



NEXA Advisors
A NEXA Capital Company



BUSINESS AVIATION EMBRACES ELECTRIC FLIGHT

How Urban Air Mobility Creates Enterprise Value

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What Others Are Saying



"It's time to look at autonomous aircraft. The addressable market is \$1.5 Trillion in our base case by 2040."

Morgan Stanley Research, December 2018

"The development of eVTOL aircraft holds significant promise for a wide variety of business aviation applications, and the potential to transform on-demand aerial transportation."

Ed Bolen, President and CEO, NBAA



"Urban air mobility could revolutionize the way people and cargo move in our cities and fundamentally change our lifestyle much like smart phones have."

Jaiwon Shin, NASA Associate Administrator for Aeronautics

"Real prototype vehicles are being built right now. So the technology is very doable."

-- Dennis Muilenburg, Chairman, Boeing Company



"We think cities are going to go vertical in terms of transportation, and we want to make that a reality."

Dara Khosrowshaki, CEO, Uber

"These are some of the most exciting innovations and developments in aerospace since the Wright Brothers, and it's all taken place over the course of a few short years."

Dan Elwell, Acting Administrator, FAA



"Imagine pulling out your phone, opening up a transportation app and summoning your own personalized ride by air taxi. That sci-fi vision of the future is actually much closer than you might think."

Brian Krzanich, CEO, Intel Corporation

"[Urban Air Mobility is] coming because it has to. We have no more room on the ground to move cars around."

Robin Lineberger --Leader, Deloitte A&D Industry Practice



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On the Cover:

EHang two-passenger electric VTOL aircraft graces a hangar with another business aircraft.

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About NEXA Advisors, LLC:

NEXA Advisors provides highly specialized transaction-focused advisory services to companies and management teams in the aerospace and transportation sectors in the U.S. and around the world. Committed to delivering enterprise value through innovation, NEXA Advisors collaborates with our clients to help them become high-performance businesses. For many years NEXA Advisors has worked with NBAA and the business aviation community to identify how aircraft can generate and sustain enterprise value for the companies they serve.

Our August 2019 study, **Urban Air Mobility (UAM) Economics and Global Markets 2020-2040**, is a joint undertaking with NBAA, Aviation Week Network, and other respected industry groups. The study analyzed 74 cities around the world, forecasting the financial and economic business case for UAM in each, using thousands of geocoded data features, unique characteristics, and custom ArcGIS maps of each city. As part of our research, we developed a first-of-its kind, user friendly online tool, highlighting the potential of UAM in key global markets – including the benefit for business aviation – at www.nexa-uam.com.

About UAM Geomatics, LLC:

NEXA's subsidiary UAM Geomatics is a new center aimed at accelerating unmanned aircraft system traffic management (UAM) investment through analytical tools and advanced models supported by geospatial data and business case analysis. We offer tools needed to begin designing airspace and infrastructure for those metro areas where electric vertical takeoff and landing (eVTOL) operations can begin shortly. This includes capabilities such as identifying simple verti-pairs (flights between two vertiports) than can support profitable eVTOL operations; current and required ground infrastructure; UAM service demand, and UTM infrastructure. Business flight departments can use these tools to identify flight pathways for electric aircraft on specific urban or regional missions.

About the National Business Aviation Association:

Founded in 1947 and based in Washington, DC, NBAA is the leading organization for companies that rely on general aviation aircraft to help make their businesses more efficient, productive and successful. The business aviation community consists of companies of all sizes that rely on many different types of aircraft to meet their transportation challenges. The vast majority of businesses in this community consists of small- to mid-size businesses and other entities including nonprofit organizations.

Introduction

Business aviation is evolving as quickly as ever, and it includes new technologies and transport modes.

Key among these is a development known as Urban Air Mobility (UAM), which incorporates remarkable technological advantages in electric motors, rotors, batteries and flight automation. This technology will become reality within just a few years, and will have profound implications for business aviation.

