

Using Urban Air Mobility to Advance Smart Cities:

UAM as an Operating Market – A Mindset
UAM as an Operating Construct in Cities – A Mindset Put to Action



Powered By:
XtraMedium Communication Group & Formenton Security Group

a Laymen's Summary of UAM/AAM Micromovements

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Q1 | 2022

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Urban Air Mobility:

The Great New Skyscape

Howdy and welcome to the future right now. Urban Air Mobility is an opportunity that is occurring at the velocity of the internet, smart phones, and digital mobility combined. Consider the highway system. Consider all the vehicles and movement that produce sales, create jobs, grow businesses & sustains commerce. Think about that.

Now add another layer of highway system about four hundred feet above that one and envision that system of jobs, infrastructure, and policy over your community. That's the proffer of Urban Air Mobility.

The premise of UAM has the allure of futuristic tech, which attracts many, while making some think the possibility is somewhat far off. If you want to really sound spooky, add a key enabling component to the mix - the *smart city infrastructure*, and many more people conjure images of the dystopian futuristic movie Blade Runner – where the future is 2019.

To that end, UAM has spawned some cities to lead their economic development by stitching commercial aerial mobility into the fabric of their urban planning and transportation goals, while many laggards simply choose to defer their citizens' fate to the actual future.

Why The White Paper: We developed this white paper to provide our perspective on AAM/UAM based on our own operational need to develop an UAM specific, globally competitive business and offer an UAM blueprint for economic development of forgotten and hard to reach areas. We believe this innovation, and tech in general, is the greatest tool for advancing our cities, and are hopeful city leaders and industry stakeholders discover a sense of urgency that matches both the needs of our cities and capabilities of UAM innovations.

We wanted to provide a layman's lens on the UAM landscape that may persuade and inform city managers, retailers, investors, and other economic stakeholders to really consider the industry's potential.

We approached this composite topic as smart city architects participating in Federal Aviation Administration AAM and NASA UAM/AAM working groups dedicated to the development of various complex elements specific to advanced air mobility regulatory, industry, and infrastructure requirements – the impending *Advanced Air Mobility nexus of need*.

We also considered our deep involvement since 2017 with the smart city sensing project, Argonne National Labs Array of Things (AoT). As UAM emerges from conceptional white board drawings, the AoT has already served to normalized public node deployment and utilization for public good.

Prior discoveries and works on the existing AoT installation by a global community of researchers, students, engineers, and urban planners are aligned to augment Commercial Low Altitude Airspace (CLAA) transportation management platforms.

Urban Air Mobility is here, and the introduction of this transportation layer is being considered to some degree, for every major city around the world. UAM will build bridges across communities and between economies with an immediate impact on environmental sustainability.

There are, however, some misconceptions and for good reason, a litany of concerns when it comes to what needs to be considered, executed, and regulated to make UAM a reality.

But first.... Dude! Is it AAM or UAM:

For the purpose of this writing, we, like most in the aviation industry use the terms UAM and AAM interchangeably. This is generally acceptable since the industry and the associated vocabulary are new. And while it is only one errant letter, it is important to consider the baseline differences between the two – primarily to get an idea of activities that will occur in each.

First let's define our take on UAM in comparison to Advance Air Mobility – AAM as the distinctions are becoming clearer as the aviation industry evolves. For this writing we use UAM generically in most cases, but here are the distinctions as we see them.

UAM: It's Here and Expanding! From our perspective, we see UAM as the commercialized, regulated, and standardized use of airspace historically separate from general aviation. This Commercial Low Altitude Airspace (CLAA) is the actualized Jetson-esque community airspace from the ground up to the 400 feet drone ceiling to the 5,000 feet ceiling for electronic vertical takeoff and landing (eVTOL). UAM is the activity in this advanced airspace within cities.

This UAM aviation traffic and commercial services are derived of unmanned flights in cities within the 400 ft maximum altitude ceiling - CLAA. These are activities such as last mile delivery by distributors to retailers, public safety operations at the neighborhood level, and consumer delivery from retailer to home.

Notionally, UAM is made of drones and electronic vertical takeoff and landing (eVTOL) aircraft executing operations in smaller flight envelopes than traditional aircraft and shorter flight distances than even what will be possible in general AAM.

