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Cost-Effective Analysis of Supplying Essential Food Materials to Indian Armed Forces through Drone Application Versus Conventional Transport by Army Trucks

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Abstract: BA stands for cost-benefit analysis. Comparative advantage analysis serves as an economic evaluation technique that quantifies the positive and negative outcomes of a particular intervention or program regarding financial worth. By assigning monetary value to all program outcomes, decision-makers can directly compare the results of various decisions. This research paper provides an overview of the Indian Army drone application, including its motivation, methodology, implementation details, and future scope. The objective of the application is to equip soldiers with the ability to choose the most appropriate drone for payload delivery tasks based on load weight, thus improving operational efficiency and effectiveness. The primary purpose of this application is to shield the tourism and hospitality sectors from the destructive effects of weapons and shelling. The drone also minimizes the impact of sending these pots, arms, and ammunition by heavy vehicles, minimizing the impact of heavy vehicles damaging hilly areas, which are prone to landslides that further damage the soil and surrounding vegetation.

Keywords: *Drone selection, Weapons, Load weight, Indian Army, Supply chain application, Mobile application regenerative plants.*

1. Introduction

This topic is essential because of these figures. With its 1,230,000 soldiers on duty, 960,000 reserve troops, and 158 aircraft, the Indian Army is responsible for defending against harsh terrains and is ranked as the world's second-largest armed force (Sankriya, 2013). The drone ecosystem can deliver essential food, medical aid, ammunition, weapons, and winter uniforms to troops stationed at high altitudes in forwarding regions at the right time and sometimes even at the correct hour. The aim of incorporating new drones into the Indian Army is to achieve self-sufficiency in acquiring and maintaining fresh capital, including ammunition and spare parts, for continuously operating equipment and weapon systems (Dr. Gagandeep Kaur and Priyanka Panday, 2019). They enhance mobility in forward areas and enable quicker responses to contingencies by providing improved equipment, such as all-terrain vehicles. According to the study, this unique supply chain can clean up the dirtiest parts of war-ravaged areas, such as Poonch and Drass. Drones can transport regenerative plants and herbs capable of repairing soils damaged by bombs and missiles in conflict zones, (Parya Broomandi, Mert Guney, Jong Ryeol Kim and Ferhat Karaca, October 2020) preserving natural vegetation in the forward direction; these areas are supposedly the cleanest places on Earth due to their geographical proximity to the Himalayas. The soldiers can send these plants according to their commanders' instructions by clicking on the unique Indian-Drone management supply chain application. A survey of people likely to have thoughts on the subjects will be conducted before settling on a course of action. All will be given access to this application to provide feedback on various functions and uses to enhance this unique application. This investigation aims to discover how the different modes of transportation aid Indian armed forces in reducing their total logistical expenses.

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2. Literature Review

How can the typical supply chain of a supermarket or military supply chain be defined? Three distinct chains can be found in an army supply chain (Maj Gen Rajan Kochhar, 2021). It moves things quickly, such as food, medicine, and clothes, like a Walmart (Sankriya 2013). Second, it carries essential weapons that must be maintained and fixed over time. The Army moves many soldiers quickly and under trying conditions in the deployment chain. The Army teaches a weapon to its soldiers, and it is entirely accountable for its upkeep, improvement, and disposition, even if its user keeps changing. Considering the variety of terrains within India, devising reliable, secure, and quicker methods for delivering goods and services to particular locations is crucial. What is the solution to creating a supplier ecosystem for the industry in India? The drone ecosystem can deliver food, vital supplies, medical assistance in an emergency, ammunition, weapons, and winter clothing to troops stationed high in forwarding regions. Low-intensity conflicts, high-altitude Himalayan border areas, and lifting 100 kg stores are some things they can do.

3. Research Objectives

● To analyze the cost-benefit analysis of supplying essential food materials to armed forces by Drones.

● To determine how the different modes of transportation help Indian armed forces reduce total logistics costs.

● To assess the limitations of new drones and find ways to enhance the entire supply chain system.

4. Statement of the Problem

The Indian Army needs to have enough ammunition and spare parts to keep their equipment and weapons working. This helps them buy new things and stay alive. Moreover, UAVs, uncrewed ground vehicles, and counter drone system mobility solutions can be used to obtain better gear to respond to unforeseen events faster. Budget constraints necessitate implementing cost-cutting measures for defense systems, as they are crucial for ensuring the highest return on investment over the entire lifespan of today's major defense systems, which spans more than 30 years.

