SPECIAL REPORT: ON-DEMAND MOBILITY AND TOMORROW'S SMART CITIES

JUNE 2019

Our team has been working the idea of urban air mobility for a few years now, and we are considering everything that might be possible.

Looking at the future development of our cities, we understand that paving roads can't be the only fix. We are running out of physical space.

So, to truly address the issue of urban mobility, we need to look to the skies. And, for our industry, the timing couldn't be better.

We are seeing tremendous technological advances in processing power, communication bandwidth and speeds, sensors, flight controls, autonomy, AI, electric energy storage and electric motors, to name a few.

Laying the foundation to continue advancing each of these technologies to incorporate when ready and without a major impact is just as important. However, technology is just one part of the equation. Without the regulatory, infrastructure and community relationships it will be difficult to accomplish.

This report outlines our beliefs around the major elements needed to navigate this complex ecosystem to ensure the success of urban air mobility.

The aviation industry has a pioneering, can-do spirit and it will take all of us to bring this vision of on-demand mobility to life.

Our team of 7,500 dedicated aerospace professionals are ready for this exciting future. Come join us.

MITCH SNYDER [PRESIDENT AND CEO, BELL]

INTRODUCTION

IoT, 5G, AI, VR, eVTOL. The language of smart cities could make anyone feel as if they need a translator. But, it won't be long before consumers adopt these acronyms into their daily vernacular, thanks to the rising number of companies across the world working to make smart cities the status quo, rather than a futuristic dream.

The road toward this new reality is paved with many challenges, and developing solutions is critical for the future of society, since currently more than half the world's population lives in cities, compared to rural areas. That number is expected to climb to **68 percent**[1] by 2050. By 2030, the world is expected to have 43 megacities, with more than 10 million inhabitants each, a projection that poses significant new challenges for housing, healthcare, energy systems, safety, transportation and a multitude of infrastructure. Perhaps the biggest concern is the lack of land mass and how to accommodate the influx of people.

Worldwide, the best and brightest are working toward solutions for the optimal smart city design. In fact, the smart cities industry is expected to be worth more than **$400 billion**[2] globally by 2020. In recent months, the **Forbes Technology Council**[3] enlisted members to prioritize the projects that government leaders should focus their tech investments. The priority that topped the list was transportation.

43
NUMBER OF
MEGACITIES BY 2050

$400 BILLION
WHAT THE SMART CITIES
INDUSTRY WILL BE WORTH
BY 2020

TRANSPORTATION

A recent **global research project**[4], conducted by GlobeScan and MRC McLean Haze, was carried out at the individual megacity level to gather objective data and perspectives on local infrastructure challenges. The project surveyed more than 500 public- and private-sector experts from 25 cities across the globe, exploring the key challenges and trends that will shape those cities in the coming years. By a large margin, transportation emerged as the top megacity infrastructure challenge, which makes sense, considering an increasing number of cities are outgrowing their transportation systems.

For example, New York's subway system was designed more than **100 years ago**[5] to accommodate a fraction of the now 8.6 million people who live there. The aging and slowing transportation network in New York is now costing the city time and money while reducing the quality of life for its residents. This is a reality for many cities.

