Advanced Air Mobility Adoption Globally by Machine Learning

Subjects: Regional & Urban Planning

Contributor: Raj Bridgelall

Advanced air mobility (AAM) is a sustainable aviation initiative to deliver cargo and passengers in urban and regional locations by electrified drones. The widespread expectation is that AAM adoption worldwide will help to reduce pollution, reduce transport costs, increase accessibility, and enable a more reliable and resilient supply chain.

social progress index | sustainable aviation | government effectiveness index

1. Introduction

International agreements on planetary accountability such as the Paris Climate Accords highlighted the urgent need for policies to limit pollutants that can harm humanity [1]. Responsive policies focus on decarbonizing transportation by electrifying road vehicles and promoting cleaner methods of energy production [2]. Consequently, nations are electrifying ground vehicles but there is less progress in aviation [3].

Advanced air mobility (AAM) is a more recent sustainable transportation initiative that seeks to use drones, which are small, electrified aircraft, to move cargo and passengers between high population areas [4]. Key enablers of AAM are the convergence and cost reduction of technologies such as distributed electric propulsion, artificial intelligence in robotics, and network-enabled on-demand transportation services [5]. The primary motivations for AAM are shorter trips by air, avoidance of road congestion, and the reduction of pollutants [6].

Drones provide other benefits such as supporting the United Nations' sustainable development goals by lowering the cost to deliver humanitarian aid, food, medicine, and disaster relief [7]. Drones can help to increase the resilience and reliability of supply chains by using the third dimension of travel to speed up deliveries [8]. Additionally, nations can use drones to more safely and efficiently monitor forest health, wildlife, farms, critical infrastructure, and post-disaster sites to justify aid.

Despite the potential widespread benefits of AAM, only developed nations like the United States, China, and some European countries are working on technologies and regulations to safely integrate drones into the general aviation airspace [9]. Countries that are advancing drone regulations will attract new markets. Therefore, policy laggards could be at an economic and trade disadvantage that may keep the global supply chain unbalanced. Furthermore, non-uniform policies and regulations worldwide can impede the agenda of international organizations concerned with human welfare. Hence, the identification of indicators that are predictors of potential AAM success can help

nations, business developers, and international organizations guide policymaking, evaluate policy impacts, take corrective action, and benchmark progress internationally.

Technology developers, market prospectors, and international organizations concerned with human welfare can benefit from the insights of this research. International organizations may include the United Nations, the World Bank Group, International Development Law Organization, International Standards Organization, International Civil Aviation Organization, International Air Transport Association, International Energy Agency, and the World Trade Organization.

Advanced Air Mobility (AAM) has the potential to change transportation as we know it. The benefits widely expected from adopting AAM are pollution reduction, greater accessibility, lower transport costs, and quicker trips in and between highly populated areas. However, most nations are not yet advancing regulations to enable AAM. The fragmentation and non-uniformity of regulations in different regions of the world could hamper the humanitarian initiatives of international organizations and prevent commercial opportunities for technology developers.

2. Common Factors

The Technical Centre for Agricultural and Rural Cooperation (CTA) was one of the first to examine regulations and policies in 79 countries [10]. CTA, an organization seeking to advance food security and inclusive economic growth in poor nations, found that in 2016, 77% of African and 39% of Caribbean countries did not have any specific rules for drone use. In the same year, Ravich (2016) found that although drone laws varied among nations, the common unifying concerns were safety, privacy, and national security [11]. One year later, the RAND Corporation published a report that summarized commercial drone regulations worldwide [12]. RAND found that the level of regulation restrictiveness reflected whether the nation favored safety over promoting recent technology. The same year, Cracknell (2017) found a trend of requiring the pilot to complete a training program and keeping a log of all flights [13]. Tsiamis et al. (2019) compared drone regulations across 35 countries of the Organization for Economic Co-operation and Development (OECD) and found that, although there were many variations in legal framework, common considerations were the vehicle size and weight, flight altitude, and purpose of use [14]. That same year, Coops et al. (2019) found that one-quarter of countries had strict laws regulating drone use, one-third lacked regulations, and six countries simply banned drones [15]. A recent analysis found there was no central European repository for data related to remote pilots, legal entities, and operational approvals that could help with monitoring and enforcement [16].

