Automated Bus Rapid Transit and Cavways
Transportation Reimagined

Table of Contents

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Introduction

In the dynamic and ever-changing sphere of urban transportation, Light Rail Transit (LRT) and Bus Rapid Transit (BRT) are frequently viewed as viable solutions to the escalating issues of traffic congestion and the urgent need for increased sustainability. LRT, distinguished by its high capacity and speed, offers a cost-effective alternative to conventional heavy-rail systems. It possesses the ability to mitigate traffic congestion, diminish carbon emissions, and stimulate economic growth. BRT, on the other hand, delivers fast, comfortable, flexible, and cost-effective services at near-metro-level capacities. BRT can integrate seamlessly with other modes of transportation, reduces congestion, and promotes sustainable urban mobility by supporting other policy initiatives like Complete Streets[i], or the 15-Minute City[ii].

A more advanced alternative is emerging with the introduction and potential integration of autonomous vehicle technology into BRT systems, henceforth referred to as Automated Bus Rapid Transit (ABRT). This cutting-edge technology not only enhances the efficiency of traditional bus transit but also boosts the competitiveness of BRT systems against LRT. ABRT has the potential to transport a larger number of passengers compared to BRT alone, in a safe and comfortable manner. It eases access for individuals with mobility challenges and minimizes the gap between the platform and the bus among other beneficial operational enhancements such as automated bus yard operations.

The transformation of our transportation system will be significantly influenced by the advent of dedicated roadway networks, colloquially termed as "Cavways". These are specifically designed for Advanced Bus Rapid Transit (ABRT) and autonomous vehicles and are also referred to as Automated Transit Networks. The introduction of Cavways will enhance traffic flow, alleviate congestion, and notably decrease travel durations.
Moreover, these networks will facilitate "placemaking", a concept that emphasizes the creation of public spaces that promote health, happiness, and well-being, while also ensuring safe community access to essential mobility options. These Cavways will serve as the ideal and optimized infrastructure for the integration of both personal and commercial automated vehicles of the future.

The potential of Cavways extends beyond transportation as we know it today. It could revolutionize logistics, emergency response procedures, and even create a new business

ecosystem. From facilitating efficient travel to providing a platform for various services, Cavways have the potential to redefine mobility.

Before exploring Cavways further, it is important to first lay some groundwork by describing the basics of LRT, BRT, and ABRT. This baseline knowledge is important for a more comprehensive understanding and discussion of Cavways and their place in the overall transportation system.

Light Rail Transit

Light Rail Transit (LRT) is a form of urban rail transit utilizing smaller, lighter vehicles than conventional rail, operating at a lower capacity, and often on exclusive right-of-way tracks. This versatile transport system combines the capacity and speed of a metro with the flexibility, lower cost and simplicity of a tram or streetcar network. Gaining global popularity as a significant mode of public transportation, LRT typically operates as an electric railway[iii] with a light volume traffic capacity compared to heavy rail. It's an efficient and environmentally friendly option for cities, reducing traffic congestion and lowering carbon emissions.

Figure 1: Seattle Light Rail, Source: bikocity.com

LRT systems are designed to provide high-capacity transit service within urban and suburban areas. They are often used in densely populated regions where the demand for public transportation is high. LRT systems are known for their efficiency, reliability, and ability to move large numbers of passengers quickly and safely.

Most LRT vehicle operators are located away from boarding areas, making on-board fare collection impractical. Therefore, most systems are trending toward off-board fare collection or electronic fare collection which allows passengers to use all doors.

In terms of infrastructure, LRT systems require the construction of track, signals, electric power systems, and specialized maintenance facilities. While these infrastructure costs can be substantial, they are often offset by the high passenger capacity potential of LRT. A few operators can manage a large number of passengers, making LRT a cost-effective solution for high-capacity transit.

However, it's important to note that LRT systems are not without their challenges. The need for expensive trackwork and signals at terminals and junctions can add to the overall cost of the system. Moreover, the fixed nature of the rail infrastructure means that LRT systems lack the flexibility to easily modify routes or service levels in response to changing demand or circumstances.

Despite these challenges, LRT remains a relevant choice for many cities due to its high capacity, efficiency, and reliability. It offers a sustainable and effective solution for urban mobility, helping to reduce congestion, improve air quality, and promote economic development.