AN INCREASING NUMBER OF CITIES ARE OUTGROWING THEIR TRANSPORTATION SYSTEMS.
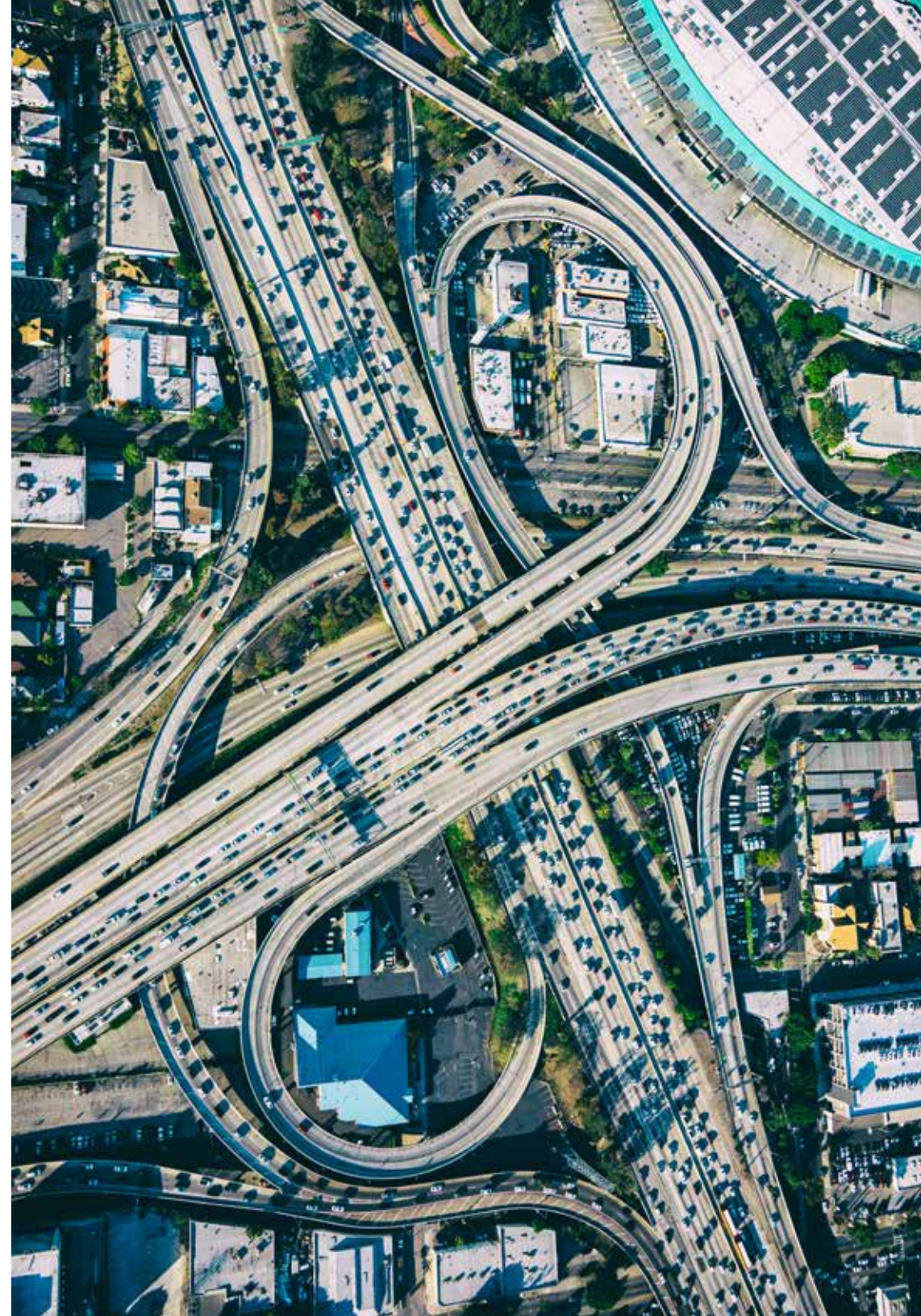
INFRASTRUCTURE

Though Congress recently agreed on a **$2 trillion infrastructure plan**[6] to upgrade the nation's highways, railroads, bridges and broadband, improving mobility won't come from building more roads alone. In fact, building more roads to address congestion only makes traffic worse, according to numerous studies – the phenomenon is called induced demand. A recent study released by the **Transportation Research Record**[7], found that for every 1 percent increase in highway capacity, traffic increases .29 to 1.1 percent in the long term and up to .68 percent in the short term.

$2 TRILLION
INFRASTRUCTURE PLAN TO UPGRADE HIGHWAYS, RAILROADS, BRIDGES AND BROADBAND

SO, WHAT'S THE ANSWER?

As one of the world's leading aviation technology companies, we see the answer lying in the vertical dimension, or the skies. Bell is a pioneer in the development of urban air mobility and is among a growing group of innovators that sees the expansion of urban transportation coming via the vertical dimension.

"Advances in processing power, flight controls, electric energy storage and electric motors, to name a few, are informing a new breed of aircraft concepts; concepts that share the tiltrotor's benefits of vertical take-off and landing (VTOL) and high-speed flight, but also concepts that use much simpler propulsion systems, making them affordable enough for large-scale commercial adoption," said Michael Thacker, Bell executive vice president, technology and innovation, in his testimony before the U.S. House of Representative's Committee on Science, Space and Technology, in July 2018. "The convergence of these technologies is accelerating our ability to achieve real improvements in air mobility and opening new possibilities for flight, such as addressing the issues surrounding transportation congestion in urban areas."
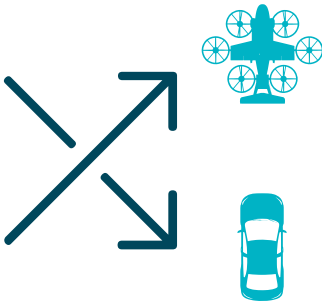
CONGESTION

Creating a comprehensive VTOL system has immediate technological and societal benefits that could take the burden off today's urban areas. It's estimated congestion costs each American **97 hours per year**[8], or $1,348 annually, for a total of $87 billion in 2018. At that rate, Americans will have lost $2.8 trillion in traffic by 2030.

