

Flying Medical Supplies Over Mountains : Embedding Drones in the Health System to reach the Last Mile.



Workshop on
Current Status & Potential Applications of
Medical Drones & Drone Regulations in Nepal

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Hotel Himalaya, Patan, Lalitpur



Government Of Nepal
Ministry Of Health and Population



WORKSHOP PROCEEDING REPORT



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Executive Summary

Unmanned Aerial Vehicle (UAV) – popularly known as ‘Drone’ – are increasingly being used in many countries to deliver healthcare supplies such as medicines, vaccines, blood and lab samples to better serve the remote or hard to reach ‘last mile’ communities. In Nepal, drones have already been extensively used in sectors such as photography, videography, surveying and mapping etc. However, some of the major sectors such as agriculture, health have only witnessed a fewer drone-based interventions. Drone initiatives in Nepal related to healthcare have not yet achieved sustainable scale and have so far been sporadic and project based. Realizing the high potentials of using drone to serve the people in the most rugged and difficult mountain terrain, Ministry of Health and Population, with technical assistance from Options Consultancy Services and Nepal Flying Lab with funding support from British Embassy Kathmandu, is working towards embedding drone in the health system to reach the last mile.

The concept of embedding drone in the health system was first discussed in the Policy Meeting of the Policy Coordination Committee (PCC) within the MoHP on 9 Falgun 2078 (21 February 2022). Following the meeting, a consultative meeting was held with selected stakeholders on 14 Baisakh 2079 (27 April 2022) in Kathmandu. Based on the feedback received from the workshop, primary data was collected from Humla and East Rukum district to understand the issues related to the supply chain systems to deliver medical supplies in the remote areas. Furthermore, a GIS based analysis was performed by the technical team to come up with a multicriteria analysis parameters to help the government decide the priority locations for drone interventions. In this regard, a workshop titled **“Current Status and Potential Applications of Medical Drones and Drone Regulations in Nepal”** was organized on 12 March 2023 in Kathmandu to discuss all achievements till date, understand use of drones in healthcare context in an international level, discuss existing legal scenario and to develop a roadmap towards embedding drones in the healthcare system to reach the last mile. The specific objectives of the workshop include sharing and learning from medical drone actors to guide the development of a sustainable drone initiative model, considering federal context, government needs, and concerns; discussing the status and potential applications of medical drones and drone regulations in Nepal; and creating a common platform where government and private sector stakeholders can sit together to discuss policy gaps and plans for the next steps. The workshop was attended by 61 people representing 36 organizations including government entities, private sector drone actors, international experts and media.

Dr Madan Kumar Upadhyay, Chief, Quality Standard and Regulation Division (QSRD), MoHP made the opening remarks emphasizing the importance of drones to improve access to healthcare in Nepal. Expressed MoHP’s expectation that the workshop would be successful in meeting the objectives, his expectations that the workshop would be successful in meeting the objectives and supporting the MoHP to take informed decisions regarding embedding drones in the health system. The workshop began with an hour-long keynote session by two international experts. They shared that drone operations depend on a complex ecosystem, cross-sectoral coordination, government acting as a market maker, and this technology complement the existing supply-chain system rather than replace. Dr Guna Nidhi Sharma, MoHP, emphasized on the need of bi-directional & multi-sectoral use of drones at the Palika and/or cluster of Palikas, and the financial and technical feasibility of the drone in the local context. He reiterated the MoHP’s commitment to function as drone ‘service user’, ‘regulator’, and ‘facilitator’ and facilitate the private sector.

Options and NFL briefly introduced the initiatives on 'Embedding drones in the health system to reach the last mile', shared the lessons learnt from the study in Humla and East Rukum; and GIS based analysis on parameters for selection of health facilities; and shared the preliminary findings of the cost analysis of drone initiatives. Based on a preliminary analysis using limited available datasets, it was found that a drone can last up to 5 years and drone delivery will cost 3,000 - 5,000 NPR per delivery to a health facility/year in remote locations of Nepal. If distribution centers have an average income of at least 3,000 NPR per month per distribution center, then private companies can make a profit of at least 3 lakhs a year.

Government officials from Ministry of Home Affairs (MoHA) and Civil Aviation Authority of Nepal (CAAN) presented the status and challenges on drone operation procedures in Nepal. Registration procedure for UAS to CAA Nepal can be accessed through www.caanepal.gov.np and involves user account, verifier, approver, distributor, and admin involvement. Two drone regulations, namely 'Drone Udaan Sambandhi Karyabidhi 2075', and 'CAAN Unmanned Aircraft System (UAS) Requirements' are effective as of now. On ensuring compliance to all the set requirements like flight details, location maps, objective, duration of flight for less than 3 months, among others, the Ministry of Home Affairs issues a flight permission letter for drones that weight more than 2 kg while for all other drones below that categories, individual district offices across the country can issue the flight permission letters. In Nepal Drones are classified into 4 categories based on size and risk they possess during operation.

Two international drone entrepreneurs from the United Kingdom and India shared how drones can improve access to health care. Drones have the potential to significantly improve access to healthcare by providing faster and more efficient delivery in areas with difficult terrain or infrastructure challenges. Drone technology in the health sector is crucial for countries like Nepal as the topographic challenges can be addressed with relative ease with the usage of drones. Drone production and manufacturing should be location specific. The usages of locally developed drones, tested in that environmental setting should be prioritized as this can be the most sustainable model of drone production. Drones should be developed with high security integration. A mechanical safety measure such as a crash prevention parachute should be integrated into a logistical drone to ensure safety.

The workshop also included a panel discussion on the drone ecosystem in Nepal: Current applications, opportunities and challenges. Dr. Ramesh Kumar Maskey, NAST moderated the panel consisting of Mr. Raju Shrestha, Director, CAAN; Arjun Poudyal, Under Secretary, MoHA; and Dr. Deepak Karki - Health Advisor, BEK as the panelists. The panel discussed the establishment of a multi-stakeholder hub and network that can work in close collaboration in all stages of planning, policy making, and implementation; multisectoral collaboration; airspace and national safety. Sharing the experience of drone applications in Nepal, the representative from the private sector highlighted the importance of establishing a multisectoral group of stakeholders that can come together for policy making and implementation; public awareness campaign; and need of a system to regulate, monitor, and control drone activities. The workshop concluded expressing a commitment to organizing such interaction soon and working towards the establishment of the network of drone stakeholders in near future

Key takeaway messages of the workshop

- Drone technology in the health sector is crucial for countries like Nepal as the topographic challenges can be addressed with relative ease with the usage of drones. The technology could be a potential means of supply chain system for managing medical supplies in the most rugged and difficult mountain terrain and during the health emergencies in Nepal. Thus, the MoHP initiative to

embed drone technology in the health system to reach the last mile is an important and timely initiative.