UAM considers many of the command & control and ground elements of CLAA flight i.e., the built environment, local ordinances, citizen sentiment, with operational, systems and infrastructure and includes references to airbases for drone operators, vertiports for eVTOL operations, last mile delivery hubs and other activities associated with all commercial UAM and AAM takeoffs and landings. UAM is the more localized, community-centric child of AAM where a city may have several disparate

UAM corridors and environments located in close proximity to the general public. Since 2018 in the United States, the FAA has been releasing authorizations, rules, and technologies that support the current evolution of CLAA operations leading to an increase in the number of UAM operators.

AAM: Not yet commercially operational, but the list of major aerial vehicle companies is growing! Advanced Air Mobility is far more integral to National Airspace (NAS), and the overarching term for operations, system and infrastructure for unmanned flight that may transport people and product over and between cities.

AAM certainly will originate, operate, and conclude in the CLAA, however elevating to altitudes up to 5,000 feet with the capability of traversing distances in excess of 250 kilometers. AAM operators such as autonomous air taxis might pick up passengers from a vertiport located in one city's CLAA and deliver them to a suburban mall or even the main airport.

Today, AAM is the broader (and more heavily invested in) consideration beyond flight over communities and takes into account the impact and requirements of UAM and AAM on National Airspace (NAS) safety, traffic deconfliction, services, and other requirements as a burgeoning transportation system and economy. Unlike the smaller individual UAM corridors, a city may have over its entirety one contiguous AAM overlay to manage aviation activity.

In the U.S., the Federal Aviation Administration, NASA and a host of industry stakeholder are diligently working to identify standards, systems, and process gaps which must be met to add this nascent layer of commerce to our skies. AAM is the enabler and dynamic integrator of that airspace through a collective network of standards, enabling tech, policies, and expectations. AAM is the overarching integration and consideration for all of the devices, people, places, innovation, and evolution to make UAM and even more advanced aviation markets possible across cities. AAM is the advanced airspace actuator throughout national airspace.

Now we'll go back to using the unified term UAM.

The Smart City as Fabric for UAM

We have been evangelizing the UAM market as something major cities should move on sooner than later especially for cities with existing or planned smart city infrastructures. Accessing the market now could prove to 'raise all ships' by identifying and training for careers that will expand a stifled economic base, while attracting much needed infrastructure investments and ultimately foot traffic to forgotten areas.

This is especially true for cities that have areas of economic drought spurred by the slow drain of manufacturing, automotive, and other traditional jobs. The initial idea of Smart Cities in the 70's was more aligned with the truly futuristic example in Disney's Experimental Prototype Community of Tomorrow, or EPCOT project.

Since 2015, the premise of the 21st century Smart City posits digital orchestration of municipal intelligence and services, where institutions and stakeholder leverage resulting data to address community-based problem.

In common with the future for UAM, the many implementations of Smart City policy, infrastructure, and use have required an alliance between communities, city managers, engineers, and scientists. Having taken this approach, these cities have laid the groundwork for the same level of engagement and collaboration to make UAM successful.

While giving citizens a voice in solving problems in the commons, smart cities also possess community-centric systems, data portals, and a rich civic tech ecosystem extensible to commercial UAM initiatives.

A keen understanding of the smart city advantage will serve to help identify low hanging fruit for development of the infrastructure, policy and industry partnerships necessary to reap the benefits of UAM.





Smart Cities - a Thing:

In 2014, Korea began an ambitious project known as the Songdo International Business District to create an entire smart city from scratch on 1,500 acres of land southwest of Seoul.

In 2016 the city of Chicago in Illinois began installing a network of 500 public sensors on streetlights and bus shelters to capture the 'health' of the city by essentially seeing, smelling, and hearing datapoints specific to areas where they were installed.

In 2017 Columbus, OH, was recently named the winner of the U.S. Department of Transportation's Smart City Challenge, garnering \$140 million in public and private funding toward projects aimed at improving transportation in the region, including data-capture sensors along roadways and driverless vehicles.

Many other initiatives have sprung up around the world and the U.S. Federal Transportation Administration's Smart City program is set to grow to \$500 million in addition to billions of dollars available under the recently passed Infrastructure Investment and Jobs Act, vastly expanding transportation innovation opportunities which include UAM.

