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Key Factors and Trends in Transportation Mode and Carrier Selection

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Companies across the country must deal with the daily question of determining the best way to get their product in the hands of their customers. Weighing all of the various factors that play into this decision can prove to be very difficult at times, and these factors are ever changing as the market fluctuates with varying consumer demand which, in turn, affects the demand for transportation. This paper will look into these factors and relevant market trends to determine what factors play the largest role in a company's decision of how to deliver its products, focusing specifically on the modal and carrier choice decision process. Market trends such as shrinking capacity, tightening cost structures, and the growing importance of environmental friendliness all will be shown to play a significant role in this decision-making process.

Introduction

This thesis is a case study of the decision-making process behind transportation mode and carrier selection. Data has been obtained primarily through qualitative methods, with the bulk of the research being interviews with industry experts. Data from the interviews will be supplemented by data gathered from existing publications related to the topic. The end result will be the identification of key factors and relevant trends related to transportation mode and carrier selection across multiple industries.

Transportation is typically viewed as the “most important single element in logistics costs for most firms” (Ballou, 2004 pp. 164). Currently, transportation accounts for approximately 62.8% of every dollar spent on logistics in the United States—that is equivalent to 5.2% of United States GPD (CSCMP 2011). It is also very important for businesses in creating time, place, and quantity utility, in addition to enabling larger scale production, geographic specialization, and increased competition.

As goods are moved throughout the market, it is important to have a well structured transportation system to create place utility by extending the boundaries of where a business can ship to. By increasing the geographic market, businesses are able to reach more customers and generate higher levels of demand (Coyle et al., 2006).

In addition to creating place utility, transportation also adds value to products by allowing them to reach customers exactly when they are wanted. This is especially valuable to products that may be time-sensitive, such as perishables or seasonable items. However, not only must the items get to the right place at the right time, but they must also be in the right quantity. A good transportation system will ensure that the right amount of the product is on hand and delivered to the right customer. As transportation management systems improve, they enable businesses to produce on a much larger scale since they have the capability and demand levels to support more volumes. As more customers are reached, competition increases while prices fall—inevitably resulting in higher product availability and the need to continue improving transportation systems to keep up with the pace of growing customer demands (Coyle et al., 2006).

For these reasons, managers are interested in making sure they leverage transportation spend to the highest extent possible. This research has the potential to benefit managers who are involved in the strategic as well as day-to-day decision making process regarding which transportation modes and carriers to select by providing data on relevant factors and trends that have and will affect the overall level of value the firm realizes from these transportation choice decisions.

Methodology

The research process began with a review of applicable literature to assist in forming a foundation of background knowledge and topics of discussion for the interviewing process.

Purposeful sampling will be used to identify participants for this research study. A purposeful sampling technique allows the researcher to select participants “based on a specific purpose rather than randomly” (Tashakkori, 2003). Each of the individuals chosen to participate in this research has been identified as a person from whom one can learn a great deal about issues of central importance to the purpose of this research. Purposeful sampling enables the researcher to learn a great deal more by focusing in depth on understanding how a small number of carefully selected managers determine which transportation mode(s) or carrier(s) to use rather than by gathering standardized information from a large, statistically significant sample.

A grounded theory interviewing approach has been utilized for this research. The grounded theory allows the researcher to utilize information gained from interviews in forming a hypothesis, as opposed to the conventional method of first forming a hypothesis, then seeking to prove it through interviews (Allan, 2003). An interview guide (Exhibit 1) was used as a prompt during interviews, but generally the interviews flowed as a semi-structured conversation between the interviewer and participant with little or no stress expected on the participant. The primary purpose of the interview was to understand the process by which managers determine which mode(s) and carrier(s) to use for freight transportation.

Interviews were audio recorded, with the permission of the participants, to allow the interviewer to focus on the conversation and to ensure a more complete record of the interview via later transcription. Audio recordings will be kept on the researcher’s personal computer in digital format, and these recordings will be destroyed within three years of the

conclusion of this research. The audio recordings were primarily used by the researcher to create written interview transcriptions/notes. The resulting transcriptions were analyzed using a variety of qualitative data analysis techniques including work/phrase coding. Names of participants and companies have been kept confidential to protect the intellectual property and reputation of firms willing to participate in the study. A description of each company can be found in Exhibit 2.