5. Hypothesis

● Ho1: There is no effect on the cost of transporting goods via cargo drones.

● H1: There is a significant effect on the cost of transporting goods via the use of cargo drones.

● Ho2: There is no effect on the total inventory management cost of using an innovative supply Chain management application.

● H12: There is a significant reduction in the total cost of military inventory management when uses an innovative supply chain management application.

● Ho3: Using drones to carry regenerative plants does not affect the improvement of soil quality under war zone areas.

● H13: Using drones to carry regenerative plants significantly affects soil quality under war zone areas.

● Ho4: There is no significant relationship between transportation charges by trucks and cargo drones.

● H14: There is a significant relationship between truck transportation charges and cargo- drones.

6. Research Questions

6.1. What is the best way to cut costs on drone flights or make them cheaper than other modes of transportation, such as motorcycles or pick-up trucks, while still providing the same or better levels of security and support?

6.2. Furthermore, most online retailers charge their delivery partners approximately 30 rupees per household for each delivery; can drones compete at this level? The success of a business depends on how well different types of transportation work together.

6.3. Are drones for cargo going to be a big deal in India's logistics? Various human resources,

infrastructures, network designs, awareness levels, and cost obstacles are crucial for ensuring

the viability and promotion of commercial drone usage in India.

6.4. To enable commercial drone flights, it is crucial to consider the potential situations, such

as delivering life-saving medications and perishable goods in a pinch. Those perks are

priceless. A high adoption rate that would lead to an amount reduction through economies of

scope are essential for drones to become commercially viable.

6.5. Can drones carry plants that can regenerate soils damaged by bombs and missiles in war zones, protecting the natural vegetation of forward regenerating areas, to be the cleanest places on earth because of their geographical location near the Himalayas? Clicking on the unique Indian-Drone management supply chain application allows soldiers to send these plants according to their instructions.

6.6. The best way to clean up the most contaminated land and soil in war-zone areas such as the Poonch district and the Drass sector? Which plant is best for removing toxic residues such as lead, aluminum and major toxin compounds that can lead to soil loss and adverse health effects?

6.7. The drone also minimizes the impact of sending these pots, arms, and ammunition by heavy vehicles, minimizing the impact of heavy vehicles damaging hilly areas, which are prone to landslides that further damage the soil and surrounding vegetation. The prompt delivery of any essential item from drugs for wounded soldiers or plants is crucial, not only because it covers greater distances in shorter periods but also because it pinpoints precise examples in front of the colonel barricade.

6.8. The new logistics plan has four parts: a digital system, a single platform for logistics, a -logistical system, and a group for improving the system. The initiative involves integration of thirty designs from seven departments. Road transport, railways, Customs, air travel, and commerce are departments whose data are integrated into the system. Integrating drone policy into the PLI plan encourages drone use in the logistics sector.

6.9. The Indian Army has recently requested bids for 1,000 surveillance helicopters, employing the expedited procedures granted to the defense forces for last-minute purchases. In addition, the Army provided detailed instructions for 80 small planes that can be controlled remotely. This is part of the same process for buying emergency equipment. Can we use the fast-track process to obtain drones to deliver emergency food?

6.10. At present, seven percent of the total defense budget is allocated to public sector units such as ordinance factories and DRDO; this figure can be separated from the defense budget and placed under 'Research grants' as applicable to ISRO to increase the number of headmen. The Indian Army needs a head to modernize it. Do you agree with this point of view, or do you have other thoughts?

6.11. The authorities emphasized the disparity between capital and revenue expenditures, stressing the need to improve the ratio of defense services to capital expenditures. The main objective is to rethink ways to reduce costs, in line with India's goal of reducing logistics costs to a few digits.

7. Research Methodology

The investigation was both exploratory and descriptive. To move forward and fulfill the purpose of the inquiry, we will examine the primary data sources. A survey of people likely to have thoughts on the subjects will be conducted before settling on a course of action. In total, 1300 drone employees (drone pilots, drone copilots, drone safety managers, drone air traffic controllers, logistics heads, CEOs, logistic managers, helicopter pilots, and civil and military veterans) will be contacted. This application can be used to provide feedback on various functions and uses to improve it.