This foresight enables city managers and UAM operators alike to be proactive in developing and standardizing the infrastructure, data fabric and workforce to support localized commercialization of drone, air taxi, and forthcoming UAM operations.

UAM will offer a slew of job opportunities as well investment in areas which are prime for UAM activities. In the US alone, the UAM market is estimated to reach US\$115 billion annually by 2035, employing more than 280,000 high-paying jobs. Many skilled and unskilled job opportunities are already being created; from drone pilot and observer to distribution hub and vertiport operations.

UAM: The Market & The Operation

We segmented concept of UAM into two parts: *UAM as an Operating Market in Aviation* and *UAM as an Operating Construct in Cities*. Market analysts suggest UAM will be a significant part of mainstream transportation by 2030.

Today, the Federal Aviation Authority, NASA, Transport Canada Civil Aviation (TCCA), European Union Aviation Safety Agency (EASA), and industry stakeholders have been methodically identifying and tackling all the elements required to combine today's general aviation with tomorrow's advanced aviation. This makes it incumbent upon cities to become very familiar with what UAM truly is for them.

UAM as an Operating Market in Aviation: These electronic, often autonomous short-hop flights are absolutely and increasingly capable of being integrated into mainstream cities due to unprecedented improvements in device technology and humongous investments in UAM vehicle development.

1. **UAM & Drones:** Drone manufacturers have achieved amazing milestones in device capability and sales growth derived from a decade-long head start. By 2019, aerial drones had evolved from hobbyist activity, to proof of commercial concept, to a key component of agriculture, real estate, photography, and entertainment industries. This era of tech speculation and economic proof also sparked a renewed interest in another area of innovative commercial flight.
2. **UAM & eVTOL's:** By 2020, billions in investments began to flow into the development of electronic passenger/cargo-specific aerial vehicles – in the category of electronic vertical takeoff and lift aircraft - eVTOL. In 2020, the majority of manufacturers may have been barely a decade old or did not exist at all a year or two before. Each of these companies leveraged years of research and development by engineers and dreamers who continued to build upon the technological probabilities and social mindset for urban flight. And then investors finally caught on.

In 2021, SPACs and a few notable deals accelerated final R&D and increased eVTOL vehicle inventory worldwide. In a span of 2 years, companies that were in highly speculative state of development were receiving billions of dollars in investments and even sales orders.

3. **UAM & Investment:** From investment to preordering of aircraft, the more advanced UAM manufacturers are not short on resources to get their birds in the air.
 - 2019 Wisk Aero: 2022 \$450m Investment by Boeing
 - 2009 Joby Aviation: 2021 \$2b Investments by Uber, Toyota, etc.
 - 2014 Ehang- 2021: \$94m in Investments
 - 2011 Volocopter: 2021 already sold 150 electric vertical take-off and landing (eVTOL) aircraft
 - 2015 Lillium: 2021 \$825m in investments

While capital doesn't necessarily equate to progress in the UAM vehicle race, this resource boost is occurring alongside a national regulatory and engineering push to modify the aerospace industry for safe, beneficial use of these new aerial device capabilities.

4. **UAM & Airspace Regulators:** Globally, aviation and airspace regulators have a stack of expectations that must be met in order specific to the safety of national airspace. We all agree there. In the U.S., the Federal Aviation Administration and NASA along with regulators and engineers worldwide are operating at deliberate pace to, in the words of a NASA Project Manager, "Make the skies safe and available for when the vehicles are available."

Fortunately, most of the regulatory aspirations driving Urban Air Mobility ecosystem is the consideration of general aviation frameworks already in place and the integrations needed to enable the use of UAM vehicles over cities. NASA and FAA UAM/AAM activities are well defined and aligned to evolve these existing systemwide flight information management systems and regulations.

As is standard, the regulators will make use of traditional and new third party integrators to fill capabilities gaps. NASA's approach to meeting the expectations of UAM is laid out in stages of complexity in the NASA Maturity Level (UML) Scale.

If you take into account the current stage of regulatory evolution and most importantly systems integration, we are at a 3-to-5-year horizon before we see regulations meet the technical capabilities required for safe and efficient commercial UAM.

