

A Theoretical Model of eVTOL as a Business Administration Vehicle for Efficiency

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Abstract

The current research paper is purposed to evaluate the upcoming Urban Air Mobility trend as a logistics alternative for the modern organisation design, as industrial complexes are directing resources to the development of these concepts. Our qualitative analysis relies on secondary data, due to scarce information available. Starting with a descriptive analysis of the technological evolutions, the study undertakes a thorough market evaluation based on key criteria that are meant to determine if the efforts to initiate this new entrepreneurial avenue will be met by a successful adoption into organisational design.

With technological and regulatory limitations in the vertical take-off and landing (VTOL) segment, nearing a century of helicopter operations, it is unlikely that electrical flight aircraft will take charge of the skies above crowded cities anytime soon. Human error and technological failures still present a high risk to urban operations. The electric vertical take-off and landing (eVTOL) concept has far greater potential, considering remote work and the adoption of the Work from Anywhere concept.

This research effort aims to clarify aspects regarding eVTOL, probing the potential of a market that is to rely on this solution. This pragmatic approach is meant to define transition milestones, relying on current rules and regulations, as well on technological hurdles that are still to be overcome.

By means of qualitative research and a thorough market evaluation, with a predictive analysis, this study reveals that organisations can now pivot their design to expand their workforce needs into wider regions, having the ability to fly their key employees into their offices periodically from the remote locations they opt to live in and/or work from. Including eVTOL aircraft into the employer branding strategy, business processes should be beneficial for organisations that wish to be looked at as pioneers by their workforce and targeted market.

Keywords

eVTOL, aviation, tourism, Urban Air Mobility (UAM), technological innovation, organizational design management

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Introduction

The novel coronavirus pandemic continues to influence business administration, forcing innovation in all industries, operations, and processes. New norms came into force as a response to a global health crisis, gradually leading to their permanent adoption as habits, particularly the "working from anywhere" concept.

No further proof is required to the claim of a permanent change in business dynamics than the phenomenon came to be known as "the great resignation" (Ksinan, 2022), with 47 million Americans opting for a new career in 2021 due to grave anxiety related to the promise of a return to normal working conditions, where organisations would not adapt to the changed circumstances (Berger, 2022). Fuller and Kerr (2022), argue that this is no coincidence, and even though the pandemic has fuelled a tendency of unrest in the workforce, the steady increase of people voluntarily leaving their jobs is closely related to a lack of hygienic motivators.

The scope of the research is to develop an organisation design that incorporates the Urban Air Mobility (UAM) market, emerging as a hypothetical alternative to ground transportation solutions, that have become dangerously overcrowded by MaaS and urban logistics. Ground transportation now sees a drastic rise in operations due to increased demand, transforming into a permanent market feature (Ikeuchi et al., 2019).

This study will rely on secondary data, as the UAM market is not yet mature enough for primary data collection. A qualitative analysis will be detailed henceforth, of the existing and developing solutions for an efficient market breach of electrical vertical take-off and landing aircraft that are proposed to be the vehicles for the future UAM market. The analysis develops from a descriptive approach of the current market, on the analytic infrastructure provided by Kaufman (2020) in “10 Ways to Evaluate a Market”.

The research concludes that eVTOL has the potential to become a disruptive technology. If proven to be safe and reliable, the growth rates and high number of aircraft required will consecrate the Urban Air Mobility (UAM) concept as a viable transportation alternative in the metropolitan area, such as air taxis for passengers and air cargo for goods. It could thus ferry anything from people to consumer goods, flying between city destinations or warehouses and stores.

1. Review of the scientific literature

1.1 Technological assessment

For the purpose of this study, an empirical research effort of UAM operations will be detailed below, which includes both manned aircraft (with pilot on board) or unmanned aircraft (without pilot on board), in the congested areas of cities and inhabited areas. We should note that operations with eVTOL should be facilitated through a range of measures, from production to certification and personnel licensing (Liu, Cai and Zhu, 2021).

