1 Introduction

The Tampa Bay Area Regional Transit Authority (TBARTA) is conducting the Innovative Transit Technologies (ITT) study to examine the technical, financial, and regulatory feasibility of implementing aerial gondolas, air taxis, and hyperloop technologies. The work for this study is being documented in a series of technical memoranda. The industry interviews represent Technical Memorandum 2. While recognizing that this type of input has the potential to be biased, the purpose of the interviews with diverse participants in the industry is to supplement information and data that could not easily be gleaned from the literature review (e.g. vehicle specifications, unit costs, system capacity, and general qualitative industry perspectives).

The other technical memoranda include:

- Tech Memo 1 (Literature Review)
- Tech Memo 3 (Government and Regulatory Review)
- Tech Memo 4 (Preliminary Corridor Analysis)

Alongside the literature review and industry interviews, the study will assess regulatory framework and governance in place, or in development. Using this information, the team will assess potential corridor market connections within the Tampa Bay region. The information from these technical memoranda will be assembled into a final report. Figure 1 shows the study process and schedule, along with an arrow that identifies where the industry interviews fall within the study timeline.

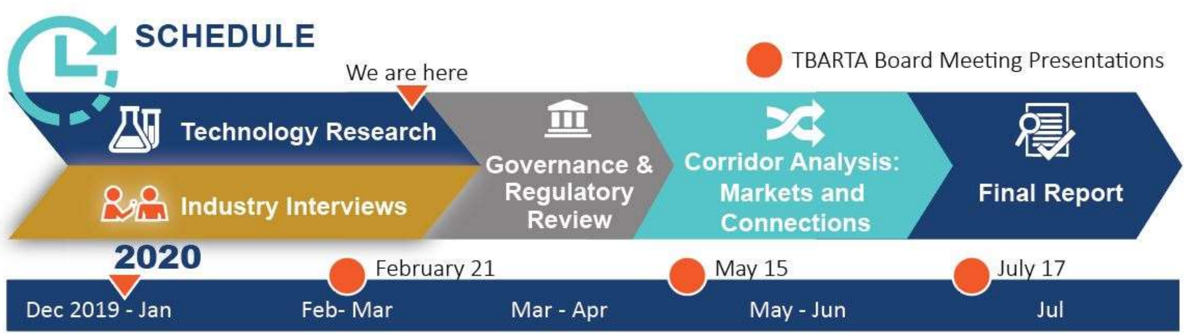

Figure 1: TBARTA Innovative Transit Technologies Project Schedule and Process

1.1 Purpose of this Document

This technical memorandum describes the process and approach for conducting interviews with a cross-section of industry experts on topics related to aerial gondolas, air taxis, and hyperloop technologies, and documents the information learned during the interviews that has contributed to the study. The information gathered from the interviews was used to provide a framework for further research and provide additional understanding related to data and publications where relevant. The information also provided insights for developing an approach for evaluating markets and corridor connections, as well as timelines for planning horizons.

This technical memorandum does not provide a final analysis, nor does it represent the extensive research conducted through other phases of the study. The compiled data from this tech memo, like the data from the other memos, will be used to support the final report. If additional interviews and discussions are held with industry experts throughout the study, this document will be updated upon completion of this study.

2 Interviews

Industry interviews supplement the research used to evaluate the potential of applying aerial gondolas, air taxis and hyperloop technologies in the Tampa Bay region. A diverse range of industry leaders were identified to provide a more complete perspective where possible, including technology developers; agencies working on studies, integration, and regulatory considerations; and operators. Interviewees were identified based on their position in the U.S. market and level of engagement in industry activities and development. Table 1 provides a list of interviews conducted during this study.

Interviews were predominantly conducted over the phone with respondents located throughout the country. Discussions focused on key aspects where there are questions related to context and qualitative considerations on published reports and studies, and to fill perspectives where literature was not available. Some of the interviewees also provided or referred the team to additional resources that were collected and summarized within the literature review technical memorandum.