- Drone production and manufacturing should be location specific. The usages of locally developed drones, tested in that environmental setting should be prioritized as this can be the most sustainable model of drone use. Importing drones that are manufactured in foreign countries could be costly and also may not be the best solution for the complex terrain in Nepal.
- The existing drone relations lacks use case specific clauses particularly in case of emergencies and disaster scenarios. Hence there is a high need of a separate step by step guideline what ensures maximum utilization of frontier technology such as drones for the benefits during the emergency situations while also ensuring the safety of the airspace as well as population on the ground.
- Drone industry requires cross-sectoral coordination; the health sector can't be the only market entry point. Drone operations depend on complex ecosystems, and this complements the existing system rather than replace.
- MoHP is committed to functions as drone 'service user', 'regulator', and 'facilitator.'
- Establishment of the network of drone stakeholders will help plan, implement and regulate drone applications in Nepal. The network could represent the collective voice of all drone businesses in the country and not only lobby for policy recommendations but also engage themselves in creative activities such as awareness raising regarding the benefits of the technology.

1. The Context

Nepal has some of the most rugged and difficult mountain terrain in the world, making delivery of life saving essential medicines and supplies challenging, putting lives at risk. Other climatic conditions such as heavy rains, snow, landslides and floods can make even accessible areas out of reach. Forty percent of the population in Nepal live in hill and mountain regions that cover about 70% of the country's geography. The scattered settlements combined with poor road conditions further exacerbates inequities and poor health outcomes, particularly for remote or hard to reach 'last mile' communities. In many cases it is left to people or animals to carry essential medicines to remote areas, a journey that takes hours.

Drones have been used in many countries to deliver health equipment, medicines, vaccines, blood and lab samples to better serve the remote or hard to reach 'last mile' communities. In Nepal, drones have already been used in sectors such as surveying and mapping, agriculture and health. Though drones have been used to facilitate tuberculosis diagnosis in Pyuthan district, and supply of drugs in Myagdi district; drone initiatives in Nepal have not yet achieved sustainable scale and have so far been sporadic and project based.

Ministry of Health and Population (MoHP) with technical support from Options Consultancy Services and Nepal Flying Labs (NFL) funded by UKaid, Foreign, Commonwealth & Development Office (FCDO), British Embassy Kathmandu, is working towards embedding drones in the health system to reach the last mile. The MoHP discussed the potential of integrating drones within the health system of Nepal to achieve sustainable scale at the Policy Meeting of the Policy Coordination Committee (PCC) on 9 Falgun 2078 (21 February 2022). Following the meeting, the MoHP, Options and NFL organized a consultative meeting with the stakeholders on 14 Baisakh 2079 (27 April 2022) in Kathmandu. Based on the feedback received from the workshop, NFL and Options mobilized research officers, who traveled to two districts namely Humla and East Rukum and interacted with the local leaders and healthcare professionals to understand the issues related to the supply chain systems to deliver medical supplies in the remote areas. Upon completion of the field-based research, desktop-based GIS analysis and the tentative cost analysis of drone application, the team organized a workshop titled **"Current Status and Potential Applications of Medical Drones and Drone Regulations in Nepal"** on 12 March 2023 in Kathmandu.

The workshop was attended by 61 people representing 36 organizations including government entities, private sector drone actors, international experts and media. This report presents the proceedings of the workshop. The detailed agenda of the workshop, the list of participants and brief biography of the international speakers is presented as Annex 1 (*Agenda*), Annex 2 (*Participants*) and Annex 3 (*Speakers biography*) respectively.

2. Workshop Objectives and Opening Remarks

2.1 Objectives

The workshop began with a welcome note by Siddhanta Neupane, the head of the program at Nepal Flying Labs. Pradeep Poudel from Options then explained the objectives of the workshop, which are to develop a roadmap towards embedding drones in the healthcare system to reach the last mile. The specific objectives of the workshop include:

1. Sharing and learning from medical drone actors to guide the development of a sustainable drone initiative model, considering federal context, government needs, and concerns.
2. Discussing the status and potential applications of medical drones and drone regulations in Nepal.
3. Creating a common platform where government and private sector stakeholders can sit together to discuss policy gaps and plans for the next steps.

2.2 Opening Remarks

Dr Madan Kumar Upadhyay, Chief, Quality Standard and Regulation Division (QSRD), MoHP made the opening remarks where he emphasized the importance of technology, such as drones, to improve access to healthcare in Nepal. He stated that MoHP is moving towards embedding drone technology in the health system to reach the last mile and expressed that today's workshop would provide detailed understanding of the ecosystem and regulatory provisions of drone technology in Nepal which would help the ministry to take informed decisions. He thanked all the participants of the workshop including the keynote speakers and those participating in the workshop online and expressed his expectations that the workshop would be successful in meeting the objectives and supporting the MoHP to take informed decision regarding embedding drone in the health system.

3. Keynote Session

The workshop began with an hour-long keynote session. Two international experts representing global organizations leading the application of drones for medical application were invited. The keynote speakers were digitally connected with the workshop.

3.1 Drones in Healthcare: Current Status, Challenges Opportunities and Economic Analysis

Dr. Olivier Defawe, Director of Drones for Health Solution Lead at VillageReach, an organization that works to solve healthcare delivery challenges in low-resource communities, discussed how VillageReach has been working on improving access to rural health in remote countries through drone interventions for the last 7 years. He described how the organization is working with different technology companies based on the contexts of different countries in Africa to reduce transportation time in rural areas of Africa through the help of drones for activities related to accessing health services. He also explained how drones transformed health logistics in Africa by reducing time in Ghana, RDC, Malawi, and Mozambique.

Defawe then explained how VillageReach, in the last 7 years, has developed some mitigation measures, including the development of a drone commission to look after policies related to drone usage. He discussed his experiences from over 6 years, 5 countries, and 7 drone programs, and shared lessons learned. He highlighted the performance, cost, and effectiveness of drone usage for health in Congo and compared pre- and post-drone stocks, vaccine availability, and polio sample transport. He also talked about the cost per dose and cost-effectiveness of using drone technology for health services.

Regarding the cost-effectiveness of the technology, he proposed that cost-effectiveness can be achieved through new market development strategies, as drone logistics services have a narrow market focus. Defawe concluded his presentation with an open call for partnerships, inviting organizations including the Nepal government to partner and work together.