Unmanned aircraft have the advantage of decreased weight on-board and increased operational range resulting in a higher profit margin by consequence. Operations can efficiently be controlled from a remote location, with a human controller (Dursun and Çuhadar, 2018). The human factor can be completely eliminated from the operation by placing algorithms into autonomous commands. A fully autonomous fleet is proven to reduce navigation errors to zero, by successful studies from the automotive industry (Bachute and Subhedar, 2021). Still, risk continues to loom, regarding the human error factor in maintaining the aircraft airworthy, as the deterioration of the aircraft mid-flight might prove disastrous, especially in overcrowded urban areas.

The sustainability of the eVTOL business relies on travel and tourism (Atn.aero., 2022) taking the market lead until the corporate world will begin to use this solution instead of the grounded alternatives (Taxi, Mobility as a Service, public transport). However, the initial use of eVTOL aircraft will be restricted to current approved flight paths, as is the case in many experimental grounds, Dubai being one of the most advanced (Tigner, 2022).

Vertical Take-Off and Landing (VTOL) aircraft are currently undertaking extensive development. VTOL aircraft refers to the possibility of using propellers or rotors that enable the aircraft to take off or land vertically, in addition to the capacity to move in any direction and to hover. In existence since the early 1940s (Boyne, 2022), helicopters are the typical example of VTOL aircraft. While helicopters have been used extensively for the transport of passengers and to reach areas that are inaccessible or hardly accessible otherwise (Amoroso et al., 2012), there is a very high cost associated with helicopter operations. And since this is due largely to the high fixed costs of the fuel, equipment, and personnel, it puts the helicopter out of the reach of the general public with no perspective to the contrary. The final objective for all VTOL manufacturers is to propose a type of aircraft that is electrically powered and requires no pilot on board, and which can perform similarly to piloted aircraft. This concept became known as eVTOL, or electric vertical take-off and landing aircraft.

Billions of dollars were invested in several projects under design or experimental phases worldwide (McKinsey&Company, 2022). The pressure is mounting on civil aviation authorities from companies seeking the type of certification required to operate eVTOL within a demanding schedule. Certification is only of the several hurdles to the new eVTOL concept taking off. Another one is of technical nature, namely, how to generate reliable powered lift and control.

Smart cities are usually referred to when discussing the impact of technology and digital solutions on the urban environment. However, McKinsey points out that we are now facing a situation where it is no longer the city that changes with the technology, but where technology is “injected more directly into the lives of residents” (Woetzel et al., 2018). As such, smartphones become the vehicles to bring information about the city – including traffic, health, various community updates – to large numbers of people, whether living in the city or simply transiting the city. This approach puts people first, instead of technology, for an improved quality of life.

According to McKinsey, there are three characteristics of the smart city, all of them having gravitated around technology, particularly ensuring that sensing is possible through mobile communication networks. Moreover, tools and applications that derive meaningful recommendations to the public from multiple data sources are a key component and a third characteristic is the ability to inspire mass adoption of these applications. There is also a positive spin from the business perspective since it creates new ways of public-private partnerships.

Flexibility and dynamic adaptation are two key characteristics of smart cities (Ilić, Milošević and Ilić-Kosanović, 2022). When considering the impact of these cities on UAM networks, we should consider urban ground & underground mobility as key competitors. Moreover, the placement of operational terminals (helipads) must consider key activity places (industry, administration, R&T, storage and distribution, entertainment, and recreational sites) (Nanaki, 2021; Zhu, Shen and Ren, 2022). Lastly but most importantly, sustainability issues, such as environmental, security and privacy aspects must be considered (Marx and Manaugh, 2022; Nickels, 2021; Pukhova et al., 2021).

