SMART CARGO - AI PRODUCT SERVICE PROTOTYPE DEVELOPMENT AND BUSINESS/FINANCIAL MODELING

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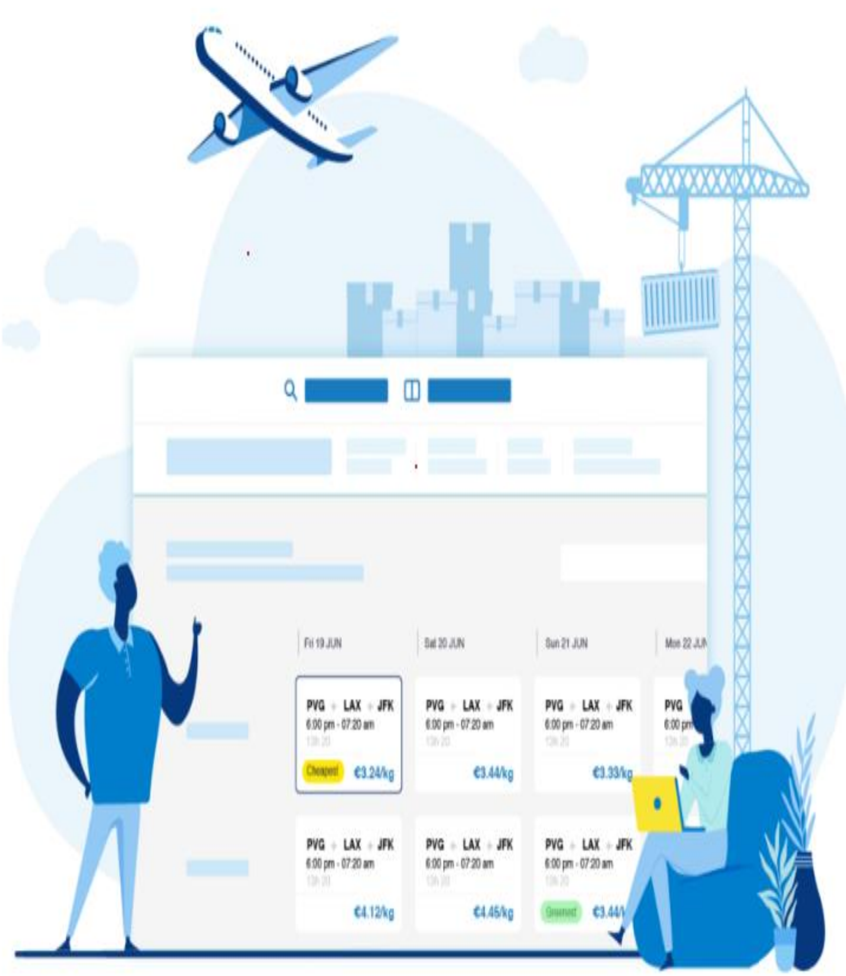

PROBLEM STATEMENT: The aviation industry has been facing several challenges in cargo operations, such as inefficiencies, low transparency, and high costs. These challenges have led to delays in cargo transportation, loss of cargo, and increased operational costs. Therefore, there is a need for a solution that can optimize cargo operations, increase transparency, and reduce operational costs.

-STEP 1: PROTOTYPE SELECTION

a. Feasibility: The Smart Cargo solution can be developed within the next 2-3 years, considering the availability of existing technologies and expertise in Machine Learning and AI.

b. Viability: The Smart Cargo solution addresses the long-term challenges faced by the aviation industry in cargo operations, making it relevant and capable of surviving for 20-30 years.

c. Monetization: The Smart Cargo solution can be directly monetized by offering a subscription-based service to airlines, cargo carriers, freight forwarders, and logistics companies. This ensures direct revenue generation.

STEP 2: PROTOTYPE DEVELOPMENT

The prototype of the SmartCargo solution involves the development of a Machine Learning model to optimize cargo loading on airplanes. While the details of the code implementation and model building are available in the provided GitHub repository (https://github.com/sudheernp/Smart-Cargo_Product-Design_ML-Model.git), a small-scale implementation using historical cargo and flight data is recommended to validate the effectiveness of the model.