3. Rulemaking Hindrances

Ayamga et al. (2021) found that the lack of skilled personnel, processes, and resources were the main factors hindering the implementation and enforcement of drone regulations in Africa [17]. Sah et al. (2021) assessed that threats to privacy and security were critical barriers to implementing drone regulations in the logistics sector [18].

Tran et al. (2022) compared regulatory considerations across the United States, United Kingdom, Canada, China, Singapore, Thailand, Cambodia, and Vietnam and discovered that rules varied in their requirements for flight permits, pilot qualifications, and operating constraints such as maintaining visual line-of-sight, altitude limits, flying at night, and proximity to airfields [19]. More generally, some in developing nations fear that technological advancements will lower worker wages [20].

4. Drone Utility

A literature review by Chauhan (2019) found that publications from 1968 to 2017 about drone utility increased at a rate of 16% annually [21]. In 2015, Oxford Analytica suggested that a push to commercialize drones will help to advance drone regulations and that a comprehensive regulatory framework will accelerate applications [22]. Kitonsa et al. (2018) suggested that drone technology can help to achieve the United Nations' sustainable development goals in matters such as addressing issues in agriculture, e-commerce, and healthcare [7]. Schulzke (2019) pointed out that drone technology advancements for civilian applications could also increase their attractiveness for military use [23]. Calandrillo et al. (2020) criticized the slow pace of U.S. regulations for stalling drone applications and forcing innovation efforts to move abroad [24].

Research suggests that AAM will complement various forms of ground transportation such as autonomous vehicles and ridesharing [25]. Drones can replace long portions of ground trips to help reduce congestion and pollution [26]. For example, the Uber Elevate use case suggests that riders can book complete door-to-door trips by taking ground ride share to vertiports where drones will more quickly complete the long-haul portion of a regional trip [27]. That is, passenger drones can take more direct air routes between cities to provide immense time savings under affordable conditions [28]. Similarly, cargo drones can bypass ground traffic to speed up package delivery in both middle-mile and last-mile operations [29].

References

1. Pegels, A.; Altenburg, T. Latecomer development in a "greening" world: Introduction to the Special Issue. World Dev. 2020, 135, 105084.
2. Olabi, A.G.; Abdelkareem, M.A. Renewable energy and climate change. Renew. Sustain. Energy Rev. 2022, 158, 112111.
3. Huete, J.; Nalianda, D.; Zaghari, B.; Pilidis, P. A Strategy to Decarbonize Civil Aviation: A phased innovation approach to hydrogen technologies. IEEE Electrif. Mag. 2022, 10, 27–33.
4. Garrow, L.A.; German, B.; Schwab, N.T.; Patterson, M.D.; Mendonca, N.; Gawdiak, Y.O.; Murphy, J.R. A Proposed Taxonomy for Advanced Air Mobility. In Proceedings of the AIAA AVIATION 2022 Forum, Chicago, IL, USA, 27 June–1 July 2022.

