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NC FIRST COMMISSION
FUTURE INVESTMENT RESOURCES FOR SUSTAINABLE TRANSPORTATION

The NC FIRST Commission was created in March 2019 to evaluate North Carolina's transportation investment needs. Their job is to advise the Secretary of Transportation of new or better ways to ensure that critical financial resources are available in the future. As part of this process, we'll be looking for input from you, the people of North Carolina! This brief is part of a "Disruptor Series" that examines technological and societal trends impacting our transportation system. This brief describes how the transportation, distribution, and logistics sector will change in the future and how these changes may impact North Carolina.

DISRUPTOR SERIES: PART 2

Transportation, Distribution, and Logistics in the Future

Overview

The transportation, distribution, and logistics (TDL) industrial sector is the glue that binds together almost every economic activity, domestic and international. While impediments to trade rise and fall, individual demand for goods is the primary determinant of what is moved, how it is moved, and when it is moved, regardless of origin. The rapid growth of e-commerce—the buying and selling of goods over the Internet—has fundamentally changed the landscape of moving freight, both within North Carolina and around the world. Consumers, not producers, are now in control. The only thing for certain is that the rate and range of change will continue over the next 20-plus years. Accommodating this pace of change will require a new approach to the development and design of transport infrastructure that acknowledges the importance of flexibility, resiliency, and sustainability.

What broader economic changes are affecting transportation, distribution, and logistics?

The "push" economy—as exemplified by Ford at the beginning of automobile mass production—forecasted consumer demand to establish production levels and distribution channels. Today, in what is referred to as a "pull" economy, consumers (both individuals and companies) control what is made and where it is delivered. Companies such as Amazon and Google are reforming their production platforms to be more flexible, customizable, and faster. Vast warehouses are being rapidly replaced by smaller distribution centers stocked by complex algorithms to respond to the immediate, ever-changing demands of the consumer. All the while, consumer preferences are shifting away from brick-and-mortar locations to convenient online shopping (**see Figure 1**), and consumers want purchases to be shipped quickly (**see Figure 2**).

Several e-commerce business models exist. Business-to-business (B2B), business-to-consumer (B2C), and manufacturer direct-to-consumer (D2C) flows are each growing at dramatic rates, with B2B flows twice as large as the B2C flows.[1] Old "push" distribution systems are being replaced with highly flexible, multichannel platforms reconfigured on average every nine months.

Figure 1: Retail E-Commerce Sales Worldwide, 2017-2023 (in trillions, % change and % total retail sales)[2]

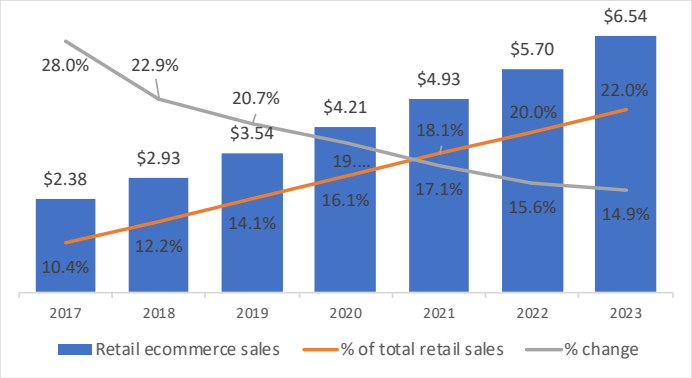
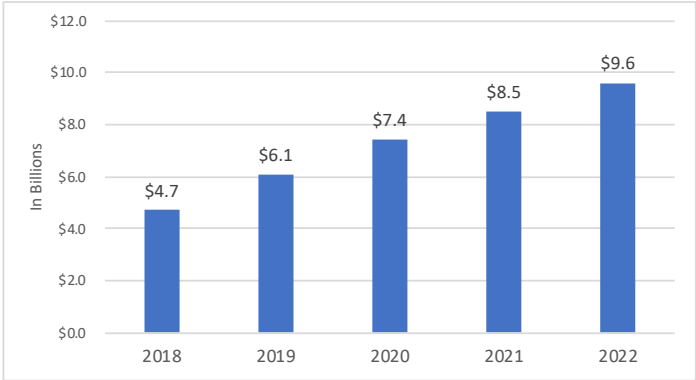