Bus Rapid Transit

Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at near metro-level capacities. It does this through the provision of dedicated lanes, with busways and iconic stations typically aligned to the center of the road, off-board fare collection, and fast and frequent operations. BRT systems are designed to be accessible for all types of passengers and to integrate seamlessly with other modes of transportation. They also aim to reduce congestion and promote more sustainable urban mobility. These systems have been implemented in cities around the world, offering a more efficient and reliable service than traditional bus systems.

Figure 2: The Greater Cleveland Regional Transit Authority's HealthLine, Source: ActiveTrans.org

Because BRT contains features similar to a Light Rail Transit (LRT) or metro system, it is much more reliable, convenient and faster than regular bus services. With the right features, BRT is able to avoid the causes of delays that typically slow regular bus services, like being stuck in traffic and queuing to pay on board.

The cost of building a BRT system is also significantly lower than for LRT, making it an attractive option for many cities. In addition to their cost-effectiveness, BRT systems can be built more quickly than LRT systems, offering a rapid solution to urgent transportation needs.

Currently, BRT operates on a mix of dedicated and shared roadways, delivering service that is typically faster than traditional bus transit. This is achieved through the use of traffic

signal priority or preemption and short headway bidirectional services. This makes BRT a highly flexible and cost-effective alternative to LRT, which, while efficient, necessitates substantial investment in infrastructure and is restricted to fixed routes.

Automated Bus Rapid Transit

The introduction of autonomous vehicle technology into BRT systems, referred to as Automated Bus Rapid Transit (ABRT), is revolutionizing public transportation. It not only elevates the competitive edge of BRT systems against Light Rail Transit (LRT) but also enhances the quality of traditional bus transit. Below are several examples of technologies that are being integrated into BRT systems.

Automated collision avoidance and emergency braking systems are being adapted for buses, with the potential to significantly reduce collision-related insurance claims for the transit industry. In the year 2019, American bus transit agencies documented 6,228 collisions, resulting in 16,594 injuries and 95 fatalities. These unfortunate incidents led to casualty and liability expenses amounting to a staggering $770 million.[iv] A significant 74% of substantial bus insurance claims, those exceeding $100,000, are reportedly due to collisions.[v]

Figure 3: Level Boarding in Wheelchair Kansas City, MO Source: KCATA

Automated precision docking systems, a key feature of ABRT technology, are particularly beneficial for disabled riders. Individuals with disabilities may require lifts or ramps when embarking or disembarking from buses. This not only generates inconvenience for these individuals but also leads to a sense of stigmatization due to the resultant delay experienced by other passengers. Furthermore, the operational inefficiencies resulting from the restricted access to Bus Rapid Transit (BRT) for disabled individuals are manifested in a significant disparity in operating costs when compared to paratransit. According to 2019 FTA data, nationwide average conventional BRT trips cost $3.43 each while the cost for accessible paratransit service is $39.51 per trip.[vi] An automated precision docking system was first successfully demonstrated at Lane Transit District in Eugene, Oregon from 2013 to 2015.[vii] Additional FTA-funded, precision docking demonstrations are being conducted by the Connecticut Department of Transportation (CTDOT) on the CTfastrak Hartford, New Britain BRT line [viii] and the Kansas City Area Transportation Authority's (KCATA) Prospect MAX BRT line.[ix]

Automated lane keeping has been successfully tested, aiding drivers in keeping buses centered on narrow shoulders, enhancing safety, reducing driver stress, and potentially lowering infrastructure costs by reducing lane widths. This technology is particularly beneficial for BRT systems operating on narrow city streets. Automated lane keeping is not a new technology and can be found in many modern passenger vehicles. In fact, it was successfully tested on buses by the Minnesota Valley Transit Authority (MVTA) back in 2010-2011.[x]

ABRT technology can also enhance the cost-effectiveness of bus yard operations. Buses can be parked and retrieved without a driver, reducing the risk of collisions and damage as buses are parked near each other and then retrieved. The potential savings may help offset the costs of implementing yard automation technology.

An innovative feature of ABRT is automated bus platooning, or the "leader-follower" system. This system allows for the creation of an electronically linked chain of buses, controlled by a single driver in the leading bus. This technology offers opportunities for on-demand capacity, overcoming the constraints of driver availability. This can improve speed and flow, increase the number of passengers per driver, and offer the flexibility to use buses individually or as part of a platoon, depending on the time of day and passenger demand.


