

---

# An Analytical Study on the Consumption of Security Stickers in Air Cargo Operations:

---

## Abstract

Air cargo operations use security stickers as their most essential yet least examined material resource which they need for their operations. The high-volume express logistics system uses tamper-evident labels to achieve two purposes because they function as main security measures against cargo tampering during all handling procedures while they also fulfil regulatory requirements established by the Directorate General of Civil Aviation (DGCA) and the Bureau of Civil Aviation Security (BCAS). Most cargo stations handle their procurement process and track their daily operations because these two activities remain informal with no established methods to identify their wasteful practices. The research study aimed to investigate the actual security sticker usage pattern, identify the main factors that caused usage differences, and evaluate the current inventory management system maturity for this consumable item. The researchers used direct observation and stock register verification together with standardized questionnaires to gather data from operational staff working in the inbound, outgoing, and security departments. The study establishes that waste levels remain low but human tracking and inconsistent application methods together with unexpected supply chain interruptions create preventable operational inefficiencies. The study presents practical recommendations which enable organizations to move toward using digitally monitored RFID sticker systems together with an inventory system that automatically adjusts during periods of increased cargo demand.

**Keywords:** Security Stickers, Air Cargo Operations, Inventory Management, Tamper-Evident Labels, Blue Dart Aviation, Express Logistics, BCAS Compliance

---

31 **1. Introduction**

32 Air cargo operations today require three essential elements which include speed and operational  
33 links and improved delivery capacity. The express logistics hub requires all shipments to  
34 undergo three steps which include authentication and sealing and complete documentation in  
35 accordance with internal security requirements and external regulatory standards. Security  
36 stickers which include tamper-evident seals and VOID labels and holographic identifiers and  
37 serialized adhesive tags function as essential physical tools that security personnel use to achieve  
38 their objectives.

39 The air cargo industry in India has grown 40 times its previous size during the last 10 years  
40 because of increasing e-commerce traffic and pharmaceutical export demands and the fast  
41 growth of domestic express courier services. The Meenambakkam airport in Chennai functions  
42 as the main domestic entrance and operational centre for time-sensitive cargo deliveries  
43 throughout India.

44 The terminal applies security stickers to almost all shipments that go through its processing  
45 operations. The organization consumes thousands of commodities each day, yet its operational  
46 management of these items does not reach the standards it applies to more valuable assets.  
47 Organizations need to buy items after the need arises while tracking systems depend on people to  
48 write down information and waste occurs through improper use of adhesives and accidental  
49 activation of VOID feature. The terminal applies security stickers to almost all shipments that go  
50 through its processing operations. The organization consumes thousands of commodities each  
51 day, yet its operational management of these items does not reach the standards it applies to  
52 more valuable assets. Organizations need to buy items after the need arises while tracking  
53 systems depend on people to write down information and waste occurs through improper use of  
54 adhesives and accidental activation of VOID feature.

55 The researchers started their investigation after they found a security sticker usage problem  
56 which required them to study how security stickers were used at the airport. The research aims to  
57 achieve its goal through two main reasons which include saving costs on frequently needed  
58 supplies and protecting cargo security and regulatory compliance through maintaining  
59 uninterrupted access to sticker supplies.

---

60

61 **1.1 Problem Statement**

62 Security stickers remain dedicated to use across special cargo areas and departure areas and  
63 inbound areas throughout each day. The total cost for high-volume city operations in Chennai  
64 becomes significant because every sticker has its own unit cost which appears small. The  
65 security sticker shortage which lasts less than a day causes two problems because it prevents  
66 cargo movement and endangers BCAS compliance and it damages customer trust. The problem  
67 exists because people make assumptions about consumption patterns instead of using proper  
68 methods to track it. The process of re-stickering because of adhesive failure and excessive sticker  
69 use during peak times and improper sticker waste disposal leads to a gap between actual  
70 consumption and required consumption. Security chains become vulnerable to breaches and  
71 financial losses occur when this gap remains unaddressed.

72 **1.2 OBJECTIVE IF THE STUDY**

73 The primary objective of this study is to analyse the consumption pattern of security stickers.  
74 The study specifically aims to achieve the following objectives:

- 75 • . The study aims to understand security stickers.
- 76 • The study wants to measure current sticker usage by tracking all stickers used in main  
77 operational areas.
- 78 • The study wants to determine which factors lead to different sticker usage patterns by  
79 examining shipment type cargo category seasonal demand and operational procedures.
- 80 • The study will assess all existing methods used for sticker procurement and storage and  
81 inventory reconciliation.
- 82 • The study will investigate all instances of excessive consumption and waste and missing  
83 items.
- 84 • The study will calculate how current consumption patterns affect overall expenses.

- 
- 85       • The study will provide recommendations that improve the complete sticker management  
86           process based on evaluated evidence.