5. Bridgelall, R.; Askarzadeh, T.; Tolliver, D. Introducing an Efficiency Index to Evaluate eVTOL Designs. SSRN 2022.
6. GAO. Transforming Aviation: Stakeholders Identified Issues to Address for ‘Advanced Air Mobility’; Government Accountability Office (GAO): Washington, DC, USA, 2022.
7. Kitonsa, H.; Kruglikov, S.V. Significance of drone technology for achievement of the United Nations sustainable development goals. R-Economy 2018, 4, 115–120.
8. Bexell, M.; Jönsson, K. Responsibility and the United Nations’ Sustainable Development Goals. Forum Dev. Stud. 2017, 44, 13–29.
9. Garrow, L.A.; German, B.J.; Leonard, C.E. Urban air mobility: A comprehensive review and comparative analysis with autonomous and electric ground transportation for informing future research. Transp. Res. Part C Emerg. Technol. 2021, 132, 103377.
10. Jeanneret, C.; Rambaldi, G. Drone Governance: A Scan of Policies, Laws and Regulations Governing the Use of Unmanned Aerial Vehicles (UAVs) in 79 Countries; Technical Centre for Agricultural and Rural Cooperation (CTA): Wageningen, The Netherlands, 2016.
11. Ravich, T. A Comparative Global Analysis of Drone Laws: Best Practices and Policies. In The Future of Drone Use; Information Technology and Law Series; Custers, B., Ed.; T.M.C. Asser Press: The Hague, The Netherlands, 2016; Volume 27.
12. Jones, T. International Commercial Drone Regulation and Drone Delivery Services; RAND Corporation: Santa Monica, CA, USA, 2017; p. 47.
13. Cracknell, A.P. UAVs: Regulations and Law Enforcement. Int. J. Remote Sens. 2017, 38, 3054–3067.
14. Tsiamis, N.; Efthymiou, L.; Tsagarakis, K.P. A comparative analysis of the legislation evolution for drone use in oecd countries. Drones 2019, 3, 75.
15. Coops, N.C.; Goodbody, T.R.; Cao, L. Four steps to extend drone use in research. Nature 2019, 572, 433–435.
16. Janke, C.; Haag, M.U. Implementation of European Drone Regulations-Status Quo and Assessment. J. Intell. Robot. Syst. 2022, 106, 33.
17. Ayamga, M.; Tekinerdogan, B.; Kassahun, A. Exploring the challenges posed by regulations for the use of drones in agriculture in the African context. Land 2021, 10, 164.
18. Sah, B.; Gupta, R.; Bani-Hani, D. Analysis of barriers to implement drone logistics. Int. J. Logist. Res. Appl. 2021, 24, 531–550.
19. Tran, T.-H.; Nguyen, D.-D. Management and Regulation of Drone Operation in Urban Environment: A Case Study. Soc. Sci. 2022, 11, 474.

20. Jongwanich, J.; Kohpaiboon, A.; Obashi, A. Technological advancement, import penetration and labour markets: Evidence from Thailand. World Dev. 2022, 151, 105746.
21. Chauhan, S.K. Scholarly output on drone research: A bibliometric study. DESIDOC J. Libr. Inf. Technol. 2019, 39, 117–124.
22. Oxford. Analytica Growing Drone Use Will Drive International Regulation; Emerald Expert Briefings: West Yorkshire, UK, 2015.
23. Schulzke, M. Drone proliferation and the challenge of regulating dual-use technologies. Int. Stud. Rev. 2019, 21, 497–517.
24. Calandrillo, S.; Oh, J.; Webb, A. Deadly Drones? Why FAA Regulations Miss the Mark on Drone Safety. Stanf. Technol. Law Rev. 2020, 23, 182.
25. VFS. The Vertical Flight Society. 11 November 2022. Available online: https://evtol.news/aircraft (accessed on 11 November 2022).
26. WB-GEP. Databank: Global Economic Prospects. 7 June 2022. Available online: https://databank.worldbank.org/source/global-economic-prospects (accessed on 6 November 2022).
27. WB-WDI. DataBank: World Development Indicators. 16 September 2022. Available online: https://databank.worldbank.org/source/world-development-indicators (accessed on 6 November 2022).
28. WGI. Worldwide Governance Indicators (WGI). 23 September 2022. Available online: http://info.worldbank.org/governance/wgi/ (accessed on 6 November 2022).
29. WB-SDG. DataBank: Sustainable Development Goals (WB-SDG). 22 July 2022. Available online: https://databank.worldbank.org/source/sustainable-development-goals-(sdgs) (accessed on 6 November 2022).