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RESEARCH ARTICLE

TECHNOLOGY ASSESSMENT OF eVTOL AIR TRANSPORTATION SYSTEM; THE POSITIVE IMPACTS (POTENTIAL BENEFITS)

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Abstract

This paper intended to provide a vision on the potential consequences of the introduction of emerging air transportation system which was based on a section of the thesis to contribute to the forming of public and policy opinion. Especially this paper tried to understand whether there were enough positive social and environmental impacts in terms of potential benefits to continue the efforts. The negative impacts are beyond the scope of this paper. Limitations of the current ground and airline transportation systems, increasing congestion, poor block speed, combined with expanding population and demand for affordable on-demand mobility are driving the development of future transportation technology and policy. The third wave of aeronautic, eVTOL (Vertical Takeoff and landing) Air Transportation System, is envisioned as the next logical step in the natural progression and could bring about great new capabilities for society that would bring aviation into a new age of being relevant in daily lives. Considering door to door block time, eVTOL Air Transportation System has the potential to achieve another five-fold increase over the auto today as the auto provided ten-fold increase over the horse, and a daily mobility reach of 125 to 250 miles. The main benefits will be on-demand, point-to-point, safe travel, further and anywhere in less travel time with almost zero environmental impact for general people. Besides, a successful implementation and sustainable transition will depend on overcoming technological hurdles, regulatory frameworks, operational safety, cost competitiveness, and sensibilities of the affected communities.

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Introduction:-

This paper tries to determine the positive social and environmental impacts, in other terms the potential benefits, regarding stakeholders' expectations and the critical factors such as travel time, time saving, reliability, efficient door-to-door block speed, daily radius of reach and emission in evaluating the benefits of the emerging air transportation mode based on a section of the thesis study. The negative impacts are beyond the scope of this paper, but of the next paper.

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Mobility is one of the basic human needs in all time periods and was as central to the functioning of society in the past as in the present, an understanding of the brief transportation transformation is required prior to outlining and discussing the subject. The developed nations entered the 1900s with a transportation system for people centered upon the horse, the railroad, and the steamship, with associated travel times the order of hours to days and weeks, depending on distance. In the closing years of the same century, the auto has long supplanted the horse and the fixed wing aircraft has nearly driven the railroad and steamship companies from the long-range passenger business. Travel times have shrunk to minutes to hours while average amount of time travelled per day has remained relatively constant. If the statistical travel data continues the same trend, it appears that once high speed, on demand travel service is offered to the market, consumers will utilize these vehicles for increased mobility reach instead of saving travel time (Craff, 2012).

Understanding the driving evolutionary forces permits an understanding of the pressures and where they may lead. We face serious challenges in areas of efficiency, accessibility, and affordability of intra-city as well as regional inter-city transportation. Daily commuting is reaching their limits during peak travel times, which results in environmental issues due to wasted fuel and loss of time and money. As the highway system has matured and filled beyond capacities in many places, the excess costs in time and energy expended in ground travel continues to rise. In 2013, traffic congestion robbed the U.S. economy of \$124 billion USD (Bruce, 2017). In Europe, approximately 100 billion Euros are lost every year because of congestion (PPlane project, 2014). In Istanbul, almost two billion Euros are lost every year because of congestion (cnntürk, 2017). The average trip time is increasing due to suburban expansion and increased congestion, causing non-trivial changes in family life as travelers attempt to utilize nontraditional time slots, or suffer long nonproductive commutes. For example, urban transport which accounts for a significant part of total mobility and for even greater proportion of its negative consequences is related to a wide range of unsolved problems and challenges that need to be tackled to guarantee a high quality of life in cities. City population faces increasing emissions of pollutants and noise, as well as congestion and reduced accessibility.

Transportation experts predict that ground travel delays due to surface gridlock will get substantially worse in the next 20 years (Oak Ridge National Laboratory, 2007). Even when and if all cars become electric vehicles, the gridlock will remain. The rate of increase in the number of cars is likely to continue to outpace the capacity growth of highways, whose average cost is \$20M USD per mile (Oak Ridge National Laboratory, 2007). The need is great for technology-enabled solutions for personal mobility that are affordable, efficient, clean, and safe. The third wave of aeronautics could bring about great new capabilities for society that would bring aviation into a new age of being relevant in most people's daily lives and could provide personal mobility solutions. In other terms, aviation has the potential to enable expanded air accessibility for more in our society.

Current air travelers are predominantly served by large airlines using the traditional hub-and-spoke system. While this system is an efficient method in many ways and has increased its capability in recent years, air travelers are increasingly dissatisfied with the current air transportation system as it gradually becomes plagued by delays, long waits, and built-in inefficiencies both in the air and on the terminal areas (DeLaurantis, 2002). In terms of door-to-door passenger time, comfort, convenience and satisfaction, the hub and spoke system is extremely ineffective for especially short to mid-range trips where the bulk of trips are taken (DeLaurantis, 2002).