Figure 4: PANYNJ Lincoln Tunnel's Exclusive Bus Lane

It is worth mentioning that the Port Authority of New York and New Jersey (PANYNJ) is currently investigating the implementation of bus platooning within its Exclusive Bus Lane (XBL). Throughout the duration of the four-hour morning rush, the Lincoln Tunnel can currently accommodate approximately 1850 conventionally driven buses.[xi] The PANYNJ is exploring the implementation of bus platoons as a strategic measure to significantly enhance bus capacity by 30%.[xii] This innovative approach is also expected to mitigate the occurrence of tunnel-wall collisions and avoid knocking down lane delimiters, which serve as crucial elements in maintaining the segregation of oncoming traffic in adjacent lanes from the XBL bus-only lane.

The deployment of ABRT systems could also aid in reducing greenhouse gas emissions beyond the typical mass transit benefits. Electric ABRT vehicles are more practical as they can cycle through operational service, autonomously charging when needed, and redeploying as appropriate. Charging infrastructure could be strategically placed based

on factors such as the existing electric grid and secondary charging and electrical load-shaving opportunities.

The integration of ABRT into current and future BRT plans is not only possible but also highly beneficial. The infrastructure supporting BRT lines forms an excellent foundation for the initial implementation of ABRT. However, to fully realize the potential of ABRT, it is important for transportation planners and engineers to consider the expansion of dedicated lanes and roadways.

The creation of a dedicated ABRT roadway network would increase operational efficiency and provide the capacity for future growth. This development will not only enhance the effectiveness of public transportation but also pave the way for a reimagined transportation system.

Cavways

One of the most significant impacts of adopting ABRT is the creation of this dedicated roadway network, also referred to as "Cavways". Drawing parallels with highways and freeways, the term "Cavways" aptly encapsulates the primary advantage of these specialized roadways – efficiency.

ABRT and connected autonomous vehicles, equipped with advanced navigation and control systems, have the capacity to streamline traffic flow, mitigate congestion, and significantly reduce travel times. By designating specific roadways for their use, it essentially creates direct, unobstructed pathways for these vehicles, hence the term "Cavways".

In essence, "Cavways" represents a transition from the less predictable nature of human-driven traffic to a more organized, predictable, and efficient system. It's a term that articulates the potential of technology to revolutionize daily commutes, supply chain logistics, and make cities smarter and more sustainable.

The creation of Cavways would involve both new and existing infrastructure. This includes the construction of new dedicated roadways specifically designed for automated transit, as well as the repurposing of existing roads, lanes, and LRT corridors. This strategic resource optimization would not only maximize utility but also ensure the transition to an automated transit system is smooth and cost-effective.

Over time, Cavways could provide the much-needed infrastructure for the optimal integration of personal and commercial automated vehicles. These vehicles would be free

from the constraints of traffic congestion, allowing them to move quickly and efficiently along dedicated roadways. They would also be physically separated from less predictable human drivers, which could significantly transform the movement of both people and goods.

One of the major benefits of Cavways is its potential to dramatically improve safety on our roads. Automated vehicles are programmed to strictly follow traffic rules, eliminating human errors such as speeding, drunk driving, drowsy driving, and distracted driving, which are some of the main causes of road accidents. Furthermore, the design of the Cavways network would facilitate efficient traffic management through the integration of V2X technology, or "Vehicle to Everything". V2X enables vehicles to interact with any entity that could affect them, such as other cars, pedestrians, traffic lights, and even the roads themselves. This interaction significantly improves road safety, reduces traffic congestion, and enhances the overall driving experience. For instance, a vehicle equipped with V2X technology could be notified of a pedestrian crossing the road or a car speeding towards a red light at an intersection in time to act appropriately. Vehicles communicating with each other, and traffic systems will enable prompt responses to changing traffic conditions and reduce the probability of accidents.

Cavways could enhance emergency response procedures. These networks have the potential to act as essential lifelines during emergencies, facilitating swift evacuations in the case of hurricanes, for example, and providing immediate, direct access to areas affected by disasters. This would support a more efficient deployment of crucial personnel and resources. The impact could be further amplified when the Cavways are paired with autonomous vehicles, thereby enhancing the operational efficiency and effectiveness of disaster management systems such as delivering mobile power, or first aid. This pioneering approach could be a pivotal shift in emergency response, potentially saving lives and maximizing the utilization of manpower and resources during crises. For example, autonomous firetrucks could leverage Cavways to swiftly reach emergency sites, assess the situation, identify hazardous substances, and commence firefighting operations even before human first responders arrive. In larger-scale natural disasters, these autonomous assets could be utilized to transport essential resources and staff to the impacted areas.