In an article, "Urban Mobility at a Tipping Point," published on **McKinsey and Company's**[9] website, writers Shannon Bouton, Stefan M. Knupfer, Ivan Mihov, and Steven Swartz, argued "Congestion is already close to unbearable in many cities and can cost as much as 2 to 4 percent of national GDP, by measures such as lost time, wasted fuel, and increased cost of doing business."

97 HRS
AVERAGE TIME WASTED ANNUALLY IN CONGESTION PER AMERICAN

$2.8 TRILLION
WILL BE LOST BY AMERICANS DUE TO TRAFFIC CONGESTION BY 2030

COMMUTER TIME

An air taxi system could reduce a one-way, 90-minute daily commute in a congested city to 30 minutes and give each commuter 500 hours back per year. Taking that a step further, utilizing on-demand mobility (ODM) transport could potentially put **1.8 billion man-hours**[10] of productivity back into the economy.

"We could cut peak commute times by more than 50 percent and reduce our energy use by a factor of 10," said Mark Moore, director of Vehicle Systems for Uber Elevate, during his keynote speech at this year's Urban Air Mobility: An Opportunity for Georgia conference in Atlanta.

Uber Elevate is Uber's air-based ridesharing network, which hopes to put air taxis in the skies by the mid-2020s and help solve the age-old problem of moving people and goods safely, affordably and efficiently – a problem that continues to be more complicated by growth in population and the on-demand lifestyle now dominating the U.S. and world population. Earlier this year, at CES 2019 in Las Vegas, Moore discussed the positive impact technologies like the Bell Nexus would have on urban mobility.

"You are going to be able to rise above the gridlock that's down on the ground in these major metropolitan markets and just simply rise above it to have incredibly productive transportation. Instead of traveling on the ground at 12 miles per hour in Dallas or Los Angeles, you'll be traveling at 150 miles per hour. And again, it's being done in a way where it will be community friendly, so that cities will embrace this."

According to Thacker's testimony, there are no road-based solutions that will be as scalable, quiet, clean, and fast as ODM transport. "It's more than a two-dimensional world. Small urban aircraft can play a role, where current solutions cannot keep up with our needs," said Thacker.

ON-DEMAND MOBILITY (ODM) TRANSPORT COULD POTENTIALLY PUT 1.8 BILLION MAN-HOURS OF PRODUCTIVITY BACK INTO THE ECONOMY.


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– MARK MOORE [DIRECTOR OF VEHICLE SYSTEMS, UBER ELEVATE]

FRAMEWORK TO SUCCESS

Industry giants in several fields are now debating the best solutions to the pressing needs of congestion as well as the time and money lost in gridlock. While that debate goes on, companies like Bell are working with both public and private partners to address the four main frameworks that must be incorporated into an ODM VTOL system - operational, regulatory, manufacturing, and technological.

OPERATIONAL

TECHNOLOGY

REGULATORY

MANUFACTURING
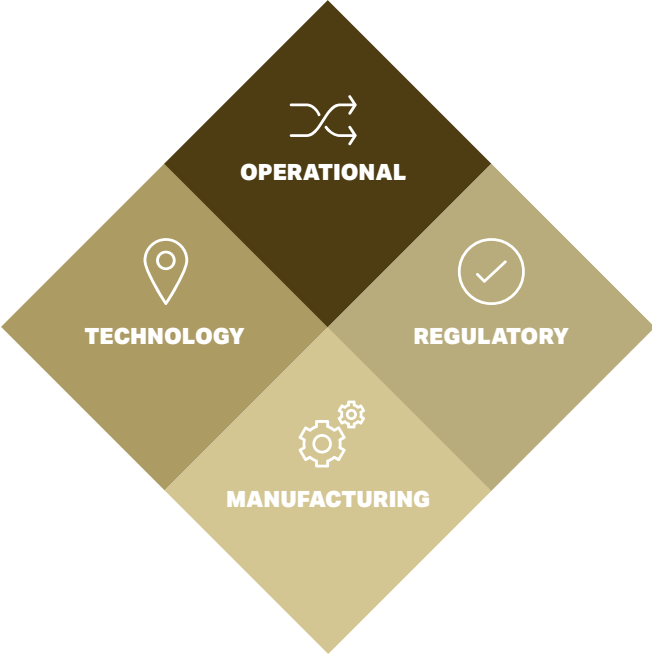
OPERATIONAL

Arguably the biggest framework that must be addressed is the operational system, which encompasses all aspects of the vehicle, from navigation and flight trajectory to fleet management, multi-aircraft traffic control and the vehicle's interaction with ground infrastructure that supports fuel charging, landing and security. All of these factors must be considered, in addition to optimizing the vehicle to cover the future demand. One of the key concerns is low-altitude air management and how to establish an air taxi program that can co-exist within a city and interact with the existing airspace system. A major first step in answering these questions was the FAA's creation of teams for the Unmanned Aerial Systems (UAS) integrated pilot program, which will collect data to expand unmanned aircraft operations in the national airspace.