Responding to a query related to VillageReach's suggestion to Nepalese organizations and authorities for medical drone operations in Nepal where majority of the land is hills and mountain Dr Olivier suggested a careful assessment of the appropriate hardware as per the geographical realities of the country / location would help to make a smart decision regarding how to achieve maximum efficiency. Beside technology, localization is the key. Local experts need to be involved and engaged in operating the technology so that the ground operations become sustainable.

Key takeaways

- **Drone operations depend on complex ecosystems** where the national drone working groups build collaboration to reach a shared outcome, understanding co-dependencies and problem solving.
- It is important to **involve regulators in service provider selection:** Multi-sectoral committees to review and select a drone service provider builds regulator clarity and confidence in the technology.
- **Start safe and small and work your way up:** A phased approach to introducing drone transportation allows you to establish safe, effective, reliable and saleable systems.
- **Drones complement rather than replace:** Drone logistics systems need to be designed around the technologies capabilities, strengths and weaknesses so that it can complement the existing systems setup for healthcare improvements over a specific location.
- **Drone industry requires cross-sectoral coordination; the health sector can't be the only market entry point.** Multi-sector market entry strategy is required so services can be provided at an affordable and sustainable price point for LMIC governments.

3.2 World Economic Forum's Medicine from the Sky Drone Delivery Programme

Mr. Vignesh Santhanam, India lead for Aerospace and drone at World Economic Forum, described the World Economic Forum as a platform for the exchange of knowledge and best practices as well as showcasing partnerships on a national and international scale. He explained how the Telangana state of India's Medicine from the Sky program served as a model for last-mile medical drone deliveries throughout the developing world and helped show how the drone industry can thrive with liberal policy changes. He said that drone technology will be a key enabler in creating healthcare infrastructure especially in developing countries where there are greater variations in healthcare quality and a higher percentage of the population lives in rural areas. He also assured that the government of Telangana would support the international adoption of models developed through the collaboration by sharing insights, lessons learned and best practices. He explained the objectives of the WEF's medicine from the sky program which includes: healthcare equity for rural areas, reduce mortality due to avoidable circumstances, make the most of innovative tech to improve medical supply chains and to revolutionize the approach to the middle and last mile. He elaborated the following four preempting challenges: Regulatory, Technical, Public perception & acceptance and Questions around cost and sustainability.

He elaborated the scope of drone delivery use cases: Blood stock, Vaccine stock, Long tail medicine and Diagnostic specimens helps in achieving targeted outcomes such as reducing mortality rate, improving immunization, diagnostic specimens and so on. He demonstrated a method for judging viability or success that takes into account factors like dependability, payload, and shock-free landings in the medical field; security, scalability, and safety in the airspace; and repeatability, consistency, and mean time between failures in technology. An economic consideration was presented by him where he listed: multi

stop drone port for distant facilities, maintenance-cum storage facility in the vicinity, government as a market maker etc. He explained an image of an airspace territory of 16 corridors earmarked in the district of Vikarabad, India that included public and primary health centers and local district hospitals. He made the argument that by implementing cutting-edge logistics systems in the sky, it would be possible to address the health system's flaws and save lives, particularly in rural areas where there is a lack of infrastructure and investment is being outpaced by growth projections.

Responding to a question related to any fixed government entity to work with in India and what can Nepal learn from that, he said that it is important for each country and society to develop its own expertise, oversight and approach to these technologies.

Responding to another question on how to address visibility problems when it's a long distance, giving an example from Himachal Pradesh he said that there should be multi-stop drone ports in case of distant medical facilities. For regular and smooth operations, a maintenance-cum storage facility in the vicinity also helps. Elaborating on the 'government as market maker' he explained that it is important to follow an ecosystem approach, it's not a one man-solution.

Key takeaways

- Multi-stop drone ports would be required in case of drone flights en route to distant medical facilities.
- A maintenance-cum-storage facility for drones in the vicinity would also be important for regular and smooth operations.
- Government acting as a market maker is a welcome move as the exploratory catalytic costs need to be absorbed to scale adoption. Drones must remain in the institutional memory post pilots to prevent it from becoming a PR exercise. For this, trials must be carried out for an extended period.
- CSR funding is not sustainable in the long run and unit costs must go down significantly. The current India model of make and provide as a service may have to be revisited.
- By stress testing systems in the Himalayan belt, we shall get a clear picture of technology maturity, regulatory leeway and operational issues.
- Economics of a no-drone scenario using conventional methods will always be cheaper when directly measured. Does this indicate a need to scale down drone ambitions?
- Intangibles are immeasurable e.g. on-road green corridor for organ transport puts a heavy load on traffic and the local administration vis a vis a drone.
- Drones should be integrated on a demand-response-routing when on routine like airport operations and flight rosters.
- When configuring a drone network, it is important to define trajectories based on minimizing distance, costs of charging and wear-and-tear while ensuring drone flights remain within their permitted flight paths.

- Local health facilities would require fixed drone landing pads and charging points built as infrastructure requirements for a drone based health service model to be properly operational.

4. Embedding drones in the health system to reach the last mile: health sector needs and potentialities

Dr. Guna Nidhi Sharma from Policy, Planning and Monitoring Division, MoHP explained the objective of his session as to share the MoHP concept of embedding drones in the health system to reach the last miles with essential health supplies and use the technology during health emergency; and learn from the past and the ongoing initiatives initiated by different stakeholders to support ministry take informed decision. Explaining the health sector's needs and potential uses of drones with regards to the ministry's move towards embedding drones in the health system to reach the last mile, Dr Sharma explained how drones can help achieve equal access to healthcare, especially in remote areas.

Elaborating the policy landscape related to embedding drone in the health system he explained that Article 35 of the Constitution of Nepal, Public Health Service Act 2075 and Public Health Service Regulation 2077 all have given mandate to the local level governments to provide free and quality basic health services to all the citizens and drone technology could serve as one of the effective tools to serve this policy provision. He explained that drone technology could also be instrumental in meeting the strategic objectives of Nepal Health Sector Strategic Plan 2023-2030 to enhance efficiency and responsiveness of the health system, and to promote equitable access to quality health services. It could also contribute to achieving the outputs like ensuring uninterrupted availability of quality medicine and supplies; reduced inequity in health services; effective management of public health emergencies and promoting use of modern technology in the health sector.

He highlighted the potential use of drones in the health sector for the supply of essential drugs and medical supplies to health facilities in rugged terrain and for the delivery of medical supplies during a health emergency. He expressed the hope that to save time and resources, the latest technology (Drone), can be an alternative solution to address the transportation barriers/challenges. He emphasized on the need of bi-directional & multi-sectoral use of drones at the Palika and/or cluster of Palikas, and the financial and technical feasibility of the drone in the local context.

