique characteristics and requirements. To reiterate, the variables and examples included are non-exhaustive; the researchers believe that UFF could be integrated into a wide variety of the sponsor company's products.

As hazmat classifications vary in each country, generic categorizations were used. Non hazmat refers to products which would not have any hazmat classification or tank requirements beyond traditional trailer. Most Hazmat refers to products at the other end of the spectrum with the most stringent regulatory, equipment and safety requirements. Medium Hazmat would be loads that fall between these two extremes with some level of complexity attributed to their hazardous status.

CSL refers to Customer Service Level and similarly, is used as a broad categorization. In this case, low CSL would be customers and lanes that have lower requirements in terms of on-time delivery, loading windows and penalties. High CSL customers would be those that require strict compliance to extremely narrow delivery windows. One example in this category could be some of the sponsor company's automobile industry customers whose contracts impose extremely strict penalties for delays. Medium CSL companies are those that fall within low and high.

Geography is relatively straightforward. Only the United States and Europe were separated from other regions, as they were the primary focus of this research. If the sponsor company wishes to explore other markets, each region's regulations, market dynamics and infrastructure should be explored in depth.

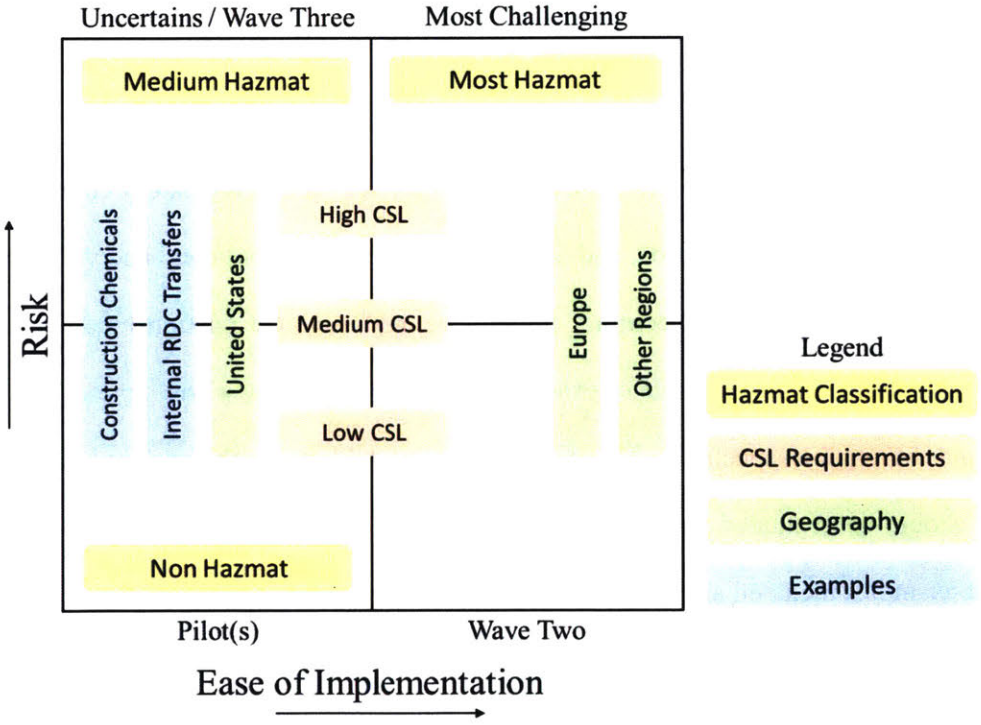

Figure 14: Risk-implementation matrix for UFF within the sponsor company

The four quadrants represent the order in which the researchers would recommend implementing UFF. Products that fall within the 'Pilot' box should be considered as the first candidates for potential pilot projects due to their low risk and relative ease of implementation. 'Wave Two' would be the next

candidates, provided that the pilot proves successful in terms of safety, cost and service. Products within the upper left-hand quadrant ('Uncertainties/Wave Three') would require additional consideration to determine whether the increased risk is worth the reward. The decision-making process for these items should weigh the benefits (cost, transparency, flexibility) with risks (safety, service etc.) to determine the best path forward. Lastly, 'Most Challenging' products might be too difficult and risky to transport via UFF. While this is subject to change based on the success and growth of the UFF model, the sponsor company should not consider these products for the near future.

In addition to analyzing the best applications for UFF within the sponsor company, the researchers also evaluated two potential structures of the model: (1) the sponsor company employs the services of a third-party UFF supplier and (2) the sponsor company uses its chemical expertise to build its own UFF business and offer services to other chemical shippers. One interviewee explained their concerns with the sponsor company serving as the operator as follows: the sponsor company works diligently to control the standards for transporting hazmat while minimizing transportation costs. In terms of quality and safety, their overall supplier base meets or exceeds their rigorous standards and there is not much room for improvement in this area. Furthermore, freight moved via trucks is fairly cost-effective currently due to low oil prices. In fact, the prices are so low on some lanes that rail is losing out to trucking. The interviewee concluded that ultimately, the freight business falls out of the sponsor company's core competencies and does not bring significant cost reductions or profits; they should leave operations of UFF to logistics experts and only consider participation as a customer.