This section lists the interviews that were conducted, and describes the general themes and takeaways from the culmination of the various discussions. The comments have not been tagged to specific interviewees in order to protect their identity. The qualitative findings from these interviews will be used to evaluate each technology's current and predicted state of development, to evaluate their opportunities and challenges, and to consider their integration and implementation potential in the Tampa Bay area.

2.1 Interview Schedule Summary

The interviews started early in the study process to coincide with the research and literature review. This helped to identify additional data and resources to inform the study. The study team reached out to a broad audience, and conducted interviews with those that were available and willing to participate in the study.

The complete list of interviews and meetings (as of the date of this writing) is provided in chronological order in Table 1.

Table 1: ITT Interview and Schedule Summary

Date	Technology	Entity	Interviewee	Attendees
December 12, 2019	Air Taxi	EmbraerX	Peter R. Berger II *Director of Innovation division for Embraer*	Peter R. Berger II (Embraer) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP)
December 18, 2019	Hyperloop	Virgin Hyperloop One (VHO)	Diana Zhou *Director of Project Strategy, VHO*	Diana Zhou (VHO) Kristen Hammer (VHO) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP)
January 8, 2020	Aerial Gondola	Doppelmayr	Ted Blazer *Vice President for Urban Development, Doppelmayr*	Ted Blazer (Doppelmayr) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP)
January 9, 2020	Aerial Gondola	Leitner Ropeways (Leitner)	Michael McGuckin *Manager, Operations and Maintenance, Leitner Roosevelt Island Aerial Tramway*	Michael McGuckin (Leitner/RIT) Daren Cole (Leitner) Jon Mauch (Leitner) Armando Cordova (Leitner) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP)
January 10, 2020	Air Taxi	Lilium	Marie Masson *Public Affairs, Lilium*	Marie Masson (Lilium) Christina Kopp (WSP) Jeff Diemer (WSP)
January 16, 2020	Aerial Gondola	Doppelmayr/ Portland Tram	Ray Gardner *General Manager Portland Aerial Tramway*	Ray Gardner (Doppelmayr/Portland Tram) Christina Kopp (WSP) Jeff Diemer (WSP)
January 16, 2020	Air Taxi	Uber Elevate	Rohit Goyal *Strategy Lead | Machine Learning Engineer, Uber*	Rohit Goyal (Uber) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP)
January 16, 2020	Air Taxi	AirMap	Pamir Sevincel *UAM Strategy Manager, AirMap*	Pamir Sevincel (AirMap) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP)
January 22, 2020	Air Taxi	University of South Florida (USF) – Smart Urban Mobility Laboratory (SUM-Lab)	Dr. Yu Zhang *Associate Professor, Department of Civil and Environmental Engineering, USF Director of USF SUM Lab*	Dr. Yu Zhang (USF) David Green (TBARTA) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP)

Date	Technology	Entity	Interviewee	Attendees
January 23, 2020	Hyperloop	Mid-Ohio Regional Planning Commission (MORPC)	Thea Walsh, AICP *Director of Transportation and Infrastructure Development, MORPC*	Thea Walsh (MORPC) Christina Kopp (WSP) Jeff Diemer (WSP)
January 28, 2020	Hyperloop	Hyperloop Transportation Technologies (HyperloopTT)	Charles (Chuck) Michael, PE *Regulatory Advisor and Feasibility Studies Lead, HyperloopTT* Shelby Phillip *Head of Executive Staff and US Public Affairs Lead, HyperloopTT (HTT)* Cesar Hernandez *Founder and Managing Director, OMNI*	Shelby Philips (HTT) Charles (Chuck) Michael, PE (HTT) Cesar Hernandez (OMNI) Brian Pessaro (TBARTA) Christina Kopp (WSP) Scarlett Sharpe (WSP)
February 5, 2020	SkyTran	SkyTran	Marco Booth *Product Development, SkyTran* Jay Helbling *President, SkyTran*	Marco Booth (SkyTran) Jay Helbling (SkyTran) Tom Nocera (BeachTran) David Green (TBARTA) Cyndi Raskin (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP) Meeting had others Invited - unknown
February 12, 2020	Air Taxi	NASA Ames Research Center	Ken Goodrich *Research Engineer, NASA*	Ken Goodrich (NASA) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP) Adrienne Lindgren (WSP)
February 14, 2020	Air Taxi	NASA Ames Research Center	David Thipphavong *Air Traffic Management-eXploration (ATM-X) Urban Air Mobility (UAM) Sub-Project Manager, NASA*	David Thipphavong (NASA) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP) Adrienne Lindgren (WSP)
March 9, 2020	Air Taxi	NASA Ames Research Center	Kapil Sheth *Aerospace Engineer, NASA*	Kapil Sheth (NASA) Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP)
March 16, 2020	Air Taxi	Hyundai UAM	Allan Fan *Global Head of Strategy and Commercial Planning, Hyundai UAM*	Allan Fan (Hyundai) Christina Kopp (WSP)

