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Confederation of Indian Industry

Advanced and short-haul air mobility

Ushering in an era of aerial vehicles

March 2023

Message from CII

India ranks as one of the most congested markets globally. A report estimates that the cost of urban congestion is over INR 1.44 trillion per year.[1] As India transforms from a country that lives in villages to one where over 50% of the population resides in urban centres in the near future, traditional mobility platforms on terra firma would be grossly insufficient. In the past decade, the aviation industry has touched yet another milestone with fast-paced developments in electric air mobility. Yesterday's dreams of electric-powered taxis and flying cars or personal air vehicles are poised to turn into reality. Hundreds of innovators across the globe are developing ways to move people and goods aboard newer, cleaner and smarter air vehicles. Advanced air mobility, especially for intra-city travel, has the potential to mimic a mass transit mobility platform, underpinned by the transition to electric craft. Compared to the traditional helicopter, the operating cost for electric vertical take-off and landing (eVTOL) craft would be lower. These aircraft would also be quieter, safer and have a lower environmental footprint.

Electric craft could eventually evolve into autonomous craft. However, this would require social acceptance. The applications of air mobility are expansive, including tourism and recreation, emergency medical services, surveillance services, weather monitoring, last-mile delivery services, air taxi services, aerial fire apparatus, and humanitarian and rescue missions. Successful establishment of an advanced air mobility platform would need a vast network of elevated vertiports – residential high rises, hotels, convention centres, hospitals, etc. Emergency medical services would need spaces on national/state highways and public playgrounds that could be used as and when there is a need. The evolution of advanced air mobility as a mass transit platform would also require the development of other tech platforms in the ecosystem – for example, traffic management systems with automated air traffic controllers providing directions to craft in order to facilitate efficiency and safety.

Our current thinking of advanced air mobility is more in terms of aviation for short-haul requirements. A more apt definition could be ground mobility that no longer needs wheels and is airborne. The future is certainly electric!

Amit Dutta
Chairman
CII Task Force on Short Haul Air Mobility

[1] https://www.businesstoday.in/latest/economy-politics/story/india-wastes-as-much-as-rs-1-44-lakh-crore-due-to-traffic-congestion-says-uber-study-104587-2018-04-19

Foreword from CII

The advanced and short-haul air mobility sector is at an inflection point. The emerging space of advanced air transport solutions includes a whole gamut of flying vehicles – from drones to aircraft that vertically take off and land (VTOLs) and eVTOLs.

Alongside the rapid development of these flying solutions, segments that support this ecosystem are also seeing innovation. These include research institutes, infrastructure such as vertiports, navigation solutions, manufactures, service providers, regulators, technical standard bodies and end users (viz. passengers and cargo).

India, which has taken a series of steps in the drone space and is at a nascent stage in eVTOL, can take a leap forward, given the scale of demand the country offers. This demand exists in multiple sectors, including applications in healthcare delivery, air ambulances, transportation of people and cargo looking to save time during travel through congested or remote areas, agriculture and defence. India has a unique opportunity to become a global leader in this space by creating conducive conditions for cooperation and co-creation in the sector. CII's conference on Advanced and Short Haul Air Mobility for All (ASHA) is one of the foundational steps in this direction.

It is only through meaningful collaboration that this growing aviation sub-sector can get the right platform to evolve and become mature and self-sufficient. To transform this vision into reality, the conference will host brainstorming sessions, bringing together important stakeholders of this emerging ecosystem so that a roadmap for the future can be prepared.

I thank PwC and all the members of CII's National Taskforce on Short Haul Air Mobility for providing their valuable feedback on this knowledge paper.

Let's do all we can to invigorate this new aviation sub-sector so that it grows wings. As the sector evolves, so shall we.

Chandrajit Banerjee
Director General
CII

Foreword from PwC

The concept of short-haul and advanced air mobility (AAM) has long been considered by governments, academia, and enterprises as a plausible solution to issues like traffic congestion and pollution caused by road transport in urban areas. Furthermore, it holds the possibility of overcoming mobility and last-mile connectivity issues in rural and remote areas. As a result, air mobility has been transforming into an industry that boasts of an array of aircraft, with variations in propulsion design, technology, capacity, range, autonomy, and compatibility. Its potential use cases may include passenger and cargo transportation, medical evacuation and defence, among many others. To leverage the benefits of this technology, different countries across the globe have taken proactive measures on different aspects including public acceptance and policies, which are critical for the development of the air mobility market. India, too, has taken a few major steps towards the adoption of air mobility through the establishment of the Drone Rules, 2021, and National UTM Policy Framework, 2021, and the announcement of the Helicopter Policy in 2021.

However, proactive measures focusing on all the key areas of the ecosystem – such as technology, regulations, infrastructure and public acceptance – must be taken in order to tap into futuristic technologies like eVTOL, which are currently at a very nascent stage in India. If we consider office commuters and airport users with high earning potential to be the early adopters of eVTOLs, India will initially require full-fledged eVTOL infrastructure to serve people in tier 1 cities in the next 20 years. Technological advancements in air mobility shall primarily focus on vehicle charging time, reduction in operational costs, and increasing operational efficiencies for tapping into the potential of the Indian air mobility ecosystem.

Also, to fuel the growth of air mobility in India, close coordination between various stakeholders and the adoption of best practices in the industry is required. To this end, CII has created a national taskforce on short-haul mobility by bringing together industry leaders, academicians and various other stakeholders, to identify initiatives that can be taken to develop a robust air mobility ecosystem in India. PwC is proud to have associated with CII as a knowledge partner for the development of this knowledge paper on short-haul mobility. This paper provides an overview of the history of air mobility, its current ecosystem, and the interventions and initiatives that will be taken to create a mainstream air mobility market in India.

I take this opportunity to thank CII and all other stakeholders who have supported us in the development of this paper and wish them success in their future endeavours.

Sonal Mishra
Executive Director and Leader, Aviation
PwC India

List of abbreviations

Abbreviations	Definitions
AAI	Airports Authority of India
AAM	Advanced air mobility
ATC	Air traffic controller
ATF	Aviation turbine fuel
BVLOS	Beyond visual line of sight
CSUAS	Certification Scheme for Unmanned Aircraft Systems
DGCA	Directorate General of Civil Aviation
EASA	European Union Aviation Safety Agency
eVTOL	Electric vertical takeoff and landing
FAA	Federal Aviation Administration (US)
GDP	Gross domestic product
GST	Goods and Services Tax
HAL	Hindustan Aeronautics Ltd
ICAO	International Civil Aviation Organization
JFK	John F. Kennedy Airport
MeitY	Ministry of Electronics and Information Technology
MoC	Ministry of Communication
MoCA	Ministry of Civil Aviation
NASA	National Aeronautics and Space Administration (US)

Abbreviations	Definitions
OEM	Original equipment manufacturer
PLI	Production-linked incentive
PSU	Public sector undertaking
R&D	Research and development
RCS	Regional Connectivity Scheme
STTR	Small business technology transfer
UAM	Urban air mobility
UAS	Unmanned aerial system
UAV	Unmanned aerial vehicle
UDAN	Ude Desh ka Aam Nagrik
UN	United Nations
UTM	Unmanned aircraft system traffic management
UTMSP	Unmanned aircraft system traffic management service provider
VLOS	Visual line of sight
VTOL	Vertical takeoff and landing

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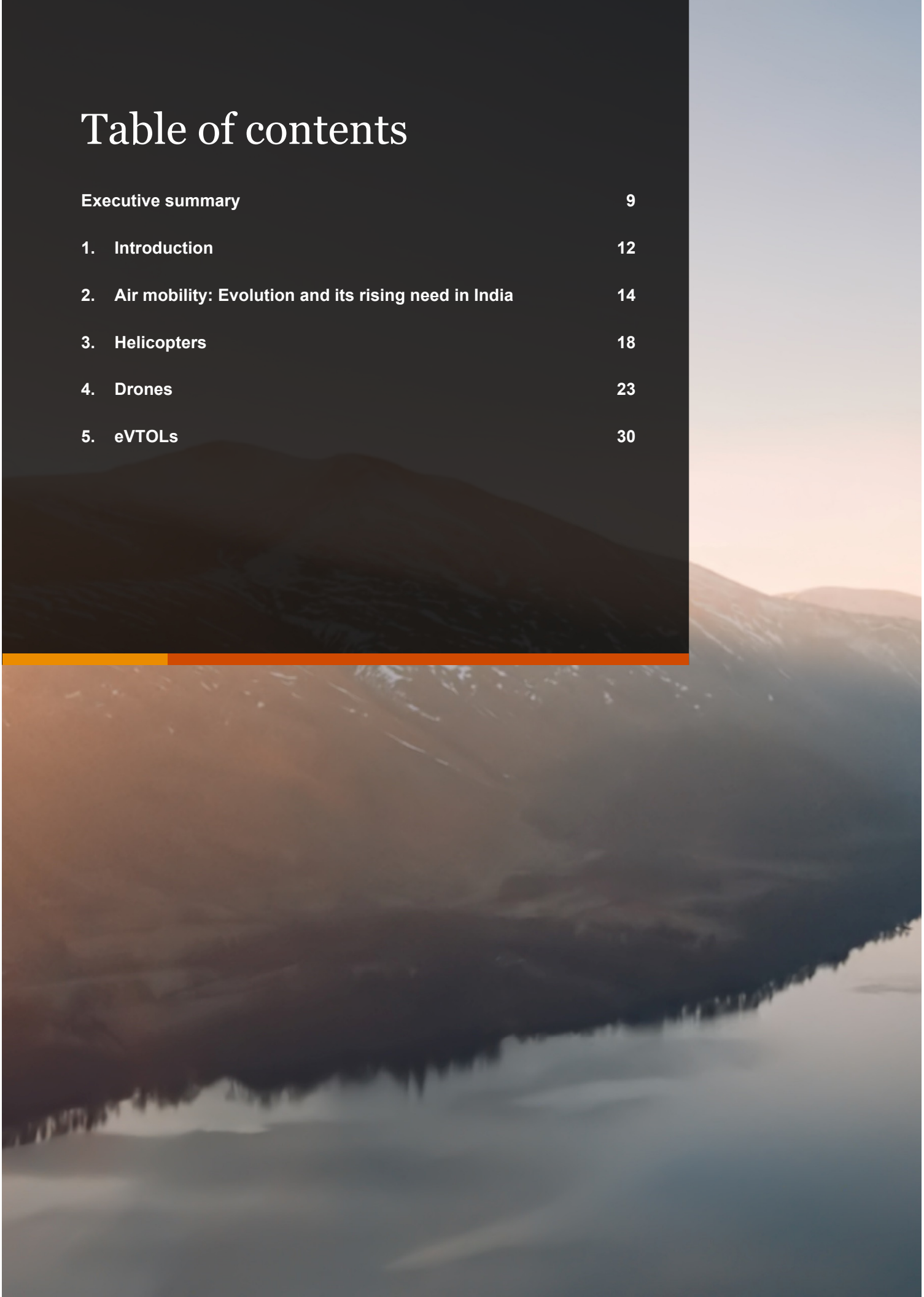


Executive summary

The modern era is characterised by radical changes and a growing need to transform from better to the best. Technology-enabled disruptions are changing the status quo across multiple sectors, making life easier for people. To revolutionise mobility in the modern age, the transportation sector has leaned on modern technology to develop innovative and sustainable solutions. Air mobility or mobility in the third dimension utilises conventional vehicles like helicopters, and AAM concepts like drones and eVTOLs for short-haul transportation. These short-haul mobility options have a wide array of applications including UAM, regional connectivity and emergency medical services. Moreover, AAM can mitigate threats of rapid urbanisation and mobility issues in rural areas, and even be used for crop monitoring, last-mile connectivity and medicine deliveries.