7.1. Delphi technique

Intuition and an interdisciplinarity approach are essential for making modern décisions. Over the past few years, more intuitive techniques have been developed. The Delphi technique is one of the most successful methods for this purpose. First, the Delphi methods is mainly used for predicting future events ; however, it is now also used to make group guesses to make predictions or decide which events will occur first. The Delphi method is often used in economics, engineering, medicine, and other fields to predict technology and make choices. The Delphi method is a standard way to investigate these issues. In this process, a group creates a questionnaire that they send to more interested people. After the questionnaire was returned, the group reduced the results and created a new group that used the results of the team to answer. The group that answered is usually given one chance to reconsider their answers after looking at the group's response.

7.2. Structured questionnaire and interviews

The questionnaire comprises two parts. This first part contains questions to help us study the logistics of the Indian Armed Forces and to determine how the different modes of transportation help the Indian armed forces reduce its total logistics cost. A cost-benefit analysis of supplying essential food materials was also performed for the latter half of the questionnaire. The necessity for self-sufficiency in new capital procurements and sustenance encompasses procuring ammunition and spare parts to ensure the operational viability of equipment and weapon systems, and is the goal of adopting new drones to supply the essentials at minimum cost for the Indian Armed forces.

8. Background on Strategic Planning

When there are problems worldwide, such as recession, more expensive fuel, political uncertainty, and the COVID-19 pandemic, we are far from the rest of the world. This is especially true for air travel. The sector requires radical ree-imagining, undergoing transformations, and the pursuit of inventive approaches. Throughout history, numerous innovations have occurred during epidemics, which makes it imperative to follow as many new ideas as possible. In the present structure, it is possible to modify the management approach, which is when innovation assumes greater significance. The ability to anticipate and anticipate these events can prove crucial, particularly in timing and positioning. The air transportation industry will likely undergo significant transformations in the coming years, but what is the question? How will we change and adapt to these new times of the pandemic? (Francisco Serrano, Antonin Kazda, 2020). What will the passenger traffic be like after the pandemic is over? Innovation must serve as the instrument that facilitates the resolution of these inquiries, a deeper comprehension of the new circumstances, and a means of adapting. The new Indian Army drone hangars and airfield enhancements to meet growing demand based on a commitment to fight climate change, reached the Level 4 Transformation of Airports Council International and World's Airport Carbon Accreditation program. To attain this accreditation, a practical solution for any airport is to continuously address broader carbon footprint emissions, including all the significant operational sources on-site and off-site.

Furthermore, defense airports must demonstrate evidence of actively engaging and leading all their stakeholders toward reducing emissions and adopting automatic drone vehicles to help passengers be easily guided through the drone terminal building to gates to the nearest metro rail or another connecting terminal. Introducing fresh tech and

cutting-edge methods is essential for current and future airport growth. Leading companies and countries use innovation as a driver of their strategic planning and growth policies. The reason is simple: innovation is constantly adding to worth and wealth, and while it requires financial support and investment, the most crucial assets are knowledge, abilities, and investigation. For upcoming aeronautical drone development, we need to improve the effectiveness and capacity of drones, generate fresh sources of income, provide high-quality and effective services, and minimize the environmental impact of drones. We are amid an unprecedented technological transformation, altering industry boundaries. As soon as we do not develop new ideas, others will. We stay ahead with ingenuity, grow, and make a difference. Inventing will help us grow together and move forward at the same time.

8.1. Innovative operations and maintenance management

This program enhances operational and upkeep procedures by employing cutting-edge technologies to improve effectiveness. At the Aena airports, new technologies such as video analysis, the Internet of Things, and self-driving cars will be developed (Pablo Lopez Loeches, 13th April 2020). Airport 4.0 is a computer program that helps make things easier for passengers and better for the environment. This includes using biometrics for identifying people online, making money, caring about the environment, helping customers, protecting the environment, and using intelligent ways to manage services. Making drone air cargo more efficient and better by using computers instead of paper can make it faster and better. Airports need to be connected to other modes of transportation, such as drone highways and drone metro stations, so that people can quickly travel to all the different parts of the country. We should focus on handling cargo quickly and reducing the time it spends in storage. The goal is to reduce the retention period for exports from the current level of 96 hours to 12 hours and for imports from the current four-week range to twenty-four hours, in line with globally accepted standards. The clearance of cargo will occur around the clock. An infrastructure for drone cargo handling, such as satellite cargo cities with multimodal drone transport, drone cargo terminals, drone cold storage and extraction systems, mechanized drone cargo transportation, computerization, and automation, will be established. These facilities must also be built in smaller or isolated places.