The deployment of efficient, high-speed autonomous vehicles on the Cavways network would also revolutionize supply-chain logistics. Cargo transport vehicles of all sizes could travel more efficiently to their local and national destinations. By reducing delivery times and costs, this could lead to a more sustainable, lower cost supply chain with reduced emissions and energy consumption.

A nationwide Cavways system, akin to and leveraging the existing federal highway system, could be utilized by autonomous long-haul trucks. Upon reaching their designated destinations, these vehicles could be stationed at local distribution centers or electric charging hubs. Here, local drivers could facilitate first and last mile operations, further streamlining the delivery process. This is not merely a possibility, but a forthcoming reality in the logistics industry as autonomous long-haul trucks are already being tested on public roadways.

An example of Cavways and autonomous trucking is underway in Texas. The Texas Department of Transportation (TxDOT) has partnered with the innovative startup Cavnue (www.Cavnue.com) to develop a high-tech freight corridor along Interstate 35, aiming to revolutionize cargo transportation. This "smart" corridor will leverage advanced technologies to streamline the movement of goods, alleviate traffic congestion, and bolster safety on one of Texas's most critical trade routes. Cavnue specializes in creating sophisticated infrastructure designed to support both connected and autonomous vehicles. Their goal is to construct the world's most advanced roads by integrating state-of-the-art sensors, cameras, and communication systems to facilitate safer and more efficient autonomous and human-driven vehicle travel. This particular approach implements a dedicated lane for the autonomous trucks with no physical dividers between Cavways and human drivers. Although a great first step, this approach may introduce complexities if human drivers veer over the line or enter the lane.

Figure 5: Lindsay Barrier Transfer Machine

A potential strategy for improving long-haul transport involves the application of Barrier Transfer Machines (BTM) to create temporary, overnight Cavways on the nationwide interstate system. A BTM is a heavy-duty vehicle engineered specifically for the task of shifting concrete lane dividers,[xiii] such as Jersey barriers. This allows for the efficient alteration of lanes. These machines are predominantly utilized in cities to mitigate traffic bottlenecks during rush hours by dynamically adjusting lanes based on need. Automated BTM vehicles could establish exclusive, Directway lanes for automated long-haul trucks during the less busy overnight hours. Equipped trucks could be operated by a mix of human drivers and automation - with human drivers taking the wheel during daylight hours on conventional roads, and autonomous operation at night on the temporary Cavways. This innovative approach could substantially extend the safe driving range for drivers and provide a solution to today's supply-chain challenges. As self-driving cars gain prevalence, it's likely these

temporary Cavways could see increased usage throughout the day. Eventually, there may be sufficient justification for making them a permanent feature.

Once established, a Cavways network also presents a compelling solution for those seeking more efficient commuting and travel options. It has the potential to cut travel times by two to three times compared to traditional manual driving, especially when considering the impact of traffic congestion. This not only streamlines the travel process but also significantly boosts the speed at which individuals can reach their intended destinations.

Moreover, the time spent in vehicles could be repurposed into a productive or relaxing period. Whether it's catching up on work, indulging in entertainment, or simply unwinding, the Cavways network would add a layer of convenience and productivity that is not typically associated with conventional travel methods.

On a larger scale, a nationwide Cavways system could transform long-distance personal and business travel. It would offer the convenience of private vehicle travel while incorporating the speed typically associated with mass transit options such as rail and short-haul air travel. This hybrid approach could potentially redefine the way we perceive and undertake travel in the future.

The introduction of a fee-based system for the use of Cavways presents a compelling solution to cover the costs associated with its creation. This system would require users, specifically automated vehicles, to pay a fee for the privilege of using this network. This approach not only ensures the financial sustainability of deployment but also provides a potential source of revenue that could be reinvested into the maintenance and further development of the infrastructure.