A current study being conducted by Volpe in cooperation with NASA shows that 29% of the total door to door trip time is the actual gate to gate time of the airliner for trips under 500 miles. The rest are terminal time 33%, access egress time 18%, and wait time 20% (Driving many miles in congestion to reach a hub, arriving early for ticketing, security, baggage checks, connection through other hubs, driving again to reach destination, etc.) (Moore, 2003). Even more, aviation might go through catastrophic events due to the terrorist attacks and pandemic which rises an important issue. Currently with a weather delay at just one of the major hubs, the entire system experiences significant setbacks. While centralized systems are efficient, they do not provide a robust system solution. This robustness is essential to prevent a catastrophic loss in mobility that would yield disastrous effects on the economy.

The current system is designed more for the benefit of the commercial airliner. The emergence of Light Sport Aircraft (LSAs) and Very Light Jets (VLJs) have both failed to produce the hoped-for transformation of aviation (Brien and Seeley, 2010). Despite expensive advertising hype for beautiful new small jets and innovative new LSAs, the annual sales of these aircraft number in the dozens instead of in the thousands. No matter how glitzy, these aircraft are not able to avoid the time wasted on ground travel to and from the airports. In contrast, on-demand eVTOL air transportation mode is the distant vision of aviation being designed around the needs of the travelling

public. In the current built environment, the only feasible way achieves such reductions is by bringing forth a new class of small, green, quiet, safe, and high speed on demand air transportation mode. If a new air transportation mode is to be developed, what goals would be established for this system? The driving factors that will shape the future aviation system are the ability for manufacturers and airline operators to make profit, the need to travel, capacity throughput, environmental impacts, safety, reliability, and consumer preferences. It appears that it would be a quite different set of objective functions than what the airlines used to shape the second wave of aeronautics. The third wave desired capabilities that appear to offer the most values are the following (Moore, 2003):

1. Ease of use and automation of aerial systems,
2. Safety and security,
3. The noise and emissions that are exposed to the local community are at levels proportional to the community use,
4. Extremely short, and vertical takeoff and landing operations,
5. Automated airspace control.

Nevertheless, there is both a need and an opportunity to include in the transportation mix eVTOL Air Transportation System. While not solution to all travel, eVTOL Air Transportation System is envisioned as the next logical step in the natural progression in the history of disruptive transportation system innovations and would provide, percentage wise, the same increase in speed as the auto provided over the horse and a better new choice up to 500 miles where airlines and automobiles provide poor block speed. The vision has been to enable people and goods everywhere to have the convenience of on-demand point-to-point travel, anywhere, anytime in less travel time, through a network of pocket airports and vertiports.

Results:-

The operational benefits of an ability to take off and landing vertically are self-evident. Conventional aircraft must operate from a relatively small number of airports with long paved runways where is usually crowded causing delays in the air and on the ground. Freeing airplane operations from long runways has been a dream of aircraft designers and users. eVTOL air vehicles have advantages over helicopters and fix-wing aircrafts. eVTOL air vehicles will have higher cruise speed, lower noise, lower vibration, and superior economics than helicopters. In comparison to the fix-wing, eVTOL air vehicles will provide more convenient downtown service, increased operational and mission flexibility, more competitive economics, and access to small cities and remote rural communities. The most important is no need long runways. Overall, eVTOL Air Transportation System will provide desired travel time, efficient block speed, travel time saving, daily radius of the action five to ten times further, point to point travel from anywhere, comfort, less distances from doorstep to portals, increasing trips per day, expanding transportation choice and reliving road traffic congestion. According to the 5th Transformative Vertical Flight Workshop's report in 2018, the societal demands and the acceptance needs such as affordable on-demand air mobility, relief from ground and air traffic congestion, time savings, personal convenience, mission/business advantage, greater safety, energy savings and environmental benefits (noise, emission) should be met by emerging air transportation mode. Now, it will be emphasized the most important benefits in detail matching those demands and needs with eVTOL Air Transportation System's capability.