8.2. Indian Army remote control towers for drone operations

All greenfield airports are improving the security, operation, and efficiency of air traffic services through new technological functionalities. Considering the necessary sum of cash, we can conclude that the solution to all these issues lies in integrating private capital into this category. We need to be open and positive about new ideas and projects to encourage this. We are considering collaborating with other countries to build or improve new airports. The private sector is becoming more involved because the government does not have enough money to build airports. The transition from monopolistic state ownership of airports to corporate rights is occurring worldwide. The ultimate goal is for drone privatization to change ownership and management.

9. The Supply Chain Application for the Indian Army Drone Selection Based on Load Weight

The Indian Army now has its first-ever supply chain application that is helping to suggest approaches for enhancing situational awareness and operational effectiveness through the integration of unmanned aerial vehicles (UAVs) or drones. With diverse operational challenges, the Indian Army requires efficient tools to aid in drone selection based on load weight considerations. The new application provides an intuitive interface for soldiers to input load weight and number of items, and select an appropriate drone from a predefined list. The app then evaluates the compatibility of the chosen drone with the specified load and provides real-time feedback to the user.

9.1. Application development methodology

The development of the Indian Army drone selection application involves several key steps:

9.1.1. Requirement Analysis: Understanding the specific requirements of the Indian Army regarding drone selection criteria, user interface preferences, and operational constraints. Several news articles and research papers on the problems faced by soldiers in the upper regions of the subcontinent were found. Additionally, the types of drones available and their loads were further studied so that they could be implemented without any hinderances.

9.1.2. Design Phase: Creating wireframes, user flow diagrams, and mockups to visualize the application's structure and interface. Several GUI beta tests were used to determine the accessibility and comfort with which a soldier can use this application.

9.1.3. Implementation: The application was developed using the Kivy framework in Python, which allows for cross-platform compatibility and rapid prototyping.

9.1.4. Testing and Validation: Thorough testing is conducted to ensure that the application functions are correct under various scenarios and load conditions.

9.2. Implementation

The implementation section provides a detailed overview of the technical aspects of the Indian Army drone selection application.

9.2.1. Kivy Framework: The application is developed using the Kivy framework, a Python library for developing multitouch applications. Kivy allows for the creation of cross-platform applications with a consistent user interface across different devices and platforms.

9.2.2. Screen Management: The application utilizes Kivy's ScreenManager to manage multiple screens. The ScreenManager enables navigation between different screens within the application. In this case, the Homepage class serves as the main screen for the application.

9.2.3. Homepage Layout: The Homepage class defines the layout and functionality of the application's homepage. It extends the Screen class provided by Kivy. The homepage layout is structured using a box layout with vertical orientation and padding for spacing.

9.2.4. Indian Army Logo: An image of the Indian Army logo was added to the homepage using the image widget. The source attribute specifies the path to the image file, and the size attribute sets the size of the image within the layout. The logo is positioned at the top right corner of the screen using the pos attribute.

9.2.5. User Inputs: The homepage provides input fields for the user to enter the load weight and the number of items. The two-label widget display prompts for entering the load weight and items. Two TextInput widgets allow users to input numerical values for load weight and items.

9.2.6. Drone Selection: The homepage includes a dropdown menu for selecting a drone from a predefined list. The Spinner widget is used to create the dropdown menu, with options populated from the keys of the self. Drones dictionary.

9.2.7. Submit Button: A Button widget labeled "Submit" was added to the homepage. When pressed, the button triggers the show_selection method, which evaluates the selected drone's compatibility with the specified load weight and items.

9.2.8. Functionality: The show_selection method retrieves the user inputs for the load weight, number of items, and number of selected drones. It validates the input values and compares the load weight against the maximum weight capacity of the selected drone. Based on the comparison results, a message is displayed using the show_info method to indicate whether the selected drone can carry the specified load and items.

9.2.9.Error Handling: The application incorporates error handling to ensure that users enter valid numeric values for the load weight and items. If invalid values are entered, error messages are displayed using the show_error method to prompt users to enter valid values.

9.2.10. Popup Messages : Popup messages are displayed using the popup widget to provide feedback to the user. The show_info and show_error methods create popup windows with titles and messages to convey information or errors to the user in a clear and concise manner.