However, this is not to say that the idea of the sponsor company managing UFF should be forgotten. Interviewee #5 discussed a past scenario where the sponsor company entered a similar business venture in the early 2000's during the European rail industry's deregulation. As a result of deregulation, chemical companies began to experience difficulties when shipping hazardous materials; customer service and quality deteriorated. In response, the sponsor company, along with several other European chemical manufacturers and shippers, formed a joint venture rail company. The joint venture catered specifically to

the hazmat industry with a goal of resolving the performance gap of current rail providers. In the current context of UFF, the trucking industry is experiencing a different scenario; quality is relatively high and stable. The interviewee supposed that if something caused performance to decline significantly in the future, then it may make sense for sponsor company to reconsider opening an UFF business; the interviewee explained that during Europe's deregulation, the sponsor company intervened because it was the only way to continue meeting customer commitments.

Although the aforementioned situation could be seen as evidence that the sponsor company should only consider starting their own UFF if external circumstances require, it does not address what the sponsor company should do if UFFs refrain from entering the chemical industry completely. Due to the perceived challenges of applying UFF to hazmat materials, many prominent carriers are afraid to move forward with UFF without the sponsor company initiating it. This is also a result of the risks with hazmat and the deregulated markets containing small fragmented carriers, which could lead to potential large scale consequences. Hence, larger brokers or carriers do not want to risk these potential consequences by initiating an UFF model within the hazmat industry. Additionally, current UFF companies are not rushing to expand their operations into hazmat due to the risk involved (one spill or accident could eliminate investment backing) and the additional complexity. Due to this lack of external initiative, the sponsor company may need to evaluate the feasibility of developing and operating the UFF business model for hazmat. This could be executed either as a stand-alone operation led by the sponsor company or a joint venture with other carriers, brokers, customers or even competitors. With a joint venture or consortium model, the expertise of each of the entities could be leveraged to build a viable UFF for hazmat, but the risk would be shared across the supply chain. Additionally, this alliance of support would help UFF to gain traction and density quicker, while allowing the sponsor company and its affiliates to provide direct input into procedures and processes. As a result, the shippers would have increased control over operational standards and be able to tailor it to their specific requirements. Another key benefit of owning and managing the UFF model for hazmat would be data ownership; the data obtained through UFF's freight-booking

processes (rates, capacities, demand, product types, etc.) could be almost as valuable as the service itself. Although this information would greatly benefit the sponsor company, other hazmat shippers (often competitors) would likely not want to participate due to confidentiality concerns if the sponsor company had full access to their transactions. Perhaps, these hazmat shippers as well as logistics partners could scrub and anonymize the data before sharing throughout the joint venture or consortium. As long as competitively-sensitive data was hidden from others, parties would be more likely to participate to gain access to this data.

7.2 Implementation

Product type: As mentioned previously, the initial pilots of UFF should focus on non hazmat or low hazmat products. While there are likely many products that fit these criteria, one option that could be a good fit for the UFF model are chemicals used in the construction industry. One interviewee explained that during certain times of the year, temperatures drop low enough that concrete requires additional fillers (sold by the sponsor company) to ensure the concrete hardens to specifications. When temperatures are expected to reach this threshold, construction companies will order this material to have on site with little notice. This chemical compound is a non-hazardous material supplied by the sponsor company and as explained, has high demand variability due to the weather. Therefore, since it is a non-hazardous material and its capacity requirements cannot be predicted, the UFF model might suit this industry quite well. The UFF model excels with the on-demand capacity it promises to bring to shippers, and would be a great complement to a business that must rapidly respond to changes in weather. Furthermore, the actual construction sites (receivers) are temporary and constantly changing as new projects begin. As a consequence, it is challenging for the sponsor company to plan and contract lanes for these customers. This type of short-term lane that requires flexibility is ideal for UFF. Another benefit of this option is that these construction chemicals are typically stored in RDCs; therefore, they would not require UFF carriers to enter the sponsor company's manufacturing site. Although this is one example, the UFF model can be applied to products of similar nature: non-hazardous, highly-variable

products that require flexibility or cost reductions; it does not solely work for construction chemicals. The researchers recommend that the sponsor company perform an analysis on its product categories to identify similar opportunities. The analysis should evaluate hazmat levels, demand variability and customer service requirements among other variables; as shown in the construction chemicals example, an insider knowledge into the ordering process can be key in determining whether UFF is a strong fit.