Responding to a query related to MoHP's plan to collaborate with other sectors as well for policy reform, he stressed that MoHP is committed to collaborate with other sectors for promoting use of modern technology including drones in the health sector.

Key takeaways

- Recognizing and learning from the use of drones in different countries and in various settings in Nepal, MoHP is looking to embed drones in the health system to reach the last mile.
- Drone technology could facilitate transportation of essential medical supplies in rugged terrain to address transportation barriers/ challenges within the scope of drone; delivery of medical supplies during health emergencies.
- It should allow two-way transportation of medical supplies and samples.

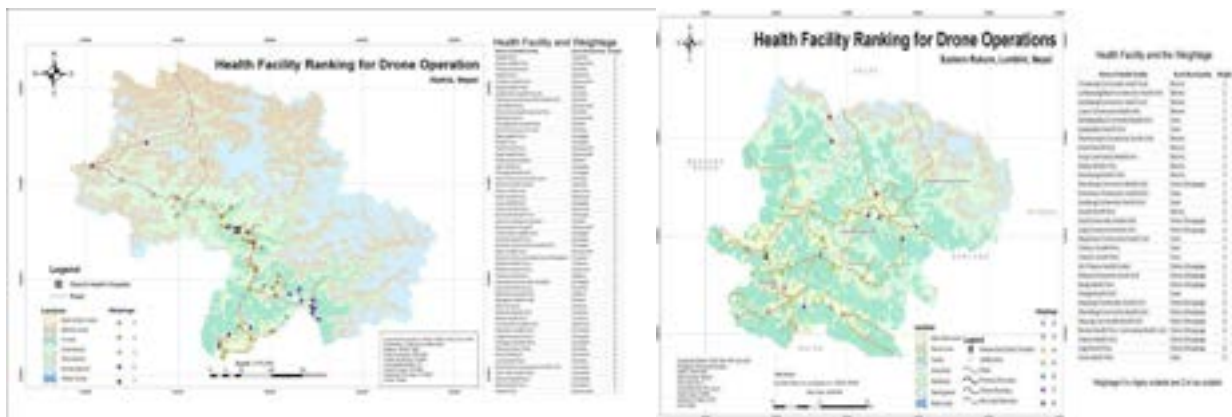
- It should offer a sustainable approach for multi-sectoral use of drones at the Palika level or cluster of Palikas.
- Drone sector to provide services tailored to the local context.
- MoHP is committed to functions as drone ‘service user’, ‘regulator’, and ‘facilitator.’

5. Flying medicines over mountains: embedding drones in the health system to reach the last mile

This session covered three areas:

- Brief introduction of the initiatives on ‘Embedding drones in the health system to reach the last mile’.
- Lessons learnt from the study in Humla and East Rukum; and GIS based analysis on parameters for selection of health facilities
- Cost analysis of drone initiatives

Pradeep Poudel from Options first explained the objectives of the workshop and discussed the pathway of the MoHP initiative to embed drones in the health system to reach the last mile. Recognizing the high time to embed drone technology in health in terms of the technological advancement, federal context where local levels have the constitutional mandate to ensure uninterrupted availability of medical supplies at health facilities to deliver basic health services and the COVID-19 context where drone could be instrumental in addressing health emergency situation, he said that UKaid/BEK, through Options and Nepal Flying Lab has been providing support to the Ministry of Health and Population to systematically investigate the potential of embedding drones in health system to reach the last mile. He then highlighted the major activities performed so far and reminded the key takeaways of the first consultative meeting held on 14th Baisakh 2079.



Pukar Parajuli from NFL presented methodology and key findings of fieldwork done in Humla and Rukum East in May 2022. After the detailed field-based data collection, the technical team worked on a GIS based multicriteria analysis to identify desirable health facilities within the district for possible drone deployment of medical cargo operations. Following the multi-criteria weighted analysis, for each facility, an average (aggregated) value was computed considering the weighted score received by the facility for

each of the six parameters: road length; road type, road circuitry, elevation/slope, type of health facility, and number of outpatient clients per year. Based on the analysis, he presented the list of selected health facilities with rankings that found potential for use of drones in the two districts.

A hybrid approach that includes scientific parametric based analysis and consultations with government and health system stakeholders has been applied to draft a list of parameters to help evidence-based decision-making process for selection of appropriate health facility for drone application. This could potentially be used in other countries with similar socio-economic and geographic contexts.

Biva Rajbhandari from Options presented the preliminary findings of the analysis on cost of the drone initiative in the given scenario. She explained that in order to establish a cost model for a drone delivery project in any district - one must consider the following factors:

Health facilities	Drones
<ul style="list-style-type: none"> ▪ The no. of health facilities to target ▪ No. of drone trips per day ▪ No. of facilities reached per day ▪ No. of days delivery runs per week 	<ul style="list-style-type: none"> ▪ Max weight of package ▪ Drone battery life cycle ▪ Highest elevation ▪ Maximum and minimum time per trip

In order to calculate the capital and running cost of the budget, there are several budget lines that have to be considered. These budget lines can also be used as a template to calculate costs for a drone delivery service in other districts:

Capital Costs	Running Costs
<ul style="list-style-type: none"> ▪ Government approvals ▪ Drone purchase and customization ▪ Establish drone hub ▪ Build a drone app ▪ Personnel Training ▪ Stakeholder engagement 	<ul style="list-style-type: none"> ▪ Drone maintenance ▪ Drone app maintenance ▪ Operating the Drone hub ▪ Stakeholder engagement ▪ Personnel training ▪ Drone Battery

Key takeaways

- A drone can last up to 5 years and drone delivery will cost 3,000 - 5,000 NPR per delivery to a health facility/year

- Costs will vary as every district/Palika will need a tailored drone delivery service as the number of facilities and packages to be delivered will differ.
- Federal funds are channeled to a local level and either:
 - distributed equally to each local level or
 - distributed based on the need of the local level.
- Private drone companies can partner directly with the local governments to implement drone delivery. If distribution centers have an average income of at least 3,000 NPR per month per distribution center, then private companies can make a profit of at least 3 lakhs a year.
- Streamlining the drone approval process and import taxes for drones could decrease capital costs by almost 7%.
- A drone delivery pilot in 2-3 districts or cluster of local levels can help identify the correct drone and additional budget lines to address any challenges (e.g. landing software)

6. Current status and Challenges on UAS Operation Procedures in Nepal

6.1 Unmanned aircraft (RPA popularly known as drone) flying related procedure, 2019 and its implications (Home Ministry)

Mr. Antosh Pradhan, Section Officer at Ministry of Home Affairs (MoHA), provided detailed insights into the drone-related flight procedures that were introduced by the ministry in 2019. He explained the steps that individuals need to follow to fly drones in Nepal starting with registering their drones at the Civil Aviation Authority (CAA) Nepal office and then applying for different government offices based on the category of the drone they wish to fly.