Results and Discussion

Throughout the interview process, a number of factors came into play when inquiring about what went into the modal and carrier selection decisions. First, however, it is important to understand the general structure for how a transportation choice decision is made, such as how the company organizes its transportation group and the tools it uses to make this decision. Next, I will discuss each relevant factor with the accompanying industry trends that have been shown to affect the modal and carrier selection process. Finally, some additional key industry trends that will play a role going forward in the transportation choice decision are examined.

Structure

The general theme from the interviews conducted points towards a transportation management structure that is very centralized across the board. As companies grow larger in their respective industries, they are beginning to realize the benefit of leveraging their size in negotiating with carriers regarding issues such as rates, volumes, and contract terms. An upper level manager from a leading paper/consumer goods company stated that “Centralized management gives us enough size and scale to be able to leverage that in the marketplace” (Participant 1, Company B). This is a key example of the primary benefit of centralizing the transportation management process.

Another example of why more companies are moving towards centralizing the transportation management process is illustrated by the simple statement that “You can do more with less people” (Participant 1, Company A). This manager from another paper/consumer products company then went on to elaborate that having a centralized group in one location allows them to allocate geographic areas to a single person, as opposed to having one or multiple people at each separate facility. This benefits the company from both a cost and control standpoint, allowing for a lower headcount while improving the consistency of how the transportation process is managed.

It can also be seen in the literature that this concept has been growing. A practitioner publication on current events and trends in the supply chain industry, states, “... the level of centralization in transportation management is increasing and evolving, with more and more companies moving to a Load Control Center model” (Supply Chain Digest, 2009 pp. 8). This Load Control Center model they refer to is the same concept as a centralized transportation management group, defined as

“... an approach to transportation in which most transportation planning and sourcing functions, and some execution processes, are pulled together into a single group, rather than being managed regionally or at individual ship sites” (Supply Chain Digest, 2009 pp. 6).

In addition to centrally managing the transportation process, it is clear that a vast majority of companies have moved towards adopting some form of a Transportation Management

System (TMS). Given the technological advancements in recent decades, this realization was very much expected—the importance of utilizing technology to keep up with the ever expanding level of complexity and competition has driven companies to invest in these high-tech solutions to manage the execution of their transportation strategies.

Cost

Given the recent economic downturn and slow recovery from the Great Recession, keeping costs at a minimum is still near the top of the list for many business's initiatives. This is a very important aspect of all areas within a business that will always gain a great deal of attention, for the simple fact that the bottom line is what keeps a business afloat. To stay competitive in a tough economy, as well as grow in a competitive environment, a business must always remain focused on increasing profitability. Writers of the Supply Chain Digest Letter suggest that "Companies in this current slump will be looking for every avenue to cut costs, and as always transportation will be one of the first functional areas where companies look for dollars" (Supply Chain Digest, 2009 pp. 6). This point definitely stood out throughout the qualitative research, with every interview participant mentioning in some way that cost was one of the primary factors in making a modal or carrier selection. For example, Participant 2 from Company B stated "... everyone will be concerned with the cost of transportation ... it's just a matter of how high up on the totem pole this [factor] is compared to others ..."

Specific to transportation, it has proven to be difficult given the current market conditions to continue reducing costs while adapting to growing volumes and shrinking capacity. A manager from a leading Paper/Consumer Products company states it simply: "It is rare that we would sacrifice cost for service" (Participant 2, Company B). This shows how important it has become to some companies to look for avenues by which they can shave costs away and improve their bottom line. However, there are a multitude of other factors that have been challenging the importance of cutting costs in the realm of transportation selection.

Product

Another factor that often is left out of discussions on transportation selection is looking at the actual physical characteristics of what is being shipped. For example, a manager from a company in the metals industry stated "We aren't really concerned too much with transit times because we are shipping a commodity ... our primary concern [in modal selection] is cost" (Participant 1, Company E). Companies shipping very low-value products usually deferred to the answer of "product characteristics" when asked about the modal choice—they simply have no motivation to spend extra for service that is not needed or economically feasible.

This idea of looking at the physical characteristics and needs of a product is what creates the first threshold for modal selection, making it the primary factor taken into consideration. From the perspective of Company D, it would be very uneconomical to ship twenty tons of a chemical via truck when the origin and destination both have rail sidings. This is a very simple concept, yet extremely important when getting past the first level of making a modal decision.