Geography: RDCs are the ideal facilities for implementation of UFF, but the geography (country or region) is also a major consideration. In order to mitigate risk early on and promote a successful pilot project, the goal is to remove or diminish as many of the complexities as possible. In terms of geography, one example of a variable is the previously described language diversity in Europe, which could pose a potential problem even for simple loads. Since North America offers the advantage that English is universal among most truckers, it would be an ideal testing site. This is not to say that UFF should not be utilized in Europe but rather that its implementation would require additional attention to these intricacies. Another reason that North America may be a better first pilot location is that laws regarding cell phone use by drivers are more relaxed and less variable than in the European Union. For example, how cell phones can be used in a vehicle varies from country to country in the European Union (see Figure 13). In order to comply with all regulations, UFF companies must ensure that their policies and drivers are within legal bounds in each country; this becomes increasingly complex in the European Union as many shipments cross one or more borders during transport. Lastly, based on the market analysis performed in Chapter 2.7, it appears that there are more UFF companies currently operating in the United States than in Europe. In addition to having more choices in UFF providers, these companies also have more operating experience than their European counterparts which have not been in business for as long. On a similar note, the passenger models in the United States are more extensive and developed than in Europe; this will make it easier for UFF companies to learn from and build upon passenger models' legal history. Although this is subject to change, at the current moment the sponsor company should first consider pilot projects in the United States, as there are more potential

UFF providers. The sponsor company should continue to monitor the startup landscape for UFF in all of its operating regions, especially for hazmat-focused UFF firms which do not currently exist.

Scale of Implementation: To mitigate risk in the implementation process, it is recommended to start small when introducing changes such as a switch to UFF. Since UFF will likely be very scalable after proof-of-concept in one business unit, it is advantageous to start in an area with low impact; although it may be tempting to pick a product or business unit with the highest potential gain, this typically comes with higher risk. It is better to successfully implement UFF for a lower impact product and then scale versus trying UFF within a complex context that fails. A way for the sponsor company to start small is by picking one type of product, one geographical region, and a certain lane. Types of products and geography were mentioned earlier in the section, however specific lanes were not discussed. As stated before the geography best to implement would most likely be the U.S. To determine a lane is going to be based on origin and destination. This is where RDCs aid in picking which lane.

RDCs serve as strong origin and destination points because of the reduced risk involved. Some RDCs only handle non hazmat or low hazardous materials unlike most of the manufacturing facilities which handle a mix of hazardous and non-hazardous materials. After determining the least risky combination of RDC lanes and products, the sponsor company should pick one or two lanes that RDCs serve to implement UFF. For those lanes, the sponsor company should hire an UFF company as a secondary or tertiary provider, not as the primary or sole supplier. In North America the sponsor company typically has up to six carriers per lane. The primary carrier usually accepts 95% of the tender capacity requested for that lane. The remaining carriers cater to the last 5% of the loads. Therefore, the selected UFF company should be brought in as secondary shipper, so that the service can be piloted but there are still back-up options available.

TMS: The sponsor company in North America is working through installation of a new cloud-based TMS into its procurement function. The TMS has the capability to onboard carriers and brokers that are certified by the sponsor company. The sponsor company approves routing guides based on the

category of freight being shipped. It also approves and contracts carriers and brokers for each lane through a boiler plate contract which is sometimes negotiated. This contract specifies the amount of insurance, truck certifications and driver qualifications among other clauses. In addition to the boiler plate contract, the sponsor company typically verifies the history of service level and safety record of its suppliers. This portion is discussed further in section 7.3.

Typically, the sponsor company will approve a carrier or broker and then agree to and sign the contract with the supplier. When the contract is agreed upon, the carrier or broker is loaded into the TMS, which manages the sponsor company's shipping needs. Hence, the UFF company of choice would need to be approved by the sponsor company in the same fashion and uploaded into their TMS for use. After integration into the TMS, the UFF company can begin accepting loads. Based on discussions with interviewees as well as the sponsor company's 3PL that manages the TMS, integrating UFF into the system will not be an issue. They would likely be treated the same way as brokers in that all records would be kept at the UFF (or broker) level rather than the driver (or carrier). UFF would be monitored from a quality standpoint as one entity and compared against its peer suppliers (carriers and brokers). Careful collaboration between the UFF company, the sponsor company and the 3PL will be required to ensure efficient data integration through the sponsor company's existing TMS. This step must not be neglected as it will be extremely important in managing key performance indicators to measure UFF's success.

Liaisons: Through the sponsor company's current method of certifying and contracting carriers, brokers and 3PLs, it also has a training system. As a part of the contract, the carriers, brokers and 3PLs must be able to receive the sponsor company's latest updates and training for its various facilities, lanes, and cargo. Since the UFF model needs to relay this information to its drivers, it would need a liaison with the sponsor company. This business requirement is possible with UFF due to its ease of communication. However, the liaison should be responsible for getting the latest information and training from the sponsor company and disseminating it to all drivers upon accepting a load. If this

process is not in place at the UFF company, it could cause unfamiliar drivers to create a negative impact on the shipping process.

7.3 Implementation requirements and next steps

Before UFF can be utilized within the sponsor company, there must be a logical progression of integration. While models where the sponsor company operates, or participates in a JV operating UFF were discussed previously, the following discussion focuses on implementation steps for contracting with a third-party UFF provider as this option is very feasible in the short term for low or non hazmat goods.