Mr. Pradhan also mentioned the increasing challenges faced by the ministry in tracking unwanted drone-related activities. He emphasized the requirement for individuals to obtain permission from the ministry before flying drones and explained the conditions that necessitate such permissions. However, he pointed out that the ministry does not currently recognize applications such as medical drones and disaster scenarios. Mr. Pradhan mentioned that the ministry plans to revise the existing regulations for such special use cases in the next revision that they are planning to do.

Responding to a query related to validity for a drone permission, he explained that there are no special provisions to get a permission that is valid for more than 3 months. The current provision only provides a permission that is valid for a maximum of 3 months period only. New approval should be taken from MoHA after three months. Responding to another query he mentioned that in general the maximum limit for horizontal flight distance is 300 meters, but the ministry does issue special permission based on the type of the project. There were some suggestions like the ministry should have special shortcut mechanisms in place to allow organizations to use drones at the time of emergencies; and regarding restricted zones for drone flight, the ministry can come up with multiple categories: e.g.- vertical zoning and horizontal zoning.

Key takeaways

- Drones are classified into 4 categories based on size and risk they possess during operation. Additionally, drones are also classified based on the purpose they serve.
- Three flying zones: General, medium, and sensitive zones are identified based on presence of controlled or protected areas, sensitivity of the given location from a security point of view and also the population of people living over that area
- Air-routes and area within 5 kms of the airport, 5 kms horizontal from the international border, within 1 kms aerial radius distance (ARD) from sensitive areas of government, 500 m from ARDs of other security agencies, protected areas, riot infused areas with security operations, and other sensitive areas are considered prohibited and controlled flying zones.
- Depending upon the flight case, some flights don't require permission while most flights require it.
- On ensuring compliance to all the set requirements like flight details, location maps, objective, duration of flight for less than 3 months, authorization letter by local agency for foreigners, pilot's biodata, identification, and visa for non-Nepali, and rule adherence claim to process permission the Ministry of Home Affairs issues a flight permission letter.

6.2 UAS Operation Procedures, Challenges and Mitigation Measures (Civil Aviation Authority of Nepal)

Samrat Pradhan, Aeronautical Engineer, Deputy Manager, Civil Aviation Authority of Nepal, started his session with a brief introduction of Civil Aviation Authority of Nepal (CAAN), an autonomous regulatory body, regulator of civil aviation as well as the service provider in the areas of air navigation services and aerodrome operations. The Ministry of Home Affairs issued Drone Udaan Sambandhi Karyabidhi in 2075. The CAA Nepal has already started issuing the Certificate of Registration to drone with Unique Identification Number (UIN) from March 2019 and till date 982 UAS has been already registered. UAV/ Drone Registration is being carried out using ONLINE software applications.

Giving examples of air risk incidents reported in the international airports across the globe he explained the categorization of drone on risk basis:

- Category A – “Very Low Risk” Operations – Less than 250 gm
- Category B – “Low Risk” Operations – 250 gm to 2 Kg
- Category C – “Regulated Low Risk” Operations – 2 Kg to 25 Kg
- Category D – “Regulated High Risk” Operations above 25 Kg

Prior approval from the Ministry of Home Affairs and CAA Nepal is required depending on the nature of operation. Insurance is required for Category C and Category D UAV/ Drone before registration. CAAN has accepted the drone as an emerging technology, hence has started to train its manpower. CAAN has also started to send its manpower to participate in various national & international workshop, safety seminars related to drones.

Responding to a query on whether the 982 registered drones are individually registered, or custom registered he clarified that these are individual/organizational registered ones. However, ownership

transfer can be done. Responding to another query on certifying drone pilots where there is no official licensing system, he explained that in C category, there are some requirements for licensing which can be used for remote licensing. But if everything is good/appropriate with trained pilots from renowned organizations, then permission can be granted but there is a strong need for an Act and policy for this.

Key takeaways

- **CAA Nepal has introduced a digital system for drone registration. Any individual who has brought a drone legally and has receipts, his personal and company details can get his/her drones registered in a day using the system.**
- **The step by step registration procedure for UAS to CAA Nepal can be accessed through www.caanepal.gov.np and involves user account, verifier, approver, distributor, and admin involvement.**
- Two drone regulations, namely “Ministry of Home Affairs- Drone Udaan Sambandhi Karyabidhi 2075”, and “CAAN Unmanned Aircraft System(UAS) Requirements, Issue 01, April 2021 (as per ICAO model regulation Part 101 & Part 102)” are effective as of now.
- CAA Nepal faces challenges in areas of airworthiness of drones, drone pilot licensing, drone flight operation procedure, drone flight permissions, and simultaneous airport operation.

7. International Experiences

7.1 “Flying into the future: How drones can improve access to health care”- Lessons learnt and suggestions from United Kingdom

Dr. Hammad Jeilani, Co-Founder and Medical Director at Apian, a health care logistics company in the UK, talked about how drones can improve access to health care. He started his presentation saying that poor logistics wastes time, money and lives illustrating how people get the ordered food within a few minutes of order and a similar facility is not available for health services even in the UK. Showing a live example of a drone initiative at Northumbria covering 80 km, 300 flights a day, to deliver blood, platelets he explained that in terms of economics, it is an electric vehicle that runs with renewable energy, the cost is automatically reduced. Starting cost is always higher; however, it gets minimized with passing of services and time. It could really be cost competitive with other transport modes. Secondary benefit of using drones is that it is able to fly in between any kind of strike, protest, traffic and calamities where electric vehicles cannot and making the service accessible to people at times. He also shared his experience working in Nepal under DroTS, where drones were used to collect the samples of sputum for tuberculosis from rural areas.

Further talking about the studies being conducted in this sector, he shared that the impact of drone vibration on the supplies it carries was also a factor to be considered. He said so far, the studies point out that the effects are negligible. On an optimistic note, he said that Nepal’s drones are easy as compared to the developed nations and this is an opportunity for the agency involved. Due to such minimal intervention from authority, Nepal can explore its usages in a more effective manner. He adds, the topographic challenges of Nepal makes it one of the most difficult countries in terms of supply chain and drones are one of the best solutions to this challenge.