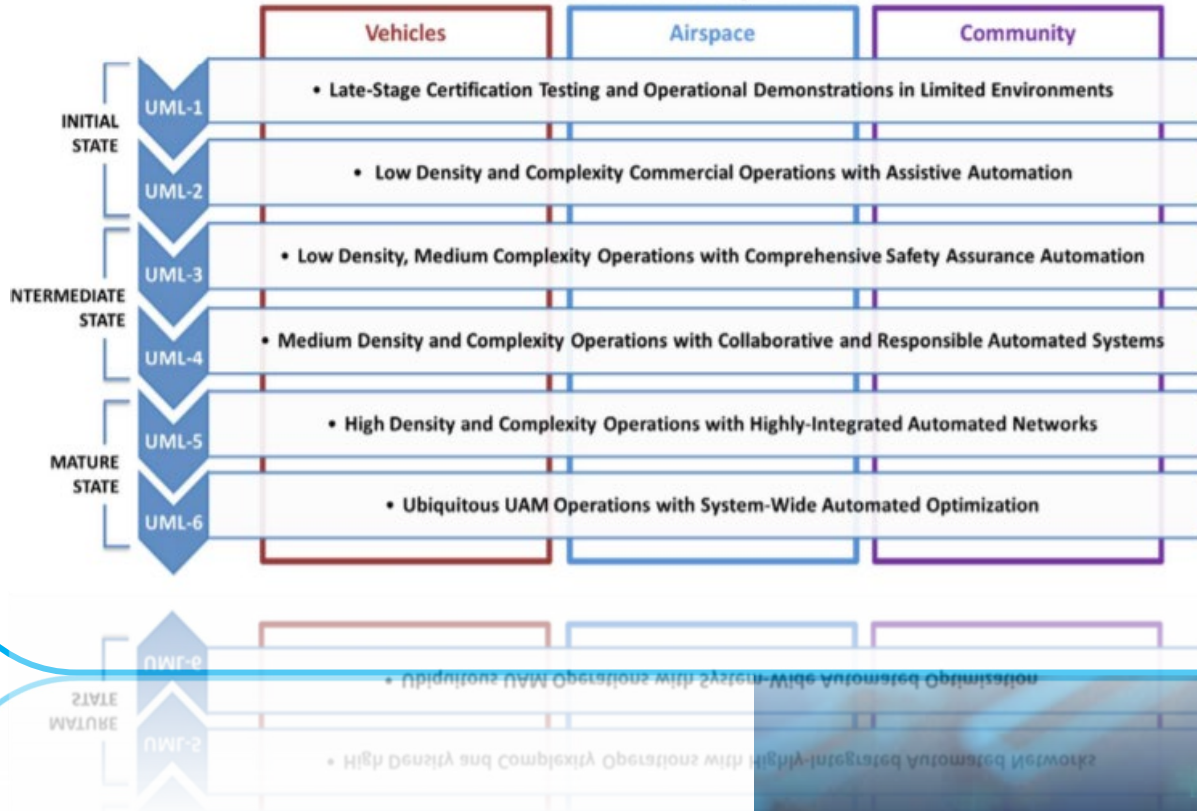
The idea is that by then – 2025 to 2027, third party integrators, i.e., software developers have successfully integrated systems that support the hyperdynamic sharing of information for safety, service, and scalability.

Under the hood, this information stack rules the new layers of sky-highway.

Let propose we've met that horizon and by 2030 we've figure out the path to sustainability, transportation, and commerce by choosing to fly 400 feet and 5,000 feet above our cities. The industry, investors, and regulators are all in. What is the operational construct for to that considerable leap in societal innovation?



UAM Maturity Levels



UAM as an Operational Construct in Cities

2022 is in fact the time to acknowledge the potential already achieved and absolute possibility for UAM. Globally, standards already exist for UAM altitudes and authorized airspace. But what would a city or neighborhood or corridor have to do consider and prepare to take advantage of this active, if not highly interesting stage in modern transportation?

Unlike general aviation, UAM originates and ends directly in communities – in neighborhoods and around businesses and homes, placing the success of the market squarely on the adoption by mainstream people in each UAM-capable community.