Along with emergency rescue services, business aviation users will be among the first to take advantage of electric Vertical Takeoff and Landing (eVTOL) aircraft. In August 2019, NEXA Advisors, partnered with the National Business Aviation Association (NBAA), released the results of a groundbreaking investigation into how the future meets the present, and what is in store for business aviation.

Global UAM Study

The study, ***Urban Air Mobility Economics and Global Markets, 2020-2040***, asks vital questions: How does society transform urban mobility from a promising concept into a future of highways in the sky, the future we clearly know is on the way? How can this transition to greater mobility provide value to companies that may also use aircraft or flight departments?

To answer these questions, we examined each city's needs with regards to UAM, including infrastructure, regulation, GDP, congestion, current transportation networks, and dozens of other factors to determine likely early users. Each city report, accessed through an interactive web portal, offers custom ArcGIS maps of the metropolitan area, thousands of geocoded data features and characteristics, and our estimation of the city's potential for UAM. Our key findings for each city include: existing heliports,



Figure 1 – Some Experts Believe NASA's Vision of Urban Air Mobility Will Become a Reality by 2020, with Major Aerospace Companies Leading the Way in Vehicle Design and Certification.

projected vertiports, estimated yearly UAM passengers through 2040, total operator revenues, total infrastructure costs, total urban air traffic management (UATM) costs, total vehicle costs, and total airports. We detail cumulative UAM passenger demand growth, vertiport buildout timelines, and cumulative revenues by market.

The online part of the study is an invaluable and unique tool for decision-making for infrastructure funds, vehicle manufacturers, city planners, CNS/ATM developers, and, most importantly, future eVTOL operators, including executive flight departments.

In part through the use of first-of-its kind research, this white paper examines the value to businesses of using eVTOL vehicles and services to solve the "last mile" or "door-to-door" challenge, complementing the flight department's existing aircraft with electric or hybrid vehicles capable of moving a team of key people quickly from the home office to a meeting in a city center, or to an outlying airport to depart on a business aircraft or scheduled airline flight. It is clear that, with the advent of UAM, NEXA's UBV formula will be forever changed.

Business aviation is a global industry, and business aircraft are tools that strengthen or leverage the impact of a company's intangible assets, including key employee talent. Fundamental to the analysis of business aviation is always a value framework, which includes the variety of aircraft utilization strategies, the benefits derived from these utilization strategies, and the financial and non-financial value that these benefits produce. In essence, Utilization strategies yield Benefits, which in turn contribute key drivers of enterprise Value (UBV) for a company.

To examine this further, we studied each city's assets and liabilities with regards to UAM, including infrastructure, regulation, GDP, congestion, current transportation networks, and dozens of other factors to determine likely early users. Each city report, accessed through the interactive web portal referenced earlier, offers custom ArcGIS maps of the metropolitan area, thousands of geocoded data features and characteristics, and our estimation of the city's potential for UAM. Our key findings for each city include: existing vertiports, projected vertiports, estimated yearly UAM passengers in 2040, total operator revenues, total infrastructure costs, total UATM (urban air traffic management) costs, total vehicle costs, and total airports. We detail cumulative UAM passenger demand growth,

According to the experts at NEXA, and confirmed through prior analysis going back over two decades, business aviation can:

- Increase revenues by improving customer relationships and accelerating transactions.
- Increase earnings growth by providing benefits far greater than costs.
- Improve asset efficiency by allowing companies to leverage intangible assets, especially top talent.
- Increase customer satisfaction by allowing more face-to-face contact and moving customers with ease and purpose.
- Increase employee satisfaction by improving work environments.



Figure 2 – The Bell NEXUS Six Rotor, Five Passenger Electric Hybrid VTOL Aircraft Can Cruise at 200 Miles per Hour.

vertiport buildout timelines, and cumulative revenues by market.

The online study is an invaluable and unique tool for decision-making for infrastructure funds, vehicle manufacturers, city planners, CNS/ATM developers, and, most importantly, future eVTOL operators, including business flight departments. Below, we briefly cover business aviation and its value to companies of all sizes, all around the world, then begin to detail the enormous impact these new electric aircraft technologies will have for the further benefit of the sector.