The first step is to choose an UFF company to partner with, but the number of players and novelty of the business model will make this more challenging than a standard sourcing event. Currently there are more than ten UFF companies desiring to be the market leader for on-demand trucking services (UFF). As each UFF company has varying levels of service, safety records, costs and capabilities, the sourcing activity should attempt to measure and compare these variables. It is recommended that the sponsor company conduct a sourcing event inviting most of the UFF companies within chosen geography with the intent to award a contract to only one UFF provider; the awarded supplier will then be incorporated into the route guides and the sponsor company's TMS. To pick the best UFF, the sponsor company should compare a variety of factors which are listed below.

Although Chapter 2.7 includes an overview of current UFF players, this landscape is constantly changing. Before initiating a sourcing event, the sponsor company should conduct a research study to develop a short list of UFF suppliers to issue the Request for Proposal (RFP) too. It is recommended that the sponsor company issues the RFP to a larger number of suppliers as not much information is publicly available relating to each company's specific capabilities, pricing and markets. The RFP should request scorable data (either based on raw numbers (e.g. years in service) or qualitative scoring (e.g. a rating out of 100 for their safety policies, or the average customer satisfaction score of their drivers in operation)) and each section

should be weighted to determine the final contract award. Some variables to be included are listed below, in order of proposed weighting (highest to lowest proportion of overall score).

Safety and Service Level: Safety is absolutely paramount to the company, so the UFF company must have an established track record and/or commitment to safety. The TMS operator for the sponsor company reported that their criteria for any broker or carrier is three years of established service. The sponsor company will look at least its past three years to determine how safe the carrier or broker has been operating. It will also determine if they meet the standards (qualifications, certifications, trucks etc.) required to be utilized for the desired capacity. In addition to safety, the UFF company with most established history and highest level of service should be considered as a better candidate. If an UFF has a lengthy and verifiable track record to show that their business model runs smoothly, then they could be the company to most likely succeed with the sponsor company. As stated previously there are many UFF companies competing. As typical with most new business models, there are usually a lot of competitors that start out in the same sector. However, after a few years of operations some of those companies either go bankrupt or merge. This consolidation will likely happen in the UFF industry, leaving only a few big players to choose from in a few years. These remaining players will have an established record and ideally have already corrected most of the inefficiencies and problems that may be unforeseen currently. The sponsor company can access the historical record for their candidates through the Federal Motor Carrier Safety Administration (FMCSA) and it will contain data on a broker's history, accidents and levels of safety and compliance. Since UFF is defined as a broker as discussed in section 4.2, then the sponsor company should not encounter issues accessing this data from the FMCSA.

From the FMCSA data, the sponsor company can now compare the different UFF suppliers. Careful consideration should be taken when choosing an UFF company. The potential UFF should meet or exceed the sponsor company's current safety standards and level of service for the lanes it wishes to employ it on. This comparison should be done in the exact same way the sponsor would onboard any other carrier or

broker. After verification and selection, the UFF supplier would be integrated into the sponsor company's TMS as discussed in section 7.2.

Cost and service level: The next important criteria for picking an UFF should be cost. One of the benefits that UFF hopes to deliver is reduced costs to the sponsor company. This is through more accurate spot market prices and reduced costs associated with reduced labor (e.g. algorithm instead of dispatchers). When examining the various bids, the sponsor company will need to evaluate the costs and service levels promised from all UFF bidders. Of course, lower costs and higher service levels should receive higher scoring in the bid evaluation process.

The specific approach for the sponsor company should be as follows:

1. Define the specific product and lane to implement UFF
2. Determine the required service level and maximum costs (as approved by business unit) for that product and lane
3. Update market research to identify potential UFF bidders
4. Issue an RFP to UFF bidders detailing service, safety, capacity, liability and other requirements
5. Evaluate bids based on predetermined scoring and weighting criteria
6. Negotiate with front-runners as required
7. Provided that at least one UFF provider meets nonnegotiable requirements such as safety, and is below business unit maximum costs, award contract to highest scoring UFF bidder

In the researchers' opinion, the sponsor company should not shy away from UFF if there is a slight increase in cost. For this reason, prior to issuing the RFP, it is recommended that the business unit approve a maximum cost they are willing to pay for an UFF transport pilot on this product and lane combination. As long as the winning UFF bid is under this maximum cost, the sponsor company should proceed with contract award (even if the bid rate is higher than that of the current carrier or broker). If the business unit is unwilling

to pay the difference, the sponsor company should consider subsidizing the pilot from another budget as it will reap strategic and cost benefits in the long-run.

As stated in section 7.2 the recommended product will likely have lower service level requirements. Therefore, it is possible that an UFF company's bid could offer a higher service level than is required for the product the company chooses. As such, the UFF could be demanding a premium price for that higher service level that is not needed by the sponsor company for a particular product. During negotiations, procurement managers should balance cost and service to create the best combination for the chosen product and lane.

One tactic the sponsor company should be cautious of is the aggressive negotiation practices that early UFF companies have utilized to win contracts (based on interviews conducted in this research). As most UFF companies are backed by venture capital, many are eager to gain market share as quickly as possible; achieving scale and first-to-market advantage is key at this point in the business model's development. Therefore, it is probable that UFF companies will underbid in the short term, even at a severe loss because they can raise prices once established in the market place. The sponsor company should be wary of this tactic and understand that even though there is a clear price advantage now, it may not be the case in the future. This can be combatted via contract structure and terms.