The versatility and compatibility of helicopters in difficult terrains make them a suitable alternative for regional connectivity in rural areas. Additionally, infrastructural requirements for the same are minimal and less capital-intensive as compared to those for conventional aircraft. Medium- and high-rise buildings in urban/semi-urban areas can be used for the development of helipads, thus making helicopters a viable alternative for UAM and other short-haul mobility services in India. Understanding the potential of helicopters, the Government introduced the Helicopter Policy in October 2021[2] to provide the necessary impetus for the sector.

With more efforts focused on regulations, policies and infrastructure development, the helicopter industry can attain its actual potential and may solve the connectivity dilemma in urban and rural India. A few recommendations are as given below:

- Formulate separate regulations for helicopters as currently, the regulations for fixed-wing aircraft – which are also applicable to helicopters – impede their ease of operation.
- Relax the flying hours to allow for operations beyond daytime.
- Include ATF under the GST regime as this will remove disparity on taxes in multiple states and provide input credit benefit.
- Create rotary wing terminals at existing aerodromes to allow for simultaneous operations with fixed-wing aircraft.

The Government of India has recognised the importance of drones or UAV (AAM technology) for further growth of the country and has thus taken steps to develop a robust regulatory and policy framework. The introduction of the liberalised Drone Rules, 2021, and PLI schemes attest to the Government's efforts to promote the sector.

Apart from taking measures in the regulatory (regulations supporting BVLOS, counter-drone measures, privacy, etc.) and technology domain (development of indigenous drone-related technologies), the Government can also work towards infrastructure development and demand generation, thereby developing a conducive ecosystem for the sector. A few recommendations for the same are given below:

- Establish regulatory sandboxes for testing drones: This would help in addressing public concerns about the complex use cases of drones.
- Enable policy-level push for driving demand, such as:
    - subsidies for procurement of drones for applications in agriculture
    - promote drone usage by ministries, Government agencies and PSUs for surveys and data collection.
- Develop infrastructure like 5G technology to ensure faster data transmission.

eVTOLs or hybrid VTOLs rely on electricity or other sustainable fuels for propulsion. Currently, there are more than 200 eVTOL-related projects around the world under different stages of design, development and testing. A majority of these are being developed in countries like the US and Europe, for which proactive measures taken by the regulators/government agencies have proven instrumental for the growth of the sector.

However, India is still at an early stage as far as eVTOLs are considered. Although some companies have developed eVTOL/VTOL concepts, the lack of regulations specific to eVTOLs – including their certification scheme – are leading to a delayed inception of the technology. Some of the recommendations to develop an eVTOL ecosystem in India are as below:

[2] PTI, The Hindu, 'Dedicated corridors & hubs: Scindia announces new helicopter policy', 8 October 2021: https://www.thehindu.com/news/national/dedicated-corridors-hubs-scindia-announces-new-helicopter-policy/article36901576.ece

- **Development of infrastructure:**
    - Develop a common testing infrastructure or controlled environment to reduce the capital burden on individual developers or OEMs.
    - Upgrade utility infrastructure to accommodate fast-charging or mega-watt charging capabilities.
    - Incentivise private sector participation for development of vertiports.
- **Development of a national roadmap for the sector:** The development of a national roadmap would be critical to identify priority use cases. This would help in the optimal allocation of resources and fast development of the required infrastructure.
- **Define principles governing AAM:** Defining values and principles pertaining to the development of AAM would help in the large-scale adoption of the technology. The principles shall focus on safety, sustainability, equity of access, low noise, etc.
- **Aircraft certification:** Development of a certification scheme specific to eVTOLs will be important for the faster deployment of the technology in the market.
- **Policy decision by MoCA:** Policies for the development of dedicated terminals for eVTOLs/VTOLs will improve the ease of access for users.

India has emerged as one of the major global forces by virtue of a large talent pool, robust policies and an aspiration to excel on the social and economic front. The recent efforts to promote futuristic technologies like drones are steps in the right direction. By focusing on new age technologies like eVTOLs and developing an ecosystem for their growth, India has the potential to become a global leader in the field of air mobility.

1. Introduction

A popular American cartoon series that aired in the early 1960s did not invent the concept of flying cars, but it certainly cemented the idea of airborne automobiles in many people's imaginations. Since then, there have been a variety of technological advancements in the area of AAM and short-haul mobility. AAM covers both manned and unmanned aircraft like drones and eVTOLs, whereas short-haul mobility covers helicopters which can carry passengers and goods over previously unserved or underserved areas – both urban and rural. However, air mobility in India may find greater applicability in urban and metropolitan areas (UAM) choked by overpopulation and severe traffic conditions.

Challenges caused by road transport such as traffic congestion and pollution in urban areas are not new and plague nearly every nation on the planet. As a result, governments, enterprises and academia have explored the concept of UAM to tackle the aforementioned problems. This has led to a degree of maturity within the space, resulting in an industry characterised by a variety of aircraft, with alterations in propulsion, technology, range, autonomy, and compatibility with the existing infrastructure. In addition to the technological advancements, there has been a significant push on the regulatory/policy front too. The EASA, for instance, released the special condition for small-category VTOL aircraft, laying down the technical specifications for the type certification of passenger-carrying VTOLs.[3] Moreover, Japan has developed a comprehensive roadmap for the launch of the AAM mission, which envisages the commencement of passenger transportation by means of VTOLs by 2030.[4]

India, too, has taken a few major steps towards the adoption of AAM through the establishment of the Drone Rules, 2021 and National UTM Policy Framework, 2021. The DigitalSky platform, a single-window online system created under the Drone Rules 2021, has streamlined the process of registration of drones and obtaining the necessary clearances. On the other hand, for short-haul mobility, the newly formed Helicopter Policy 2021 lays the foundation for the establishment of a robust helicopter ecosystem within the country. Though these are significant steps in the right direction towards creating an enabling environment for the development of air mobility ecosystem in the country, facilitating further growth of the same would require close coordination between various stakeholders and the adoption of best practices in the industry.

This paper provides an overview of the evolution of AAM across the globe, covering major milestones and highlighting the factors that drive the need for AAM in India. It also provides an overview of different short-haul mobility and AAM-related technologies, viz. helicopters, drones and eVTOLs[5] in the Indian context. Furthermore, the potential applications, current landscape in terms of technology, infrastructure and regulations, critical challenges and recommendations on the interventions required for AAM have been explored.

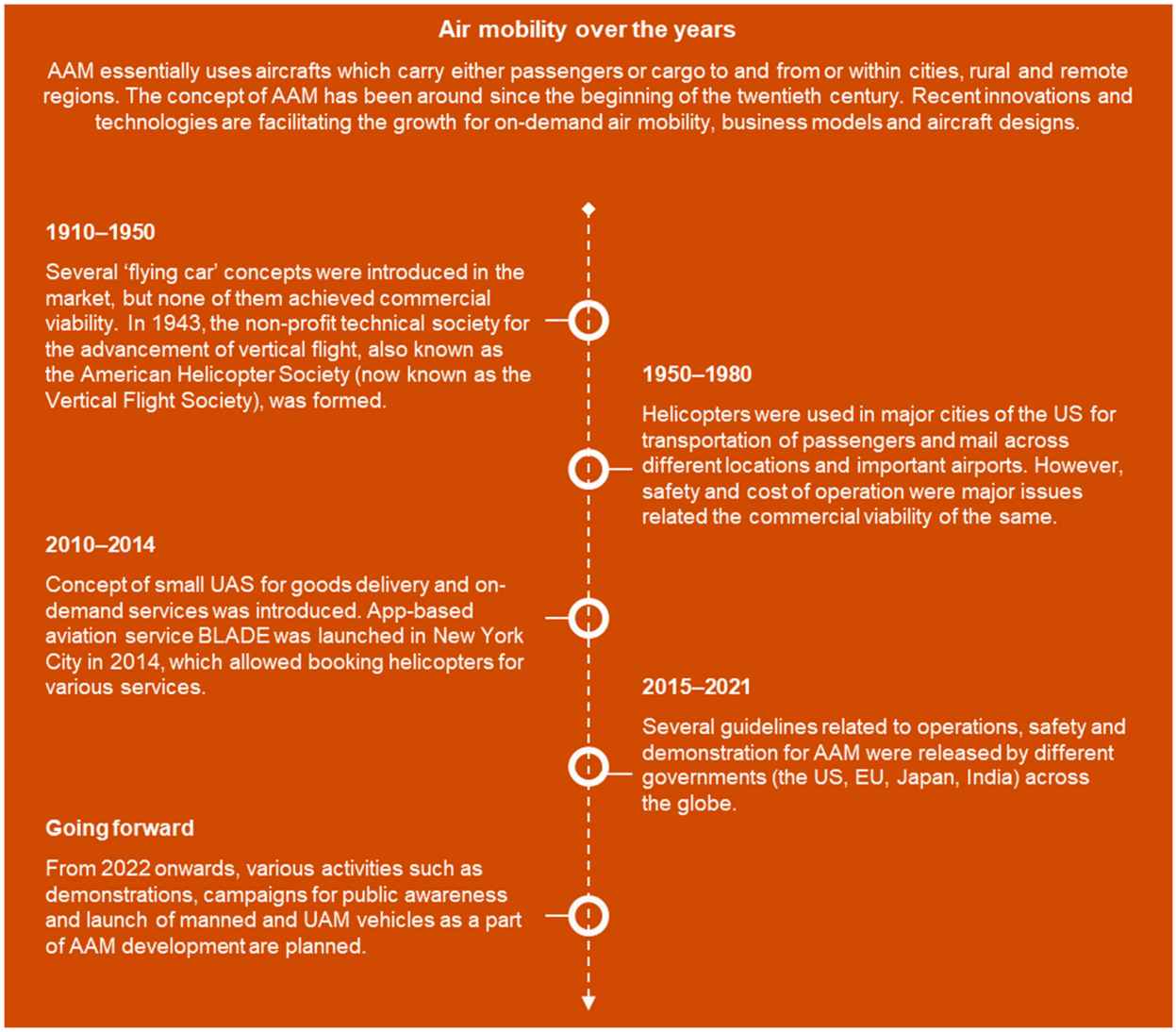
[3] https://www.easa.europa.eu/sites/default/files/dfu/SC-VTOL-01%20proposed.pdf
[4] https://www.mlit.go.jp/koku/content/Advanced_Air_Mobility_in_JAPAN_2021.pdf
[5] In this paper, eVTOLs refer to passenger-carrying vehicles (piloted and non-piloted).