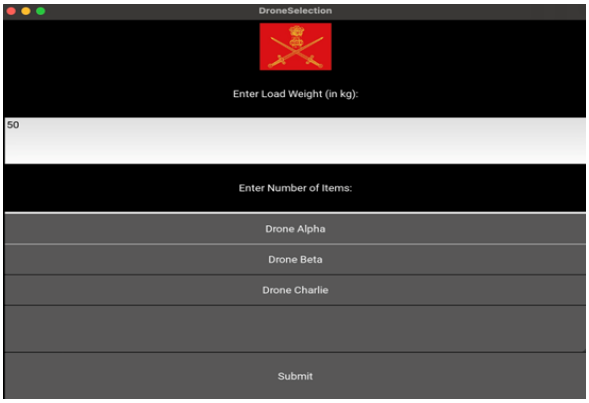
9.3. CODE

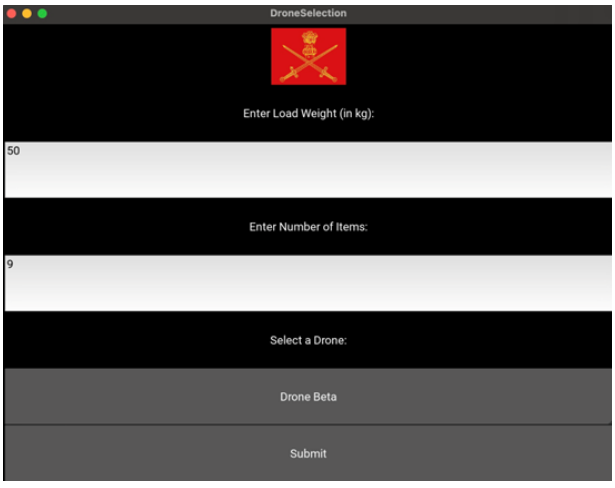
```
from the kivy.app import app
from kivy.uix.boxlayout import BoxLayout
from kivy.uix. label import Label
from kivy.uix.spinner import Spinner
from kivy.uix.textinput import TextInput
from kivy.uix.button import Button
from kivy.uix.popup import Popup
from kivy.uix.image import Image
from kivy.uix.screenmanager import ScreenManager, Screen
class HomePage(Screen):
    def __init__(self, **kwargs):
        super(HomePage, self).__init__(**kwargs)
        self.drones = {
            "Drone Alpha": {"max_weight": 50},
            "Drone Beta": {"max_weight": 150},
            "Drone Charlie": {"max_weight": 300},
        }
        layout = BoxLayout(orientation="vertical", padding=10)
        # Indian Army logo
        indian_army_logo = Image(source="indian_army_logo.jpeg", size=(50, 50), pos=(400, 400))
        layout.add_widget(indian_army_logo)
        # Weight input
    weight_label = Label(text="Enter Load Weight (in kg):")
        layout.add_widget(weight_label)
        self.weight_input = TextInput(hint_text="Enter weight")
        layout.add_widget(self.weight_input)
        # Item input
```