Density and Capability: In addition to cost, other factors to be considered are density and platform capability and reliability. To ensure that the UFF model can be scalable (if it is an initial success), the company will need to pick an UFF with substantial and growing density within the desired lane. The UFF company must have a vast network across the geographic region it operates in (most likely North America) and have many *active* carriers serving in its network. The key is that these carriers need to be actively participating in UFF and not simply using it periodically. In New York City, there are over 30,000 app-based (e.g. Uber Inc., Lyft) drivers (New York City TLC, 2016). However, only a small portion are considered full time drivers (New York City TLC, 2016). Therefore, the sponsor company should request quantitative data regarding UFF bidders' scale so they are not lulled into a decision only to find out the UFF company cannot carry its

desired capacity. If the UFF company cannot support the capacity, this will cause prices to increase, and will reduce the cost-effectiveness of this solution.

Density will likely be increased with the longer-established UFF companies but this should be confirmed. Therefore, density concerns are another reason to pick an UFF with an established track record. Since an UFF with a long verifiable history of accomplished service should attract more shippers and carriers, then it will have higher density. The higher density is a result of a reinforcing feedback loop that will allow the UFF to gain a critical mass of carriers that are required to successfully service the sponsor company's needs.

Just as the UFF must have capacity, it should also have platform capability. If the platform cannot perform basic functions with minimal training, it will be harder to implement throughout multiple business units. Additionally, it should be reliable so it can be utilized at any time. If it lacks this functionality and adaptability, then it could be hard to gain traction by shippers and carriers. It must not only be functional for a shipper but for the carrier as well. If it is not functional for the carrier, they will use another service as their number one choice for obtaining loads. This reduced functionality leads to the UFF company with a lower density, which could hurt service level and fail in the sponsor company's business. Although evaluating functionality and platform capability can be challenging, one option would be to request a demonstration as part of the RFP process. Trial users of the system can then rate their experience in terms of interface, usability and other factors. The UFF platform should also be evaluated in terms of how easily it can be integrated into the sponsor company's current TMS. The RFP should request information from UFF companies regarding how long system integration will take, additional costs, full timeline and their proposal for a detailed project plan. Some other simple guidelines for the sponsor company to look at our stated below.

1. Understand the number of carriers and shippers actively using each UFF bidder
2. Use the UFF bidders' history of other comparable shippers to see if they are meeting a similar shipper's needs
3. Determine ease of implementation across multiple business units.

a. Is the interface easy to understand and operate?

b. Has the platform been reliable?

c. Look at the platform from the carrier and driver perspective. Is it easy for the carriers to operate and use? If it is not user-friendly for drivers or carriers, they are more likely to leave the system and reduce that UFF bidder's density

d. Put yourself in your customer's shoes. Is this a product they would choose to use or is just a nice to have with no real added value?

After implementation: Once implemented, the sponsor company will need to monitor the progress and performance of the awarded UFF company. It should focus on four key areas: cost, service level, safety and platform reliability. As mentioned earlier in this section, safety is one of the most important factors to monitor. The sponsor company should aggregate data on the UFF's performance over the first few months to evaluate its continued use. Factors to monitor include compliance with driver qualifications and equipment requirements, procedural compliance, adherence to sponsor company standards or KPIs and overall compliance with trucking regulations. The latter can again be found through investigation into the FMCSA.

The sponsor company should also compile a list of any near misses and incidents the UFF entity is involved in, internal and external to the sponsor company. The near misses can be classified as any event where failing to follow a procedural step almost resulted in potential problem or had it been a more hazardous chemical would result in much more severe consequences. Any other incidents which are required to be reported by regulations or industry standards must also be examined. In both of these cases, the sponsor company should follow industry protocols to determine root causes of the failure. From the root cause analysis, any lessons learned should be disseminated with any other business units implementing UFF. These incidents and near misses should also be analyzed for trend analysis and compared to the rest of the industry to determine problems specific to UFF.

Likewise, service level should be analyzed for deviations from traditional brokers and carriers. The sponsor company will need to keep track of pick-ups and deliveries to get a true understanding of how UFF is meeting service levels. Specific metrics to track include arrival and departure times relative to scheduled pick-up and deliveries. Load times, travel times, and drop-off times to customers should be noted as well. These and other KPIs the sponsor uses to measure carrier performance must be carefully tracked to ensure the UFF is meeting the committed service level. If the sponsor company is developing the UFF internally they will need to ensure their Information Technology systems can process this data to get an accurate understanding of the UFF service.

The last indicator the sponsor company should monitor closely is cost. Cost is predicted to be one of the major benefits of the UFF model. If the UFF cannot compete with the cost of the other primary and secondary carriers or brokers for a given lane, then the business proposal should be reexamined. Even if UFF is not cost effective in the test pilot program, it does not mean it will fail everywhere; it may work better for another lane or perhaps needs more time and scale to achieve cost optimization.