An understanding of the most prominent goals of transportation investments is required prior to outlining and discussing positive impacts. The value of travel time is a critical factor in evaluating the benefits of transportation investment, and the most prominent goals of transportation investments are time savings and, to a lesser extent, improvements in the reliability (i.e., predictability) of travel time. In other terms, reduction of delay in passenger or freight transportation is a major purpose of investments. As William Seifert's 1968 prediction is that "Any form of transportation that offers the lowest door-to-door travel time will always drive out lower speed competing modes unless the economics of the higher speed system are grossly unfavorable". Within this context, it can be argued that a new socio technical transition will come about like the transition from horse drawn carriers to autos. To elicit such values, we need to discuss theory of the value of travel time and reliability a little bit (Belenky, 2011). The Value of Travel Time refers to the cost of time spent on transport, including waiting as well as actual travel. The Value of Travel Time Savings refers to the benefits from reduced travel time costs. The other topic in the value of time research that has attracted increased attention lately, is the value of reliability. Especially in urban areas where congestion is common, many travelers consider it more important to decrease the uncertainty of the travel time than to reduce the travel time itself. If travelers are uncertain about travel time, they typically include a "buffer" in their schedules, leaving early and sacrificing a known amount of time at the origin to insure against a more costly delay in

arriving at the destination. Alternatively, insuring against delay may mean choosing a more reliable route or mode with a slower expected speed or a higher monetary cost.

Hub Spoke airline travel achieves a far average speed, but once the true door-to-door travel time is considered, the advantage decreases significantly and is often less important than the flexibility produced by automobiles. Only 19% of all trips over 100 miles are captured by aviation, with automobiles being used for almost all the rest due to their freedom from prescheduled service (American Travel Survey, 2011). Within this context, eVTOL Air Transportation System has the potential that will provide better door-to-door block speed up to 500 miles where airlines and automobiles provide poor block speeds and can save travel time as we can see in the figures 1, 2 and 3 below.

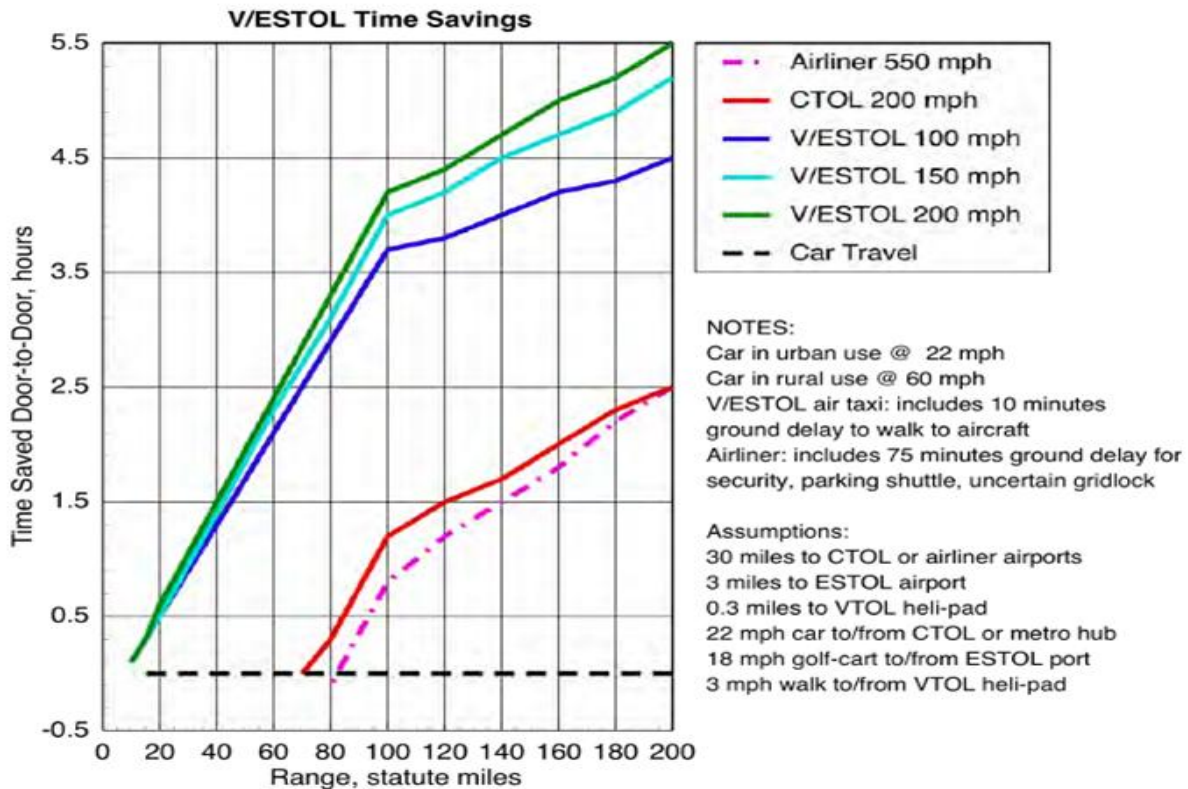


Fig. 1:-Travel Time Savings by Mode, (Brien and Seeley, 2010).