We concur with Melo et al. (2022), that the environmental footprint of eVTOL will make it a prime option for tourism from a carbon emissions perspective. The comparison is made with electric vehicles (EVs) since both eVTOL and EVs operate using batteries and electric power. What makes a big difference is the trajectory of the trip, which brings down the travel time and this saves energy and reduces emissions, as clearly illustrated in the Figure 1, below:



Figure no. 1. Trajectory effects on resources utilization, EVs vs eVTOL
Source: Melo et al., 2022

According to Aviation Benefits Report 2019, the aviation industry generates roughly 65.5 million jobs and 3.6% of the world GDP, having an economic impact of 2.7 trillion USD. What we found particularly noteworthy is that the tourism catalytic impact accounts for one-third of the GDP and 56% of the jobs. This corroborates with the fact that the largest growth in terms of travel and tourism are taking place in Asia-Pacific and the Indian subcontinent (World Travel & Tourism Council WTTC, 2022), where wages are significantly lower compared to Europe or North America, and despite the fact that jobs amount of 185.1 million and account for 10% of the total employment, information summarised in Figure 2, below:

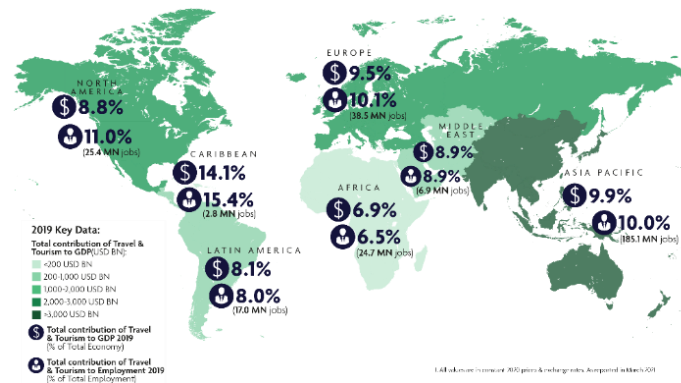


Figure no. 2. Travel to GDP correlation
Source: World Travel & Tourism Council (WTTC), 2022

Expected to be all-electric, eVTOL would contribute to sustainable urban mobility (Melo et al., 2022). Several major cities have already started to plan for eVTOL operations, with Dallas, Los Angeles and Melbourne considering introducing them as early as 2023 (Wai, Tan and Low, 2021). Though some of the main considerations for eVTOL adoption stem from adding a layer of UAM that would bypass road traffic

congestion and allow for a high degree of travel convenience, we concur with the above-mentioned authors that tourism would also benefit from this endeavour.

Questions remain about the feasibility of eVTOL operations, the externalities associated with such new means of transportation, and not least the costs involved and the final price of the ride. Most of the eVTOL research has focused on the technical characteristics of these aircraft, mainly payload and technology, and specific applications, such as aerial works, military, search and rescue, supply (Intwala and Parikh, 2015; Wilson, 2009).

1.2. Organizational Design Management

Several conclusions can be drawn from the previous section, regarding the paradigm shift in corporate logistics and the involvement of corporations in the development of this new technology. Moreover, a subdivision of logistics begins to take shape in literature, which this current research effort wishes to accentuate by means of empirical evidence, as it drastically changes organisation design, from the infrastructure corporations are relying on for their functioning, to the urban norms within the cities where organisations conduct affairs in (Ma et al., 2021; Rześny-Cieplińska, Szmelter-Jarosz and Moslem, 2021; Trecozzi, Iiritano and Petrunaro, 2022).

City/urban logistics are more constrained to complying with sustainability standards, operators functioning under social pressure to positively contribute to their environment, as per the findings of Hauge, Birkie, and Jeong (2021). Li, Rombaut and Vanhaverbeke (2021) study further technological developments in urban logistics, by means of complete autonomy in operations, that further increase the positive effects on the environment by complete process optimisation in elaborate transportation networks. Starting from the cities and expanding the systems regional-wide would translate into a bottom-up integration of innovative and sustainable logistics systems (Tan, Wang and Zhang, 2022) for organisations that would consider the transportation of goods and cargo a parallel activity to the main activity of the organization.

Having the option to reach new regions easily and sustainably, both in digital and physical realms, corporations open new avenues of business. Magazzino, Alola and Schneider (2021) accentuate trade openness as a crucial aspect for business continuity, that has gradually been facilitated by technological progress and bottom-up revolutions in logistics, from urban people and cargo dynamics to global integration.