Figure 2: Same Day Delivery Market in U.S., 2018–2022 (in billions)[3]



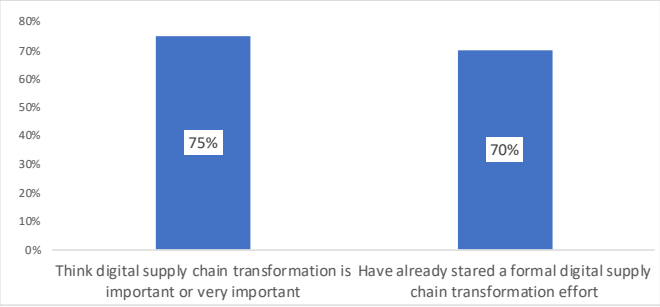
[1] https://impressionsmagazine.com/build-your-business/trends/market-watch-b2c-vs-b2b/
[2] https://www.emarketer.com/content/global-ecommerce-2019
[3] CSCMP's 2019 Annual State of Logistics Report

What are the key factors influencing changes in supply chains?

In 2017, MHI—the nation's largest material handling, logistics, and supply chain association—released its *Material Handling and Logistics U.S. Roadmap 2.0*.[4] That report focused on four forces influencing changes in supply chains: technology, consumers, workforce, and infrastructure. Based on hundreds of interviews and extensive research, the authors identified a series of specific issues related to each force.

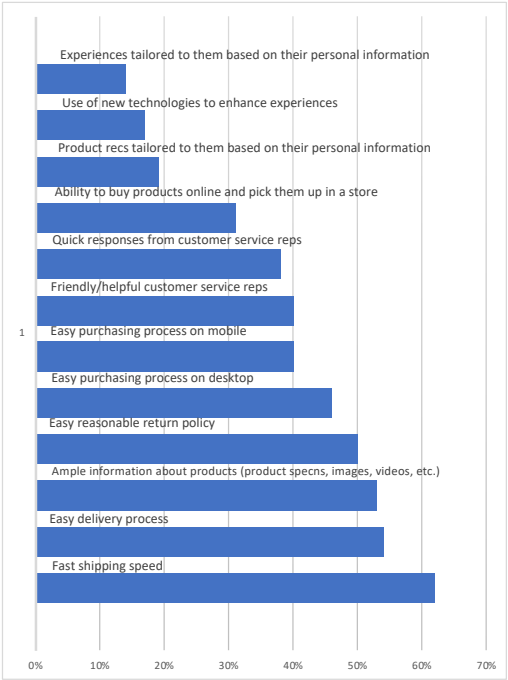
Technology. Technologies such as drones, cloud computing, artificial intelligence, data analytics, Internet of Things, 3D printing, and others are expected to create new markets, meet demands in existing markets, change how business is done and alter the workforce landscape for the better. A survey of more than 330 executives from large manufacturing and retail organizations in more than 20 countries found organizations are working toward digitization (**see Figure 3**). All rail and road corridors must now incorporate a high bandwidth data link to facilitate the flow of data, which is used to manage the physical flows of goods. Individual unit shipments are replacing larger shipments of many units. This, in turn, is changing the complexion of truck fleets, as more smaller vehicles, including drones, are appearing on and above urban streets and rural roads carrying packages to individual consumers and businesses alike. [5]

Figure 3: How Important Is the Digital Supply Chain Transformation?[6]



Consumers. The consumer is not a monolith. Individualism is translated into product personalization, points of delivery, elapsed time between order and receipt, and so on (**see Figure 4**). According to consumer research firm Narvar, "83% of US online shoppers expect regular communication about their purchases." Clearly e-commerce customers are engaged, following their deliveries.[7] Corporate purchasing departments are being replaced by sensors, while more orders are being placed directly by factory workers or fulfilled through complex algorithms. The result is an increasing focus on speed and reliability. The former is a response to the consumers. The latter is an essential tool for replenishing stock among networks of distribution centers that can range from million-square-foot structures to individual stores. While traditional brick and mortar stores will never fully disappear, their structure and operations are changing—and with those changes, a need is arising for a different transportation system.