Figure 1 reveals that a large amount of time can be saved by V/ESTOL vehicles in air taxi service. The time saved door-to-door is highly dependent upon the ground travel time to and from the airport, both from one's departure doorstep and to one's destination doorstep. In the model presented in the figure, V/ESTOL is the only aviation modality with substantial time savings relative to car travel on trips of less than 80 miles. Note that in a round-trip commute scenario, the amount of "time saved" shown on in the figure is doubled, such that on as short as a 50 miles commute, one can save over 3 hours per day. The time saving varies according to the type of airport being used. The typical conventional large airports for airliners and general aviation's conventional take-off and landing aircraft (CTOL) is presumed to be 30 miles distant. Future pocket airports are presumed to be < 3 miles distant if ESTOL and less than 0.3 miles distant if a VTOL port. Figure is modeled upon a 22-mph freeway gridlocked car speed enroute to airliner or CTOL departure. It presumes an 18-mph golf cart on residential streets enroute to ESTOL departure and walking at 3 mph enroute to VTOL departure. The corresponding ground travel times will be 82 minutes for airliners and CTOL but only 6 minutes for both ESTOL and VTOL. Note that these times apply to both the ground travel trip to the airport as well as the one from the airport.

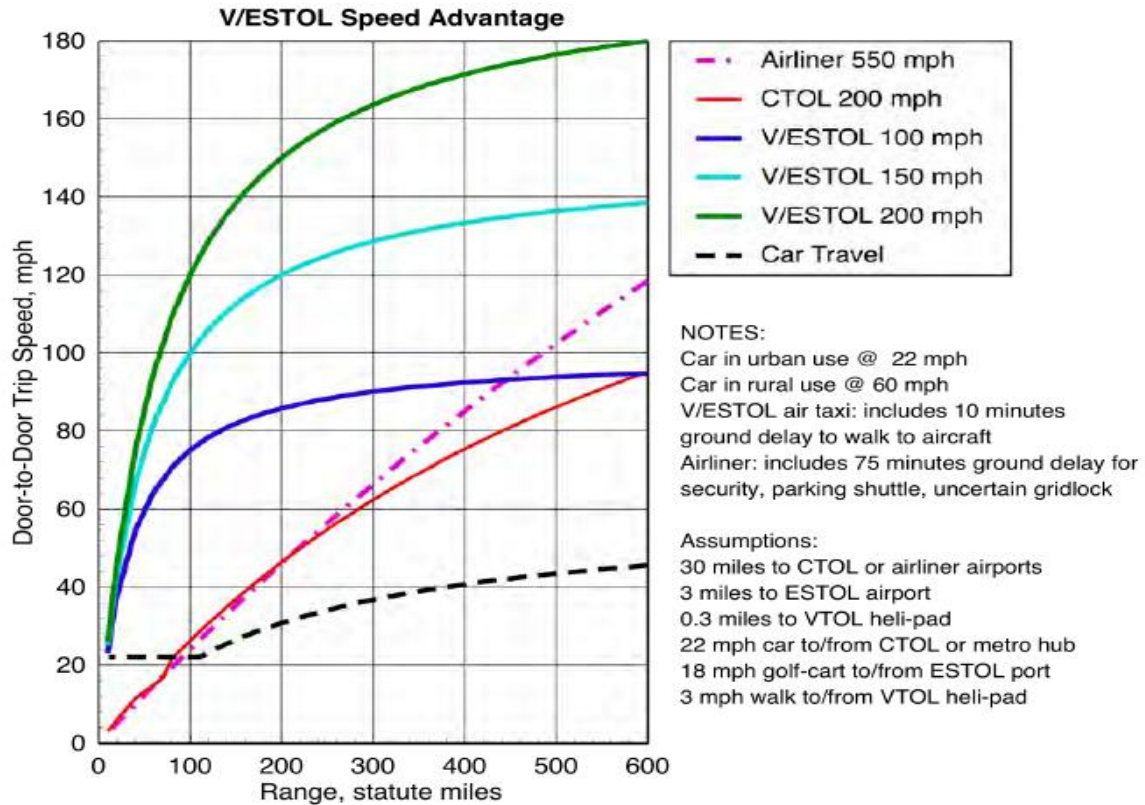


Fig. 2:- Speed Advantage by Mode, (Brien and Seeley, 2010).