Key takeaways

- Drones have the potential to significantly improve access to healthcare by providing faster and more efficient delivery of medical supplies, particularly in areas with difficult terrain or infrastructure challenges.
- Drone technology in the health sector is crucial for countries like Nepal as the topographic challenges can be maintained with relative ease with the usage of drones.
- The use of drones in healthcare logistics can help minimize the risk of infection transmission, particularly during times of public health crises such as pandemics.
- As drone technology continues to evolve, there may be opportunities to use them for more complex medical procedures and emergency medical evacuation.

7.2 Experiences of Operating a Medical Drone Delivery Project in India

Mr. Vikram Singh, CEO & Founder, TechEagle, India, shared experiences of operating a medical drone delivery project in India. He suggested that Nepal adopt India's certification strategy. He discussed the difficulties, causes, and solutions associated with using drones in India. He thinks that any organization or individual operating drones should have a permit or license, and any airspace they use should be approved. Additionally, he said that certification of drones and identification of their capability to operate in topographically challenging areas should exist.

Since the drones imported from China could only travel 20 km, it is necessary to import drones that could travel up to 100 km or more. According to him, drones must be simple to transport and assemble, avoid operations being interrupted, be able to fly at night, and have different designs depending on the location's landscape and weather. Along with emergency detection and the closest point of emergency, redundancy in propulsion and communication should be taken into account. It is also essential to be able to alert security agencies and operators. He claims that a parachute serves as the last line of defense by safely bringing down a malfunctioning drone and serves as ultimate safety if all other safety measures are unsuccessful.

He argued that drones ought to be made specifically for each location in addition to being thoroughly tested in a variety of environments and geopolitical setups. He mentioned that the deployment should follow the hub and spoke model. He claimed that even though the drone has an autonomous system that can pick up and drop samples and packages by itself, having a receiver would be preferable. He listed a few obstacles, including the inability to immediately obtain blood and blood components due to a lack of a continuous supply of essentials, the delay in vaccine delivery to rural areas caused by a lack of temperature, the need for controlled last-mile delivery in remote or difficult terrain, and disasters that call for quick action.

He gave notice by mentioning a crash involving a Chinese-made drone in the Delhi metro system. Additionally, he discussed the Beyond Visual Line of Sight (BVLOS) case in Telangana, Nagaland, and Himachal Pradesh in India, where vaccine delivery was carried out in low-temperature. In Arunachal

Pradesh, India, he claimed that they had built a hub that connected 20–30 villages where no ground transportation was feasible.

Key takeaways

- Drone production and manufacturing should be location specific. The usages of locally developed drones, tested in that environmental setting should be prioritized as this can be the most sustainable model of drone production.
- Drones should be developed with high security integration. A mechanical safety measure such as a crash prevention parachute should be integrated into a logistical drone to ensure safety.
- Manual intervention during receiving and loading of payloads is preferred even when all the processes can be automated. This enables validation of the quality of service provided and safety of the complete operation.

8. Drone Ecosystem in Nepal: Current Applications, Opportunities and Challenges (Panel Discussion)

A panel discussion with distinguished panelists was sessioned during the event. Dr. Ramesh Kumar Maskey, NAST moderated the panel consisting of Mr. Raju Shrestha, Director, Civil Aviation Authority of Nepal; Arjun Poudyal - Under Secretary, MoHA of Nepal; and Dr. Deepak Karki - Health Advisor, British Embassy Kathmandu. The session started with a concise introduction to the topic of the panel discussion. Dr. Maskey talked about the focus of the discussion. He addressed practicality, potential challenges, and limitations of the current drone ecosystem in Nepal; special for medical logistics as the main focus of the session. He added the exploration of roles of public and private organization in developing this ecosystem will also be touched. In order to converge the response towards the focus Dr. Maskey also summarized that the discussion expects outcomes in areas like drone permission process streamlining, public-private partnerships, awareness and education, identification of major policy gaps, drone innovation hubs establishment.

The discussion started with Dr. Maskey questioning Mr. Raju Shrestha about CAAN's approach towards implementation and update of drone regulations and policies. Mr. Shrestha shared that CAAN has rules, regulations, and guidelines effective in tandem. These rules are being developed and implemented as per international standards such as ICAO model UAS Regulations Part 101 and 102, and ICAO Part 4 Annex 6. A checklist has been developed that covers the permission requirements and necessary procedure for registration of drones. He told the panel that CAAN has been updating its drone policy and regulations in line with ICAO standards. Following up on that, Dr. Maskey further questioned Mr. Shrestha about the challenges in acquiring drone permission and registration to which he answered that CAAN has made the procedure open to access for all through their website. He adds that the documents from the checklists can be uploaded through their online portal and the registration can be completed within half an hour. However, he indicated there is a lack of awareness and communication gap that has made it seem difficult.

The discussion further shifted towards Mr. Arjun Poudyal as Dr. Maskey questioned him about the Home Ministry's approach towards drone permissions request handling. Mr. Poudyal responded that the Home

Ministry tries to expedite the process as much as it can. He adds the process is not difficult per se, and Home Ministry, at an individual level, won't take long. However, he says the process involves multisector approval, so it adds to the delay. Dr. Maskey further questioned him about the challenges the Home Ministry has been facing while monitoring drone activities in Nepal. Mr. Poudyal replied that the lists of challenges for the ministry are longer than for the users. He said the limitation of regulation reflects on the controlling and monitoring of drone use. He adds the rules only allow confiscation of the drone if found to be used without permission. This low consequence punishment has made the public ignorant. He adds there should be stringent rules from a security perspective. It is further assured that the request when presented for humanitarian application will be processed with ease without compromising the security.

The discussion was drawn towards the health sector with Dr. Maskey questioning Mr. Deepak Karki about the relevance of drones in the health sector of Nepal. Mr. Karki established that the integration of technical parts in social service is much needed in Nepal, especially in the health sector. He presented that only 1.3% of the health facilities have prompt access to life saving medicines. The major challenges lie in procurement, supply chain, and transport of such medicine. He adds the availability of medicine hinders the supply chain and this situation is directly against the fundamental right to health. He added that integrating technology into this can be extremely useful and can shift the paradigm completely.

Shifting the direction of the discussion, Dr. Maskey asked Mr. Shrestha about activities that can curate a more drone friendly ecosystem. Mr. Shrestha clarified that the conventional aviation system sees "drones" as airspace "intruders". He weighed that such technology poses life-threatening risks to low flight operation aircraft and helicopters. He says the only way out is to develop procedures and operation rules that will segregate these conventional aerial vehicles and UAVs.