2. Air mobility: Evolution and its rising need in India

The idea of air mobility has evolved over the years. In the 1900s, inventors and automakers developed many concepts of 'flying cars'. However, these inventions were not commercially viable. The ideas matured in the 1950s, with companies providing helicopter services in different cities of the US, even though the applications of air mobility were still limited by factors such as commercial viability, safety and operational costs. Also, due to limited business opportunities in the past, inter-city passenger transportation was the only imaginable use case for air mobility services.

In the last 20 years, due to rapid globalisation, the way of doing business has transformed. The world is more interconnected than ever before. Factors like lead times, responsiveness, security, logistics cost and sustainability are now gaining more weightage, thus extending the scope of air mobility use cases to the likes of drone delivery services, helicopter emergency services and surveillance. Moreover, the recent advancements in electric propulsion and battery-operated vehicle technologies have allowed rapid growth in the drone sector, and paved the way for the development of manned as well as autonomous aerial vehicles for civil use in urban and some rural settings as well.

Figure 1: History of air mobility



Source: PwC analysis

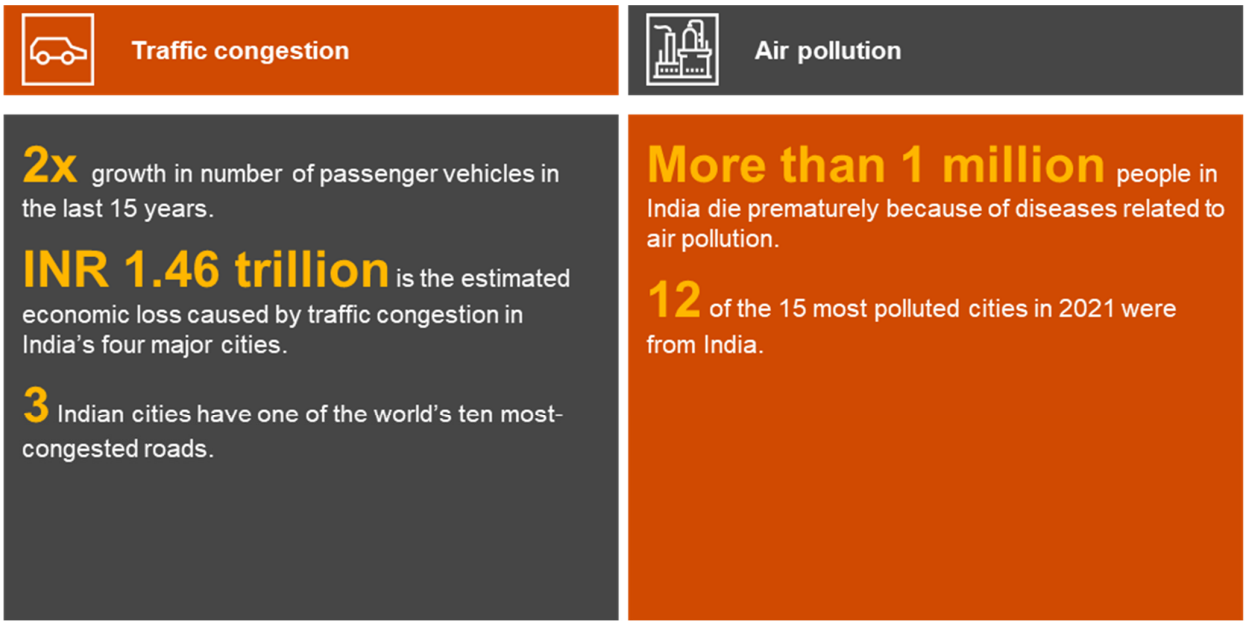
In terms of the geographical spread, AAM innovation has largely been seen in European and North American markets, with many companies reported to be in the advanced stages of eVTOL development. As per regulatory agencies like the EASA and US FAA, the commercial operations of eVTOLs are likely to start by 2024–25.[6] There are several eVTOL companies in regions which are at the forefront of innovation and close to commercially deploying their vehicles for the public. Furthermore, some major airlines have begun exploring various ideas within the UAM space for urban locations and conceptualised eVTOLs in their endeavour to build sustainable urban mobility solutions.

India too has witnessed a major leap in the AAM space over the years. In the recent past, Indian start-ups have played an active role in the development of drones and eVTOLs by relying on indigenously developed proprietary technologies. In 2022, the number of start-ups in the UAV space reached more than 200.[7] Apart from the development of AAM technology, the country has taken major strides on the policy front as well through the establishment of the Drone Rules, 2021 and the National UTM Policy Framework, 2021. Realising the importance of helicopters in both UAM and regional connectivity, the Government of India also announced the Helicopter Policy in October 2021. Although significant progress has been made on the air mobility front in India, rapid adoption of the same would be crucial to offset the growing concerns raised by urbanisation and substitute the traditional methods.

Rising need for sustainable mobility in India

The number of passenger vehicles in India has more than doubled during the last 15 years, and this considerable increase in traffic is affecting the country's economy.[8] As per a study conducted by Uber, the Indian economy loses approximately INR 1.44 trillion because of traffic congestion in its four major cities – Mumbai, Bengaluru, Kolkata, and Delhi.[9] Three of these cities (Delhi, Mumbai and Bangalore) have been among the cities with ten most-choked roads in the world and have consistently featured on this list.[10]

Figure 2: Impact of traffic congestion and air pollution



Source: BBC, TomTom, Business Today, Autocarpro

6 https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf
7 https://inc42.com/startups/eyes-in-the-sky-12-india-drone-startups-looking-for-major-pie/
8 https://www.autocarpro.in/analysis-sales/passenger-vehicle-sales-india-double-decade-21595
9 https://www.businesstoday.in/latest/economy-politics/story/india-wastes-as-much-as-rs-1-44-lakh-crore-due-to-traffic-congestion-says-uber-study-104587-2018-04-19
10 https://www.tomtom.com/traffic-index/ranking/

The Government has tried to cope with the increasing urbanisation by rapidly improving road infrastructure but is still unable to match its pace with the increasing number of vehicles on the road. Road traffic congestion is also one of the major reasons for the increase in air pollution in major cities, and results in premature deaths of over two million people in India because of diseases related to air pollution.[11] To reduce the air pollution, the Government has adopted policies and targets for promoting the adoption of electric vehicles and decarbonisation of the power sector. The Government, however, would require more initiatives in multiple other domains to achieve its target of net zero emissions by 2070.[12]

UAM can be considered as an alternative to primarily address the congestion and environmental issues faced by major cities today. Furthermore, it may also help in addressing some of the secondary challenges faced by the country today, which include high lead times for medical emergency services, last-mile deliveries, and inadequate safety and security standards at public places. Regional connectivity is another area that is gaining momentum in India, as large-scale connectivity between tier 2, tier 3 and metro cities becomes a necessity. The growth of India's aviation sector in the future would be primarily driven by these cities. It is in this context that helicopters and eVTOLs may play an important role. In this paper, we focus on different air mobility alternatives like helicopters, drones and eVTOLs, their applications, current landscape in terms of technology, infrastructure and regulations, and the critical challenges and recommendations on the interventions to unlock their potential.

[11] https://www.bbc.com/news/world-asia-india-61489488
[12] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1847812

3. Helicopters

Although the concept of a helicopter was designed by scientists as early as the fifteenth century, it was only during the first half of the twentieth century that passenger-carrying helicopters were successfully tested.[13] These helicopters, however, were largely used for military and training purposes. With advancements in technology in terms of safety, comfort, and viability in the latter half of the twentieth century, helicopters were extensively being used for commercial purposes. The use of helicopters for intra-city travel can be traced back to the 1950s when New York Airways and Pan American flew passengers between JFK and Newark airports.[14] Since then, the use of helicopters for UAM as a short-haul mobility service has increased, and they are currently used for inter/intra-city travel in many countries.

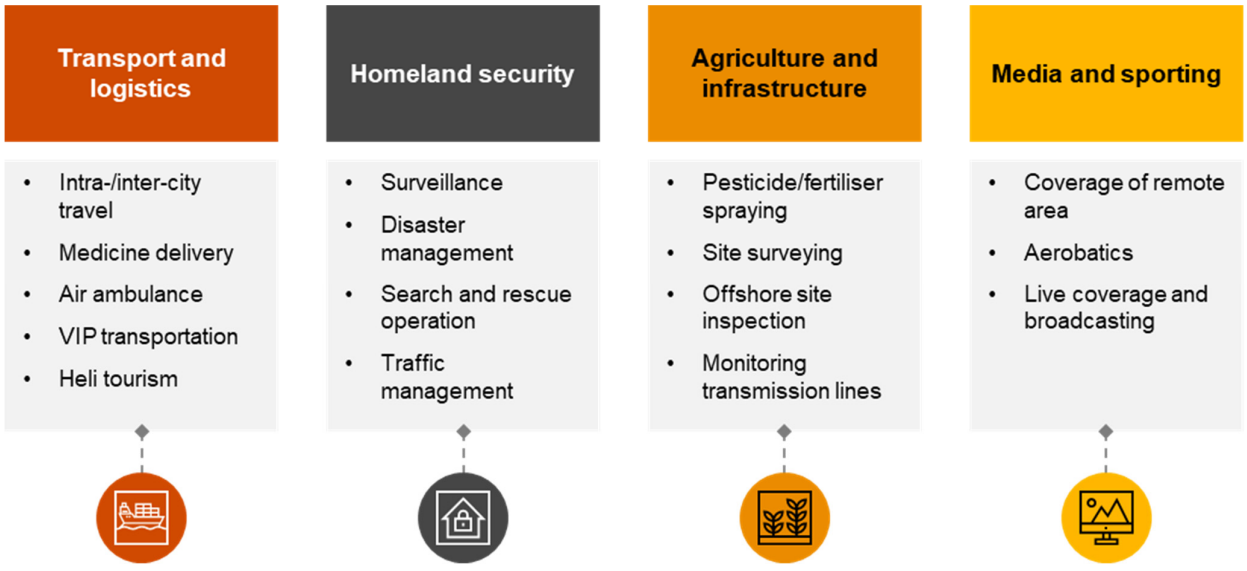
Helicopters today are considered an important mobility-related solution for a variety of reasons. Their capability to hover in the air, land and take-off vertically and minimum infrastructural requirements for operations increases their versatility and makes them a viable alternative to fixed-wing aircraft in many areas. Currently, helicopters are widely used to transport people and cargo to remote locations, airlift passengers during disasters, conduct surveillance and provide air ambulance services. Owing to their ease of operation, we believe helicopters could play a pivotal role in providing a sustainable solution to tackle road congestion and other mobility-related issues in India.

Current landscape of the helicopter industry in India

In recent years, India has been dealing with the issues due to rapid urbanisation, of which mobility-related issues are a major concern. With domestic passenger traffic in India being at the third position in 2017 globally, there has been a significant and continuous increase in the demand for air travel in the country.[15] Keeping up with this trend, Indian airports can expect the passenger traffic in metro cities (Delhi, Mumbai, Bangalore, Hyderabad, Chennai and Kolkata) to treble in the next ten years and cross 950 million pax throughput mark p.a.[16] (as compared to approximately 211 million pax p.a. throughput in 2020).[17] Moreover, considerable growth in the civil aviation sector is envisaged from regional connectivity to and between tier 2 and tier 3 cities in the future.