Business Aviation Creates Enterprise Value

Companies everywhere have long benefitted from business aviation, as demonstrated by a host of studies, surveys and other types of analysis. For example, a 2017 study from NEXA Advisors measured the effects of business aviation on shareholder value creation of the S&P 500. The report found that business aircraft make a substantial difference in how a company performs

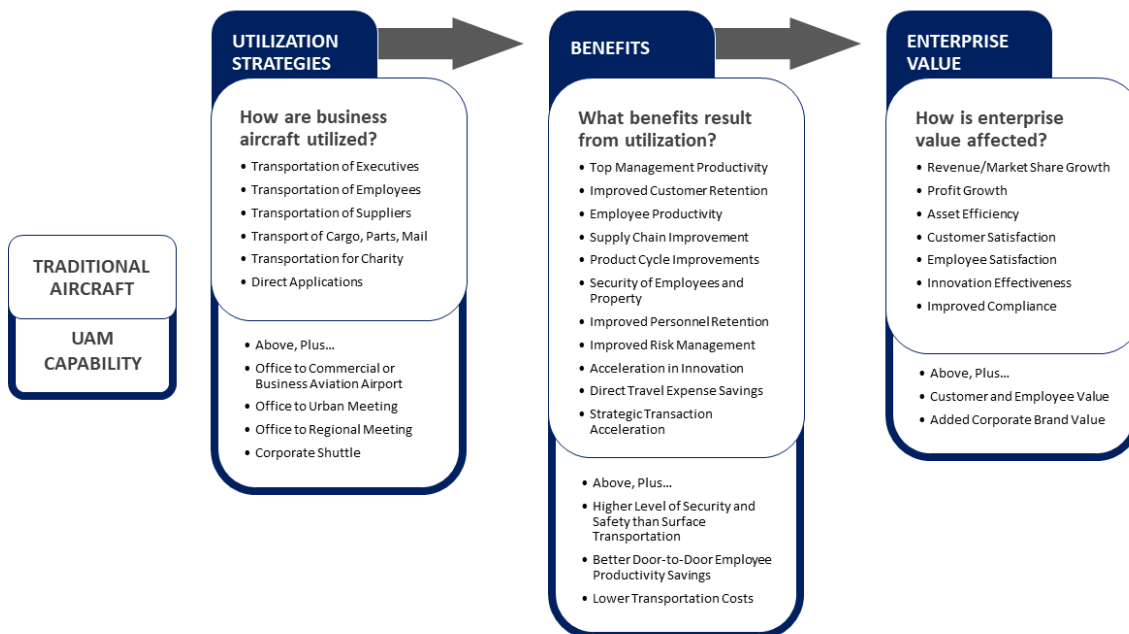


Figure 3 The eUBV Framework: Electric Vehicles Add Utilization Strategies That Deliver Greater Benefits and Enterprise Value

its mission, in many cases generating significant gains in shareholder value. Increased mobility was at the core of these gains—satisfying management’s need for greater organizational agility, knowledge integration and transaction speed.

That said, some of the benefits of business aviation cannot always be explained in terms of financial metrics alone. That’s why NEXA developed the UBV Framework of Analysis (Figure 3), which considers business aircraft utilization strategies, the variety of financial and nonfinancial benefits that accrue to operators, and the value drivers those benefits influence. The construct recognizes that the utilization strategies yield benefits which affect an enterprise’s value drivers. Abbreviated, this formula shows how “Utilization yields Benefits which yield enterprise Value” or UBV. Figure 3 now augments this to illustrate how eVTOL utilization will only further optimize business aviation value. With this paper, we coin the phrase “electric UBV” (eUBV) to highlight the additive utilization strategies that will be brought about by UAM vehicles.