You might compare this moment to the when the U.S. decided to build roadways for the automobile industry at the benefit of the economy. “Why and how do we want to put this new highway in our town?” Unlike the national campaign to actually construct the national roadway system, this time cities and neighborhoods, are themselves are the one left to figuring out what UAM is all about.

UAM upgrades of traditional airspace standards are derivative of proven rules, flight management, systems integration, and safety protocols, across NASA, EASA, CATSA, and other aerospace experts. NAS is primed and ready for the integration of UAM in a proven air traffic system.

UAM is however, is less about National Airspace and more about cities. What’s left is consideration for the policies, frameworks, and operation of UAM in those new smaller sectors. These are literally ground-based issues for cities.

Working backward, UAM landing areas or aerodromes, the sustainability options for the facility, and the impending operation should inform the key Operational Constructs for activating UAM into your neighborhood. Ground based infrastructure has long been considered insurmountable in light of structural, data processing, and other constraints.

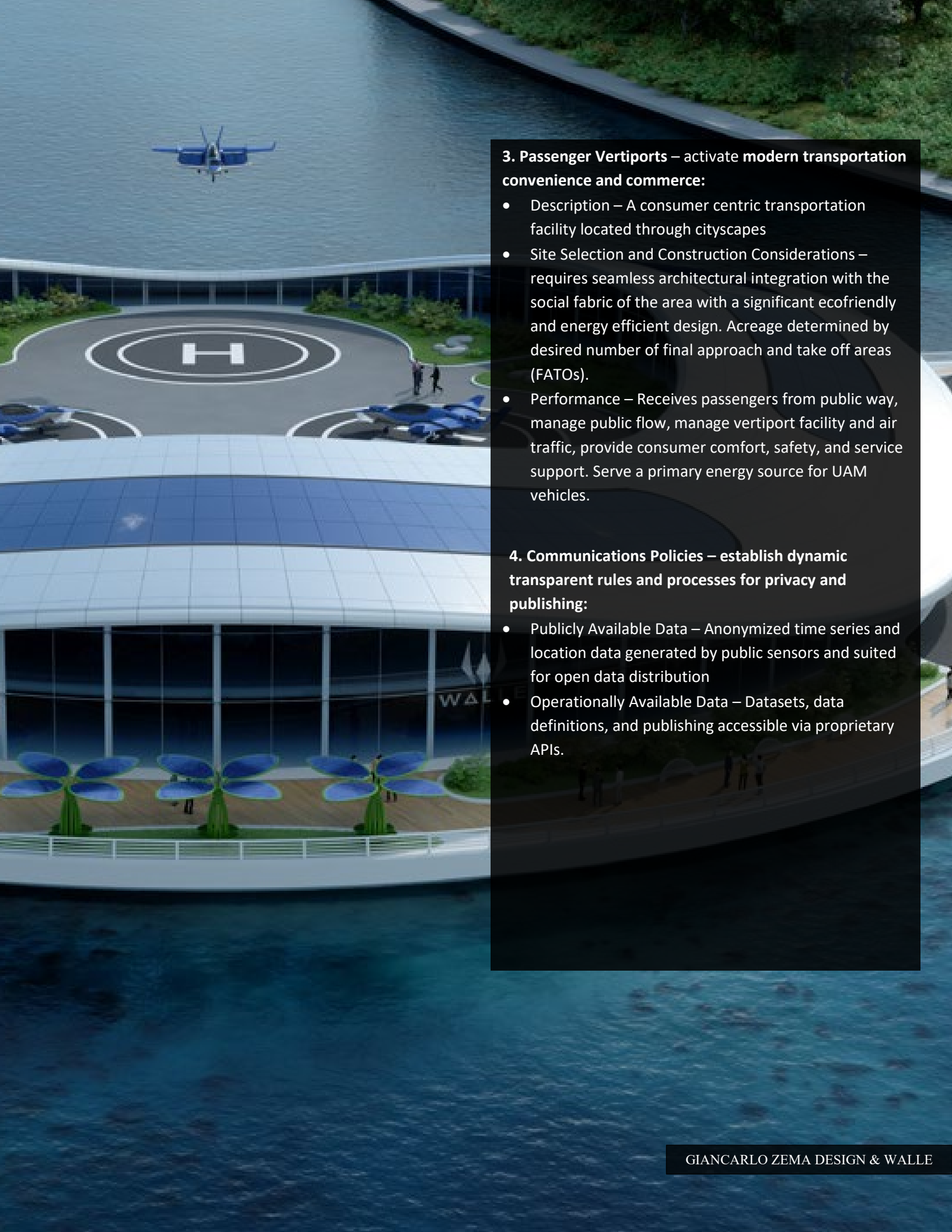
Now, the introduction of software defined UAM frameworks provides a workaround allowing the planning regimen and regulatory paths to converge with emerging operational requirements.