In terms of carrier selection, product characteristics also play an important part if the product has a special trait, such as temperature or special handling requirements. These product characteristics will automatically limit the pool of carriers the company has to select from. For example, Company F ships a great deal of frozen products; therefore, they simply cannot select a carrier that doesn't have the capability to meet the temperature requirements to keep the product frozen. Another example comes from Company D, which

ships some hazardous materials. They are forced to select carriers that have the proper equipment and meet safety protocol necessary to ship the given material so everyone is in line with government regulations.

Service

As stated before, the research has indicated that companies often first take into consideration product characteristics before deciding on a mode or carrier. Yet, before they give significant thought to cost, many companies turn an eye towards the service levels that modes and carriers are capable of delivering. According to a supply chain expert, “The Internet, just-in-time operating procedures, and continuous replenishment of inventories have all contributed to customers expecting rapid processing of their requests, quick delivery, and a high degree of product availability” (Ballou, 2004 pp. 14). Ballou firmly believes that measures of service such as transit time and transit time variability should rank ahead of cost in the battle of mode and carrier selection. In a study by Michael McGinnis, he suggests the following:

“Nearly twenty years’ empirical research into freight transportation choice, using a wide range of methodologies, before and after deregulation, in different industries, with regional and national samples, indicates that shippers in the United States generally valued service more highly overall than cost in the freight transportation choice process before and after deregulation” (McGinnis, 1990).

As convincing as both this statement by McGinnis and the opinion of Ballou may be, the business climate within the US is much different than it has been in years past. Within the past four years, the US has encountered numerous financial hardships that have accompanied the global recession in addition to becoming an even more globalized, competitive marketplace with increasing pressures to drive costs down. This has caused a heavier weight to be placed on costs than ever before, making a strong argument that the priority may not be so strongly placed on service as opposed to cost. However, qualitative research has depicted an opinion similar to that of McGinnis and Ballou.

In regards to modal selection, service does have a very large role to play. Although as stated before, product characteristic seems to be the primary driving factor that “sets the stage” for the decision. However, similar to product characteristics, service levels also seem to create somewhat of a threshold for modal selection. If the mode does not meet a given level of service required by the company for a particular product, this mode simply will not be considered as an option. This, of course, is not always the case. For example, if an emergency arises with an important customer, the general trend is that service will instantly become the most important factor in modal selection because that relationship with an important customer is vital to any company’s profitability.

When trying to determine whether cost or service takes precedence in carrier selection among interviewed companies, it is a difficult decision to make. While all of the companies interviewed have a focus on costs, many of them take into account a carrier’s service capabilities before even considering the cost. This is in many ways the same type of decision made in regards to product characteristics for modal selection—a carrier’s service capabilities is the first threshold for whether the carrier is even in contention for selection. For example, Companies D, E, and F all clearly indicated that before making a carrier choice, they limit the pool according to the carriers’ ability to meet service requirements. Once each company has determined that the carrier can deliver the service levels required, other factors then come into play.

Relationship

The development of relationships when making the carrier choice is an interesting factor that was not expected at the onset of this project. However, after the qualitative research, it is obvious that relationships play a very important part in the carrier selection decision. Company D holds what they call “Supplier Days” where they are able to meet with carriers to build the relationship, stay informed on industry trends, and determine how much volume they plan to assign to these carriers. Similar to this, Company C holds quarterly meetings with each of their carriers to ensure that both parties are aligned and informed of changing market conditions that could affect business going forward.

Another interesting factor involving relationships is the strategies by which companies tend to manage their carriers. A recurring trend that was noticed is the inclination to group carriers according to their importance to the firm and manage the relationships by that group. Company F has what they call three “tiers” of carriers, from the first tier being the largest and most important to the third being the smallest least important (yet, still of strategic importance). A Tier 1 carrier would have national capacity, the ability to move freight using more than one mode, and can move different types of freight according to the level of service required. A Tier 3 carrier would be a smaller (termed “Mom and Pop”) carrier who might specialize in one particular type of load or be located in one geographic area. Managing carriers in this tiered system allows Company F to reduce complexity by having to manage three different types of relationships instead of individually managing each and every carrier.