	Activity Period	Operating Airline	Operating Airline IATA Code	Published Airline	Published Airline IATA Code	GEO Summary	GEO Region	Activity Type Code	Cargo Type Code	Cargo Aircraft Type	Cargo Weight LBS	Cargo Metric TONS
0	200507	ABX Air	GB	ABX Air	GB	Domestic	US	Deplaned	Cargo	Freighter	45423	20.604
1	200507	ABX Air	GB	ABX Air	GB	Domestic	US	Enplaned	Cargo	Freighter	106869	48.476
2	200507	ATA Airlines	TZ	ATA Airlines	TZ	Domestic	US	Deplaned	Cargo	Passenger	55427	25.142
3	200507	ATA Airlines	TZ	ATA Airlines	TZ	Domestic	US	Deplaned	Mail	Passenger	50278	22.806
4	200507	ATA Airlines	TZ	ATA Airlines	TZ	Domestic	US	Enplaned	Cargo	Passenger	74183	33.649

```
# Check the data types and missing values in the dataset
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 35599 entries, 0 to 35598
Data columns (total 12 columns):
 #   Column                       Non-Null Count  Dtype
---  ------                       --------------  -----
 0   Activity Period              35599 non-null  int64
 1   Operating Airline            35599 non-null  object
 2   Operating Airline IATA Code  35545 non-null  object
 3   Published Airline            35599 non-null  object
 4   Published Airline IATA Code  35545 non-null  object
 5   GEO Summary                  35599 non-null  object
 6   GEO Region                   35599 non-null  object
 7   Activity Type Code           35599 non-null  object