In the same way, Dr. Maskey stirred conversation towards the engagement of different stakeholders in drone operation. He asked Mr. Poudyal about the areas of coworking among different stakeholders. Mr. Poudyal objectively suggested that the government is willing to work with different stakeholders from the root level. Activities like policy development, and regulation updates are to be proposed by private sectors. He said the government may be reactive in innovation, but the private sector can push us to curate such innovation through project formulations. He further pointed out that a multi-ministry, multi-stakeholder discussion should be ignited as there are other ministries that are directly benefited by such activities. He adds a segregated use case report of drones relevant to different industries can be developed to ensure the relative use strength and can be a guiding document for the government as well.

Coming back to the health sector, Mr. Karki was questioned about the potential drones carry in improving the livelihood of rural people. Following up on that thought, he was asked about UK Aid's vision for drones and Nepal. Adding up on that, discussion on feasibility for drone production in Nepal was also ignited. Mr. Karki responded that integrating drones and similar tech in the supply chain system is required. He shared that all 7 provinces have medical stores and the challenge lies in reaching the last mile. Drones can reduce inefficiencies, and can tackle that. On development of local drones, he suggested that UK aid is always willing to support innovation in science and technology. However, he mentioned that government ownership in such a project is required. In order to establish a sustainable model, he requested the government to take ownership in such projects while the private sector can lead and support them during implementation.

The collaboration between private business and government was discussed with Mr. Shrestha as well. He recalled past activities that have been conducted under CAAN involving such partnership. Reinforcing the multi-stakeholder approach, he said a holistic policy that fosters diverse use cases should be established through engagement. Mr. Poudyal's thoughts on the topic were similar. While shedding light in disaster risk management, he talked about the ministry being positive and willing in expediting drone permission for emergency usage during disaster and calamities. Dr. Maskey suggested that drones may be useful in regular monitoring for disasters.

The panel also addressed a few questions from the participants. The involvement of private organization during formulation of drone policy was questioned to which Mr. Raju recalled a few such engagements where different stakeholders were involved. He pointed out that as a member country of ICAO, such engagements are mandated by ICAO and they are happy to lead such meaningful events. He was further questioned about the difficulty experienced by drone operators in getting permission. Mr. Shrestha clarified that a non-negotiable for CAAN is flight safety so the current operating laws are as easy as it gets. He said there are challenges in tracking, and monitoring of lost UAVs. He took an example of the UAV incident in Heathrow Airport, UK and established the sensitivity of the issue. Lastly he was asked about the status of confiscated UAVs that were auctioned. He responded that the returns are governments property and were handled with clear transparencies. Finally, he responded that development of innovative operation procedures can be discussed and researched further in close collaboration with CAAN to ensure both applicability and safety. Mr. Poudyal addressed the participants by acknowledging the lack of resources while establishing the willingness to initiate policy updates. He said private sectors hold the responsibility of provoking government agencies in such involvement. He requested private sectors to conduct research, develop robust proposals, and implement plans and approach the government to establish a coherent and holistic drone ecosystem.

Key takeaways

- A multi-stakeholder hub and network should be established that can work in close collaboration in all stage of planning, policy making, and implementation.
- Drone industry in Nepal is still evolving. All the private sectors who are involved in this industry also need to coordinate, collaborate and approach respective government organizations for necessary policy reforms. Beside that , the private sector themselves also needs to be engaged and involved in awareness building activities as more negative and irresponsible drone activities have increased in recent days.
- Health sector will benefit from drone integration however, other sectors that can be benefitted should be clearly identified. Government is interested to see a study of all of the major use cases of drones as per the different sectors such as survey, healthcare, photography, agriculture etc. have been identified and compiled. It would be an interesting reference book for the government to understand different possible applications and consider that during next policy reforms.
- Policy gaps exist as the current permission procedure processes all permission requests in the same manner without considering the tactical difference of locations and area of interest.
- More inter agencies coordination is needed among different government ministries as regulating drones is a concern for multiple government organizations. The representatives mentioned a commitment to organize more internal discussion sessions in this regard.

- Airspace and national safety is non-negotiable for CAAN and MoHA. The current restrictions for flights in sensitive areas are placed with careful consideration of the weight of the issues. Updates are possible only when no compromise to national security is observed.
- Support organizations expect government ownership in most initiatives related to such technology integration to ensure sustainability in the long run.
- CAAN and MoHA are willing to curate and collaborate with private organizations that are working in this sector and will be inviting them to most awareness campaigns and policy discussion meetings.
- Current regulations are functional yet incomplete so the organization will be updating them as per new findings and updates to international standards such as ICAO Annexes.
- Health sector will unarguably and evidently benefit from logistical drone usage for countries like Nepal; however, a robust policy and permission system that support such a program is needed.

9. Drone Applications in Nepal and Issues faced by private sector

Mr. Raj Bikram Maharjan, CEO at Airlift, and Galli Maps, shared his experiences regarding drone applications in Nepal. He is one of the pioneers when it comes to the use of Drones in Nepal. He began his presentation with his personal story back in 2010, where he used to work with RC planes. He then recalled his undergraduate studies in China when there was a popular news article about RC planes being used to keep an eye on rhino poachers in national parks of Nepal. This news broadened his mindset of using technology for good.

Following up on the anecdote, he shared how the 2015 earthquake shook Nepal to its core. He reflected that this event pushed him to find a solution in reconstruction and preservation. Usage of photogrammetry where 2D photos could be merged into 3D models assisted in such activities. He added that he started taking aerial images of heritage monuments from a drone and converted them into accurate 3D models. These ventures were later supported by WeRobotics and Nepal Flying labs and now they converted that into a business model for sustainability.

His experience with the commercialization of the idea was hurdled. He shared that the lack of clear drone operation policy has been an obstacle in scaling these ideas. The introduction of the, now effective policy of MoHA, has already lifted a heavy burden from his way however he claimed a lot of work is yet to be done. He claimed that several other use cases such as medical delivery, search and rescue, large scale mapping and agriculture, the then regulation was still a hurdle.

Further he drew the attention of the parties focusing on private sectors and commercial drone operators needing to come together to help government agencies formulate a new regulation that would ensure public and air safety as well as boost innovation in drone applications. He believes Nepal has a chance to become a leading player in the field of UAVs, its development and applications. He listed some examples of usages such as drones being used for search and rescue during 2015 earthquake, finding trekkers stuck in an avalanche, use for heritage reconstruction, control poaching and medical delivery.