2. Research methodology

The comprehensive literature review, spread over the two previous chapters, covering both the technological advancements in aerial logistics and the ability of organisations to assimilate them into new organisation design standards, that open new productive avenues, is enriched following the criteria developed by Kaufman (2020) in his book “10 Ways to Evaluate a Market”. The *urgency* with which the market demands such services, the *market size*, *pricing policies*, *cost of converting customers*, *fixed and variable costs of transition to this specific solution*, *uniqueness of offer*, *speed to market*, *financial effort to breach*, *connected businesses and potential to evolve and the ability of the new business to become a necessity* will be analysed henceforth.

The analysis is developed by engaging secondary data analysis techniques. Data was collected following trustful sources, these being mainly academic literature reports, technical reports, official statistical databases, and indexed books. The credibility of secondary analysis must be carefully reviewed as the researcher has no influence, control, or involvement when data is acquired (Bryman, 2004). Sources of data were therefore cautiously chosen for the study, based on credibility, year of publication, size and consistency of sample and topic relatedness.

3. Results and discussion

The paper therefore disseminates the findings into a market evaluation based on criteria detailed by Kaufman, 2020. The *urgency* aspect of our analysis can be treated from various perspectives, as new methods of safe, secure, and cost-efficient transportation of people and goods are always a priority for a global economic community. However, in an increasingly digitised environment with offset production, eVTOL transportation can easily be substituted. eVTOL technologies are envisioned as a faster, and ideally more efficient, alternative to land travel for both inter-city and intra-city travel. They are not intended to replace

planes, but rather to cater to short-distance travel. Therefore, the tourism industry would consider implementing business processes that rely on this technology ‘of high priority and urgency’. Moreover, electric ‘flying vehicles’ are expected to lower the number of automobiles on the road, ease traffic congestion and shift some of it to the skies. This would have a cascading effect, reducing vehicle noise and carbon emissions and encouraging a greener city.

We next evaluate our proposed technology by looking at its current *market size* and forecasts. Analysts show positive upward trends, as Marketresearchfuture.com (2022) records a steady increase of the market, reaching USD 2,000 mil. in 2020. By the end of the forecast in 2030, a more rapid increase of the market is expected. The eVTOL Aircraft Market is projected to grow at a CAGR of 30.30 %, reaching a market value of USD 4,063.3.

The major regions of Asia Pacific, North America, Europe, Latin America, and the Rest of the World are considered in the geographical analysis of the global eVTOL Aircraft Market. Because of the largest UAV fleet used in military and civil applications, North America is the world's top region in terms of market share. Due to air traffic congestion in nations such as India, China, and Japan, Asia-Pacific is expected to increase at the fastest rate over a projected period of 2021-2027 (Bizwit, 2022).

The effort to bring eVTOLs to the mainstream market is becoming visible, and the reasons mainly rely on a fair *pricing potential* for both the aircraft and, respectively, the unit price per utilisation on the business to client dimension. Head (2022) finds that the eVTOL is much cheaper to produce than current VTOL solutions, capable to accommodate more passengers at better operational costs, mainly due to their electric propulsion systems and eliminating crew costs. Fuel and crews are the two most important factors in the pricing policy for aviation transportation products. Al Haddad et al. (2020) argues that the eVTOL technical solution is being developed parallel to the evolution of shared mobility software, that ensures cost efficiency to customers. With intuitive software that evenly distributes the financial effort for the trip between clients matched by the system, customers are to be met by a very fair offer in the eVTOL market.