Electric Flight and Business Aviation

Electric vertical take-off and landing vehicles are rapidly becoming a reality, due to the intersection of several breakthrough and maturing developments:

Improved Energy Use and Storage: Powerful batteries making use of lithium ion technologies—which have recently made Nobel Prize-winning



Figure 4 - Four Passenger All-Electric Boeing Design Utilizing Eight Rotors

headlines—along with hydrogen fuel cells and hybrid charging, now can provide hours of electricity to power vehicles.

Motors Using A “System of Systems”: Advances have been made with motors that work with each other to transform battery power into high torque, rotor-induced lift, more effectively and efficiently than ever before. These lightweight, multi-rotor designs provide an unprecedented degree of safety and performance.

Emerging, Super-Light and Safe Vehicle

Composites: Composites not available even a decade ago offer greater design freedom, enabling the creation of complex aerodynamic shapes, and requiring less maintenance, while operating at a safety level characteristic of the highest aviation standards.

Next-Gen Avionics: Electric vehicles will make use of precision navigation capabilities, with GPS augmentation through kinematic accuracy improvements, embedded inertial sensors and independent ground beacons.

Advanced Pilot Assistance and Flight Automation: Certified sense- and-avoid technologies, predetermined “tunnels in space” and pilot assistance modes will provide safer flight operations.

In combination, these developments are poised to produce some of the safest, greenest and most efficient air vehicles imaginable.

UAM and Regional Air Mobility (RAM) open up new possibilities for company flight departments and charter operators that cater to business travelers.

A new class of vehicles to complement the aircraft in the flight department will be capable of solving the “last mile” or the “door-to-door” part of a business trip. This new class of flying is only possible because of these unique traits:

A Smaller Infrastructure Footprint: Most vehicles of this class are of a size that will fit onto a cul-de-sac or a two-lane driveway.

Access to Existing Heliports: Over 25,000 heliports exist around the world today. Some 4,200 have

been documented and geocoded for the 74 cities included in our recent study: **UAM Global Markets – 2020 to 2040.** (More on this topic in the next section of this report.)



Figure 5 - German Design Company Lilium’s All-Electric Five Passenger Vehicle Designed Specifically for Inter-City Operations

A Lower Noise Signature: Recent noise-signature testing shows that two-passenger electric vehicles generate less than 65 decibels (dB) hovering at about 250 feet of altitude, or 35 dB at 1,500 feet, significantly quieter than existing commercial rotorcraft.

An Ideal Range of Operations: Electric flight will span a wide range of missions, from those encompassing anywhere from 10 miles to perhaps as many as 200 miles, all while avoiding traffic congestion and residential areas.

A Green Footprint: These all-electric or hydrogen/electric vehicles have zero emissions, and can become important tools for the increasing number of companies whose mission statements prioritize sustainability.