1. Delivery Hubs: increase product availability/decrease emission and traffic:

- Description – a last mile delivery location for redistribution of goods into neighboring communities
- Site Selection and Construction Considerations - warehouse or industrial park-sized, highly secure with a sustainable energy source as well as significant room for entry and exit of trucks and a corresponding UAM aerodrome system
- Performance – intake of products, loading, dispatch, inventory management
- Workforce – receiving and loading, administration, maintenance, logistics

2. Installed Flight Hubs: establish drone bases:

- Description – locations installed in the built environment specifically for takeoff, landing, and delivery specific to nearby business location or personal property
- Site Selection and Construction Considerations – requires small room sized footprint, must be placed at secure height on trustworthy structure such as a rooftop
- Performance – supports manned or autonomous goods pickup/delivery, security activity, and associated system/personnel
- Workforce Development - loading goods, maintenance



3. Passenger Vertiports – activate modern transportation convenience and commerce:

- Description – A consumer centric transportation facility located through cityscapes
- Site Selection and Construction Considerations – requires seamless architectural integration with the social fabric of the area with a significant ecofriendly and energy efficient design. Acreage determined by desired number of final approach and take off areas (FATOs).
- Performance – Receives passengers from public way, manage public flow, manage vertiport facility and air traffic, provide consumer comfort, safety, and service support. Serve a primary energy source for UAM vehicles.

4. Communications Policies – establish dynamic transparent rules and processes for privacy and publishing:

- Publicly Available Data – Anonymized time series and location data generated by public sensors and suited for open data distribution
- Operationally Available Data – Datasets, data definitions, and publishing accessible via proprietary APIs.

Elements of Market Movement: From Whence it

We believe that the UAM market is dynamic and rapidly emerging as general commercial aviation regulations and systems expand to accommodate the impending traffic and as investments pour into industry segments.

A sustain period of investment in drone manufacturing from 2012 – 2018 began to transition in 2019 - 2021 toward massive investments in eVTOL aircraft, systems, and infrastructure. Alongside a more innovative regulatory body, these present the first major components of for the new skyscape system – AAM. In 2017, we began tracking the industry subsets to forecast the potential industry movement and momentum.

Subsets Feeding the AUM:

- Regulatory and Scientific Prerogative
- High Impact City Reinvestment
- Smart City Coupling
- Web 3.0. Of things
- Sustainability
- **Regulatory and Scientific Prerogative:** As regulatory movement and industry collaborate in a faster and more focused than normal collaboration, the AAM nexus of need is meant to be ultimately addressed by innovators. The FAA has become increasingly dedicated to ensuring “The airspace systems will be ready when the vehicles are ready.”¹
- **High Impact City Reinvestment:** The needs to advance and repair cities will converge with the curiosity of innovative entrepreneurs and well

sourced public private initiatives to enable and invite AAM.

- **Urban Air Mobility:** Truly an emerging industry that is already transforming the landscape of transportation in cities around the world. Where cities like Los Angeles, New York and Detroit are partnering with UAM companies to plan policies and infrastructure, Chicago is already being positioned to be left behind. Many skilled and unskilled job opportunities are being created; from drone pilot and observer to distribution hub and vertiport operations.
- **Smart City Coupling:** We believe prior investments in public sensing technologies, vision aware public cameras, will be considered the fabric of city growth and spur city agencies to create policies which place citizen sentiment at the center of city growth, thus enabling unprecedented development rates.
- **Web 3.0 - Of Things:** In a mere 2 decades we’ve transitioned from digital mobility which enabled people to digital mobility machine which enables machines. This is humankind’s jump from typewriter to TV to a simple interest in smart phones to the combined advantages of every digital innovation created since the dawn of computing. It’s like going from caveman to racecar driver.
- **Sustainability:** We believe there will be significant gains in environmental and economic efficiencies led by the electronic nature drones and eVTOLs include energy efficient travel, lower noise impact, less street congestion.