"The NASA System Integration and Operationalization (SIO) program will integrate state-of-the-art technologies into UAS to inform FAA creation of policies for operating UAS that have communication, navigation and surveillance capabilities consistent with Instrument Flight Rules (IFR) operations," Thacker continued. "NASA also has recently announced the Aeronautics Research Mission Directorate Grand Challenge, with high-level goals to demonstrate the potential safety of urban air mobility and provide the opportunity for the community to learn together in relevant and realistic operational environments."

On the industry side, initiatives like Uber Elevate provide opportunities to bring together stakeholders from across the industry spectrum to address system-level needs. Participants from the infrastructure and technology industries, as well as regulatory bodies, communities, operators and aircraft original equipment manufacturers (OEM), have all taken part in the network, creating opportunities for public/private partnerships to help address other concerns, such as noise and emissions, and ensure this initiative creates good community members.

REGULATORY

The top priority on the regulatory side is to meet early and often, with the FAA and other international regulatory bodies, such as the European Aviation Safety Agency (EASA) and Transport Canada, to identify any gaps for implementing ODM and establish a timeline that will allow for a launch of the technology. Establishing a consistent regulatory environment in the U.S. and internationally will mitigate risk management of the aircraft while helping to establish standards for noise, emissions and regulation of vertiports.

"It's clear much of the regulatory framework for ODM vehicles and operations is already in place. The key areas of discussion to move forward will be to meet, or exceed, the current safety parameters with these new vehicles," said Thacker.

BELL'S GOAL WAS TO BUILD A PEOPLE-CENTRIC VEHICLE, WHICH WOULD PROVIDE UNIVERSAL ACCESS TO VTOL FLIGHT, COMFORT AND THE ABILITY TO MAXIMIZE A PASSENGER'S TIME.

MANUFACTURING

From a Bell perspective, the manufacturing framework is focused on production volume, cost, weight and environmental impact. Bell is currently developing advanced manufacturing technologies to ensure the future factory is safe, efficient, flexible and accurate.

The company is exploring a variety of rapid prototyping techniques for full-scale production, and is employing a variety of tactics to ensure these techniques hold the potential to enable faster, more efficient production. This will bring costs down and provide flexibility in design to meet weight and safety requirements.

Once an ODM system is approved and moves into production for worldwide demand, it could mean manufacturing thousands of aircraft per year, which is a radical shift from the hundreds of aircraft currently produced by most aviation OEMs.

TECHNOLOGY

The final piece of the framework is the technology itself, which is driven by the other three. Bell's goal is to build a people-centric vehicle, which would provide universal access to VTOL flight, comfort and the ability to maximize a passenger's time. The challenge then became to build a new type of aircraft that would be a hybrid-electric propulsion tiltrotor VTOL vehicle that's lighter in weight and reduces noise and emissions. While the Bell Nexus will be built to be autonomous from the start, it will launch with a pilot, or mission manager, on board to help ease the transition and any concerns regarding safety. To help achieve its ambitious design, Bell engaged partners from across the globe, including Safran, which is building the hybrid-electric propulsion system; Thales will produce the flight control computers; Moog will make the actuation system; EPS is innovating a battery system; and Garmin will provide the so-called nervous system, which will tie them all together.

One of the biggest questions regarding ODM technology is the timeline for availability. The race to be first to market is on and at least a dozen companies are vying for that spot. Bell has its eye on the mid-2020s and is more focused on meeting or exceeding safety standards than being first.

"Companies can rush some sort of technology demonstration but having what it's going to take for a demonstration and having a viable path with the FAA and other stakeholders to get it done, are two different things," said Thacker.

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[EVP OF TECHNOLOGY AND INNOVATION, BELL]

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– MICHAEL THACKER [EVP OF TECHNOLOGY AND INNOVATION, BELL]

FINAL THOUGHTS

While there is still much regulatory work to be done before anyone can start hailing a flying taxi, it's clear the world's urban areas are in desperate need of a radical mobility solution. Whether that solution is delivered by air or ground will come down to which technology can produce the safest, fastest and most reliable, energy-efficient outcome, with the least amount of disturbance to the general public.

"The future of our cities, rests on the ability to expand our footprint in terms of transportation, connectivity, and ease of movement," said Thacker. "What seems groundbreaking today, will be the expectation of our children."

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SOURCES:
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