Business Aviation and Heliport Access

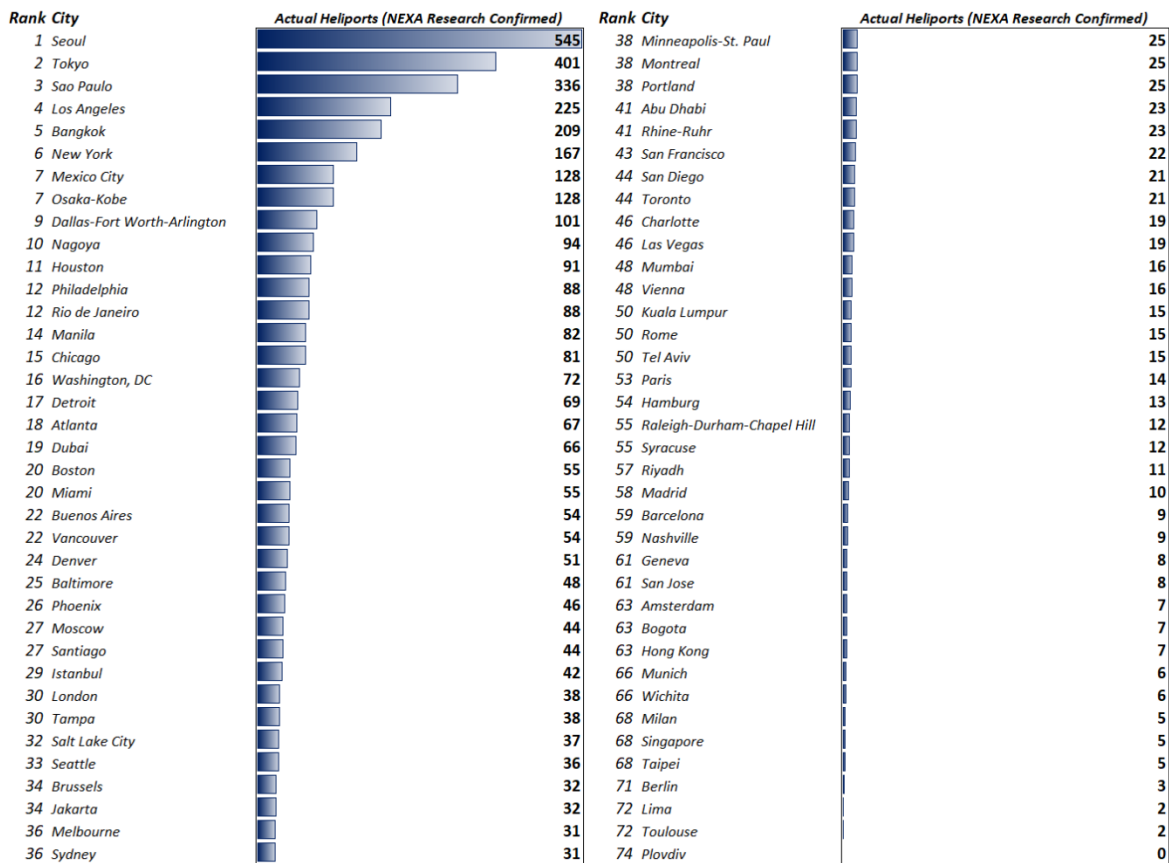
Existing heliport infrastructure, particularly outside of commercial and general aviation airports, provides eVTOL business aviation users with access to highly convenient urban destinations. Many current heliports have the operating certificates and air rights to begin stationing eVTOL aircraft immediately, though some heliports will need to undergo modification to offer recharging stations, hybrid vehicle refueling, passenger shelters, and other amenities. We estimate the cost to retrofit a simple landing pad into an eVTOL vertiport to be very affordable.



Figure 6 - XTI Trifan Hybrid Air Vehicle Landing on a Heliport at Dusk

In **UAM Global Markets – 2020 to 2040**, we identified some 4,200 heliports within the seventy-four cities examined. Curiously, 40% were not registered with regulators; we found them through

intensive research supported by satellite imagery. Some were built for emergency purposes only or fell victim to local concerns about noise and safety. There are probably thousands more heliports



throughout the U.S. that remain, for the time being, unregistered. Yet they present hundreds of millions of dollars of existing infrastructure with the potential for rapid development at reasonable cost. Those built for emergency purposes will suddenly become valuable real estate, and those shuttered for community concerns may well reopen.

eVTOL aircraft will create less noise than helicopters and offer greater safety; therefore, local municipalities will inevitably need to modify local ordinances. As a result, heliports currently in use will likely see the addition of and transition to eVTOL aircraft, and those heliports not in use—a goldmine in economic opportunity sitting idle—will obtain revised operating certificates and air rights for UAM use.

In terms of business aviation trips to an airport via eVTOL aircraft, most airports already have helicopter landing facilities which can be easily modified to support UAM. A well-run airport will seek to blend UAM with conventional airport operations to maximize the utility and convenience of its facilities. Airports are the logical point of ingress for eVTOLs into an urban transportation network.

With regards to trips from one company's office to another, the first certified hybrid eVTOL aircraft are likely to travel distances up to 150 miles between refueling/recharging. A team of business people will be able to board a vehicle at or near their office in, say, Los Angeles, and fly directly to another office in San Diego, or from a suburb of Boston to a heliport in suburban New York, avoiding highways and airports altogether.