Another example of this grouping can be found in Company A’s strategy, where they choose to partner with seven key carriers and assign the majority of their volume to these transportation providers. While these seven carriers move the bulk of Company A’s volume, they stressed the importance of still maintaining a relationship with the smaller carriers that might not play as large of a role in the movement of their products. Participant 1 at Company A stresses that this relationship with the smaller carriers certainly isn’t as instrumental to success as the relationship with the core carriers, but there always may be a day when something goes wrong and he may have to call in an unexpected favor.

The most significant factor playing a part in why all of these companies are pointing out the importance of building a relationship with a carrier is so that the business can rely on the relationship through a difficult, volatile market. When asked how they deal with volatility in the marketplace, all but one of the companies interviewed answered that they rely on their relationship formed with the carrier. This shows how important forming a bond with particular carriers can be, especially with uncertain market conditions and, most importantly, the tightening of capacity.

Capacity

Once the global recession hit in 2008, concerns about available capacity have been paramount to almost any individual involved in transportation. The Council for Supply Chain Management Professionals releases an annual report, titled “The State of Logistics Report,” that outlines industry performance and trends. According to this report, more than 16 percent of truck capacity has been permanently removed from the market since 2006 (CSCMP, 2011). In 2007, Class 8 truck sales slowed and fleet sizes were reduced as companies responded to an industry-wide reduction in shipments in addition to the uncertainty of what new equipment standards would come from environmental regulations expected in the future (Kirkeby 2007). On the rail side, the report states “...railroads are in very good shape from an infrastructure, equipment, and personnel basis” (CSCMP, 2011). So why is

capacity tightening in the trucking sector? There are a number of factors that point to this, many of which were touched on within the qualitative research. A manager from Company A states:

“Fuel and continuing government regulations around clean energy are going to continuously apply pressures on the carriers. Since it’s very low margin anyways, this will make it tough for smaller carriers to survive. This takes capacity out of the market ... which drives up the cost for everyone.”

This manager mentions two major issues that are having large impacts on capacity within the U.S—fuel and government regulations. From the point that diesel fuel first reached over \$2.00 per gallon in 2004, prices have raised steadily. Diesel reached a high mark of \$4.70 per gallon in July of 2008, just as the global financial crisis began to unfold. From then, prices plummeted to \$2.09 per gallon in 2009, but they have steadily risen since then to a current price of \$3.80 per gallon (EIA, 2011). These steadily rising fuel prices are now increasing the costs for all carriers, forcing them to pass the burden along to their customers in the form of fuel surcharges. The costs to businesses for trucking services was up 9.3 percent in 2010, but most of this additional cost came in the form of fuel surcharges, with most carriers not being able to fully recover the actual increase that they sustained from these additional fuel costs. (CSCMP, 2011).

In addition to the rising financial pressure from fuel costs, carriers must deal with government regulations that are warranting additional levels of investment. There are numerous environmental regulations to be discussed in a later section that are increasing equipment costs for carriers. In addition to this, regulations such as CSA-2010 are causing a negative effect on human resource management and recruitment. Before these new CSA regulations went into effect, less than two percent of motor carriers underwent compliance reviews (McCarty, 2009). The new CSA regulations are designed to monitor safety and compliance through measurement, evaluation, and intervention, forcing carriers to maintain data about any safety violations that occur in a central database for administrators to monitor (USDOT, 2011). It is estimated by industry observers that nearly 30% of current drivers could be out of a job after the new regulations are fully into effect due to deficient ratings in regards to safety (McCarty, 2009). In addition to losing bad drivers, carriers will also be forced to pay more for their good drivers, as these employees will now have reason to demand a higher wage for their more valuable driving skills.

Even before the CSA legislation arrived, the labor scenario in the trucking industry was very grim. Over the last four years, the trucking sector has experienced the largest decrease of employees among all other modes of transportation, losing 13.4 percent of its workforce (CSCMP, 2011). Also, about one in six truck drivers is age 55 years or older, with less than one quarter of current drivers being under the age of 35 in addition to declining growth in employment of that under-35 age segment (CSCMP, 2011). The manager from Company D touched on one reason for this lack of interest in trucking as a career: “We will not have enough [drivers]. Drivers want to be at home at night, not on the road for three weeks.” A manager from Company C emphasizes that statement by saying, “Trucking is not a glamorous lifestyle ... this will result in a shortage of capacity down the road.”