 8   Cargo Type Code              35599 non-null  object
 9   Cargo Aircraft Type          35599 non-null  object
 10  Cargo Weight LBS             35599 non-null  int64
 11  Cargo Metric TONS            35599 non-null  float64
dtypes: float64(1), int64(2), object(9)
memory usage: 3.3+ MB
```

```
# group data by Operating Airline and count number of occurrences
airline_counts = df.groupby('Operating Airline')['Operating Airline'].count()

# select top 10 airlines by count
top_airlines = airline_counts.nlargest(10)

# create a bar plot of the top airlines
plt.figure(figsize=(10, 6))
plt.title("Operating Airline Frequency")
plt.xticks(rotation=90)
sns.barplot(x=top_airlines.index, y=top_airlines)
plt.xlabel("Airline")
plt.ylabel("Frequency")
plt.show()
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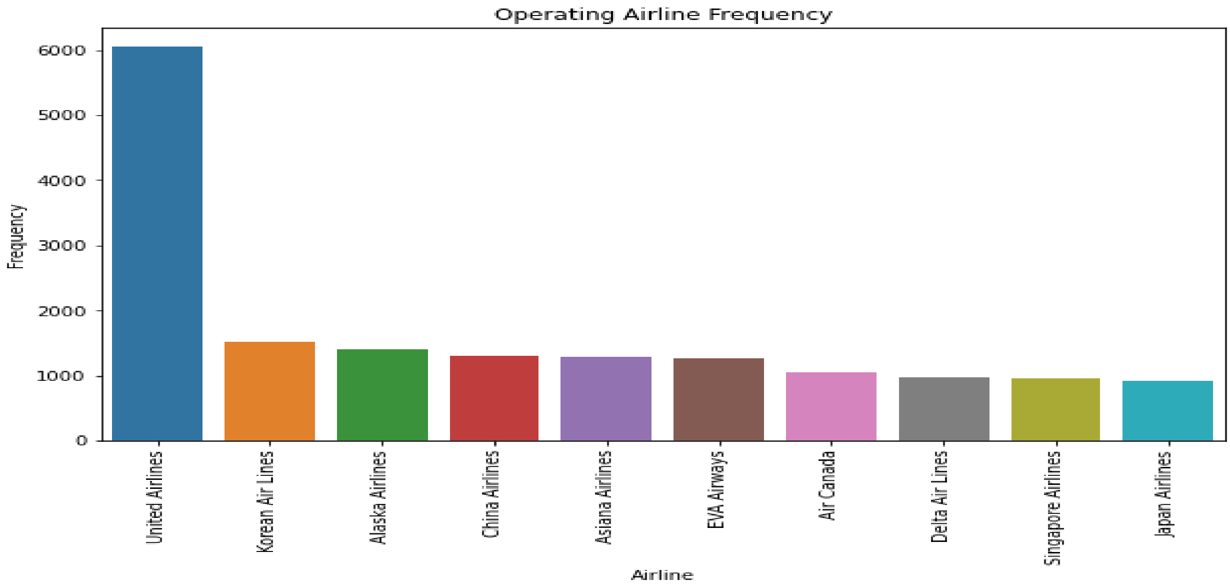
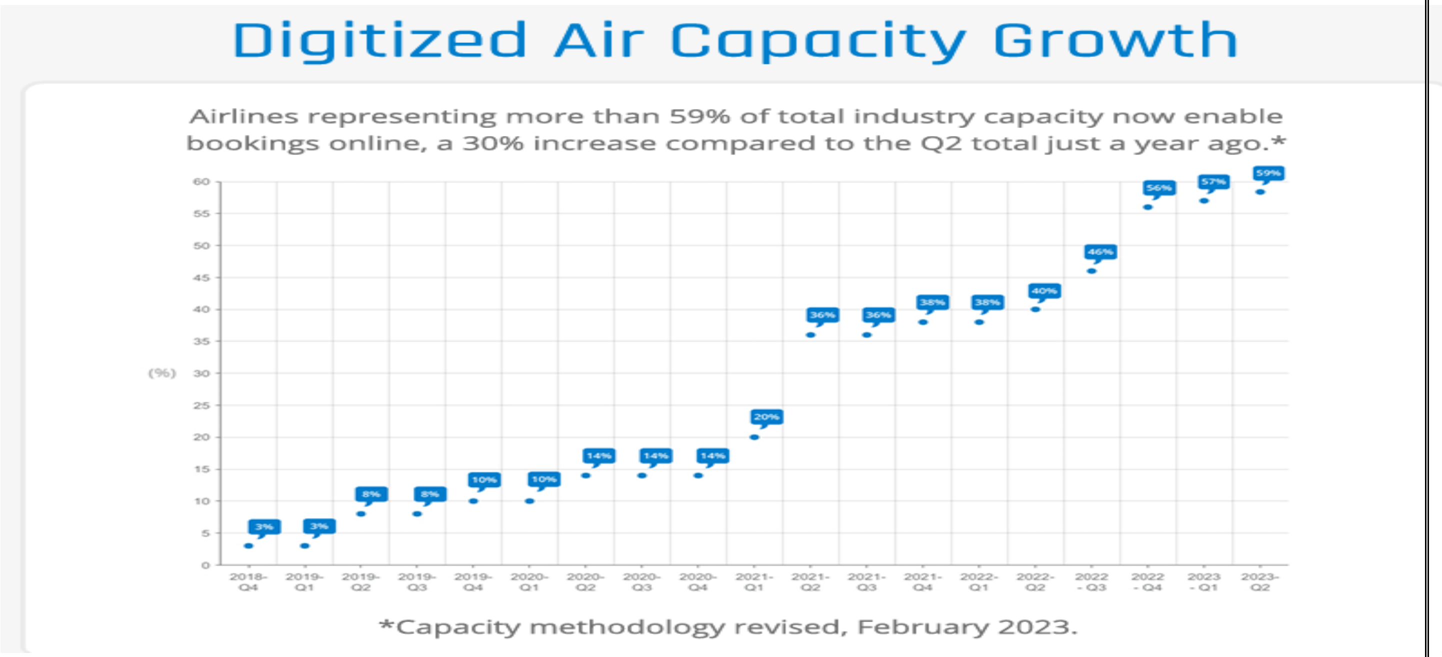


STEP 3: BUSINESS MODELLING

The target market for Smart Cargo includes airlines, cargo carriers, freight forwarders, and logistics companies in the aviation industry. The solution addresses their needs by optimizing cargo operations, improving transparency, reducing operational costs, and enhancing customer satisfaction. Market research, competitor analysis, and defining the value proposition are essential aspects of the business modeling process.