The New Frontier: Electric Vehicle Missions

The utilization strategies below will be capable of driving significant new benefits and value to flight departments, and the companies they serve.



Figure 7 - Artist's Rendering of Joby Aviation 4 Seat Electric Vertical Take Off and Landing Air Taxi Prototype

Office to Meeting or “Shuttle” Services

Fundamental to the analysis of business aviation is the value to companies of using eVTOL vehicles or services to solve the “last mile” or “door-to-door” challenge. For businesses, complementing the flight department's existing aircraft assets with electric or hybrid vehicles capable of moving a team of managers, salespeople, maintenance technicians or others quickly from the home office to a meeting in a city center, or to an airport to depart on a business airplane, will make sense. Such missions can mean the difference between having to add an overnight stay to what could otherwise be an out-and-back, one-day trip.

Another powerful application would be for daily shuttle services between a company's own offices or facilities. To avoid delays, and guarantee the arrival of a specialist team, companies can make use of electric vehicles to cost effectively complete a mission.

On-Demand Air Taxi Services

On-demand air taxi services have the potential to radically improve urban mobility for businesses. The time lost in daily commutes, or getting from one location to another, is substantial. According to Uber Elevate, just as skyscrapers allowed cities to use limited land more efficiently, urban air transportation will use three-dimensional airspace to alleviate



Figure 8 - Volocopter Two-Passenger, 18-Rotor Vehicles Parked Inside a Corporate Flight Department's Hangar

transportation congestion on the ground. If a flight department does not have its own vehicle, hailing an “air taxi” can fill the void and address the problem.

Regional Air Mobility Services

Some manufacturers of eVTOLs are investing in hybrid vehicles that have the ability to gain altitude from a vertiport under electric power, and then transition to vertical flight using lift from fixed wings. Powering and recharging batteries using small turbine generators while at altitude, these vehicles have the range and capability to fly point-to-point from one city to another, and could do so using a new UAM infrastructure available at thousands of locations, including existing heliports or newly constructed vertiports. A strong preference for short inter-regional travel finds new demand that airlines cannot serve, and that business travelers would greatly value.

For example, numerous studies¹ find that traveling by air using UAM for short inter-regional trips (e.g., a Reston, VA heliport to an outlying Baltimore-area

heliport, or a downtown Los Angeles heliport to a suburban San Diego heliport) makes sense.

Regional air transport using eVTOLs is also potentially disruptive to today’s commercial air transport model. “We believe the regional transportation ecosystem is ripe for disruption and startups like Joby Aviation will revolutionize how people move across urban areas,” according to Bonny Simi, President, JetBlue Technology Ventures.

New Tools for the Flight Department

As an example, the New York City region, including parts of New Jersey and Connecticut, offers about 167 existing heliports in addition to the 12 close-in airports. Figure 9 illustrates a geocoded, feature-rich map of the region (heliports are in green), and is a starting point for flight departments to undertake route planning. It is possible to design routes

¹ *Urban Air Mobility (UAM) Market Study 2019*, Booz Allen & Hamilton, McLean, VA, USA (www.bah.com)