In addition to the general lifestyle of the trucking industry being unattractive, with new Hours of Service regulations, carriers along with the drivers now will be less productive than before. These new regulations will only allow a maximum of thirteen consecutive driving hours before drivers are required to take a one hour break as opposed to the

fourteen hours that was previously allowed (USDOT, 2011). It is also being considered to reduce maximum allowable driving hours within the “driving window” from the current eleven hours to ten, which would have a huge impact both on carriers and shippers (USDOT, 2011). A manager at Company F spoke about how many companies have created their distribution networks based on these eleven hours of driving, choosing to locate distribution centers and production facilities within a one day transit time range of any destination within a particular geographic region. Now, if there are fewer hours allowable for driving, companies will be unable to reach some locations in one day; this will cause problems with their existing network structures and will, assuredly, increase costs for both shippers and carriers going forward.

Thus, with costs rising and labor on the decline, shippers fear that capacity will become the most important issue in the coming years in terms of modal and carrier selection. This is why so many companies have turned towards the development of relationships to hopefully mitigate the risk of losing their much-needed capacity. A manager from Company C states, “Not only is it important for us to have good partners, but it is important to understand who is feeding the capacity to us.” Adding to this statement, a manager from Company F also commented, “We rely on constant communication and our relationship with the carriers to deal with the volatile market now and in the future.”

Security

Transportation security is an issue that has created more buzz than usual over the past couple of years. In October of 2010, two packages coming from Yemen in route to Chicago were intercepted and found to contain bombs; one was shipped via FedEx, the other by UPS (Cole, 2010). This then sparked an outcry for tighter regulations on cargo screening and more attention to be paid to freight transportation in addition to passenger transportation. When asked about their views on enhanced security and whether or not this is a factor in the modal or carrier selection decision, most study participants stated that security is no more of an issue today than it has been in the past in regards to carrier selection. Of course, depending on the product being shipped, security has a varying level of importance to different shippers. For example, Company D ships hazardous chemicals—so they pay special attention to security and the carrier’s ability to maintain the highest levels of compliance when transporting their products. Although, on the other end of the spectrum, Company C is the least worried about security since they ship canned food products with tamper-evident seals that automatically notify them if a product’s security has been compromised. Therefore, the shipper’s outlook on security is heavily dependent on the product being shipped—this determines how important this factor is in the transportation selection process; however, as it stands today, companies are not willing to go out of their way or incur additional costs for safety as long as their product does not require it and the carrier meets all legal requirements.

Environment

Environmental concerns are becoming increasingly important in transportation selection as society becomes more concerned with energy conservation and reducing their carbon footprint. Many companies interviewed are concerned with becoming more environmentally friendly as well. Company F has an initiative of doubling its business while reducing its carbon footprint by 50% over the next ten years. Companies A, B, and D are all participants of a program called SmartWay, which is a program started by the Environmental Protection Agency to provide incentives to shippers for improving their fuel efficiency in order to reduce environmental impact (EPA, 2011).

A key driver that motivates companies to jump on board with environmental initiatives is government regulation. The transportation industry contributes to approximately 57% of the carbon monoxide that pollutes the air, so it obviously is a key target of the government as an area to improve upon (Coyle 2006). By 2018, most tractor trailers will be required to achieve up to a 20% reduction in fuel consumption and greenhouse gas emissions, resulting in a savings of up to four gallons of fuel for every 100 miles traveled (EPA Office of Transportation/Air Quality, 2011). For carriers, this means a significant investment in upgrading current equipment. The new regulation, as well as a few others of the same kind, is expected to cost the industry approximately \$8 billion to adopt. Since this regulation requires an increase in fuel efficiency, it inevitably reduces fuel consumption, which is expected to save vehicle owners up to \$50 billion—however; this is over the lifetime of model 2014-2018 vehicles (EPA Office of Transportation/Air Quality, 2011). For many smaller carriers, these savings will not be realized because they will be unable to afford the initial costs of upgrading to meet the new fuel efficiency standards. This is yet another reason why the issue of capacity constraints is the number one concern on the mind of those involved in the transportation industry.

Conclusion

There surely are a number of factors that firms take into consideration when making the modal and carrier selection decision. Among these, the primary factors that have stood out during this research have been cost, service, product characteristics, relationships, and capacity. However, an important finding of this research is that many of these factors often tend to play a part in the modal and carrier selection decision simultaneously, and not as part of a stepped process as was previously assumed.