Figure 2 reveals that the ground travel times are doubled to account for the travel to and from the airport involved in any one-way trip by air. This gives one-way ground travel times of 164 minutes for airliners and for CTOL and 12 minutes each for ESTOL and VTOL. The graphs also add an additional 75 minutes for each one-way flight by commercial airliner. This 75-minute delay does not apply to CTOL trips; it is due to airline baggage-check and shoes-off security check-in, park & fly shuttle, and the additional uncertain buffer time of 30 minutes for ground travel delays that one typically adds to assure not missing one’s scheduled flight. Note that, with a round trip such as a daily commute by air, the ground travel time between the airport and one’s doorstep must be quadrupled. The Door-to-Door Trip Speed of the 100 mph V/ESTOL aircraft surpasses that of cars, airliners and CTOL aircraft until trip length is more than 400 miles. Many of all single and twin engines GA flights today are trips of under 400 miles. The Door-to-Door Trip Speed of the 150-200 mph V/ESTOL aircraft surpasses that of cars, airliners and CTOL aircraft until trip length is more than 600 miles.



Fig. 3:- Travel Time Saving in a Sample Mission Scenario, (Lilium, 2018).

Figure 3 reveals that you can reduce your one-hour (55 min) commute from JFK International Airport to Manhattan down to 5 minutes by eVTOL Air Transportation System. Imagine never being stuck in traffic again and paying no more than the cost of a train fare. Depending on your commute, you could save as much as 2 hours every day.

Another important benefit is that you can go further and wherever you want without access roads. Considering door-to-door block time, eVTOL Air Transportation System has the potential to achieve another five to ten-fold daily mobility reach increase over the auto today as seen in figure 4 below. Providing an improvement in trip speed provides a non-linear improvement in the regional area that can be accessed for daily use. Current ground travel provides average trip speeds of less than 33 mph, with a daily reach of about 2500 square miles (based upon an average radius travel time allocation of 1.25hr). eVTOL Air Transportation System could provide at least 4 times auto speeds, with 16 times the daily mobility reach.

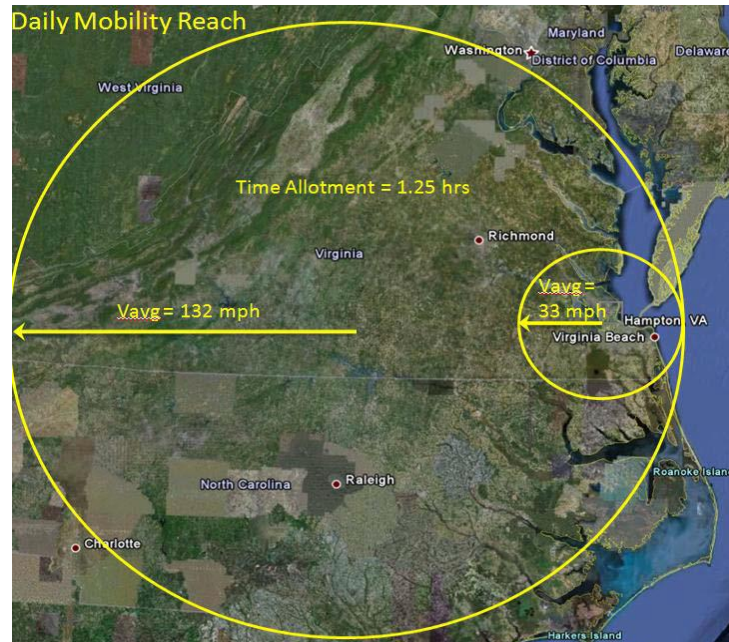


Fig. 4:- Daily Mobility Reach Comparison of Car and eVTOL Air Transportation System, (Moore, 2010).

One of the important societal demands is affordable on-demand air mobility near car utility different from scheduled commercial airlines. For example, only 19% of all trips over 100 miles are captured by aviation, with automobiles being used for almost all the rest due to their freedom from prescheduled service. On-demand eVTOL Air Transportation System is a transportation mode that has the potential to provide immediate and flexible point-to-point air transportation. Users will dictate trip origin, destination, and timing. It will enable trips that are not time/cost effective with current transport modes. It will operate from near vertiport infrastructure and/or existing heliports, roof tops and barges (Anticiff, 2018). Such opportunity for mobility freedom will help regional cities to preserve their urban growth boundaries by encouraging infill development (Brien and Seeley, 2010). Pocket airports will also invite sustainable green surface transportation such as low-speed, electric vehicles, folding electric bikes, co-located mass transit stations, rentable bicycles as well as walking.