Figure 4: How Do U.S. Digital Shoppers Define Positive Experiences with Digital Brands/Retailers?[8]



[4] Folger, G., Edwards, C., Ferrell, B., Hopper, S., Magliola, D. Schneider, D., Material Handling & Logistics U.S. Roadmap 2.0, MHI, April 2017

[5] Koch, L., "Delivery Speed Can Make or Break a Customer Experience", eMarketer Retail, August 25, 2019

[6] http://mktforms.gtnexus.com/rs/979-MCL-531/images/GTNexus-Digital-Transformation-Report-US-FINAL.pdf

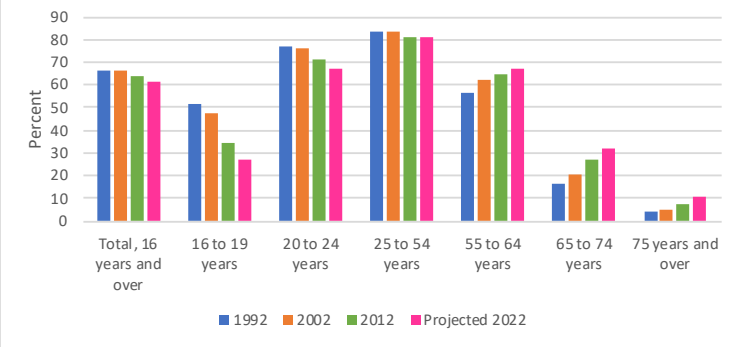
[7] https://see.narvar.com/rs/249-TEC-877/images/Connecting%20With%20Shoppers_Narvar%20Consumer%20Report%20Q1%202018.pdf?aliId=1109557

[8] Avionos, "Shoppers Demand Superior E-Commerce Experiences," eMarketer.com, June 11, 2019

How else could these changes affect the future of our transportation system?

Workforce. The changes in the TDL industrial sector is a double-edged sword for its workforce. On the one hand, Millennials and subsequent cohorts have different expectations about the work they do. As Elizabeth Dukes, founder of Houston-based software firm iOffice, explains, "Millennials feel companies place too much weight on the financial aspects of running a business and not enough on the organization's impact on its employees, the community and the environment."[9] Beyond a shift in focus and motivation, the pattern of continuous change is reflected in different skill sets, constant training, and the need for a team approach based on adaptability. As artificial intelligence and other technologies invade the workspace, many existing jobs will be replaced with those demanding higher skills, which in turn will require significant changes in education. The MHI Roadmap predicted that there will be challenges to finding enough workers[10] (**see Figure 5**). While these workforce-related changes are not expected to alter the physical transportation network, they will increase the demand for high bandwidth data links that allow rural populations to participate in the new economy as much as their urban counterparts.

Figure 5: Labor Force Participation Rates in 1992, 2002, 2012, and Projected 2022, by Age [11]



Infrastructure. At the highest level, logistics infrastructure consists of links and nodes in the network that allow freight traffic to flow. The links include not only physical links such as roads, bridges, rail lines, water routes, air routes, and pipeline corridors, but also communication corridors. Integration of the movement of goods is increasingly dependent on the free flow of a huge volume of data. The World Bank's 2016 edition of its Logistics Performance Index notes that "logistics performance both in international trade and domestically is central to the economic growth and competitiveness of countries."[12] The development, design, and construction process—especially where public and private transport operations and facilities merge—will require closer coordination at local, state, and national levels by 2030. Planners and developers will be measured and compensated not just on what they build, but on the integration of it all with industry and commerce. The adoption of new technologies creates pressure on policy makers at all levels to alter, amend, or even formulate new policies and associated rules and regulations. Among the many issues they face are:

- ⇨ Establishing a new environment for assessing liability issues arising from accidents involving semi- and fully-autonomous vehicles;
- ⇨ New design criteria for roads, bridges, and other infrastructure elements that are used by semi- and fully-autonomous vehicles;
- ⇨ Accommodation of communications systems and sensors used by semi- and fully-autonomous vehicles, and;
- ⇨ Protection of the data flowing between and to/from semi- and fully-autonomous vehicles. This will involve the creation of standard protocols and restricting access to commercially sensitive information.