Lastly, the sponsor company should monitor and record any lapses in system reliability from the chosen UFF supplier. As the entire transaction is heavily dependent on applications and electronic communication, the system must be extremely reliable to be effective. The sponsor company should monitor any data inconsistencies, data breaches, system outages and other inconsistencies or issues they encounter during the pilot. Similarly, the sponsor company should also survey frequent users or stakeholders of the UFF provider to gauge their satisfaction with the system and service overall. Although this data is qualitative, it will be useful in evaluating UFF's effect on the business.

After the test pilot program, the company should determine whether or not to scale up or down. If the UFF performed at or above expectations for safety, service level, and cost, then the sponsor company should look into scaling up into other business units, potentially medium hazmat. The sponsor company should look at the four main indicators (cost, service level, safety and reliability) as a combined whole to determine if there is another business unit, product, or region that would be well suited for UFF. As a part of further

integration, the sponsor should incorporate any lessons learned from the pilot program. Conversely, if the UFF provider did not measure up to the success that is expected, the sponsor company should attempt to investigate whether this is at the fault of the specific UFF provider or the model in general. This could be analyzed by attempting UFF with other suppliers and comparing their success. If these subsequent pilots continue to fail across different combinations of UFF suppliers, products and business units, then the sponsor should consider suspending the use of an UFF venture. As the model is still relatively unproven, it is not guaranteed that these businesses will achieve the scale and sophistication required to be successful, especially for chemical transport.

8 Conclusion

This research has three primary objectives: first, to better define the UFF model including its main processes and stakeholders second, to clarify the distinction between traditional brokers and UFF and third, to analyze a case study involving the application of UFF within the sponsor company's shipment of hazardous materials.

Although the term UFF has garnered recognition and awareness, it became clear that there was no consensus among industry professionals (internal and external to the sponsor company) on the model's inner workings and benefits. Furthermore, many questioned the distinction between UFF and a traditional brokerage leveraging freight-matching technology – what is this model doing differently? This research establishes the key processes, players, benefits and challenges of the model based on interviews with startups in this space and the researchers' analysis. The main challenges will be scale, quality of service and shipper requirements, while the benefits will include efficiency (payment and transaction), enhanced shipment visibility, and increased access for all parties. In terms of clarifying the distinction between UFF and existing broker services, one difference is that UFF will automate many of the human-driven inefficiencies in the current process; an algorithm-based application will match loads, push updates to stakeholders and coordinate payment rather a broker representative managing these tasks. It is anticipated that once executed at scale, this swap will reduce process time as well as cost within the system.

To evaluate the applicability of UFF within the sponsor company, representatives from various functions, product lines and geographies were interviewed. Additionally, the researchers performed outside research to better understand the complexities of the chemical industry and specifically the transport of hazardous products. Confirming hypotheses made early in the project, the researchers concluded that the use of an UFF provider does not make sense for many of their product offerings; the risk in terms of safety and customer service does not outweigh cost or efficiency gains. This model is more suitable for less complex, non-hazardous materials with manageable customer service commitments. By analyzing the requirements of various business units, geographies and customers, the researchers recommend several areas as

prospective pilot projects, such as non-hazmat construction chemicals and internal transports between regional distribution centers. The recommendations are intentionally non-prescriptive and open-ended to reflect the researchers' sentiment that this model could be utilized for any other shipment with similar requirements. Upon completion of a successful pilot, the sponsor company can scale UFF as a freight solution for products where it has proven to be most beneficial in terms of cost, quality and efficiency.

Although this research could be supplemented through additional interviews or concrete data about the operations (pricing, service levels, etc.) and success of current UFF companies, the findings based on the performed methodology sufficiently support isolated implementation of this service. Upon receipt of a written proposal from an UFF provider, the sponsor company should quantify the true costs and service impacts as compared to current suppliers. Implementing UFF in carefully selected contexts will allow the sponsor company to differentiate its supply chain services and offer its customers best-fit transportation options.

To expand on this thesis, similar research could be performed focusing on other products such as perishables, defense or medical to better understand their complicating factors; each industry is unique in its requirements and UFF may or may not be a strong fit for all shippers. Additionally, once actual data is available from shippers and carriers working within the UFF model, further research could focus on quantifying the impacts to shippers and carriers as well as confirming the researchers' hypotheses of UFF's challenges. While this thesis formalizes the UFF model and builds a foundation for the sponsor company to understand its potential application within their operations, the researchers welcome further research on this innovative transportation concept.

Appendices

Appendix A: Sponsor company representative interview guide

Interview Guide for Uber for Freight

Sponsor Company only

A priori guidelines

Thank you for being part of our research project! The project is an investigation regarding the application of 'Uber for Freight' concepts to the chemical industry as part of a Thesis towards the Master in Supply Chain Management at MIT. The research team consists of two Master Candidates – Leah Davis & Joe Lucido. Our thesis advisors is Dr. Jarrod Goentzel from MIT's Center for Transportation and Logistics.