He also proposed some solutions to the government to deal with the existing challenges and issues that the private sector is facing. He recommends some measures and immediate next steps such as formation of a multisectoral group involving representatives from multiple sectors to deal with the issues with the technology, more investment from government to create awareness among the public, use of digital systems to regulate and monitor drone activities, and about the need for drone dedicated spaces to promote drone based innovations.

Key takeaways

- Establishment of multisectoral group of stakeholders that can come together for policy making and implementation.
- Drone awareness campaigns should be organized more frequently to warn the public about the appropriate usage of such tech.
- Add space to curate drone-based innovation within the nation.
- A system to regulate, monitor, and control drone activities is required as the first priority.

10. Closing Session

Mr. Uttam Pudasaini, Executive Director gave a closing remark and the program ended formally. Speaking during the closing session, Mr. Pudasaini thanked all the speakers and guests who participated in the event. He showed his appreciation towards the technical team, organizer team, participants, and all the management. He addressed the event committing to organizing such interaction in the near future and working towards the establishment of the network of drone stakeholders. He briefly talked about the exemplary deed of Nepal flying labs and requested all the stakeholders to curate such drone initiatives to leverage the full potential of such technology in order to propel the development in an efficient manner.

Annex 1: Agenda, Participants and International Speakers

Annex 1: Agenda of the workshop

09:00-09:30	Breakfast & Registration	
09:30-09:45	Welcome and objectives of the workshop	Pradeep Poudel, Options
09:45-10:00	Opening remarks	Dr Madan Kumar Upadhyay, Chief, Quality, Standard and Regulation Division, MoHP
10:00-10:30	Keynote speaker: Drones in Healthcare: Current Status, Challenges Opportunities and Economic Analysis	Olivier Defawe, Director, Drones for Health Solution Lead, VillageReach
10:30-11:00	Keynote speaker: World Economic Forum's Medicine from the Sky` Drone Delivery Programme	Vignesh Santhanam, India Lead, Aerospace & Drones at World Economic Forum
11:00-11:30	Embedding drones in the health system to reach last mile: Health sector needs and potentialities	Dr. Guna Nidhi Sharma, Senior Health Administrator, PPMD, MoHP
11:30-12:00	Flying medicines over mountains: Lessons learnt from the study in Rukum East and Humla district	Pradeep Poudel, Options Pukar Parajuli, NFL Biva Rajbhandari, Options
12:00-12:30	Unmanned Aircraft (RPA Popularly known as Drones) flying related procedures, 2019 and Its Implications	Antosh Pradhan, Section Officer, Ministry of Home Affairs
12:30-01:00	UAS Operations in Nepal: Challenges and Mitigation Measures from CAA Nepal's Perspective	Samrat Pradhan, Aeronautical Engineer, Deputy Manager, Civil Aviation Authority of Nepal
01:00-01:45	Lunch Break	
01:45-02:15	Experiences of Operating a Medical Drone Delivery Project in India	Vikram Singh CEO & Founder at TechEagle, India
02:15-02:45	Flying into the future: How drones can improve access to health care	Hammad Jeilani Co-Founder and Medical Director, Apian
02:45-04:05	<p>Panel Discussion on “Drone Ecosystem in Nepal: Current Applications, Opportunities and Challenges”</p> <ul style="list-style-type: none"> ▪ Raju Shrestha, Director, Civil Aviation Authority of Nepal ▪ Arjun Poudyal, Under Secretary, MoHA ▪ Dr. Deepak Karki, Health Advisor, British Embassy Kathmandu 	Moderated by Prof. Dr. Ramesh Kumar Maskey, NAST

04:00-04:15	Issues faced by private sector regarding drone applications in Nepal	Raj Bikram Maharjan CEO- Airlift, Galli Maps, Nepal
04:30-05:00	Closing session followed by Hi-Tea	

Annex 2: List of participants

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59	Pushpa Rai	Nepal Flying Labs				
60	Smarika Rijal	Nepal Flying Labs				
61	Anup Aryal	Nepal Flying Labs				

Annex 3: Brief biography of the international speakers

Dr Olivier Defawe is an innovation development and global health expert. He leads a portfolio of innovations to improve healthcare access in low/middle-income countries. Olivier's 17+ years of experience working in Africa makes him savvy in navigating local challenges and influencing strategic partnerships to achieve success. He also leads VillageReach Drones for Health program and oversees the deployment of drone transport services in Mozambique, Malawi, the Democratic Republic of Congo, and Central African Republic. Finally, Olivier is the founder and co-coordinator of the UAV for Payload Delivery Working Group, a global community of over 350 stakeholders involved in the advancement of drone technology for use in supply chain systems. Olivier holds a PhD in Biomedical Sciences from the University of Liège in Belgium.

Mr Vignesh Santhanam is the India Lead for Aerospace and Drones at the World Economic Forum India Centre. He was instrumental in the design and commissioning of the flagship 'Medicine from the Sky' program which is now being scaled to the Himalayan belt of the country. A software engineer and a MBA by qualification, Vignesh has over 13 years of Industry experience having handled technology accounts in Warsaw, Singapore, North America, North Africa and the Middle East. He was also the first President and Founding Member of the Drone Federation of India – the voice of India's UAV industry that focuses on industry advocacy, governance, and policy.

Mr Hammad Jeilani is Co-Founder and Medical Director, Apian. Hammad is a doctor and an NHS Clinical Entrepreneur. Together with Chris and Alex, he founded Apian, a medical drone logistics startup delivering faster, smarter and greener healthcare. Hammad is passionate about reducing health inequalities at scale and believes drones will transform how we interact with healthcare through just-in-time logistics and the data that comes with it. He studied his Masters at LSE in Health and International Development, obtaining a specialism in Applied Development Economics. His dissertation was titled: "Drones in healthcare: a global review and case study in Nepal".

Mr Vikram Singh is CEO & Founder at TechEagle, India. Vikram Singh Meena is a visionary leader, innovator, and entrepreneur with a mission to revolutionize the last-mile and mid-mile logistics industry using drone technology. Vikram has over 10 years of experience in the aviation & drone industry. He is a drone tech innovator by passion and has won several national and international awards, including the Boeing, Lockheed Martin & NASA organized events. He founded TechEagle in the hostel garage of IIT Kanpur with the vision of building the world's largest on-demand drone logistics airline to save and improve billions of lives. His company Tech Eagle is revolutionizing last & mid-mile connectivity with in-house developed end-to-end drone delivery technology. Company has launched Asia's 1st Drone Delivery Network with the World Bank and Govt of Meghalaya to deliver healthcare products in the state. In 2022, his name was listed in the Forbes 30 Under 30 Asia Magazine