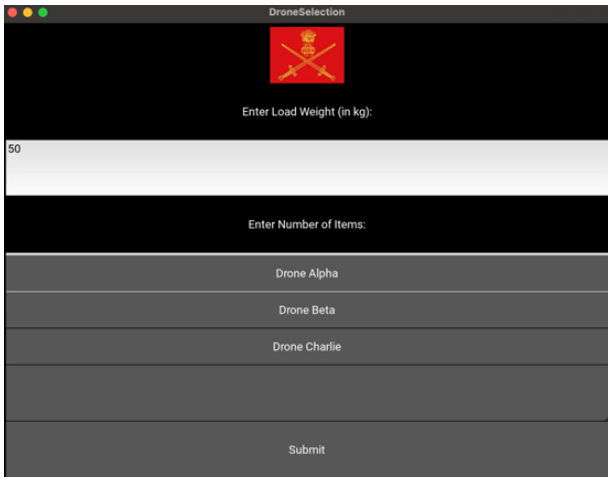
```
        item_label = Label(text="Enter Number of Items:")
        layout.add_widget(item_label)
        Self.item_input = TextInput(hint_text="Enter items")
        layout.add_widget(self.item_input)
        # Drone selection
        drone_label = Label(text="Select a Drone:")
        layout.add_widget(drone_label)
        Self.drone_spinner = Spinner(values=list(self.drones.keys()))
        layout.add_widget(self.drone_spinner)
        # Submit button
        submit_button = Button(text="Submit", on_press=self.show_selection)
        layout.add_widget(submit_button)
        self.add_widget(layout)
    def show_selection(self, instance):
        try:
            load_weight = float(self.weight_input.text)
            num_items = int(self.item_input.text)
        except ValueError:
            self.show_error("Error", "Please enter valid numeric values.")
            return
        selected_drone = self.drone_spinner.text
        max_weight = self.drones[selected_drone]["max_weight"]
        if load_weight <= max_weight:
            message = f"{selected_drone} can carry the load and {num_items} items."
        else:
            message = f"{selected_drone} cannot carry the load and {num_items} items."
        self.show_info("Selection", message)
    def show_info(self, title, message):
        popup = Popup(title=title, content=Label(text=message), size_hint=(None, None), size=(400, 200))
        popup.open()
    def show_error(self, title, message):
        popup = Popup(title=title, content=Label(text=message), size_hint=(None, None), size=(400, 200))
        popup.open()
class DroneSelectionApp(App):
    def build(self):
        sm = ScreenManager()
        home_page = HomePage(name='home')
        sm.add_widget(home_page)
        return sm
if __name__ == "__main__":
    DroneSelectionApp().run()
```

9.4. The results of the application

Preliminary testing of the application demonstrated its effectiveness as an easy GUI based application that can easily assist Indian Army personnel in drone selection tasks. The user-friendly interface and real-time feedback mechanism streamline the decision-making process, enabling soldiers to make informed choices regarding UAV deployment based on load weight considerations. Further discussion includes the usability, effectiveness, and potential limitations of the application. The results of the application are shown below:







9.5. Future features that will be added to this application:

We will add the recorded voices of the soldier's mothers to these applications, connecting these lonely soldiers working in harsh conditions and giving them more power to continue their duties to protect our nations from the crooks on the other side. We will also add the SPI feature to this application. The built-in simple-to-use feature, which recognizes the soil automatically, gives the soil pollution index of the sample, and then, on the resulting Value action, will be used to check soil pollution.

10. Suggestions

The Indian Army has more than 5 lakh items in its inventory with minimal stock visibility. The automation of supply chains and inventory management has had different results in the last 20 years (Rear Adm AP Revi, Jul-Sep2008). Thus, there is, an immediate need to absorb enabling technology with an adequate focus on human resource management. The acquisition lead time, in practice, is much greater than the time stipulated as per the Defense Procurement Procedure. A limited vendor base is another issue that urgently needs to be addressed. The current way of buying, fixing, and maintaining things must be replaced with a system that works together and follows the life cycle concept. Until recently, we continued to have military farms despite having the 'White Revolution.' We breed horses and mules when the country's Equine industry is well developed.

Transportation, catering, uniforms and accessories, repair and maintenance of vehicles/ equipment, and construction and maintenance of buildings are some of the outsourced noncore functions. An underdeveloped industrial base and communication network made it necessary to hold 180 days of war wastage reserves at independence. Industrial progress led to a reduction in reserve stock levels from 90 days to 60 days in 1979 (Col Sushil Chander, 2018). In 2010, the duration increased to 40 days and at an intense pace. We can also use this whole mechanism of transporting regenerative plants for our enemy Pakistan, as we believe in humanity and nonviolence, and we use technology for advancement, not for drugs and weapons, which our neighbor usually does to disrupt peace.

Are the armed forces ready to change? To meet future operational and logistics challenges, a roadmap for change must be developed and debated.

11. Conclusion

The development of a Comprehensive Logistics National Power Grid requires the integration of national logistics, infrastructure, and military logistics. The codification started in 2008 in India, and 30% of stock items have been codified in the last ten years. At this rate, we may achieve 100 % codification by 2038 or beyond, so our inventory will swell to 3 million items. The development of the Indian Army drone selection application represents a significant step toward enhancing operational efficiency and effectiveness in military missions. By leveraging modern mobile technology and user-centric design. principles, the application empowers soldiers with the tools necessary to select the most suitable UAV for payload delivery tasks. Future enhancements may include integration with additional drone specifications, optimization for performance and scalability, and deployment on mobile platforms for widespread adoption.

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Conflict of interest

The authors declare no conflicts of interest.

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