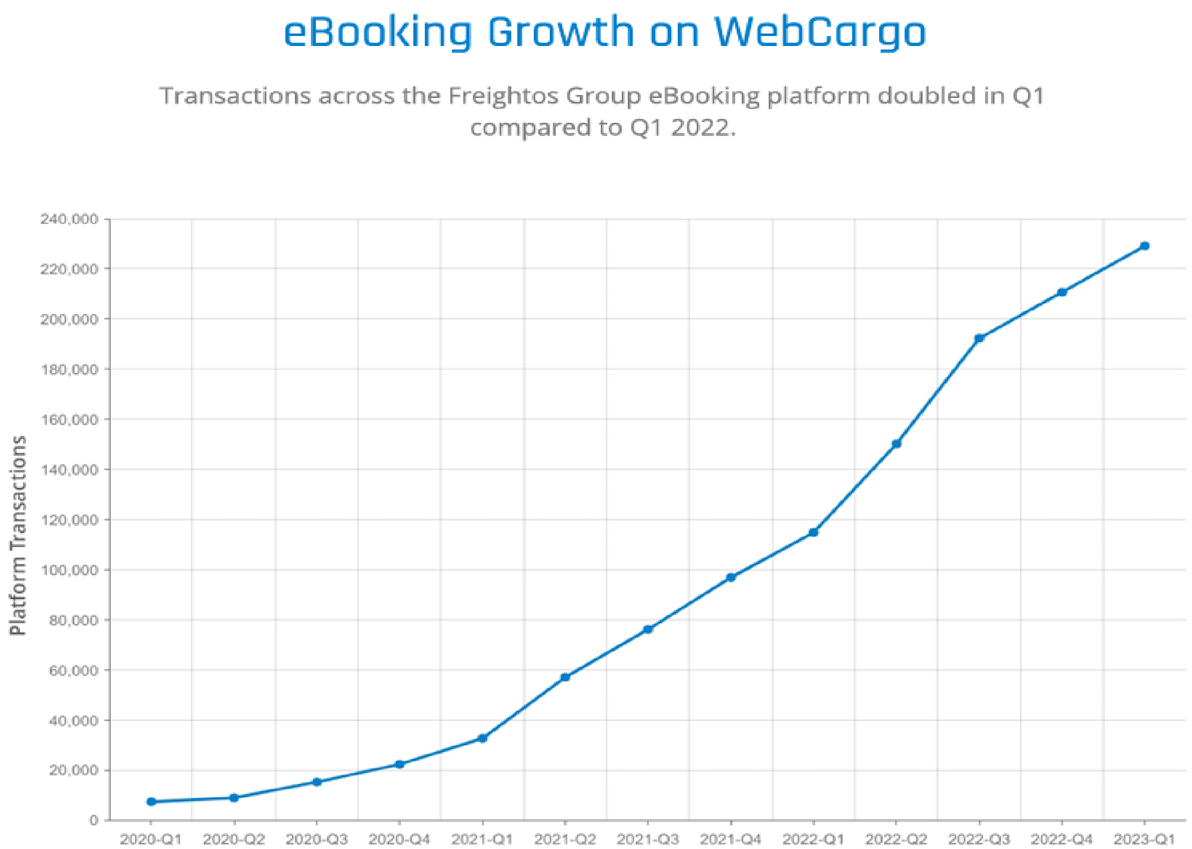
A. DEMAND TRENDS:

Recent data indicates a continuous recovery in passenger travel, with the demand expected to surpass pre-pandemic levels soon. This growth in passenger travel increases the total cargo capacity available, despite a decline in freighter capacity. Moreover, the rates for cargo transportation have started to normalize, with significant declines compared to the previous year. For instance, Asia - N. America rates have decreased by 60%, transatlantic prices by over 40%, and Asia - Europe rates by more than 40%.



B. EBOOKING ADOPTION:

In May, WebCargo, a digital air cargo company, reported various expansions and features implemented by airlines and cargo carriers. For example, Qatar Airways Cargo enabled allotment eBookings, Air Canada Cargo expanded its WebCargo offering to India, Turkish Cargo automated AWB generation for faster bookings, Silk Way West Airlines added routes to LHR, and Emirates SkyCargo went live in Switzerland. WebCargo, with its extensive network connecting over 3,500 forwarders across ten thousand branches to hundreds of airlines worldwide, compiles the monthly Digital Air Cargo report.



STEP 4: FINANCIAL MODELING WITH MACHINE LEARNING & DATA ANALYSIS

a. Identify the Market: The Smart Cargo solution will be launched in the aviation industry, specifically targeting airlines, cargo carriers, freight forwarders, and logistics companies involved in cargo operations.

b. Data Collection: To perform accurate financial modelling, relevant data and statistics about the aviation industry, cargo transportation, and market trends need to be collected from reliable online sources. This data will serve as the basis for the financial analysis and predictions.

c. Data Analysis and Pre-processing: Once the data is collected, it needs to be analysed and pre-processed to identify any outliers, missing values, or inconsistencies. This step ensures the data's quality and reliability for further analysis.