eVTOL Air Transportation System is free from large infrastructure requirements. Unlike surface transportation, flying can provide highways in the sky with unlimited numbers of lanes and overpasses, off-ramps, and merges. A highway in the sky is never blocked by accidents, toxic spills, “rubberneckers” or pedestrians. It can be dynamically reconfigured instantly and does not require public purchase of expensive land that must be permanently removed from open spaces or any other use. Unlike paving with asphalt and the urban heat islands it creates, building aeronautical highways does not require millions of barrels of crude oil. Current auto and airport hub-based travel would facilitate overcoming natural travel barriers that otherwise would require additional expensive bridges, roads, and highways (e.g., \$20 million per mile) and commercial airports (e.g., \$1 billion per major commercial runway) (Brien and Seeley, 2010). Moreover, eVTOL small air vehicles that could achieve a low enough acoustic signature and require new high capacity vertiport or pocket airport infrastructures, affordable parcels as small as 2 acres that

can be situated within a noticeably short distance from one's destination doorstep, to enable much closer proximity aviation operations to neighborhoods and businesses. That short distance, modeled as just 3 miles or less, can be traveled by walking, biking, golf cart or vehicles on low-traffic residential streets. Landing site cost tends to be proportional to the square of the runway length. A commercial takeoff and landing with 5000-foot runways, though 10 times longer than a pocket airport with 500-foot runways, can cost 100 times more (Brien and Seeley, 2010). As a result, new emerging air transportation mode may reduce dependences on paved surfaces, highway maintenance and eliminate need for additional surface routes. Pocket airports or vertiports will also offer a redundancy for airborne disaster relief and a more distributed system for medevac air ambulance operations.

Improving travel options can benefit all travelers on a corridor, both those who shift modes and those who continue to drive. Shifting traffic from automobile to other travel modes not only reduces congestion on that facility, but it also reduces the amount of vehicle traffic discharged onto surface streets, providing downstream congestion reduction benefits. As we covered before, traffic congestion refers to the incremental costs resulting from interference among road users. These impacts are most significant under urban-peak conditions where traffic volumes approach a road's capacity. The resulting congestion reduces mobility and increases driver stress, vehicle costs and pollution. Traffic congestion is a nonlinear function, meaning that a small reduction in urban peak traffic volume can cause a proportionally larger reduction in delay. A 5% reduction in traffic volumes on a congested highway may cause a 10-30% increase in average vehicle speeds. As a result, even relatively small changes in traffic volume or capacity on congested roads can provide relatively large reduction in traffic delay. For example, the INRIX Corporation (2009) uses a "SMART Dust Network" of GPS-enabled vehicles which report roadway travel conditions to evaluate highway traffic congestion. Their 2008 annual report indicates that U.S. traffic congestion decreases nearly 30% from 2007 to 2008, apparently due to a 4% reduction in total traffic volume. In another example, according to the Metropolitan Transportation Commission statistics, there are 88,500 road vehicles that cross either the Golden Gate Bridge or Richmond San Rafael Bridge every morning during commute hours in Northern California. Vehicles from Sonoma County comprise 13,500 of those morning bridge crossings. In accordance with traffic flow studies that show gridlock to be relieved by as little as 4% reduction in vehicle traffic, it appears that removing 3500 of those 88,500 morning bridge crossings could undo the surface gridlock that plagues commuters there. Assuming the same average occupancy rate as surface traffic, 3500 commuting small air vehicles operating each morning from pocket airports in Sonoma County could undo the surface gridlock there. Simply put, this would entail 350 air vehicle departures from each of 10 pocket airports. If those airports were like the one where 240 operations per hour are possible, each airport could depart its 350 aircraft in 1.5 hours, such as between 6:30 AM and 8:00 AM (Brien and Seeley, 2010).

Transportation planners find that the public is very resistant to giving up the security and autonomy of their cars. People place high value on privacy and personal space. Recent brain imaging studies confirm that human brains have innate 'hard-wired' alarms that are activated when personal boundaries are violated (Kennedy, 2009). The public resists using public transit for other reasons too. Buses and trains are inherently constrained to the limitations of two-dimensional, single-file surface travel and they impose the added delay of multiple stops. People deem the waiting, transfer maze, delays, and limited distribution of transit stations to be unacceptable. These factors cast doubt on the likelihood that public transit solutions to gridlock will succeed. Converting communities to pocket airports will be powerfully green and could spare the need for more lanes on highways. However, to attract travelers who have the option of driving, eVTOL Air Transportation System must be fast, comfortable, convenient, reliable, and affordable. In short, eVTOL Air Transportation System has the potential to attract travelers and to help relieve traffic congestion especially in the cities in figure 5 where they have highest potentials for eVTOLs in terms of time saving value.