The fee-based system offers a dual advantage. On the one hand, it provides businesses and commuters with a faster, more efficient means of travel, similar to the use of congestion pricing[xiv] and high-occupancy toll (HOT) lanes.[xv] This could significantly reduce travel times, increase productivity, and improve the overall commuting experience. On the other hand, it provides highway owners with a steady revenue stream. This could potentially transform the financial dynamics of highway ownership, making it a more attractive and profitable venture.

Furthermore, this system could potentially revolutionize the way we perceive and approach travel. By making travel more efficient and less time-consuming, it could change our attitudes towards commuting and make it a more enjoyable experience. Moreover,

the revenue generated could be used to fund further technological advancements, leading to continuous improvements and innovations in the field of automated travel.

A major barrier to the widespread adoption of Cavways, however, is the availability of autonomous vehicles. In the United States, the automotive industry achieves about 15 million new vehicle sales annually, against a backdrop of some 278 million registered vehicles.[xvi] Given this data, optimistically, it would take several decades to completely refresh the country's vehicular fleet. This slow turnover rate presents a barrier to the widespread adoption of Cavways for level-5 autonomous vehicles beyond niche applications. However, a new, innovative technology called AxiomDrive is poised to bridge this gap with its innovative system.

AxiomDrive's approach is to retrofit vehicles with technologies similar to highway autopilot and utilize an array of shared, road-based, control and command technology to autonomously navigate vehicles within a defined corridor. This innovative approach treats the corridor as a comprehensive, complex system, allowing for a more choreographed and efficient operation, resulting in enhanced traffic management, improved safety, optimized space utilization, and reduced environmental impact.

By retrofitting existing vehicles, AxiomDrive allows for non-autonomous cars to operate with autonomous capabilities within a controlled environment. AxiomDrive technology can be integrated into a wide array of applications such as Cavways, BRT, bus depots, and truck yards - helping to accelerate the transition to autonomous transportation without waiting for a complete national fleet overhaul. Considering that one of the top reasons for early hybrid vehicle adoption was access to high-occupancy-lanes, a market for this technology is well defined. Additionally, AxiomDrive would reduce accidents and improve efficiency in bus depots and truck yards making a compelling business case for adoption.

Cavways Ecosystem

The integration of ABRT and Cavways has the potential to not only revolutionize the transport of people and goods, but also holds significant potential for the creation of a new business ecosystem supported by efficient mobility. The impact of this shift is comparable to the transformation brought about by the evolution of the mobile phone. What was once a basic device for communication has now become a dynamic platform that hosts a myriad of applications, altering the way we live and work. Similarly, the reimagination of the automated transportation ecosystem that leverages the Cavways platform could bring about a revolution in the business landscape.

The focus of this platform extends beyond mere commuting. It has the potential to offer a comprehensive service experience for the modern commuter, especially as commuting and work patterns have changed, and more attention has been made to address the needs of essential workers. From facilitating efficient travel to providing a platform for various services, Cavways is set to redefine the transportation experience.

Just as the advent of the smartphone triggered an app revolution, this new transportation paradigm is poised to stimulate a wave of innovative enterprises. From logistics to retail, the possibilities are endless. With vehicles assuming the role of driver, passengers can repurpose travel time for productivity or leisure. Below are a few more-obvious in-vehicle entertainment and productivity services that could evolve from the availability of autonomous vehicles:

1) In-Car Cinema: Autonomous vehicles could be equipped with large immersive screens, high-quality sound systems, and even virtual reality (VR) technology, transforming the car into a personal movie theater. Passengers could enjoy their favorite films, TV shows, or streaming services during their journey.
2) Mobile Office: Passengers could engage in video conferencing, access cloud-based work platforms, or even use fold-out desks and office equipment, allowing them to stay productive during their commute.
3) Interactive Gaming: Autonomous vehicles could offer interactive gaming experiences, either through screens or VR technology. This could include multiplayer games that allow passengers in different vehicles to play together.
4) E-Learning: Educational platforms could be integrated into autonomous vehicles, allowing passengers to take online courses, learn new languages, or engage in other educational activities.
5) Personal Enrichment: Autonomous vehicles could offer platforms for writing, drawing, music creation, or other creative activities, turning travel time into a chance to explore and express creativity.
6) Wellness Services: Autonomous vehicles could offer wellness services such as telehealth, guided meditation, yoga instruction, massages, or even dental hygiene.
7) Shopping and Dining: Autonomous vehicles could integrate with online shopping platforms, allowing passengers to browse and shop during their journey. They could also integrate with food delivery services, allowing passengers to order meals that are delivered enroute. Or even act as dining rooms that are private or through VR walls, connect with other vehicles to form a virtual dinner party.
8) Virtual Tourism: With VR technology, autonomous vehicles could offer virtual tourism experiences, allowing passengers to explore different locations around the world from the comfort of a customized mobile platform.