Date	Technology	Entity	Interviewee	Attendees
April 6, 2020	Air Taxi	Sikorsky/Lockheed Martin	Jonathan Hartman *Disruptive Technologies Lead, Sikorsky Aircraft*	Jonathan Hartman (Sikorsky/LM) Christina Kopp (WSP) Jeff Diemer (WSP)
April 15, 2020	Aerial Gondola	Doppelmayr/ Portland Tram	Ray Gardner *General Manager Portland Aerial Tramway* Richard Eisenhauer *Bureau of Transportation Program Manager, City of Portland*	Ray Gardner (Doppelmayr/Portland Tram) Richard Eisenhauer (City of Portland) Christina Kopp (WSP) Jeff Diemer (WSP) Alan Danaher (WSP)
April 24, 2020	Aerial Gondola	Walt Disney World – Skyliner	Todd Ruoff *Senior Transportation Engineer at Walt Disney World* Adrianna Sekula *Government Relations and Public Policy at Walt Disney World*	Todd Ruoff Adrianna Sekula Brian Pessaro (TBARTA) Christina Kopp (WSP) Jeff Diemer (WSP) Alan Danaher (WSP
Scheduled at the writing of this report				
June 16, 2020	Aerial Gondola	Walt Disney World – Skyliner	Alison Armor *Vice President of Transportation Operations at Walt Disney World* Greg Moore *Senior Project Coordinator at Walt Disney World* Grace Stepp *Transportation Operations Proprietor – Skyliner Operations at Walt Disney World*	Alison Armor (Disney) Greg Moore (Disney) David Green (TBARTA) Brian Pessaro (TBARTA) Chris DeAnnutis (TBARTA) Christina Mendoza (Forward Pinellas) Christina Kopp (WSP) Jeff Diemer (WSP) Amy Dunham (WSP) Scott Pringle (WSP) Michelle Kendell (WSP) Alan Danaher (WSP)

2.2 Key Takeaways

Aerial Gondola

Aerial Gondolas, also referred to as Cable Propelled Transit (CPT), are an existing technology operated today throughout the world. Doppelmayr and Leitner are the two main companies that develop, manufacturer and operate aerial gondolas in the U.S. The study team interviewed both companies to understand the technology, applications, and operational considerations. The study team also interviewed operating staff from the two operational urban aerial gondolas in the U.S., the Portland Aerial Tram and the Roosevelt Island Aerial Tram. Walt Disney World recently implemented the Skyliner gondola system to connect visitors between various resorts and theme park entrances in Orlando, Florida. As a project that was implemented recently and in close proximity to the Tampa Bay area, the study team interviewed staff involved in the implementation and operations.

Technology

The basic components of the gondola system are simple, consisting of cabins that travel along a ropeway (cable) that is supported by towers, with stations throughout and at either end. There are three main types of gondola systems used in urban transit. They include: Monocable, Tricable, and Aerial Trams. The type of system selected is based on the service needs and number of passengers that need to be transported. The Tricable technology provides the most robust transit system. Its larger cabins allow it to move more than 6,000 passengers per hour. No matter the length of the entire system, the design must include short segments between towers, and exact segment length is dependent on the cable type.