d. Forecasting and Predictions: Regression models or time series forecasting techniques can be applied to the collected data to perform forecasts and predictions on market trends. These models will help in understanding how the market is expected to grow or decline over time.

e. Financial Equation Design: Based on the identified market trend, a corresponding financial equation will be designed to model the relationship between the variables. Let's consider an example for a linear financial model using the equation $y = mx + c$:

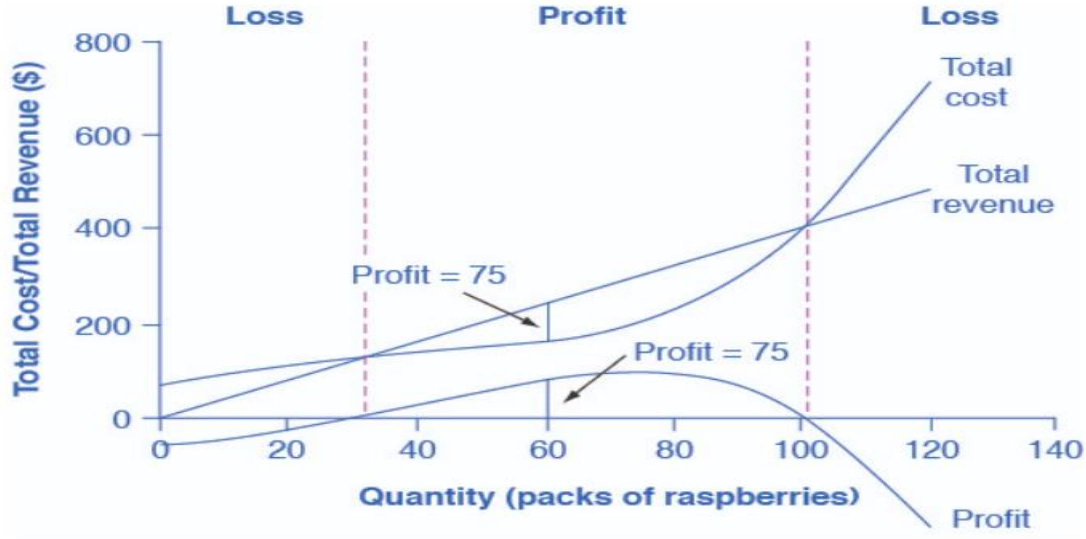
- Linear Financial Model: In this scenario, let's assume the market is growing linearly. The financial equation will be of the form $y = mx + c$, where:
- y represents the total profit generated by the Smart Cargo solution.
- m represents the pricing of the Smart Cargo solution, indicating how much revenue is generated per unit sold.
- x represents the total sales or market size as a function of time.
- c represents the fixed costs involved in production, maintenance, and other operational expenses.

Sample values for the equation: - Assume the pricing of the Smart Cargo solution (m) is \$10 per unit. - The market size (x) can be measured in terms of the number of cargo operations. - Assume the fixed costs (c) for production, maintenance, and other expenses are \$5,000.

The resulting equation would be: $y = 10x + 5000$.

Note: The actual values for the equation parameters (m, c) would need to be determined based on market research and analysis specific to the Smart Cargo solution and the aviation industry.

f.Graph the equation. To do this, you can use a graphing calculator or software. The graph will show the relationship between the total profit generated by the Smart Cargo solution and the total sales or market size.



As you can see, the graph shows that the total profit generated by the Smart Cargo solution increases linearly as the total sales or market size increases. This is because the pricing of the Smart Cargo solution (m) is constant, and the fixed costs (c) are also constant.

It is important to note that the actual values for the equation parameters (m, c) would need to be determined based on market research and analysis specific to the Smart Cargo solution and the aviation industry. However, the general relationship between total profit and total sales is still linear.