Corporations stand to benefit most, as volume traffic that fills empty seats will be highly sought after by operators. Attractive packages for corporate mobility will most likely result in customers opting to pay for mobility services through their employers. Audretsch et al. (2021) argue that labour mobility services come to consolidate the community within organisations, as a key part of the employer branding strategy, as acquiring the best performers from the workforce requires catering to their needs. 4

Moreover, the *uniqueness of the offer* has the potential to be disruptive, taking a long time for potential competitors to emerge on a segment with high barriers of entry, that is quickly transforming into a red ocean between few players. The *upfront investment* is important at this stage, as it defines the high barriers of entry. Opting to adopt such services into organisational processes, as a user, will most likely guarantee a fair cost for the service, while operators compete for business. The *value-delivery cost* and the technological efforts are tremendous, as new aircrafts are built to break the laws of physics in cost-effective conditions. However, the eVTOLs are built for specific business processes, with ROI calculations already, with more than a century of engineering behind successive technological evolutions (Zhou, Zhao and Liu, 2020).

Speed to market is intrinsically tied to global aviation safety standards and aircraft type certification regulations. The industry is far beyond the proof-of-concept stages, being now in the latter stages of certification for several models that come into production. Aviation safety and security standards are some of the most rigorous ones that can encounter in any industry, similar to those applicable to nuclear applications. Such standards apply to eVTOL operations, as Rice et al. (2022) reveal. Shared mobility services by means of eVTOL solutions will be available in locations where the infrastructure allows it, such as the airport infrastructure with a very dense airport presence in key areas of access to important cities. Similarly, building heliports become an important component of the eVTOL deployment. The availability of such specially designated/built places where eVTOL could land or where it could take off from will make the difference when discussing how fast eVTOL can be put into service, how large of a range they could cover, and how many clients they could reach.

A diverse collateral market is foreseeably emerging, on a conceptual level, from business cases drawn up around the eVTOL solutions. The tourism sector stands to gain most from the *up-sale potential* of sustainable aerial vehicles carrying clients to remote destinations for short experiences. Moreover, delivery services stand to benefit as well, with a much wider area of operations insured by this technology.

The eVTOL solution is not a concept anymore. It is close to causing significant business disruption in the mobility industry. Yet, several aspects must be adjusted before eVTOL aircraft can breach the city air-scape, however new markets emerge with eVTOL availability, such as regional connectivity on helicopter

flight paths. The innovative aircraft studied in this article is to expand the urban concept by connecting cities with each other, rather than pollute unique cities' skylines.

The tourism industry stands to gain the most, and fastest, from the emergence of businesses that use this technological conception. With rapid integration of these services into the organisational design, starting from employer branding tactics of companies that wish to employ the best that the regional workforce has to offer, corporations are to finance the eVTOL transportation industry. Having to find solutions to cope with the 'great resignation', a phenomenon that promises to continue disrupting the labour market, corporations are to concede to the workforce's demand for a flexible, yet socially rich labour experience, by letting employees choose their most productive work environment and flying them in when necessary. This is a viable secondary market, foreseeable a new organisation design.

The analysis developed under this section reveals very lucrative industry segments emerging together with eVTOL as new technology that promises to disrupt the transportation market. Operators, direct clients, and the corporate environment all stand to benefit from new financial influxes that accommodate this solution. As revealed by the analysis, eVTOLs take shape as a solution to environmental issues, to social discomfort in the workforce, to a pivoting opportunity in the tourism industry that demands an alternative to the declining aviation sector.

Conclusions

More research needs to be conducted regarding the infrastructure required to accommodate eVTOLs into the mobility industry, starting from dedicated airports or the modernisation of unused regional airports and connecting this transportation service into regional and continental intelligent transportation. An analysis of eVTOLs as key components into intelligent transportation systems will clarify the aspects regarding the required infrastructure and door-to-door services that would benefit both direct clients and the corporate environment.

As the current research succeeds to find new business processes and models new organisation designs that function based on eVTOL availability, a new design has to be drawn for organisations that operate this aircraft, solving business operations issues and regulatory problems as well.

The paper identifies several impediments regarding product-to-market in the eVTOL developing industry. At the same time, it finds a range of benefits in the potential market and hypothetical user base. New research will stand to resolve the pending issues recognised in this paper and enable the successful deployment of an instrumental product to a welcoming market.

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