A key feature of the helicopter is the minimal infrastructural requirement for its operations. As helipads are cheaper and easier to construct as compared to airports, helicopters can be used for ensuring connectivity between tier 2 and tier 3 cities. The factors above, although non-exhaustive, are indicative of an inherent demand for helicopter applications. A few key areas across which helicopters can be used in India are given below.

Figure 3: Possible use cases for helicopters in India



Source: PwC analysis

[13] https://www.britannica.com/technology/helicopter
[14] https://www.atca.org/Uploads/symposium/2019/WhitePapers/A%20Roadmap%20to%20Certify%20Flying%20Cars.pdf
[15] https://timesofindia.indiatimes.com/business/india-business/india-becomes-3rd-largest-aviation-market-in-domestic-traffic/articleshow/57837992.cms
[16] PwC analysis
[17] AAI traffic news

Although helicopters can be of use in multiple areas, India currently does not have many helicopters in operation. There are around 250 helicopters, of which nearly 72% belong to non-scheduled operators while the rest are operated by PSUs/governments/private parties.[18] In comparison, countries like Brazil and the US, which have a smaller population compared to India, have more than 1,200 and 14,000 helicopters respectively. The lower number of helicopters in India is representative of a huge gap in terms of supply and inherent demand, caused by factors like high cost of operations and acquisition, difficulty in availing finance and operational constraints.

Most helicopters used in India – namely AgustaWestland, Bell and Sikorsky – are foreign manufactured, and the cost of a few popular models used are in the range of USD 1 million to USD 15 million.[19] Although HAL largely caters to the defence sector, it now offers its Dhruv helicopters for civilian purposes as well.[20] This twin-engine helicopter with a maximum seating capacity of 14 has the operational capability to provide emergency medical services and transport to offshore facilities. Large-scale production of such helicopters indigenously would help in reducing the dependency on foreign manufacturers and may also decrease the capital intensity associated with the business.

Apart from the high capex required for acquisition, helicopter financing remains a key challenge in the industry. Due to the perception of lower commercial viability and creditworthiness, owners and operators find it difficult to avail credit from banks/financial institutions. In addition, with banks not willing to accept helicopters as collateral (non-recourse loan), owners generally resort to purchasing the asset entirely on equity. Capital deployment in the form of equity would raise the cost of capital, thereby resulting in higher tariffs and reduced demand. As scheduled operations envisaged under schemes like RCS are expected to generate sufficient demand for helicopters, bottlenecks related to financing would require more attention. For this, proactive involvement of the Government would be required in order to build confidence among financial institutions by apprising them on assured viability to operators in case of RCS.

[18] https://www.civilaviation.gov.in/sites/default/files/GM-CIVIL-HELICOPTER-E-Book.pdf
[19] https://economictimes.indiatimes.com/infrastructure/choppers-are-the-new-jets/helicopters-cost-between-1-2-million-and-15-million/slideshow/12132797.cms
[20] https://hal-india.co.in/Civil%20Products/M__416

Helicopter Policy – a paradigm shift

Acknowledging the importance of helicopters for ensuring regional connectivity and intra-city travel, the Government of India announced the new helicopter policy in October 2021. By covering aspects like the establishment of helicopter corridors and helicopter acceleration cell, and waiving the parking and landing charges, the policy has outlined significant measures to nurture a conducive ecosystem in the industry. Some of the key announcements as per the policy are as follows.[21,22]

Figure 4: Interventions in the helicopter sector

Source: FICCI; NDTV

Although the helicopter policy is in consonance with the industry's requirement, there still are few regulatory and operational impediments for its growth. For instance, in this policy, helicopters have been treated similar to fixed-wing aircraft in terms of airfield taxiing and traffic management, which prevents from tapping into the ease of operations, which they offer otherwise. Therefore, the development of this industry would depend on a holistic review of the ecosystem and stakeholder inclusiveness in order to develop adequate interventions.

[21] https://www.thehindu.com/news/national/dedicated-corridors-hubs-scindia-announces-new-helicopter-policy/article36901576.ece
[22] https://www.theweek.in/news/biz-tech/2021/11/23/new-helicopter-policy-to-propel-growth-of-civil-aviation-sector-.html#:~:text=Under%20the%20new%20policy%2C%20the,for%20heliports%20or%20helicopter%20companies

Potential interventions to encourage growth of the helicopter industry in India

A few key interventions that can be explored to foster growth of helicopters in India are as follows:

- **Development of separate regulations for helicopters:** Currently, helicopters rotary aircraft fall under the Aircraft Rules and are treated similar to fixed-wing aircraft in terms of certain operational requirements, thereby impeding their ease of operations. Thus, creation of a separate vertical for helicopters under the regulator would help in tailoring regulations and other requirements accordingly.
- **Relaxation in terms of flying hours:** Currently, helicopter operations are restricted during the daytime (20 mins before sunrise to 20 mins after sunset),[23] thereby limiting the flying hours and commercial viability. An extension of allowable flying hours would improve capacity utilisation and hence yield better unit economics.
- **Inclusion of ATF under the GST regime:** Fuel contributes to about 40% of the operational costs for helicopters. Currently, the excise duty on ATF stands at 11%, while the VAT charges by states vary between 1–25%. The inclusion of ATF under GST will remove the disparity in tax rates across different states in the country and present the benefit of availing input tax credits for airlines.
- **Creation of rotary wing terminals at existing aerodromes:** As helicopters currently fall under the regime of the Aircraft Rules in India, they are bound to operate and follow airport procedures that are followed by larger commercial fixed-wing aircraft. This results in operational delays to and from airports. Therefore, earmarking an area or zone within the airport – specifically for rotary wing aircraft – tailoring procedures and rules for their operations, creating a new ATC facility, etc., may be undertaken to allow for simultaneous operations of helicopters and fixed-wing aircraft. This could enable a seamless air mobility experience for passengers who are travelling within the city or short-haul destinations, without ever having to leave the airport.

[23] https://helisewa.civilaviation.gov.in/Uploads/Heli%20Disha-%20CIVIL%20HELICOPTER%20E-Book_compressed.pdf

4. Drones

The world has witnessed a number of technological disruptions in the past few decades, with a few of them reshaping the status quo of several industries. Innovations surrounding digitalisation, automation and artificial intelligence have replaced legacy systems in multiple sectors, either partly or wholly, with much advanced technologies. The transportation sector, in the recent years, has relied on digital solutions and automation to develop technologies that would revolutionise mobility in the modern age. Drones or UAVs are such revolutionary innovations that usher in an era of digital revolution in the transportation sector. These remotely piloted vehicles are widely used for applications ranging from photography to goods delivery. Moreover, this concept of mobility in the third dimension (AAM) is considered to be a panacea for issues related to road traffic congestion and inaccessibility to remote locations.

The origin of UAVs dates back to the mid-nineteenth century, when unmanned balloons were used by the military forces for warfare.[24] However, it was only during the first world war that the first 'heavier-than-air' UAVs or auto-piloted aircraft were experimented by the US military force for airstrikes. During the Second World War and in the latter half of the twentieth century, numerous technological advancements led to large-scale adoption of drones for military campaigns. The applicability of drones for commercial purposes, like goods delivery, were first explored by e-commerce companies in the early twenty-first century. The spectrum of commercial drone applications has widened thereon. Currently, drones are used for site monitoring and inspection, medicine delivery, land survey and surveillance, among many other applications spanning multiple sectors.

India's ambition to become a leading economic powerhouse of the world by being self-reliant and self-sustaining has made it a global leader in multiple industries. This trend is expected to continue and thus scale up the overall demand and supply for goods and services. For instance, the e-commerce industry in India is expected to reach USD 350 billion in terms of gross merchandise value by 2030, which is 500% more than the current market.[25] In this context, drones become an important technology which need to have widespread adoption to enable growth across multiple sectors. However, in order to tap into the potential of drones, it would be pertinent to explore and develop suitable applications, create conducive policies and facilitate development of indigenous technology.

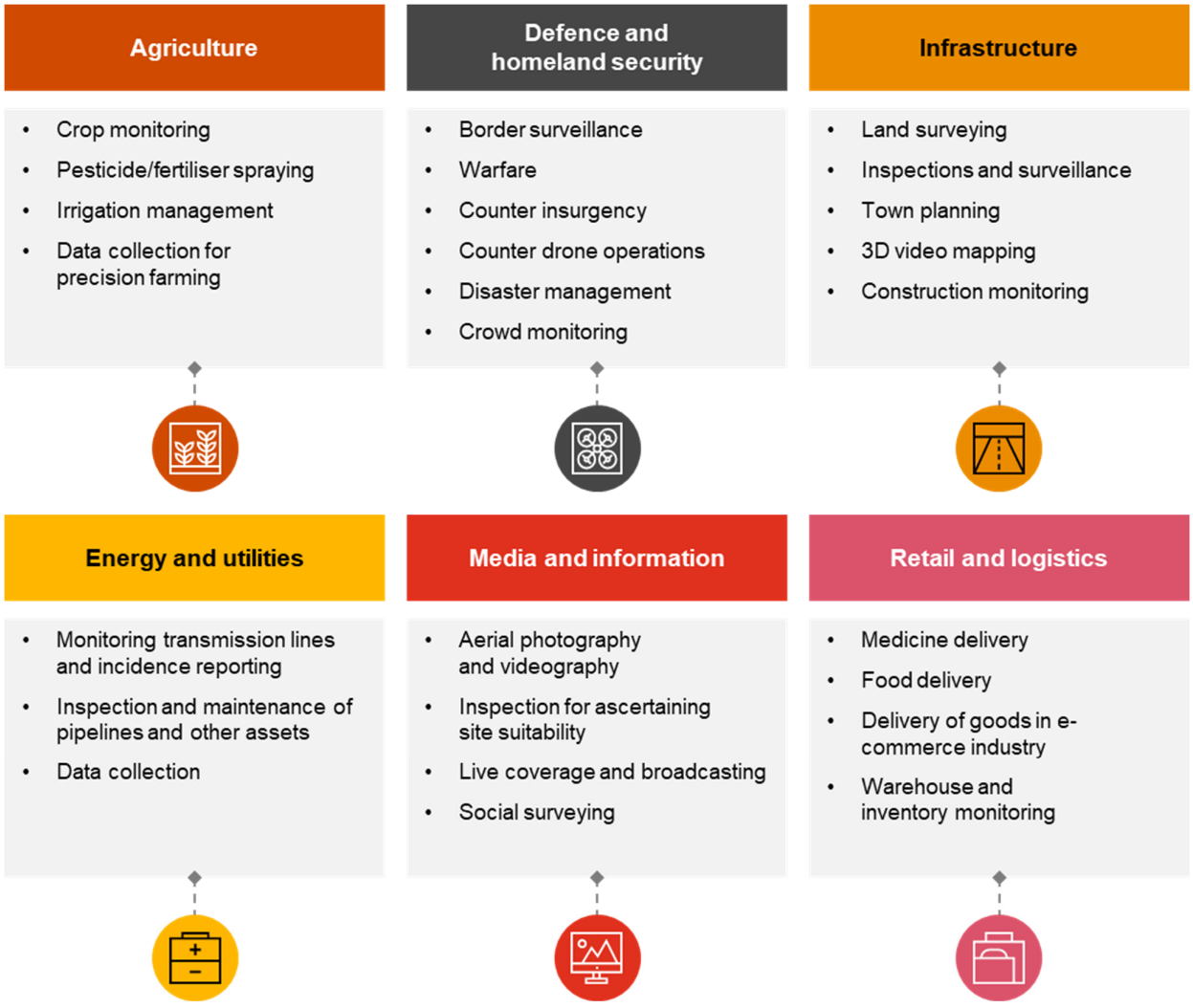
[24] https://www.pbs.org/wgbh/nova/spiesfly/uavs.html
[25] https://www.investindia.gov.in/sector/retail-e-commerce/e-commerce

Drones in India: The expanding spectrum of applications

During the last 50 years, the macroeconomic, demographic and technical landscape of India has undergone a massive transformation. For instance, agriculture, which contributed to more than 50% of India's GDP in 1950, was replaced by the services sector (>50%) as the major contributor in 2021. Despite such a shift in the growth pattern, nearly three quarters of India's population still depends on agriculture and allied sectors for their livelihood.[26] Therefore, it is essential to improve sectoral productivity by adopting latest technologies to ensure productivity and sustainability. Owing to their technological prowess, drone use in the agricultural sector is gaining currency among agriculturalists. They are being widely used for monitoring of crops, spraying fertilisers/pesticides and collecting data for precision farming.