Modal Selection

The principal first level of choice depends on the nature of the product—it must make economic sense given product characteristics to ship on a given mode. If product characteristics allow a modal choice to exist, the decision is heavily weighted towards cost and capacity with firms being increasingly motivated, both by regulations and corporate citizenship, to factor in environmental concerns in their decision.

Carrier Selection

For carrier selection, the primary deciding factor tends to be service, with many shippers limiting the pool of carriers they can choose from based on a set service level threshold. All of the companies involved in this study, however, are concerned about future capacity. Therefore, the issue of contracting capacity is a major factor that will play a part in the future of carrier selection. A prevalent yet unexpected trend is for shippers to form strong relationships with carriers in an effort to mitigate the ill effects of a volatile, highly competitive globalizing market. These relationships are often seen to take precedence over the all-important factor of cost. This is due to the fact that in an unstable market companies need to feel comfortable that a carrier will be there with the capacity needed to support growing volumes and an economy emerging from recession.

After determining exactly what factors play the most important roles in modal and carrier selection, a very important theme that has come from this research is the fact that these transportation selection decisions are not always made in a stepped process as was previously thought (Coyle et al., 2006). Instead of first making the modal decision, then making a carrier decision, results of this research indicate that the decisions are beginning

to blend together, sometimes even being made simultaneously. For example, a company may choose mode and carrier primarily based on product characteristics—mode is not necessarily chosen first if the carrier has multi-modal capabilities. The most important fact in this example is that the carrier selected must have the physical capability to ship the product at the service level required—regardless, of mode, the company selecting a carrier is only concerned that their product arrives on time. This is a point that shows how the modal selection decision does not always occur directly before carrier selection. This shift in the previously accepted process represents an emerging important trend regarding modal and carrier selection, and it will impact how this topic is studied and taught going forward.

Future opportunities for research could exist in looking at how the shipper-carrier relationships are formed and some of the factors taken into consideration on both ends when a long-term, structured relationship is in its infancy. In addition to this, more research opportunities exist in looking at how this transportation selection decision process may be evolving from a step-by-step process to a more flexible, fluid decision-making process. Also, new trends will need to be analyzed as the transportation industry and global marketplace continues to evolve, especially in regards to trucking capacity. The capacity problems plaguing the trucking industry are likely to have a very large impact on the structure of the industry as well as the modal split, so there are a number of research opportunities ahead as this scenario unfolds.

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VI. Exhibits

Exhibit 1: Interview Guide—Keith Roberts

- How would you describe your industry in terms of products, customers, competitors, etc?
- How long have you been involved in transportation, and what is your role in the transportation selection process?
- How is outbound transportation managed in your company? Does each division control its own transportation? What are the advantages/disadvantages of the strategy you currently employ?
- What are the various transportation modes that you use? What percentage of each is used?
- Can you walk me through process of how a typical modal decision is made?
- Now, within the context of the previous question, can you explain how you choose specific carriers? Can you point out the most critical factor(s) that goes into this decision?
- Do you currently use any types of private fleets or dedicated services in any of your transportation? If yes, what led to the choices to use private vs. dedicated vs. for-hire? Has it been profitable; do you see it continuing to be more/less profitable?
- Explain the trade-offs that can go into making the modal/carrier selection decision?
- How does volatility in the market affect your decisions?
- What is your opinion of how the following issues have, do, or will factor into making mode and carrier selection decisions:
 - Environmental and energy usage concerns
 - Security
 - International growth
- Are there any key trends you can identify related to transportation?

Exhibit 2: Company List Descriptions

- Company A: Paper and Consumer Products
- Company B: Paper and Consumer Products
- Company C: Food
- Company D: Chemicals
- Company E: Metals
- Company F: Consumer Products

About the Author

Keith Roberts graduated in May of 2012 from the University of Tennessee with a degree in Logistics and International Business. He was a member of the CBA Global Leadership Scholars and the Chancellors Honors Program, and he started as a Procurement Associate at ExxonMobil in Houston, Texas in July of 2012.

About the Advisor

Dr. Mary Holcomb received her B.S., B.A., M.B.A., and Ph.D. from the University of Tennessee. She is an Associate Professor of Logistics in the Department of Marketing and Supply Chain Management at the University of Tennessee. Her research focuses on logistics and network design. Her professional career involved Oak Ridge National Laboratory and the U.S. departments of Energy, Transportation, and Defense.