Takeaways:

- UAM is a technological leap in transportation.
- Federal Regulators are evolving toward a sophisticated transportation framework.
- UAM Stakeholders are wholly dependent upon city infrastructure, policy and sentiment.
- City leaders can expand their imagination to stitch UAM into urban design and economic development.

¹ NASA DIP AAM Working Group Data Integrations
November 17, 2021

SNAPSHOTS

AAM Business Models

Consumer acceptance continues to evolve as Covid-19 introduced the first highly visible UAM operations as drones became normalized method of conducting medical supply delivery. Key business segments are increasingly eager for UAM to bring forth significant advancements in last-mile delivery, security, consumer transportation. Here are a couple of them.

Drones as a Service (DaaS)

When the drone market is split into 3 segments (hardware, software, and services) it becomes clear that it is transitioning to a service-oriented market. Roughly 78% of global drone-related revenue is generated through services rather than hardware or software.

The DaaS segment is set to grow at a rate of 9.6% CAGR and reach US\$30.7 billion by 2026.

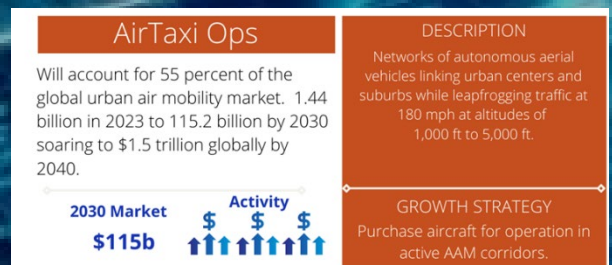
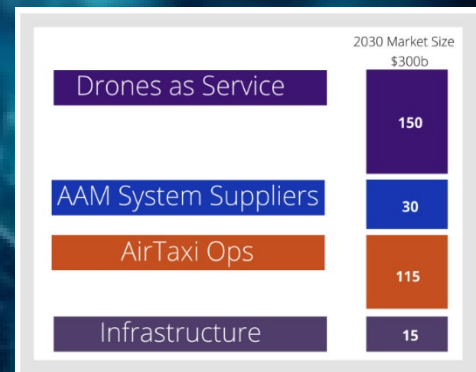
The service segment is mainly driven by business-internal drone activities, i.e., companies that use drone technology for their internal business processes. This share is over 70% within services today and will increase in the future.

The second largest and fastest growing share is held by so-called Drone-Service-Providers (DSPs), who offer their services to third parties (which include deliveries, inspections, and a plethora of other applications).

Advance Air Mobility System Suppliers

AAM Suppliers is the class representing third-party software/systems operation that supply innovations which enable AAM operations, i.e., Unmanned Aerial Vehicle Traffic Management (UTM), data exchange between the AAM ecosystem and FAA/NASA systems, customer service systems, Low Altitude Authorization and Notification Capability (LAANC), ground-based airspace augmentation (GBAAS), etc.

Airspace regulators worldwide consider these industry stakeholders crucial to the development of a transportation schema fully capably and robust enough to integrate into existing nation airspace systems. The market will be competitive and characterized by competitors pushing the edge of regulatory concern.





About MySkaut Mobility

A line of business jointly managed by the equity partnership between Illinois Corporations XtraMedium Communications Corp and Formenton Security Group Inc, MySkaut Air Mobility is a commercial operator of small unmanned aerial vehicles under FAA Part 107 certifications, provider of commercial UAM services, and designer/integrator of UAM systems.

About Formenton Security Group

The Formenton aerial robotics system maximizes security operations and captures details often missed during after-action investigations. The aerial robotic surveillance equipment allows a variety of intelligent monitoring and security management with the ability to autonomously patrol sites individually or in groups, covering various sectors while working collaboratively with client command center for the future of security.

About XtraMedium Communications Inc.

XtraMedium Communications is a Chicago based civic tech design & architecture consultancy for city managers and property developers dedicated to aggressive and creative use of IoT 'next wave' innovations to enable retail, hospitality, travel, live entertainment, and consumer driven industries to thrive in hyperlocal retail corridors.