Apart from agriculture, drones would be critical for the accelerated growth of industries and service sectors too. With rising complexity in projects and growing need for faster delivery of goods and services, human interventions are expected to reduce in various processes, paving way for the advancement of drones across multiple sectors. Some of the key areas where drones shall be explored in India are given below.

Figure 5: Potential applications of drones in India



Source: PwC analysis, secondary research

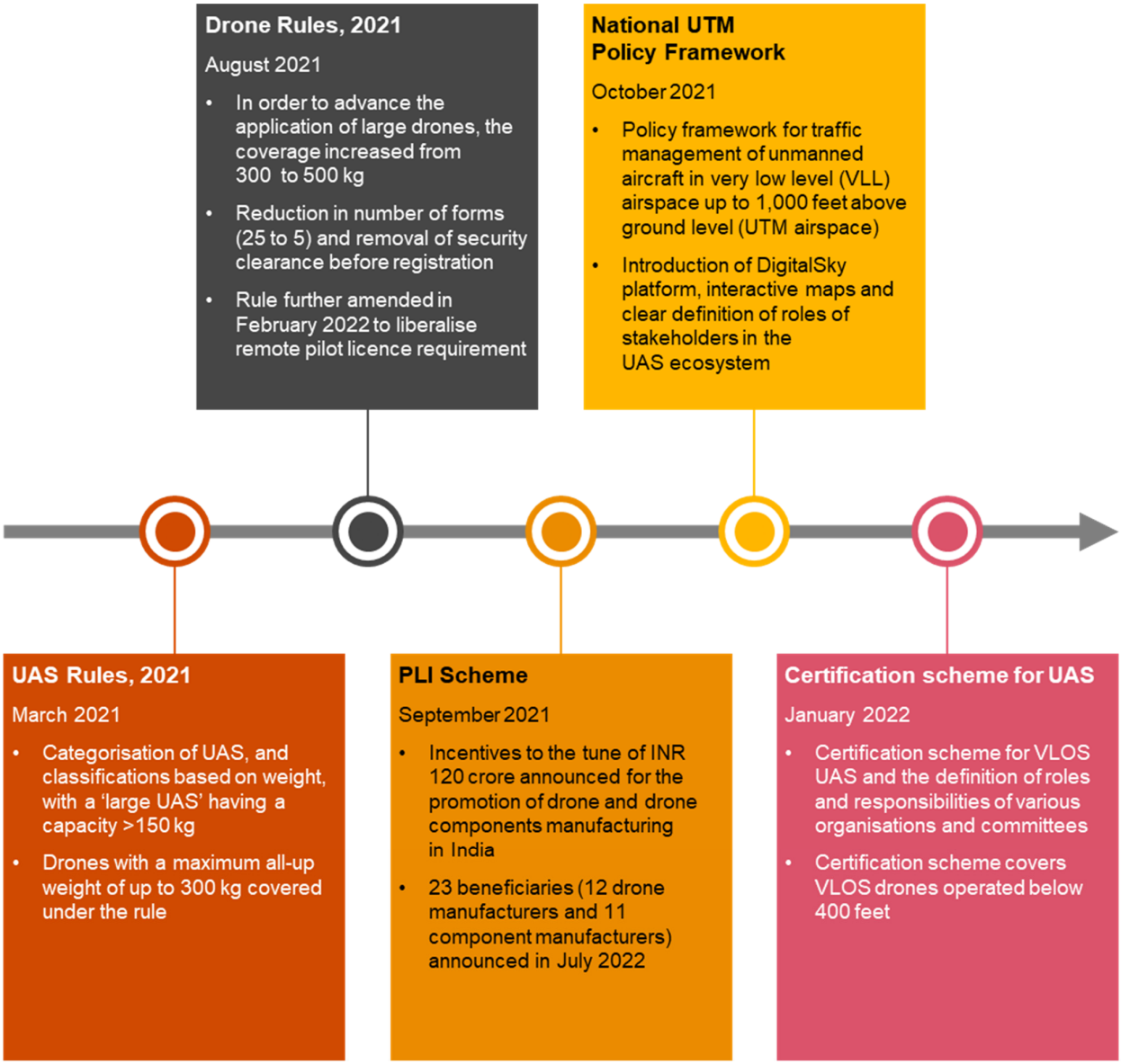
The above applications are not exhaustive in nature. The ease of implementation of drones across sectors and applications also varies based on factors like commercial viability (revenue augmentation versus cost of deployment), availability of technology and conducive policies/regulations.

[26] https://www.worldbank.org/en/news/feature/2012/05/17/india-agriculture-issues-priorities

Drone ecosystem in India in an era of liberalised rules

Over the past few years, India has been proactively developing policies and regulations to promote the UAV ecosystem. With liberalised drone rules, UTM Policy Framework, the production-linked incentive (PLI) schemes and drone certification schemes, all pieces seem to be in place for the widespread adoption of this technology. Moreover, the establishment of the DigitalSky platform, liberalisation of forms and procedures, and inclusion of safety and security measures are steps in the right direction for ensuring public safety and ease of operations.

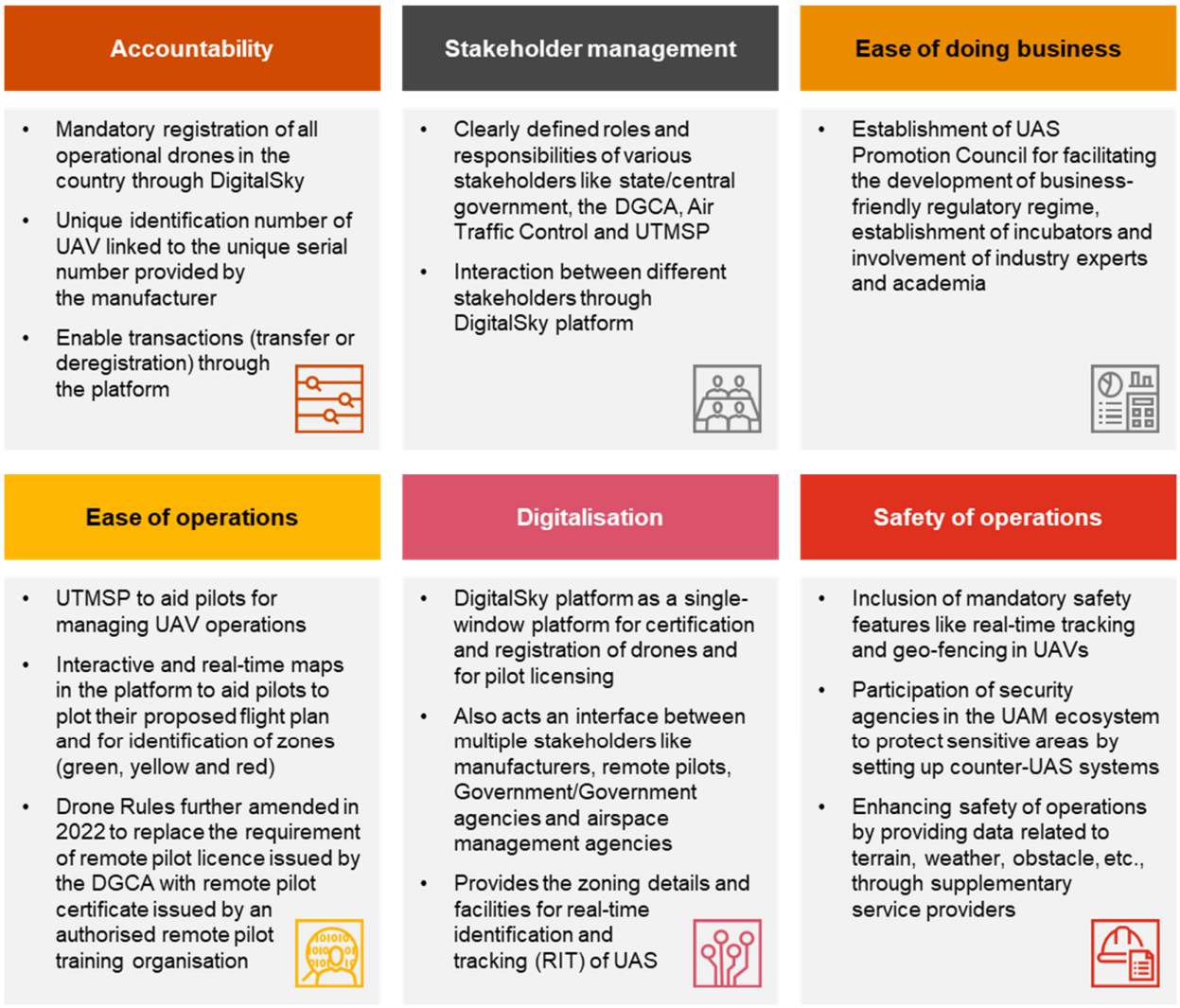
Figure 6: Timeline of key policies, rules and schemes



Source: DigitalSky

Some of the key features of the Drone Rules and National UTM Policy Framework are given below:

Figure 7: Key features of Drone Rules and National UTM Policy Framework



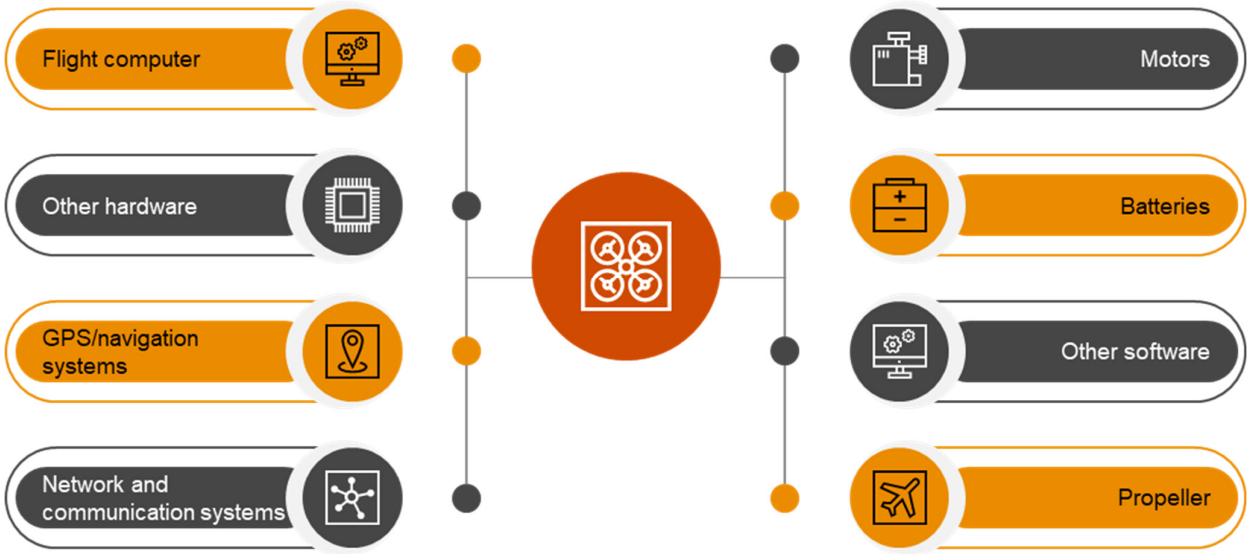
Source: Ministry of Civil Aviation; The Gazette of India

Drone Rules, 2021, National UTM Policy Framework, 2021 and CSUAS, 2022 are laudable efforts on the policy front and provide the industry with the much-needed impetus for its growth. However, there are a few areas that require further attention in order to tap into the industry's full potential.

- **BVLOS operations:** The enablement of BVLOS operations would be essential for the advanced use cases of drones like cargo, medicine, and food delivery. However, the current certification scheme only covers drones for VLOS operations. It is therefore important for the regulator to identify critical areas of intervention to ease BVLOS operations and also address public concerns regarding the same.
- **Counter-drone measures:** Although the integration of drone operations through the DigitalSky platform improves the accountability of drones in the sovereign airspace, robust counter-drone measures need to be developed to prevent security threats. Counter-drone measures must be developed separately while utilising the existing capability of the DigitalSky platform for real-time tracking.
- **Privacy and data protection:** As drones would be used for purposes like surveillance, crowd monitoring and data collection, issues such as intrusion of privacy of citizens and protection of personal data might have to be addressed. In order to do this, development of laws for personal data protection and their integration into the UAS ecosystem would be an important step going forward.

While regulations lay a robust foundation for the industry, development of adequate technology would be critical for it to prosper. Although the PLI announced for drones and drone components would promote manufacturing in the country, it does not address the capital needs for the R&D of this technology. Due to this, India has a higher dependence on countries like China, Taiwan, the US, and Europe for several drone components like propellers, batteries and navigation systems. To promote R&D of drone technology in the country, the Government would need to make funds available to research organisations and technological institutions. The US FAA, for instance, has awarded over USD 18 million in 2022 to select universities to promote research on drone technology, covering areas like UAS cybersecurity and guidance systems.[27]

Figure 8: Review of key drone technologies in India



Batteries

- Lithium-ion batteries are the most commonly used battery technology.
- Currently, a larger share of the batteries used in India are imported from China, Taiwan and the US, etc.
- Hydrogen fuel cells may be explored as an alternative for exploiting the capabilities of drones for deliveries and other long-range applications.
- Development of battery manufacturing facilities in India, focusing on developing and manufacturing alternative technology like hydrogen cells is important.

Motors

- India has recently begun manufacturing motors suitable for drones.
- However, shortage of magnet manufacturers (a critical component of motors) leads to reliance on countries like China and the US for these components.
- Perception of superiority in terms of quality of motors built in other countries leads to poor demand for Indigenous models.
- Increasing R&D spend to develop superior motors and components indigenously would be an important step to further development.

Communication systems

- The current communication systems enabled by 4G network may not be conducive enough for the development of advanced BVLOS use cases like medicines/goods delivery and even applications involving transfer of high-quality data/images/videos.
- The development of 5G network would lead to high speed, better quality and ease of handling big data.

Source: PwC analysis

[27] https://www.faa.gov/newsroom/faa-awards-44-million-drone-research-grants-seven-universities

Policy and other interventions for unlocking the potential of drones in India

Although regulations and technology would take care of the sectoral needs, efforts should also be focused towards building infrastructure enablers and creating sufficient demand. In addition, proactive measures need to be taken to address public concerns surrounding drone applications. All of these would be critical in building a conducive ecosystem for the industry in India. Some of the interventions that may be considered are as follows.

1. **Establishing regulatory sandboxes for testing drones:** Testing complex drone use cases in civilian areas could raise public concerns. Therefore, it is important to develop sandboxes or controlled environments that can be used as common testing facilities by manufacturers. The following measures can also be adopted for the same:

    - utilising excess land available with central/state governments and agencies to create test sites

    - defining regulations for maintenance and operations of test sites.

2. **Policy-level push for driving demand:**

    - Offering subsidies for the procurement of drones could incentivise users. Schemes similar to the one announced by the Union Ministry of Agriculture for providing 100% subsidies on agricultural drones, may be applied across other sectors as well.

    - Drone usage can be increased by governments/agencies for activities like data collection, traffic management and site surveying.

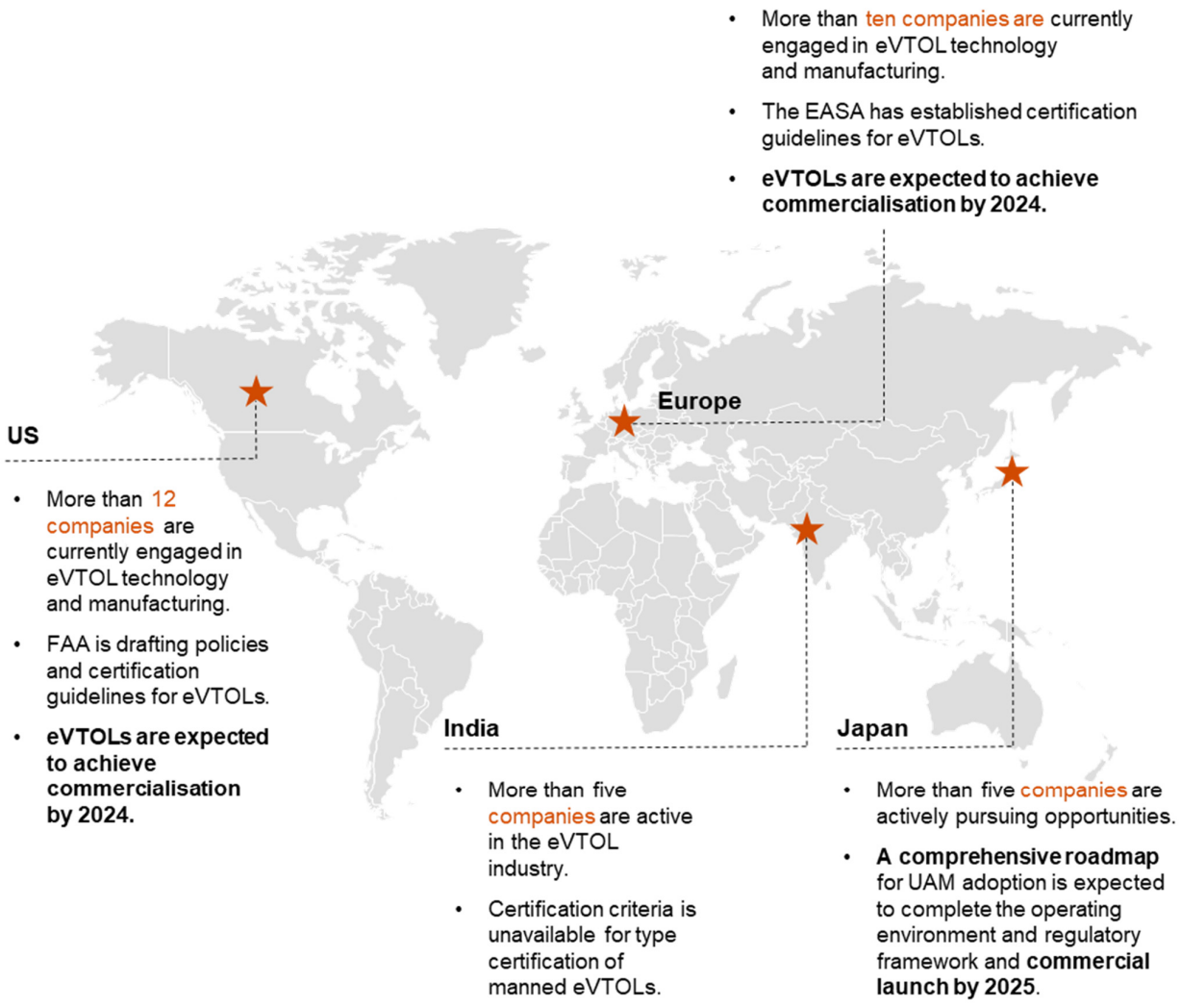
3. **Development of enabling infrastructure:** Technologies like 5G would be critical for the advanced use cases of drones and to improve their efficiency. Moreover, close coordination would be required between MoCA, DoT and MeitY and other relevant ministries and agencies to fast-track the implementation of the technology and its integration into the drone ecosystem.

5. eVTOLs

The concept of sustainable development, which recognises the interconnectedness of 'environment' and 'development', was first introduced in 1972 at the UN convention in Stockholm.[28] Since then, it has garnered significant attention from around the world, with policymakers, environmentalists and enterprises actively developing sustainable development targets and strategies. This emphasis on the environment and society, while developing new technologies, is palpable in the transport sector too. eVTOLs are an important component of this strategic shift in the sector.

eVTOLs or even hybrid VTOLs rely on green technology like electricity, new decarbonised fuels such as sustainable aviation fuel and hydrogen fuel for propulsion, and thus have a lower carbon footprint. Moreover, by leveraging on the third dimension or air as a mode of transport, they are expected to reduce the loss of time, money and lives caused by road congestion in urban areas. These factors have been the primary drivers for the development of eVTOL technologies across the globe. As a result, currently, there are more than 200 eVTOL-related projects globally,[29] under different stages of design, development, and testing.

Figure 9: eVTOLs across the globe



Source: PwC analysis; secondary research

[28] https://www.sd-commission.org.uk/pages/history_sd.html
[29] https://evtol.news/aircraft

Market assessment of eVTOLs in India

To meet the mobility needs in urban settings and keep up with the climatic and environmental commitments, there is an urgent need for an alternative mode of transport. This is where eVTOLs come in, offering various applications:

- **Air taxis:** eVTOLs can be used in major cities in the country as air taxis, as they significantly reduce travel time and are less polluting. By avoiding road congestions, these vehicles would be able to reduce travel time significantly compared to ground transport. This segment is anticipated to be mainly served by eVTOLs due to range limitations.