Gondola cabins are outfitted with various customer amenities. Towers and stations can be developed to fit within a community's characteristics. Aerial gondola manufacturers are consistently involved in developing innovative technologies to address wind speeds, air conditioning, and electricity.

Infrastructure

The infrastructure requirements are considered to be minimal, with little right of way needed for towers. More space is needed for station locations. Corridors can navigate geographic constraints like waterways and narrow right of way, providing a compatible technology for dense, urban areas.

Regulations/Governance

Evaluating alignments and potential impacts is similar to other transit technologies. Construction can take between one year and 18 months, with a similar timeframe for the design of the system.

Markets and Corridor Connections

The greatest use for aerial gondola systems is to connect locations that have physical barriers, such as mountains or waterways. Once gondolas are in the air, they can travel over physical impediments and congested roadways.

The U.S. is most familiar with aerial gondolas used to transport within ski resorts and theme parks. However, the technology has significant carrying capacity to serve urban populations, as done throughout the world. Urban gondolas can serve commuter based trips in the morning and afternoon peak periods, with a blend of tourist trips during off-peak hours. Different types of aerial gondolas can be selected based on passenger demand. The success of an urban system also relies on integration with existing transportation infrastructure.

Existing Examples

There are two urban gondola systems currently operating in the U.S. They are the Roosevelt Island Aerial Tram in New York City and the Portland Aerial Tram in Portland, Oregon. The former is operated by Leitner, and the latter is operated by Doppelmayr. Both systems are integrated with the local transit system scheduling. The Roosevelt Island Aerial Tram also utilizes the same fare payment system as the Metropolitan Transportation Authority (MTA). Both of these aerial trams provide a transportation connection over a geographic obstacle. The Roosevelt Island Aerial Tram provides transportation over the East River to Manhattan. The Portland Aerial Tram connects the Oregon Health and Science University at the top of Marquam Hill to the South Waterfront at the bottom of the hill. The Portland Aerial Tram was funded through a unique financial framework that included significant private investment. Additionally, significant transit oriented development has appeared along the waterfront tram station. Both systems report reliable service and are noteworthy as iconic symbols within their cities.

The interest in urban aerial gondola systems is growing across the U.S. and locally with interest from various governmental entities and private developers.

Air Taxis

Because air taxis and Urban Air Mobility (UAM) are an emerging technology, many of the assumptions being made about their development rely on data provided by the developers of these aircraft. At this early stage, reports indicate there are anywhere from 100 to 170 companies working on this technology. Much of the information about aircraft development currently underway is proprietary and cannot be detailed at this early stage. While interviews with developers can be challenging to obtain, the study team was able to interview several developers and UAM partners. The interviews led to a better understanding of the current state of the technology, a better understanding of developers' goals and objectives moving forward, and identification of perceived obstacles and challenges for implementation. The study team interviewed individuals from companies, agencies, and other organizations that are involved in various aspects of UAM development. These aspects include UAM visioning, operational integration, and regulatory framework.

Aircraft Technology

Currently, aircraft developers are focused on testing and evaluating various designs of aircraft technology, with a race to be the first to demonstrate a viable case for investors to move forward. Electric Vertical Take-off and Landing (eVTOL) capabilities are the current focus. Operational capabilities and travel distances will improve alongside the continued development of battery technology. The emergence of designs with quieter rotors and distributed electric propulsion allows for more flexible take-off and landing operations, with less community noise; an element considered to be critical to public acceptance.

The design efficiencies of eVTOL aircraft are anticipated to lead to improved accessibility and affordability over existing helicopter air taxi service. Many small start-up developers are testing with demonstration prototype aircraft. In order for these companies to penetrate the UAM market, there will need to be major capital investment, as well as a significant ramp-up of production. As such, major aircraft manufacturers or industries like automobile manufacturers may be a helpful resource to bring these aircraft to mass production. Various markets are involved in the aircraft development including original equipment manufacturers (OEMs), operators, network providers, and technology suppliers.