Cavways will also catalyze a transformative shift in the business sector by enhancing job accessibility and workforce flexibility where remote working is not an option. The new, efficient transport system will reduce travel times and increase reliability, enabling businesses to draw from a wider talent pool beyond traditional geographic constraints. This shift promises to open up employment opportunities, particularly benefiting low-income and marginalized communities previously hindered by transportation limitations. As a result, companies will be poised to diversify and strengthen their staffing strategies.

Additionally, Cavways can broaden the talent pool available to employers. Businesses located along these efficient transit corridors can attract employees from a larger geographic area, ensuring that they have access to a diverse and skilled workforce. This can lead to a more competitive job market, with companies vying to offer better wages and working conditions to attract top talent.

The integration of Cavways into urban landscapes will not only improve the movement of people but will also have a profound impact on the movement of goods and logistics. Cavways will streamline supply chains, leading to quicker and more cost-efficient delivery of goods. The anticipated cascading economic effect includes a potential reduction in consumer prices and a boost in product availability as companies benefit from reduced transport costs and enhanced production efficiency.

With Cavways, businesses will experience increased adaptability to market changes, allowing for better inventory control and minimized waste. This agility could translate into a broadened supply curve. Meanwhile, consumers might enjoy more accessible goods and lower prices, potentially resulting in increased purchasing activities and an expanded demand curve. The overall impact of Cavways could, therefore, be a significant shift in both supply and demand dynamics, fostering a more competitive marketplace.

The ripple effects of Cavways and ABRT systems will likely extend beyond transportation and logistics, fostering innovation and entrepreneurship. New business models may emerge, catering to the needs and opportunities created by this more physically connected and mobile society. Just as ride-sharing platforms transformed the taxi industry, Cavways could spur the development of new services and technologies that capitalize on the increased connectivity and efficiency of urban transit.

Cavways are much more than a transportation solution; they are a catalyst for a new business ecosystem. By improving access to jobs and labor, optimizing supply chains, and shifting supply and demand curves favorably, Cavways promise to drive economic growth

and innovation. As cities and businesses adapt to these changes, we can expect to see a more dynamic and resilient economy, ready to meet the challenges of the future.

Conclusion

The future of transportation is undoubtedly leaning towards automation. The integration of autonomous vehicle technology into Bus Rapid Transit systems, creating ABRT, has the potential to transform public transportation, enhancing efficiency, safety, and accessibility. The advent of Cavways, dedicated roadway networks for ABRT and autonomous vehicles, promises to alleviate traffic congestion, decrease travel times, and revolutionize logistics and emergency response procedures.

However, the true potential of Cavways extends beyond transportation. It could stimulate the creation of a new business ecosystem, akin to the revolution triggered by the advent of the smartphone. From in-car entertainment and productivity services to wellness and shopping experiences, the possibilities are endless.

Yet, the realization of this vision requires visionary investment, strategic planning, and a commitment to innovation. As we continue to grapple with the challenges of traffic congestion, inefficient logistics, and safety, the promise of ABRT and Cavways offers a beacon of hope. The future of transportation is not just a distant vision, but a tangible goal within our reach. It's time to embrace this future and reimagine transportation for a more efficient, sustainable, and connected world.

About the Author

Jeffrey Barghout is an accomplished Business Strategist with 30 years of experience in business strategy, technology development, evaluation, and commercialization. As the CEO of Robocist, he is dedicated to developing and accelerating the adoption of emerging transportation technologies, including connected, autonomous, and electric vehicles, as well as utilizing artificial intelligence (AI) to quantify the driven environment.

Jeff's extensive background includes serving as an engineer and strategic planner at Chrysler, assessing technologies for NASA, and holding the position of Vice President of Transportation Initiatives at a leading research and consulting firm. He has been a successful serial entrepreneur, launching and growing businesses in various industries.

He participates in numerous advisory groups and serves on the Board of Directors for organizations like E4 Carolinas. With a proven track record of delivering results in both technology and business strategy, Jeff has navigated the complex intersection of technology, market forces, regulation, and stakeholder opinions, perceptions, and needs.