- **Regional connections:** Long-range eVTOLs can become a decisive catalyst for regional routes between major cities in India as well as tier 2 and 3 cities. Thus, a new network of aerial lines with minimal infrastructure can be developed to provide a new and efficient transportation system complementary to the existing commercial aviation routes. This segment is anticipated to be mainly served by hybrid and hydrogen eVTOLs.

- **Medical evacuation**: In India, one in every ten patients dies on the way to hospital, primarily due to road congestion. With the number of vehicles expected to increase in metro cities, timely access to healthcare facilities could be a major concern. eVTOLs, along with helicopters, could be utilised by hospitals or other organisations for transporting patients within the 'golden hour' (the one-hour period immediately after the occurrence of a traumatic injury during which prompt medical and surgical treatment has the highest likelihood of decreasing death), thus saving lives.

- **Last-mile aerial delivery:** As the e-commerce industry in India is set to grow at a rapid pace, the demand for last-mile delivery is expected to increase. eVTOLs, along with drones, can be used for last-mile deliveries as they have a lower carbon footprint and faster turnaround time.

- **Disaster response**: As eVTOLs are equipped to carry passengers, they can be used to deploy trained personnel at disaster sites much quicker than road transport.

Assuming that all the required interventions are made at the right time by different stakeholders in the UAM value chain, India – being home to approximately 20% of the world's population – can present a huge market opportunity for UAM players across the world. If we are to examine solely urban areas and UAM here, considering office commuters and airport users in metro cities with higher per capita income as the early adopters of eVTOLs, India would require a full-fledged eVTOL infrastructure to serve the people in the tier 1 cities for the next two decades. The technological advancements in air mobility shall primarily focus on vehicle charging time reduction in operational costs and increasing operational efficiencies for tapping into the potential of the Indian air mobility ecosystem.

To seize the potential of advanced urban air technology, an ecosystem that is conducive for its growth needs to be built. To facilitate this, the Government and private companies will have to work closely, and an action plan to be undertaken by the stakeholders involved in developing this ecosystem – regulators, local governments, academia, industrial players, airspace service providers and infrastructure operators – will have to be developed.

Integrated approach for the large-scale adoption of eVTOLs

The current situation of eVTOLs in India and potential interventions required from various stakeholders for the growth of the sector are highlighted below. Moreover, insights on some of the developments undertaken in other parts of the world are provided. The recommendations are based on extensive primary interactions with various stakeholders in the industry, in an attempt to find a plausible solution for the challenges faced by the sector across the four key pillars – **technology, infrastructure, regulation and public acceptance.**

(a) Technology

The development of the required technology for eVTOLs, the vehicles and their components/sub-components, along with their certification are crucial for their public acceptance and large-scale adoption in the future. Certain Indian companies have already begun conceptualising, designing, developing and even testing their eVTOL/VTOL prototypes with proprietary technology.[30]

[30] https://www.forbesindia.com/article/take-one-big-story-of-the-day/flying-cars-the-future-of-mobility/71079/1

Even though there has been some progress in the development of eVTOL/VTOL technology in India, challenges in terms of unavailability of key components in the country and absence of a certification scheme would impact the roll-out of eVTOLs in the country. The unavailability of components like motors, batteries and flight control systems may lead to greater dependency on the US, China and Taiwan for their supply. Moreover, development of an indigenous technology would be important for the timely roll-out of eVTOLs in the country in a cost-efficient manner. To this end, disposal of funds by the Government to the industry and academia would be an important step for fostering R&D in the sector. In the US, the government has spent more than USD 100 million on eVTOLs so far, with more than USD 30 million being spent on R&D.[31]

Considering the nascency of the industry, policies/incentives shall focus on product development to enable indigenous capability. Additionally, higher collaboration between OEMs and academia shall be promoted by mandating collaboration as a criterion for fund disposal. For example, in the US, the disposal of funds through programmes like small business technology transfer (STTR) grants require formal collaborations between small businesses and non-profit research institutions in the initial phases of product development.[32]

One of the key technological areas in which R&D is required is batteries. Since the primary propulsion systems in eVTOLs are electric or hybrid, there is a need to have viable batteries. These batteries need to be energy efficient, capable of storing more energy per kg. They must also have faster charging rates and a long cycle life (number of charges and discharges a battery can complete before losing performance). The Government could adopt proactive measures to foster quality research in the development of eVTOL batteries. This could include funding technology institutions (IITs, NITs, etc.) and research labs to develop indigenous technology.

(b) Infrastructure

1. **Testing infrastructure**

   To make passenger-carrying eVTOLs a reality, it is essential to conduct a substantial number of test flights in a controlled environment. For long-distance test flights, large areas of ground and air space might be required to create a controlled environment. However, procurement of such large tranches of land for creating testbeds would be capital-intensive for eVTOL developers and may require clearances and approvals from regulatory authorities. All of these factors might be perceived as risky by investors, thus leading to their reluctance in investing in product R&D. To mitigate these risks, the Government should identify and develop areas suitable for development of common testing facilities that shall then be utilised by the private players for testing their eVTOLs. An example of a controlled environment for eVTOL testing can be found in Paris, France, where eVTOL tests are currently being performed in the experimental vertiport built by Groupe ADP.

2. **Utility infrastructure upgrade**

   Given the power demand for eVTOL charging as well as the infrastructure at various vertiport sites, it is anticipated that the utility distribution system may require significant upgrades. This demand may range from service line extension to the development of new feeders and/or new substation transformer and capacity increase.

3. **Development of the ecosystem**

3.1. **Charging stations:** One of the key components of the eVTOL ecosystem is the charging station, as most of the eVTOL/ AAM vehicles rely on electricity for their propulsion. Charging stations must also be equipped with sufficient space and other infrastructural capabilities to accommodate multiple eVTOLs simultaneously. Also, to realise the potential of eVTOLs /AAM and meet the charging requirements of large aircraft with long flight durations, mega-watt charging stations (more than 1 MW capacity) may also be required in the future.

   Although the EV charging infrastructure in India has grown over the past few years, the suitability of this charging infrastructure for eVTOLs needs to be evaluated in detail.

[31] https://evtol.news/news/us-air-force-primes-the-evtol-industry
[32] https://www.sbir.gov/about

3.2. **Vertiports:** Vertiports are areas designated for eVTOL operations like take-off and landing. In addition to providing a designated space for carrying out these operations, vertiports must also be equipped with ancillary infrastructure like charging stations and passenger handling facilities. To tap the potential of eVTOLs for solving mobility related issues in densely populated Indian cities, vertiports might be required in larger numbers. However, due to challenges in terms of availability of land, vertiports might have to be built on high-rise buildings and other vertical structures that also meet the safety requirements. Vertiports may also take advantage of existing infrastructure, such as helipads and retrofitted public buildings. However, the planning and design would involve adequate parking, access to public transportation, take-off and landing pads for multiple eVTOLs, and battery recharging stations – all within a reasonable distance. eVTOL operations would be more suited for urban landscapes due to higher paying capacity of urban citizens and help mitigate road congestion issues. Although tier 2 and 3 cities and remote locations have greater swathes of land available for vertiport construction, they would be smaller in size and capacity due to less demand as compared to urban areas.

    In the west, companies like Skyports have announced the launch of a commercial vertiport in Europe in 2024.[33] However, there has been limited discussion in India about the physical infrastructure for the same. Therefore, the Government may be required to play an active role in initiating the planning of an adequate physical infrastructure.

3.3. **Rotary wing terminals and dedicated ATC facility:** The development of rotary wing terminals, which are earmarked areas or zones in existing airport/aerodromes, can be adopted for eVTOLs too. These terminals will support vertical take-offs and landings for both helicopters and eVTOLs. Also, there will be cost sharing between both in terms of passenger waiting areas and other associated infrastructure. Furthermore, a dedicated ATC facility shall be developed at this terminal to facilitate and accelerate permissions for eVTOL take-offs and landings.

(c) Regulations

1. Type certification/airworthiness

Robust type certification guidelines will be a key factor in ensuring the safety of VTOLs and thus building public confidence in the technology. In India, the Certification Scheme for Drones 2022 lays down the type certification guidelines for UAS up to 500 kg, whereas for UAS above 500 kg, Aircraft Rules 1937 are applicable. However, there aren't any regulatory guidelines currently available for type certification of manned eVTOLs. The characteristics of these vehicles makes them different from fixed-wing as well as rotary aircraft. Hence, it would be pertinent to create regulations that address the uniqueness of the vehicle, while also aligning with the regulatory objectives for fixed-wing and rotary aircraft.

Due to the unavailability of set standards, different OEMs in India have adopted different designs, with a few commonalities. While preparing the special condition for VTOLs, the EASA allows a certain degree of flexibility in certification, while ensuring that all developers are provided a level playing field at the same time and the safety objectives are being met. In order to promote innovation, the special condition does not prescribe any design standards.

Further there is a need to bring in additional inspection protocols for test flights and other safety aspects for eVTOL flight operations which safeguard lives on board and below the crafts. However, due to the lack of defined eVTOL manufacturing standards, a variety of unique designs exist currently. It may therefore be impractical to create protocols for each unique design, or for protocols to be based on the regulations for helicopters since helicopters use traditional propulsion systems. Regulators may endeavour to create inspection regulations in close consultation and coordination with stakeholders in order to adapt the protocols to the various functionalities and designs.

2. Ease of import

Currently, there are no domestic companies that manufacture key components like motors, flight controllers and communication devices, thus requiring them to be imported. In order to ensure a seamless supply of raw materials, the focus in the short term shall be to enable the ease of import, until we achieve an indigenous capability in terms of product development. Some eVTOL components (like communication devices) are categorised as aerospace components. As a result, the customs procedures for the same are delayed as some of these components require up to five levels of permission clearances. Therefore, we need to re-evaluate eVTOL component categorisation and its customs procedure to avoid delays in import.

[33] https://skyports.net/skyports-to-develop-europes-first-test-vertiport-in-paris/

3. Design standards for vertiports

Vertiport is a key infrastructural requirement for AAM operations which ensures safe take-offs and landings of eVTOLs. At present, there aren't any vertiports designed specifically for eVTOLs in India and neither are there any regulations available for their design and operationalisation. The regulators shall explore the applicability of standards for heliport designs as provided in ICAO annex 14, volume II, 'Heliports' considering the vertical take-off and landing capability of eVTOLs being similar to helicopters. However, the design standards should also consider the infrastructural requirement for charging stations and a safe operating environment for unmanned/autonomous eVTOLs in the long term.

The EASA released the prototype specifications for the design of vertiports for manned VTOLs in March 2022. The agency has reflected on the heliport standards, while also tailoring the design standards to suit the versatility of eVTOLs. For example, to account for the differences in urban environment in which eVTOLs will operate and their performances, the design standards allow for an omnidirectional approach path to vertiports through an innovative concept of a funnel-shaped area above the vertiport. This is significantly different from heliport designs which only allow for a constrained approach catering to conventional helicopters.[34]

4. Airspace management

Increasing the eVTOL fleet size in the future would require a robust airspace/traffic management system. The National UTM Policy Framework leverages the DigitalSky platform for UAS traffic management, which helps in the interaction between DGCA, AAI and UTMSPs and the drone/AAM operators. The document defines the roles and responsibilities of all the stakeholders and emphasises on the ease of operations. In the case of eVTOLs, deciding the stakeholders, their functional frontiers and the roadmap for integration with the conventional airspace would require more attention. Digitisation, as adopted in the case of UAS, would help in ensuring efficient operations with considerable focus on the accountability, security and safety of operations.