Air Mobility Networks

UAM has two main passenger mobility concepts being considered: Air Metros and Air Taxis. Air Metros would operate within air corridors (on fixed-schedules, similar to ground transit), along corridors where noise can be tolerated, such as highways and public rights of ways, or above waterways and rural lands. Air Taxis would provide on-demand and point-to-point service, as requested by passengers. Uber has been on the forefront of advancing the Air Taxi concept, working with various aircraft developers, as well as architect and design firms to envision a mobility hub that can fit within an urban community fabric. There are six aircraft developers working with Uber towards their Air Taxi concept. Uber is the predominant network provider involved in the UAM development. The industry as a whole is generally advocating for open infrastructure. Some of the interviewees believed Air Metro service will be deployed before Air Taxis service because of their more controlled operating environment and the fact that they would require fewer mobility hubs (also referred to as vertiports, vertihubs, and vertistops). Some questions remain related to the cost and applicability of implementing Air Metros.

Infrastructure

The success of an air mobility network will depend on substantial infrastructure to provide easy accessibility to the public. Whether an Air Metro or Air Taxi network, urban integration will require vertiports, vertihubs, and vertistops for eVTOL. Vertiports are essentially mobility centers for UAM where there is eVTOL infrastructure for charging as well as take-off/landing capabilities. Additionally, rooftops of buildings and parking garages could be retrofitted to accommodate landing space for eVTOLs to mitigate the number of vertiports necessary to support UAM. Various concepts of vertiports have been developed, including private and/or public, on-demand rideshare hubs.

Airspace

Currently, there is open airspace available for UAM operations between commercial aviation (above 10,000 feet) and small, unmanned drone operations (below 1,000 feet). There is no Air Traffic Management System (ATMS) in the airspace below where commercial aviation flies today. Adapting the ATMS to accommodate UAM – or developing an entirely new system for UAM operations between 1,000 and 10,000 feet– was noted in the interviews as one of the greatest operational challenges to deploying this new technology. An ATMS infrastructure and process would be necessary for either an Air Metro or Air Taxi model. It is assumed the ultimate UAM ATMS would be developed utilizing an automated and digital platform. Various challenges exist in developing the management system for airspace, including communication technology, spectrum usage, and Information Technology (IT) security.

Community Integration

Public acceptance will be just as important as technology, air traffic management, and infrastructure. Without a framework existing today, there will be challenges in understanding how all the intricate factors will work together for the seamless operation of UAM. According to the interviewees, public concerns about air taxis using eVTOL aircraft relate to noise, safety, visual pollution (i.e. too many aircraft in the sky), and the functionality of the technology. As helicopters are the only urban air mobility mode operating today, their high levels of noise are the only frame of reference the public has, which could lead to significant concerns.

Regulations/Governance

From a regulatory perspective, the Federal Aviation Authority (FAA) has authority over all navigable airspace. The FAA is actively working to address policy development and regulations for UAM. The National Aeronautical and Space Administration (NASA) is also working to support the development of a regulatory framework and operational ecosystem for the future. The two greatest issues of concerns identified are noise and safety. While the federal government has jurisdiction over air space regulations, local governments will have land use and zoning authority over the placement of landing pads, where aircraft are permitted to take-off and land, and noise levels.

Market Connections

Interviewees indicated that the first deployments of UAM are likely to be in highly urbanized metropolitan areas. While airports would be an ideal connection for air taxis, there will be some constraints to consider due to restricted airspace. A key initial connection may be between airports and high-demand locations, and utilizing existing helipads.

Timeframe

There is some lack of clarity in the market adoption rates for UAM, while electrification and automation are still in their infancy. These are the two largest technical challenges for aircraft certification. Demonstrations and pilot projects are anticipated within the next five years and will focus on addressing real world use cases.