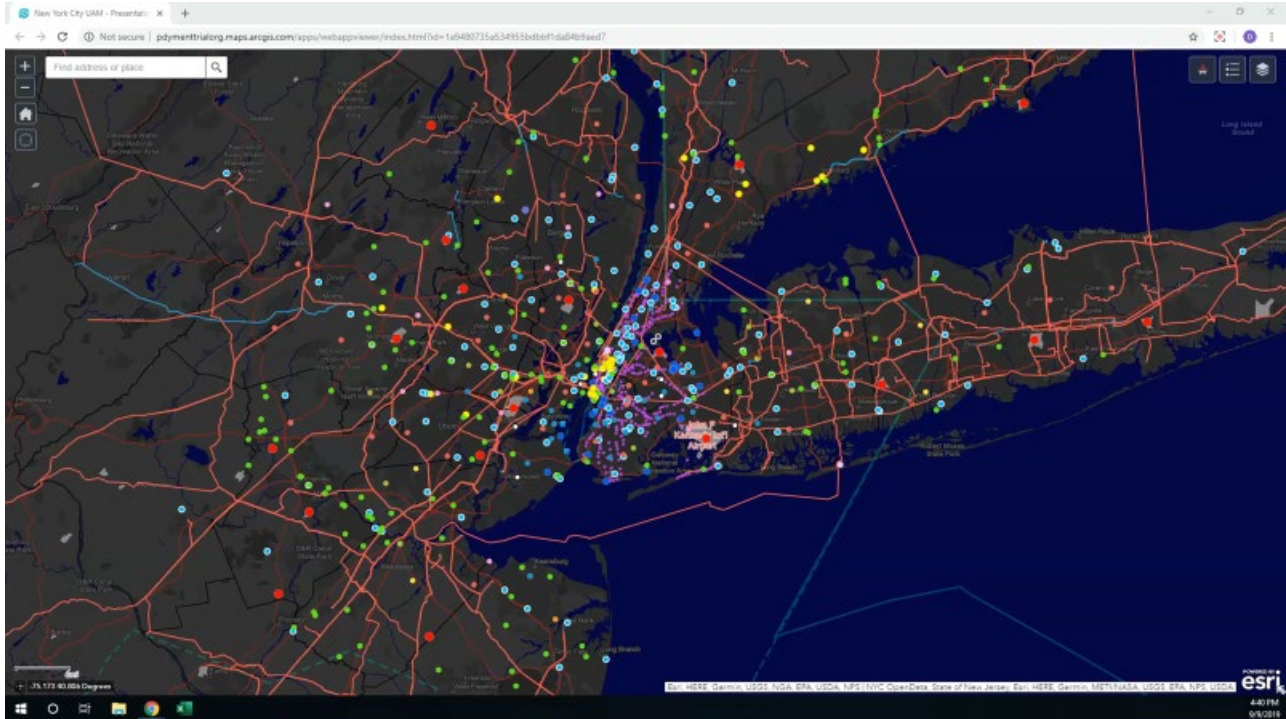


Figure 9 - New York Region Map with Important Geocoded Features is a Starting Point for eVTOL Flight Planning. 73 Other Cities Have Similar Detail and Can Be Accessed by the Flight Department: www.nexa-uam.com

representing “tunnels in space” that can avoid air traffic congestion and are configurable over ground that avoids residential areas.

Conclusion

For business aviation, eVTOL will deliver increased “enterprise value,” an economic measure reflecting the market value of an entire company, and the sum of claims from all security interests: debt holders, preferred shareholders, minority shareholders, common equity holders, and others. In short, enterprise value is one of the fundamental metrics used in business valuation, financial modeling, accounting, and portfolio analysis.

Benefits accruing from use of eVTOL vehicles are similar to those generated by business aircraft, and contribute directly to shareholder value creation at multiple levels:

- Shareholder level (e.g., market share growth, profit growth, asset efficiency).
- Enterprise level (e.g., dimensions of improved quality, cost and time).

- Transport of key employees, including efficient travel, but also team thinking regarding business execution, etc.
- Reflection of the vehicles’ use as part of the overall company’s brand, and sharp focus on sustainability.

While keeping these undoubtable benefits in mind, the course of NEXA’s research revealed some fundamental questions. For example:

- How will flight departments best and most safely plan for and introduce eVTOLs into their business aviation planning?
- How can companies ensure that employees are knowledgeable about, and comfortable with, the new technology as a way to address their transportation challenges?
- How will municipalities work with federal and other authorities to develop a safe, robust infrastructure for the new vehicles?

NBAA and other organizations continue their work to address these and myriad other questions, but one thing is clear: Urban Air Mobility will have a profound impact on the future of business aviation.

For Further Information:



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