About Robocist

Robocist is a technology firm, headquartered in North Carolina, that supports the global automotive and technology sectors. With strategic partnerships across the United States and India, the firm offers cutting-edge solutions across a broad range of industries, such as transportation, agriculture, and healthcare - specializing in machine vision and learning, AI based roadway assessment, and connected, autonomous, and electric vehicles.

Robocist's unwavering commitment to technological progress, coupled with its strategic global partnerships, positions it as a go-to choice for organizations in search of innovative tech solutions. Its proven track record in delivering tangible results in technology development and business strategy has earned the trust of many corporate and government entities. Notable among these are the U.S. Department of Defense, Federal Transit Administration, U.S. Department of Transportation, as well as local and state Departments of Transportation.

Robocist and its strategic partners are often called upon as technical experts to support larger projects. They have contributed to initiatives spanning 21 countries for high-profile clients such as NASCAR, Michelin, Robotic Research, Visa, Sony, Disney, ESPN, and Spotify, among others. Robocist stands at the forefront of technological innovation, consistently pushing the boundaries of what is possible. They are dedicated to providing custom solutions for clients aiming to leverage advanced technology for impactful change.

References

[i] https://highways.dot.gov/complete-streets
[ii] https://en.wikipedia.org/wiki/15-minute_city
[iii] National Transit Database (NTD) Glossary. (n.d.). Retrieved October 05, 2020, from https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary
[iv] "National Transit Database, Safety and Security Time Series Data," https://www.transit.dot.gov/ntd/data-product/safety-security-time-series-data and "2019 Annual Database Operating Expenses," https://www.transit.dot.gov/ntd/data-product/2019-annual-database-operating-expenses, Federal Transit Administration, accessed July 14, 2020
[v] J. M. Lutin, A. L. Kornhauser, J. Spears, L. F. Sanders, "A Research Roadmap for Substantially Improving Safety for Transit Buses through Autonomous Braking Assistance for Operators," Compendium of Papers, Paper Number 16-1246, 95th Annual Meeting of the Transportation Research Board, Washington, DC, January 12, 2016
[vi] "NTD National Transit Database 2018 National Transit Summaries and Trends," Office of Budget and Policy, Federal Transit Administration, US Department of Transportation, December 2019, https://cms7.fta.dot.gov/sites/fta.dot.gov/files/docs/ntd/data-product/134401/2018-ntst_1.pdf
[vii] R. Gregg and B. Pessaro, "Vehicle Assist and Automation (VAA) Demonstration Evaluation Report," Report 0093, Federal Transit Administration, U.S. Department of Transportation, January 2016, https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Report_No._0093.pdf
[viii] Connecticut Department of Transportation, "CTDOT Receives 37 Million in Federal Grants, *Automated Bus Technology*," https://portal.ct.gov/DOT/News-from-the-Connecticut-Department-of-Transportation/2020/CTDOT-Receives-37-Million-in-Federal-Grants
[ix] Kansas City Transportation Authority, "KCATA Receives $600K Innovation Grant for Precision Guidance Sensors," August 31, 2020, https://www.kcata.org/news/innovation-grant-for-precision-guidance-sensors
[x] B. Pessaro, Impacts of the Cedar Avenue Driver Assist System on Bus Shoulder Operations, *Journal of Public Transportation, Vol. 16, No. 1,* 2013, https://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1073&context=jpt
[xi] Port Authority of New York and New Jersey, "Port Authority Board Approves Demonstration Program to Test Groundbreaking Technology for Increasing Bus Capacity in the Lincoln Tunnel Exclusive Bus Lane," December 12, 2019, https://www.panynj.gov/port-authority/en/press-room/press-release-archives/2019_press_releases/port-authority-board-approves-demonstration-program-to-test-grou.html
[xii] https://abc7ny.com/port-authority-lincoln-tunnel-technology-buses/5750552/
[xiii] https://www.lindsay.com/usca/en/infrastructure/brands/road-zipper/
[xiv] https://ops.fhwa.dot.gov/congestionpricing/cp_about.htm
[xv] https://www.transportation.gov/mission/health/High-Occupancy-Vehicle-Lanes
[xvi] https://www.forbes.com/advisor/car-insurance/car-ownership-statistics/#many_cars_section