While many aircraft developers are working to develop eVTOL aircraft within existing FAA requirements, there is still significant work to be done related to airspace management and the supportive infrastructure that will be needed before this technology can be widely deployed. The industry anticipates that we will see limited scale demonstration projects of eVTOL air taxi or air metro with certified pilots on board by 2025. During this time, there will be a focus on analyzing community impacts, public opinions, noise, and safety. By 2030, it is predicted there will be scaled implementation in major metropolitan locations. Advancements in automation will allow for unmanned operations, and aircraft will be able to carry more passengers. While some believe the Air Metro network concept is more likely to be deployed prior to on-demand Air Taxi services, some questions have been raised regarding the initial demand to support an Air Metro model in early years of staged implementation.

Hyperloop

Hyperloop is an evolving high-speed transport technology led by a few private developers, including Virgin Hyperloop One (VHO), Hyperloop Transportation Technologies (HyperloopTT) and TransPod. VHO and Hyperloop TT are the two that have been the most prominent in the U.S. Both have been involved in various hyperloop studies in different U.S. states. Both companies were interviewed for this study. The study team also interviewed staff from the Mid-Ohio Regional Planning Commission (MORPC) involved in the Hyperloop Midwest Connect Initiative. This is a multi-jurisdictional study being conducted in cooperation with VHO that looks at connecting Chicago, Columbus, and Pittsburgh.

Technology

The hyperloop technology consists of a grade-separated vacuum tube, with a pod/capsule that can travel inside the tube at very high speeds (theoretically up to 760 mph). The tubes can be elevated, at-grade or underground, depending on right of way availability and geographical or physical barriers. The most cost-effective method is at-grade construction. Corridor studies have typically examined highway and expressway corridors, with a preference for alignments that are flat and straight.

VHO and Hyperloop TT have test facilities in place where speed tests are being conducted. VHO was the first to open a test track (DevLoop) in Nevada, just outside of Las Vegas. HyperloopTT opened their test track in Toulouse, France in 2019. To date, a full-length test facility has not yet been built, and speeds have not reached the 700+ mph during testing. The highest speed test has reached 260 mph.

Implementation/Operations Framework

Hyperloop developers are working with local and regional governments to evaluate hyperloop as a potential high-speed transportation mode. VHO and Hyperloop TT see themselves primarily as technology developers, licensers, and integrators but not necessarily the operators. It is likely that consortiums will be needed to implement hyperloop projects, with additional roles in the future for manufacturers, builders, and operators. However, exact roles and partnership arrangements remain flexible at this time and there is a general openness to explore public-private partnership (P^3) arrangements. Projects will depend on local jurisdictions to drive initiatives forward and will require strong regional partnerships.

Key Markets/Connections:

The key to evaluating the feasibility and potential success of a hyperloop route is the market and ridership between station areas. The greatest value in the technology is its potential to connect mega regions. The hyperloop market is similar to high-speed rail and regional air routes. Connectivity and proximity to other modal hubs and transit service is a consideration when identifying connections.

An early potential use case for Hyperloop technology would be for freight connections. This would provide for technology demonstration prior to operations with passengers.

Economics/Funding

The hyperloop companies believe the potential service will be financially self-supporting. P^3 and consortiums have been noted as opportunities to move projects forward. The technical and environmental feasibility is said to be a local issue, and one that should be addressed by the local planning agencies.

Regulatory/Governance

Governance is considered a challenging aspect to implementing the technology, leading to some unknowns related to timing for implementation. It is unclear which federal agency would have the lead oversight role in the environmental review process: Federal Railroad Administration (FRA), Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and even some thoughts of involvement from Federal Aviation Administration (FAA).

The U.S. Department of Transportation (USDOT) developed the Non-Traditional Emerging Transportation Technology (NETT) council to help guide a regulatory path forward for the emerging technology. As an aside, the USDOT will need to update the Manual on Uniform Traffic Control Devices (MUCTD) to account for hyperloop being part of the surface transportation system.