Within the past years, a range of companies (most prominently Uber) have successfully launched new business models which use open networks to provide high service levels to customers at low cost. Given the low asset utilization in the poorly interconnected and very fragmented transportation sector it can be argued that disruptive technologies such as the Uber concept may be applicable to optimize the freight transportation industry. Accordingly, an increasing number of logistics forwarders are investigating the potential of the 'Uber for freight' concept. As many of these companies are already moving freight, the purpose of our project is to research and evaluate the applicability of these innovative transportation technology concepts in the chemical industry.

Although the 'Uber for freight' concept is explained in detail in other attached documents, we will provide a brief overview of the model at the start of the call. In the interview, you will primarily be asked about your opinions regarding various hypotheses around potential applications of this concept to Sponsor Company's chemical logistics. As we have limited experience to Sponsor Company's specific operations and the nuances of chemical transportation, we are seeking critical feedback around the benefits and/or feasibility of this model. Please feel free to share your honest opinions so that we can adjust and improve the model.

The interview will last no more than 45 minutes. Your contribution is entirely voluntary. All data collected from the interview will be kept confidential and under no condition your name or personal data will be disclosed or shared outside of the research team.

In order for us to review and analyze our conversation, we would like to ask for your kind permission to record the interview. The recording file will be securely stored on devices owned by the research team and at no point in time, the recording will be shared outside of the research team consisting of the two students only. The advisors will not have access to the recording. You have the right to revoke this permission at any time.

Introduction (~3 mins)

Hi, _____, this is Leah Davis / Joe Lucido, calling from MIT's Center for Transportation and Logistics). How are you doing today?

Thanks for agreeing to talk with me. The purpose of this interview is to obtain feedback you're your opinion regarding the 'Uber for Freight' concept's application to the chemical industry.

This interview is part of a research project we are conducting. I would like you to think of it as an open conversation, rather free flowing, about your opinions as well as additional relevant experiences. It won't take more than 45 minutes.

As part of an academic interview, as the respondent:

All the information you give me today will be treated confidentially.

- I have a confidentiality agreement in place with *Sponsor Company*
- Your name and personal information will not be linked to any answer.
- The interview is voluntary, which means...
    - ...you have the right to decline to answer any given question,
    - ...and you can stop the interview at any time.
- I now request your permission to record the interview, if that's OK with you.
    - You have the right to revoke this permission at any time.
    - The recording file will be securely stored on devices owned by the research team. At no point in time, the recording will be shared outside of the research team consisting of the two students only. The advisors will not have access to the recording.

Positioning questions (~2 minutes):

1. How long have you been in your current position?
2. What are the responsibilities of your current position?
3. What were you doing before?
4. How many years of experience do you have in logistics/supply chain?

General Questions (~10 minutes)

1. In your opinion, which aspects or qualities of chemicals add the most complexity to the logistics process?
2. What is the current process for shipping hazardous materials (Inflow & Outflow)
    - How is a load planned/tendered (process, systems, timing)
    - Who are the carriers (volumes, relationships, contracts, etc.)
    - What is the receivers role in the process
    - What do governments currently impose as regulations on hazardous shipping
    - Specific routes
    - Procedures for picking up and dropping off
    - Driver/Vehicle qualifications/certifications
    - Regional Specifics
3. Currently, what are *Sponsor Company's* major sticking or inefficiency points in terms of logistics (could be related to transportation/load planning, working with brokers or carriers directly, unloading/loading, etc.)

Evaluation of 'Uber for Freight' Model (~30 minutes)

<Insert brief explanation of 'Uber for Freight' Model>

Based on our description of the Uber for Freight Model and its potential application to the chemical industry...

1. Without getting into the specifics yet, overall do you think this could benefit *Sponsor Company?*

2. What do you see as tangible benefits? *Leave open ended but if needed, probe with examples such as reduced costs, efficiency gains, increased utilization, better visibility)*

3. What are the challenges or barriers you see with this on-demand model? *Leave open ended but if needed, probe with examples such as contractual concerns (liabilities), verification (of carrier/driver/rig/container), challenges in meeting Sponsor Company/governmental standards, other regulatory concerns, integration with current systems (ERP/TMS/load planning)*

4. Regarding active monitoring of hazardous freight specifically, what do you see as the major upsides or downsides in comparison to *Sponsor Company's* current practices? *Leave open ended but issues could be external data security, upsides could be carrier*

performance tracking, truck diversion from traffic, better accident response, improved planning (route updating due to traffic/weather, arrangements for late delivery)

5. Do you think this model would work of all of *Sponsor Company's* products/chemicals? If not, which products do you think this product works best for? What are the qualities of the products where this may not be a good fit?

6. Where do you see this model being most successfully implemented within *Sponsor Company*? (Other than products, segment by region, division, etc.?)

7. If *Sponsor Company* were to serve as the principal in this model, do you think other chemical shippers would be willing to utilize our services? What issues would deter them from participating? *Leave open and probe with examples if required – i.e. pricing too high, competitive factors (IP issues), change management from current service, Sponsor Company quality of service, safety/trust, etc.*

8. Conversely, do you think *Sponsor Company* would participate in this model if the agent was a 3rd party? (i.e. Uber or another competitor). Why or why not?