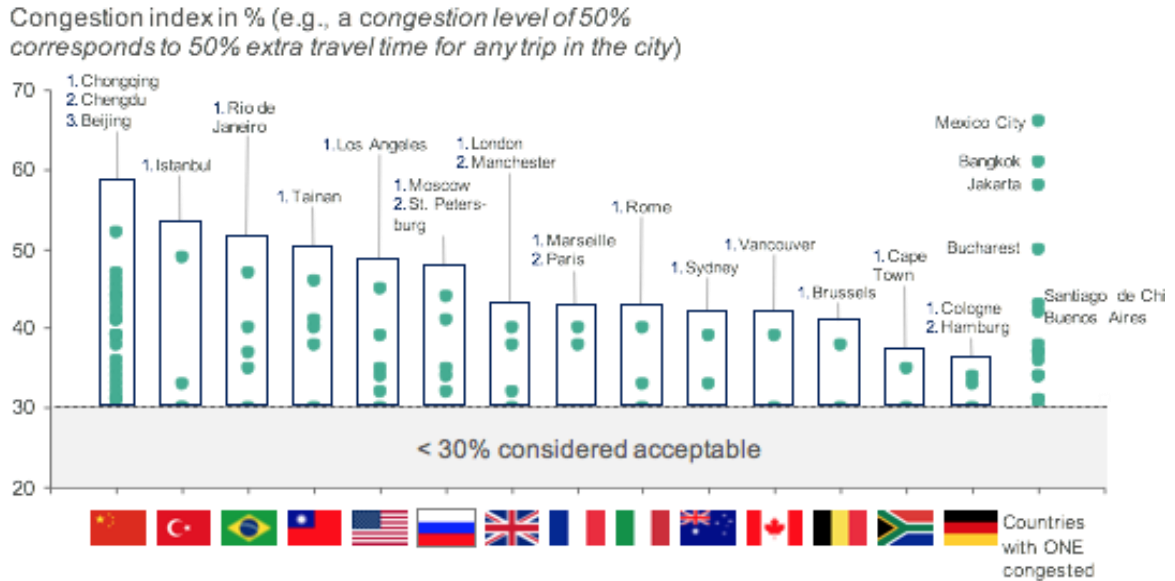


Fig. 5:- Congestion Index and Highest Potentials for eVTOLs in terms of Time Saving, (Airbus, 2018).

Transforming air transportation system will also produce many societal benefits including growth in airspace capacity, great mobility, enhanced safety, green technology, jobs, and manufacturing. It can be argued that developing a transformative mobility age for society would provide a similar economic productivity impact as the information age. As fully autonomous systems are achieved over the years, eVTOL Air Transportation System will enable more travelers to experience enhanced mobility. Transportation markets will provide disruptive investments that create while new industries and societal capabilities that do not currently exist. As typically happens in new product markets, the basis on which such aircraft will be chosen by early adopters and consumers will evolve from function to reliability to convenience to price. As this process proceeds to lower prices that enable high volume production. For example, NASA’s Chief Scientist has forecast that this can become “a potential Trillion Dollar Market”. Early applications such as small air vehicles could open a new market whose potential is predicted to approach \$1 trillion USD. The worldwide projection of urban mobility in figure 6 supports that forecast.

Number of flights per year - commercial a/c, package logistics, and urban mobility

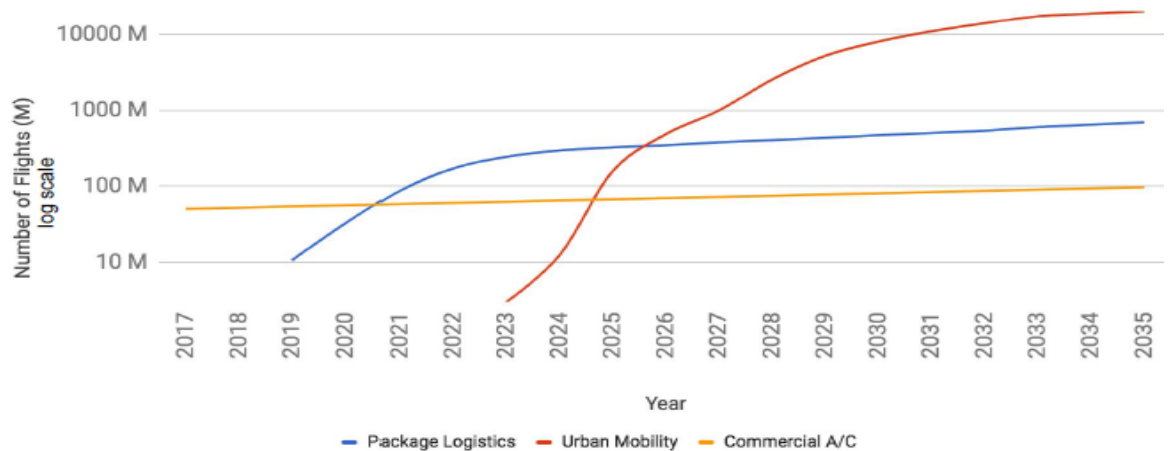


Fig. 6:- The Worldwide Projection of Urban Mobility in Number of Flights per Year, (Dyment, et.al., 2018).