[9] https://www.iofficecorp.com/blog/millennials-workplace-trends

[10] Folger, G., Edwards, C., Ferrell, B., Hopper, S., Magliola, D. Schneider, D., Material Handling & Logistics U.S. Roadmap 2.0, MHI, April 2017

[11] U.S. Bureau of Labor Statistics

[12] (Connecting to Compete 2016: Trade Logistics in the Global Economy) World Bank, 2016

How will these changes impact North Carolina?

The North Carolina Multimodal Statewide Freight Plan forecasts a 43% increase in total tonnage moving on the state's highways from 2015 to 2045, plus a 31.1% increase in rail freight and 73.0% growth in intermodal rail flows.[13] As shown in **Figure 6** and **Figure 7**, outbound commodities travelling on highways and on the rail network will grow at the fastest rate. The increased movement of goods is expected to worsen road and rail congestion and deteriorate road conditions. At the same time, innovative business practices that leverage technology will change the landscape for freight in North Carolina. Truck platooning—in which trucks are wirelessly connected and travel closely in a convoy to reduce fuel consumption—stands to reduce freight costs by more than 10% of the total cost of ownership by 2025.[14] As autonomous vehicle technologies advance and are implemented, additional highway transport savings may reduce the number of rail shipments in the future, shifting the overall balance of freight movement in the state. This will have implications for both modes and especially for infrastructure investment planning decisions. The benefits to the citizens of North Carolina will be realized through easier access to markets, consumer products, and the world beyond our state borders. The challenges that will face the state must be approached with a holistic, creative, and collaborative approach.

Figure 6: N.C. Highway Commodity Flows[15]

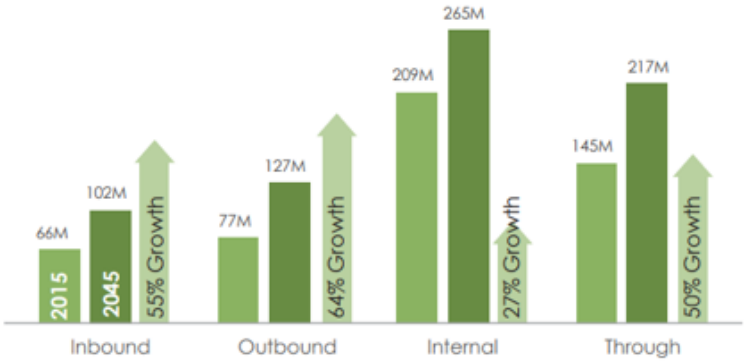
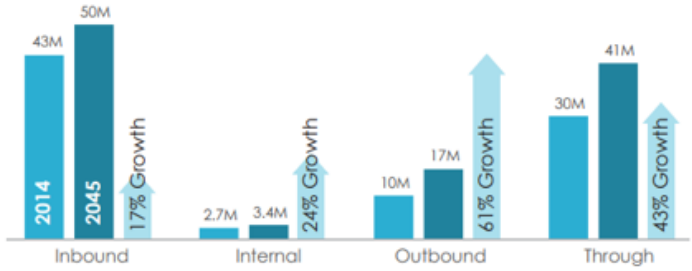


Figure 7: N.C. Rail Commodity Flows[16]



Summary

The significant changes to the transportation, distribution, and logistics industrial sector will have a profound impact on the way transportation infrastructure projects are developed, designed, and constructed. Just as consumers are demanding full flexibility, as technologies unheard of even a decade ago are influencing operations, and as workforces are facing a need for adaptable education and training, so too, the approach to infrastructure development and design, rooted in decades old manuals and systems, must undergo radical changes in a short period of time.

[13] https://connect.ncdot.gov/projects/planning/Statewide-Freight-Plan/Documents/NCDOT_SWFrtPln_FinalReport_180209.pdf

[14] https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/distraction-or-disruption-autonomous-trucks-gain-ground-in-us-logistics

[15] https://connect.ncdot.gov/projects/planning/Statewide-Freight-Plan/Documents/NCDOT_SWFrtPln_FinalReport_180209.pdf

[16] https://connect.ncdot.gov/projects/planning/Statewide-Freight-Plan/Documents/NCDOT_SWFrtPln_FinalReport_180209.pdf