Total Cost and Total Revenue at the Raspberry Farm

Quantity	Total Cost	Total Revenue	Profit
(Q)	(TC)	(TR)	
0	$62	$0	−$62
10	$90	$40	−$50
20	$110	$80	−$30
30	$126	$120	−$6
40	$138	$160	$22
50	$150	$200	$50
60	$165	$240	$75
70	$190	$280	$90
80	$230	$320	$90
90	$296	$360	$64
100	$400	$400	$0
110	$550	$440	$−110
120	$715	$480	$−235

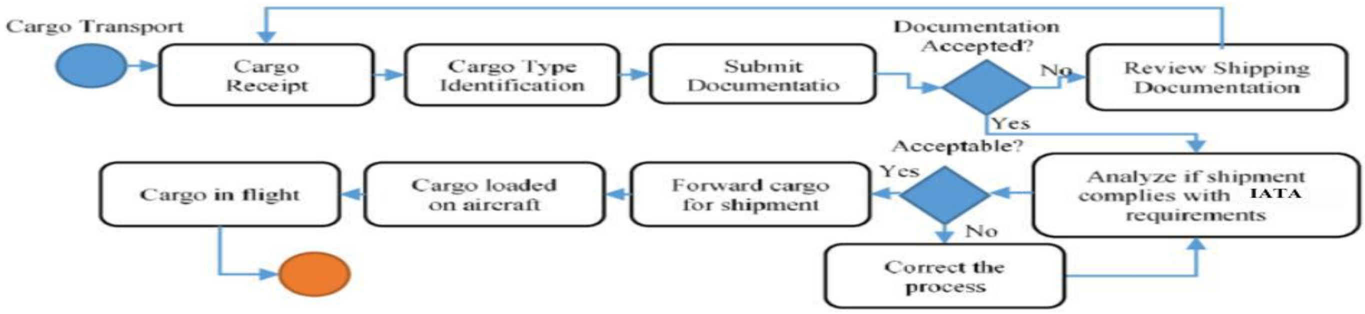
For a perfectly competitive firm such as the raspberry farm, determining the quantity of output that maximizes profit can be achieved by analyzing the total revenue and total cost curves. The profit is calculated by subtracting total cost from total revenue at any given quantity. To identify the most profitable quantity, one can examine the point at which the vertical gap between total revenue and total cost is the largest. The difference between total revenue and total cost at a specific output level represents the profit, such as at Q = 60, where TR = 240 and TC = 165, resulting in a profit of 75. It is important to note that the firm does not generate profit at all levels of output. In the provided example, losses occur at output levels from 0 to approximately 30, while profits are earned between output levels 40 to 100. However, beyond an output greater than 100, the firm experiences increasing losses as total costs exceed total revenues. The maximum profit is observed between 70 and 80 output units, amounting to $90. When the price drops significantly, causing the total revenue line to fall below the total cost curve, the firm can only endure losses. Nevertheless, a profit-maximizing firm seeks to minimize losses by selecting the quantity of output where total revenues closely align with total costs.

g. Sensitivity Analysis: It's important to conduct sensitivity analysis on the financial equation to assess the impact of changes in variables (m, x, c) on the total profit (y). This analysis helps in understanding the sensitivity of the model to different market scenarios and making informed decisions.

h. Business Decisions: The financial modelling results, including forecasts, predictions, and the financial equation, provide valuable insights for business decisions. The analysis can guide pricing strategies, revenue projections, resource allocation, and overall business planning for the Smart Cargo solution.

By performing financial modelling using the $y = mx + c$ equation, the Smart Cargo solution can gain a better understanding of its potential profitability, revenue generation, and cost structure in the aviation industry. It allows for informed decision-making and helps shape the business strategy to maximize financial success.

i. Final Product Prototype (abstract) with Schematic Diagram: Our innovative ML model, "SmartCargo," is specifically developed for airline cargo operations. With a focus on optimizing cargo loading and enhancing operational efficiency, SmartCargo considers crucial factors like cargo weight, size, destination, flight capacity, and route. The primary goal of SmartCargo is to maximize cargo capacity while minimizing the overall number of flights required for transportation



CONCLUSION

In summary, the Smart Cargo solution offers a promising approach to tackle challenges in the aviation industry's cargo operations. By utilizing machine learning and artificial intelligence, it optimizes cargo loading, enhances operational efficiency, and improves transparency. Extensive research has identified potential customers such as airlines, cargo carriers, freight forwarders, and logistics companies, aiming to improve their operations, reduce costs, and satisfy customers. Financial modeling using the equation $y = mx + c$ provides valuable insights into profitability, guiding pricing strategies and revenue projections. Smart Cargo's business model relies on a subscription-based service, aligning with industry standards for sustainable revenue. Expertise in machine learning, AI, and the aviation industry is crucial for successful development. The effectiveness of Smart Cargo has been demonstrated through a small-scale prototype and data analysis, showcasing its potential to optimize cargo loading and reduce costs. Overall, Smart Cargo has the potential to revolutionize cargo operations by addressing pain points, increasing efficiency, and improving customer satisfaction in the aviation industry.