Similar to the helicopter channels created under the Helicopter Policy, UAM intra-city channels can be created. These channels can be created at a different height band to ensure simultaneous and safe operation of eVTOLs with other aerial vehicles. The corridors can be created along the present road networks within cities and existing airports to ensure ease of access for passengers, and provide access and evacuation routes for emergency services if needed.

(d) Public acceptance

As AAM is a novel concept, public acceptance of the same would be challenging. Thus, it is up to the industry and Government to proactively create awareness among the public and incorporate their feedback to develop a roadmap for this technology. For example, the EASA has taken a structured approach towards building public confidence in AAM. As the first step, the aviation agency conducted a comprehensive study to gauge the social acceptance of the concept. The results of the study were then utilised for the development of regulations and national level framework for the adoption of AAM.[35] A similar approach can be taken in India as well.

Second, pilot operations – such as cargo movement and emergency medical services – should be launched under controlled environments to make a compelling case of AAM and boost public confidence. The Government should join hands with OEMs in order to develop large-scale demonstrations. For example, the government of Osaka City (Japan), partnered with SkyDrive Inc. (eVTOL manufacturer) for the practical application of AAM to bolster public confidence through demonstrations.[36]

[34] https://www.easa.europa.eu/downloads/136259/en
[35] https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf
[36] https://en.skydrive2020.com/archives/6010

Third, manufacturers and regulators need to work towards ensuring that eVTOL operations do not lead to any undesirable levels of noise pollution. Noise pollution from drones could lead to resistance from the public, as was observed in the case of drone deliveries in Brisbane.[37] To better understand the noise profile created by eVTOLs, NASA, in collaboration with Joby Aviation, conducted its first acoustic test flight in September 2021. The findings from the study revealed that that the loudest noise level recorded by the eVTOL was roughly equivalent to the noise level of normal conversation in an office.[38] Therefore, agencies in India and abroad need to partner with their local eVTOL manufacturers to conduct acoustic test flights with the aim of determining the source of noise and finding proactive solutions.

Another potential issue which may arise from eVTOLs is the invasion of privacy. Many citizens are not comfortable with having remotely controlled devices equipped with high-definition cameras and recorders flying through neighbourhoods at window and balcony levels. For this, regulators would have to ensure that strict policies are put in place to protect the general public by restricting access to any recorded footage and making AAM companies liable in case of any data leaks. The regulators would therefore also need to work with the AAM service providers to create preventive and effective checks which safeguard the public's right to privacy.

Case study: EASA study on public acceptance[39]

Public Acceptance

In November 2020, the EASA launched a comprehensive study on the societal acceptance of UAM across Europe. This was based on the philosophy that in order to have an adequate regulatory environment, which reflects the needs and aspirations of the European society and provides a stable and clear framework for the industry, one would first be required to measure the citizens' willingness to accept this new mode of transport and collate their possible concerns and expectations. Some of the key areas include safety, security, privacy and the environmental impact.

The main conclusions from the study were as follows:

1. General or public use cases for UAM are better supported than those for private or individual needs.
2. The main benefits expected from UAM are faster, cleaner and extended connectivity.
3. EU citizens want to limit their own exposure to risks, particularly related to safety, noise, security and the environmental impact.
4. Safety and noise are the top two concerns.
5. UAM is seen as a good option to improve the local environmental footprint, through reduced urban traffic congestion and better local air quality. However, citizens express major concerns about UAM's impact on wildlife.
6. The results also demonstrate a limited trust in the security and cybersecurity of UAM, and thus UAM would require threat-prevention measures.

37 https://evtolinsights.com/2022/09/wing-drone-delivery-noise-australians-complain-its-gone-too-far/
38 https://verticalmag.com/features/nasa-first-published-evtol-acoustic-test-data-set-stage-future/#:~:text=Landing%20configuration%20was%20the%20loudest,or%20a%20bustling%20business%20office.
39 https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf

Way forward

India has displayed its determination to be a pioneer in the AAM landscape, as evidenced by the recently released Drone Rules and other related rules and policies. With the world moving towards much advanced technologies like eVTOLs for passenger transport, it is essential to develop an ecosystem that covers all the major areas. This would require extensive stakeholder participation and continued coordination among them. Thus, the Government will have to play the role of a facilitator and ensure development across all the key pillars of the AAM ecosystem. A few interventions that shall be explored to unlock the potential of eVTOLs are as follows:

1. Development of a national roadmap for the sector

As the AAM technology is advancing at a rapid pace, new and innovative use cases of drones and eVTOLs are being envisaged by various technology companies. However, focusing on a few priority use cases in the Indian context and conducting a gap assessment for these use cases for factors like technology, infrastructure and regulations would help in the optimal allocation of resources and creation of robust policies and regulations. To meet this objective, there is a need to develop a national vision/roadmap for the AAM industry. This would ensure that the utilisation of resources for key strategic areas for the development of AAM is optimised.

Case study: Japan – AAM roadmap[40]

Japan has taken proactive measures to develop an UAM ecosystem and is one the few countries that have begun testing eVTOLs for UAM. It has even released a nationwide **AAM roadmap.** Since 2018, the Japanese government and the private sector have been working together to develop a new market and clarify the regulatory framework. To ensure the safety of UAM service provision, the Bilateral Aviation Agreement (BASA) between Japan Civil Aviation Bureau (JCAB) and the FAA/EASA has been taken into consideration to develop appropriate safety provisions for next-generation AAM in Japan.

Japan has even tested the potential use cases for UAM/AAM within the country, with the plan of operationalising eVTOLs from 2025 and reaching a high level of AAM by 2030.

	Pre 2025	2025	Post 2025	Post 2030
Objectives	• Completion of operating environments and regulatory framework • Launching flight demonstrations	• Commercial services launch at Expo 2025 • Launch package delivery and passenger transportation services	• Expansion of package delivery and passenger transportation services • Launch air ambulance demonstrations	• Launch urban passenger transportation services
Social Implementation	• Package delivery services to isolated islands • Scenic flights • Two-point passenger transportation in limited areas	• Two-point passenger transportation between aerodrome and gulf coasts	• Expansion of regions and distances for passenger transportation services • Launch air ambulance demonstration	• Passenger transportation between suburban and urban areas, air ambulance transportation, cold district services and private use

[40] https://www.mlit.go.jp/koku/content/Advanced_Air_Mobility_in_JAPAN_2021.pdf

	Pre 2025	2025	Post 2025	Post 2030
Social acceptance	• Resident acceptance in certain areas	• Improve public recognition through Expo 2025	• Improve public recognition throughout Japan	• Integrated into everyday life
Takeoff and landing areas	• Alternative takeoff and landing areas	• Aerodrome utilisation	• Vertiport (takeoff and aerodrome utilisation landing areas for eVTOL)	• Flight areas throughout Japan • Flights between suburban and urban areas • Gulf coast, isolated islands, depopulated areas, etc.

2. Define principles governing air mobility

There is a risk of air mobility becoming a niche product due to higher initial capex and opex, thus preventing the technology to tackle the challenges at hand. Therefore, it is important to define the values and principles pertaining to the development of air mobility. For instance, the World Economic Forum and City of Los Angeles released the 'Principles of the urban sky'. This document defines the principles and values that underpin the development of UAM. The seven UAM principles provided in the document include safety, sustainability, equity of access, low noise, multimodal connectivity, local workforce development and purpose-driven data sharing.[41] While the principles will define the problem one is trying to solve, the roadmap will provide the direction on how to solve the problem.

3. Aircraft certification

India currently does not have a certification scheme for eVTOLs, thereby delaying the launch of the technology for commercial purposes. The immediate step, hence, must be taken towards the development of a type certification process, based on a detailed evaluation of the safety requirements. Additionally, harmonisation of the certification standards with those of the EASA and FAA would help in reducing complexity for the industry.

4. Policy decision by the MoCA

The Indian civil aviation sector is greatly benefiting from the upgrade of existing airports and creation of new airports across the country. The decision to undertake this expansion and upgrade has led to greater connectivity and reduced tariffs for passengers across most routes. Similarly, a policy-level decision by the MoCA can have a major impact and provide an impetus to kickstart the eVTOL sector in India. For instance, the MoCA can create policies for promoting the development of rotary wing terminals in major cities which support eVTOL operations. These policies can also focus on the creation of eVTOL corridors for uninterrupted UAM services and later be expanded to include regional connectivity as well.

[41] https://www.weforum.org/press/2020/09/world-economic-forum-and-city-of-los-angeles-release-principles-for-making-inclusive-aerial-mobility-a-reality-in-cities/

The problems highlighted in this paper – traffic congestion, vehicular air pollution, delay in emergency services, etc. – are not restricted to the Indian context and are common issues faced by developing countries across the world. Due to the increasing population, issues with mobility are also expected to rise exponentially. The requirement for faster, convenient and eco-friendly mobility necessitates the exploration of more sustainable alternatives, like drones and eVTOLs. Transportation of goods and people via the third dimension is not new to humanity, as intercontinental travel via air has been a reality for many decades now. However, air travel for short distances has gained momentum in the recent years. Some countries and companies have begun to analyse the possible deployment of eVTOLs and drones to mitigate issues stemming from urbanisation from a realistic and commercial point of view. India has already gotten the ball rolling with the creation of DigitalSky, launch of the new helicopter policy and publishing of AAM related regulations. Moreover, the country is already on the path of making AAM a reality and tapping the untapped potential of the short-haul mobility market. However, this would require specific interventions to be made across technology, infrastructure, regulations and public acceptance. With all these aspects in place, India could be a world leader and pioneer in the air mobility space.

Notes

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About CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering Industry, Government and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organization, with around 9000 members from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 300,000 enterprises from 286 national and regional sectoral industry bodies.

For more than 125 years, CII has been engaged in shaping India's development journey and works proactively on transforming Indian Industry's engagement in national development. CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialized services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with civil society organizations carry forward corporate initiatives for integrated and inclusive development across diverse domains including affirmative action, livelihoods, diversity management, skill development, empowerment of women, and sustainable development, to name a few.

As India completes 75 years of Independence in 2022, it must position itself for global leadership with a long-term vision for India@100 in 2047. The role played by Indian industry will be central to the country's progress and success as a nation. CII, with the Theme for 2022-23 as Beyond India@75: Competitiveness, Growth, Sustainability, Internationalisation has prioritized 7 action points under these 4 sub-themes that will catalyze the journey of the country towards the vision of India@100.

With 62 offices, including 10 Centres of Excellence, in India, and 8 overseas offices in Australia, Egypt, Germany, Indonesia, Singapore, UAE, UK, and USA, as well as institutional partnerships with 350 counterpart organizations in 133 countries, CII serves as a reference point for Indian industry and the international business community.

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