Transportation engineers at Virginia Tech have predicted up to 15 million Small Aircraft Transportation System passenger-trips/year if an air taxi service could be provided at a cost of \$1.85 per passenger-mile in 2010 in a simulation. When technology matures, costs of \$1.25 per passenger mile might be possible increasing the market share to 29 million passenger-trips/year. Today, business passengers travelling in commercial airlines pay \$0.90 per

passenger-mile in a typical 350-mile trip. However, eVTOL Air Transportation System travelers would save an average of 3 hours per trip based on an analysis.

eVTOL Air Transportation System can also contribute to security, safety, and public services. Small air vehicles will be less attractive than large airliners for any terrorism actions and for being used for unlawful acts since low mass and speed resulting in limited kinetic energy, low fuel capacity and limited payload capability (Tallec, 2012). Besides, an alternate approach to make the aviation system potentially less prone to attack is to decentralize (smaller and more numerous pocket airports/vertiports), downsize (reduce the value of individual targets by using smaller vehicles, with lower inherent destructive potentiality, and fewer number of passengers onboard them), and increase overall command and control (by tightly integrating autonomous systems into the airspace). High system automation has made significant progress on flight safety and advances in automated/autonomous systems will also contribute to commercial flight safety. eVTOLs will also enhance public services such as medical transport, law enforcement, search and rescue and emergency response etc.

Conclusion:-

Limitations of the current ground and airline transportation systems, increasing congestion and poor block speed, combined with expanding population and demand for affordable, on-demand mobility will drive the development of future transportation technology and policy. One approach to satisfying these expectations is to develop eVTOL Air Transportation Systems that embody a network of self-operated or fully autonomous small electric air vehicles that take off and land vertically, capable of use and affordable by a large portion of the public, and small and inexpensive landing pads and central places in cities. Recent technological, business and societal developments have made the dream closer to a reality, but a stakeholder consensus was desired to increase the likelihood of success. The development of an ecosystem of urban eVTOL Air Transportation System includes collaborating with cities, vehicle manufacturer, operators, infrastructure developers and regulator partner. Besides, a successful implementation and sustainable transition will depend on overcoming technological hurdles, regulatory frameworks, operational safety, cost competitiveness, and sensibilities of the affected communities which are in the scope of another paper.

The rush to create eVTOL air vehicle for use as air taxi for intra-city and inter-city is attracting serious interest and money. The number of companies which was involving the subject was 7 when I started the thesis study in 2014, and with a sharp increase it was more than 200 in 2019, even including big players. However, even more with the successful test flights, it will be a while before any of us are taking sky taxis to our destination. The vision of eVTOL air taxis using urban skies to ease road traffic congestion and create a new dimension in flight as a question is not if, but of when. Key technology developments are driving these expectations. Key technology areas with prioritization based on enablement are simplified vehicle operation and autonomy, distributed electrical propulsion, noise, safety systems, and airspace and advanced air traffic management systems. The air vehicles we may see flying over cities in a few short years will mark the arrival of the new era of eVTOL. In addition to autonomous vehicles in the cities without drivers we and urban planners should start getting ready for the sky to be taken over by autonomous air vehicles.

In short, the main benefit of eVTOL Air Transportation System will be to enable people and goods to have the convenience of on-demand, point-to-point, safe travel, further, anywhere in less travel time, through a network of pocket airports and vertiports. Overall, if we try to list main positive social and environmental impacts, they are:

1. eVTOL has potential to reduce travel time by a factor 5, in other terms will increase daily radius of reach at least by a factor of 5,
2. eVTOL has potential to enable you to access city centers and will reduce the need for a car which means there will be less transit traffic, less noise in cities and less traffic congestion,
3. eVTOL will not require infrastructure investments like roads, bridges, and runways. Landing pads can be developed by anyone, the relevant authorities will only provide the requirements and invest in the early phase,
4. Quite eVTOL will have almost zero operational environmental impact,
5. eVTOL has potential to enable a variety of missions ranging from private use to urban air taxis to regional biz jets or air minibuses. eVTOLs will also enhance public services such as medical transport, law enforcement, search and rescue and emergency response etc. Pocket airports or vertiports will also offer a redundancy for airborne disaster relief and a more distributed system for medevac air ambulance operations.
6. eVTOL has potential to bring personalized, clean, and affordable air travel to general people whenever we want and wherever we want,

7. eVTOL has potential to contribute new business opportunities such as urban and regional air transportation services, manufacturing new vehicle types and systems, and new industry investments,
8. eVTOL has potential to produce growth in airspace capacity and enhance better utilization of existing infrastructure.

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