9. What other things do you think we should consider when evaluating or developing a model that works for *Sponsor Company's* chemical transport operations?

Pursue interesting areas in the form of a conversation. Pay attention to what the respondent says, and try to understand it, and ask follow up questions.

During the course of this conversation, try to move the conversation from the individuals to the function, and try to keep it anchored on concrete activities and the goal behind these activities.

- *For interesting things, ask:* "Tell me more about X".
- *When the respondent is getting vague, ask:* "Can you give me an example of X?"
- *If the conversation is getting lost in operational details, ask:* "What is the purpose of this?", *or* "What is the philosophy/idea behind this?"
- *If the conversation is getting too focused on implementation feasibility,* redirect the conversation to analyze broader concepts/opinions rather than the specifics

Wrap up

If interview was not successful or an interesting lead was identified – Is there anybody that you can think of who would be willing to participate in our research and answer a few questions?

That's pretty much what I had to ask you. Thank you very much for your time and sharing your opinion. I hope I can contact you with follow up questions after I have analyzed our conversation. Thanks again!

Appendix B: Comparison of shipper concerns with UFF counterarguments

Category	Shipper perceived challenge(s)	UFF companies' and researchers' counterarguments and/or plans to address this concern
Equipment Requirements	UFF must be able to meet all equipment requirements with 100% accuracy in terms of correct tank or truck and additional equipment (e.g. PPE, straps or forklift)	The UFF interface can be designed to include all of these as input fields (for shipper requirements and conversely, driver or carrier capabilities and equipment). Logic tables will ensure that loads are accurately matched with the **right** driver with the **right** equipment. Drivers who do not abide by extra requirements such as PPE can be reported and/or rated badly which will force them out of the system.
Driver requirements	UFF drivers must meet all regulatory requirements (e.g. CDL endorsements or TWIC) with 100% accuracy. UFF drivers, on average, may have a reduced knowledge of hazmat safety due to reduced barriers to entry in UFF model.	Using the same technology mentioned above, the UFF platform will ensure that matched drivers meet the regulatory obligations required by each load. The knowledge acquired by drivers by obtaining Hazmat endorsements is deemed sufficient by the federal governments (U.S. example). Any additional training requirements (site trainings, etc.) can be specified by the shipper in instructions before the driver accepts the load.
Language barriers	UFF will need to be available in a variety of languages and must accurately translate sponsor company requirements for safety and compliance purposes. UFF may exacerbate current issue of drivers not speaking the same language as loading employees.	UFF can be made available in all regionally-relevant languages before introduced to market. All drivers will be informed to not accept a load if they do not fully understand the instructions. This is not very different from current dealings with broker and carrier drivers. For especially complex loads, shippers may have the capability to specify driver language as a requirement. This could improve the current inefficiencies by matching site loader and driver language proficiencies.
Safety	UFF might not be able to meet higher-than-industry-norm safety standards or even be approved as a supplier. UFF might not be able to respond as quickly to an accident or spill.	Shippers could take cautious approaches (with quantity, size and complexity of lanes) when onboarding an UFF provider, just as they do with a younger carrier or broker. Thus far, there is not any evidence that an UFF provider would be less safe than a broker or carrier. In cases of accidents, UFF may be able to provide an even quicker response due to: (1) greater visibility into driver location, (2) the UFF platform could ensure that required contact numbers (EPA, shipper contact, etc.) are easily available (versus shuffling through written papers or calling broker or carrier dispatch first).
Insurance & liability	Liability may become confusing with the inclusion of UFF as an agent. Drivers may not be able to meet high sponsor company insurance requirements.	Liability could likely be handled in a similar manner as brokers. It would be clearly spelled out in the contracts between shippers and UFF providers as well as between each UFF provider and its drivers. Using the same logic described

		previously, UFF can ensure that shipper loads are matched with carriers and drivers that meet their insurance requirements.
Regulatory	UFF drivers may experience similar employment status issues as passenger models. This may be complicated by union membership. UFF's legality might also be challenged by varying cell phone rules, especially in the E.U.	Passenger models such as Uber Inc. are gradually working with regulators to abide by local laws in all of their markets; this has been done successfully in many countries thus far. These learnings, in terms of employment status and cell phone use, could be applied to the UFF context. Union concerns will be complex but could be addressed through contract structure.
Service level guarantees	UFF may produce more uncertainty around delivery windows.	Required service levels for UFF would likely be specified in the contract. UFF might be able to more accurately determine whether a delay is due to the driver or unavoidable external variables (traffic, weather, etc.). Delays caused by the driver would produce poor ratings or a report which would remove them from the system.
Data integration	UFF must be able to integrate into current shipper's system rather than produce another reporting source. Alerts and notifications need to be prioritized.	With technology expertise, UFF providers should be able to support enterprise software integration; those that do it best will be the most successful. Shippers will likely be able to program their notification preferences in the UFF platform to control unnecessary noise.

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