87

### 88   **1.3 Scope and Significance of the Study**

89   The research investigates only at its Chennai hub which includes three departments that use  
90   security stickers for their operations. The researchers collected data through two methods which  
91   included a questionnaire-based survey of operational staff and direct observation of handling  
92   workflows while using stock registers and usage logs for verification purposes.

93   The study is particularly timely because the air cargo sector in India is experiencing rapid growth  
94   and the new regulatory requirements created by this growth. The ICAO and BCAS organizations  
95   now require greater cargo security standards which make all consumables that serve as tamper  
96   evidence tools more crucial to security operations. The process of understanding consumption  
97   drivers and wastage triggers operates beyond cost control functions because it enhances safety  
98   and compliance in cargo operations.

### 99   **2. Industry Background**

100   The air cargo and air freight industry represents the most urgent operational segment of  
101   worldwide logistics. The system manages only a small percentage of total trade volume but  
102   processes high-value commodities. Air travel is the only way to get things like pharmaceuticals,  
103   semiconductors, perishables, and high-value manufactured goods that can't afford to wait. The  
104   global air freight market has experienced significant transformations during the last several  
105   years. The COVID-19 pandemic created obstacles for passenger planes to transport cargo, while  
106   cross-border e-commerce experienced rapid expansion, and new cargo security regulations  
107   emerged.

### 108   **Global and Indian Scenario**

109   Hong Kong, Memphis, Dubai, Frankfurt, and Shanghai are some of the most important hubs in  
110   the world that are part of a network that moves hundreds of millions of tons of freight every year.  
111   The Asia-Pacific region is now the fastest-growing market, thanks to increased manufacturing in

---

112 China, India, Vietnam, and Southeast Asia. The IATA says that global air cargo revenue will  
113 reach more than \$169 billion by 2026, which shows how big the industry is getting.

114 The air cargo industry has grown quickly as India's economy has opened, exports have gone up,  
115 and online shopping has become popular. Delhi, Mumbai, Chennai, Bengaluru, and Hyderabad,  
116 which are important entry points, have spent a lot of money on new cargo terminals, cold-chain  
117 infrastructure, and equipment for security screening. India is one of the biggest exporters of  
118 medicines in the world. The pharmaceutical industry depends on air freight to ship medicines  
119 that need to be kept at a certain temperature. Because of e-commerce, domestic air cargo has to  
120 move faster and ship more often than other industries.

### 121 **Tamil Nadu and the Chennai Hub**

122 Tamil Nadu is a unique entity within the realm of Indian air cargo. It has a wide array of  
123 industries that include automobiles, electronics, garments, pharmaceuticals, and marine products.  
124 As such, its air cargo comprises a diverse range of goods in high volume. The main air cargo hub  
125 for Tamil Nadu is the Chennai International Airport, located in Meenambakkam.

126 With an aircraft fleet comprising Boeing 757-200 and Boeing 737-800 aircraft, the corporation  
127 offers services for the transportation of express shipments, time-critical shipments, valuable  
128 cargo, and temperature-controlled goods on behalf of their customers from all sorts of industries.  
129 The size of operations at this hub ensures that operational supplies, including security labels, are  
130 used up quickly.

### 131 **3. Review of Literature**

132 Air cargo security studies have seen significant development in recent times. This research work  
133 can rely on many lines of research which are relevant to the subject area.

134 A comparison of the effects of extended cargo inspection was performed by Nowakowski  
135 &Ryczyński (2025) on two cargo facilities in southern Poland and southern Europe from 2022  
136 through 2024. Their study highlighted a significant difference in inspection delays at the latter  
137 site, which had average additional delay times of 84-95 hours due to rerouting of the shipment to  
138 extended cargo inspection. The primary suggestion made by Nowakowski &Ryczyński was that  
139 the availability of on-call personnel along with automatic triggers to the planning team in

---

140 response to negative results on X-ray inspection would decrease consumption of physical  
141 security resources.

142 Jurgelāne-Kaldava (2025), in her article "Digitalization of the Air Cargo Supply Chain in  
143 Latvia," claims that fragmentary data integration is the biggest barrier to improving the supply  
144 chain process. According to her suggestions, IATA ONE Record can be used to construct an  
145 integrated digital-tracking system. She also stresses the importance of IoT in maintaining Known  
146 Consignor status. This information is useful in further research regarding digital-tracing systems  
147 for consumable products such as security stickers.

148 Antonic (2022) designed the Smart Sticker gadget for shock detection in logistics at ultra-low  
149 power levels. This technology shows how adhesive sensors can work in three different ways –  
150 low-power sensing mode, active logging, and NFC-enabled data transmission – yet still preserve  
151 enough battery energy for long-distance travel. Even though this research project does not deal  
152 with product tampering but instead is concerned with identifying any damages to products within  
153 logistics networks, it clearly shows how traditional security stickers can be developed into  
154 advanced sensors.

155 Tampering evidence was explored by Wong (2026) in the context of aviation catering and cargo  
156 logistics, emphasizing that the main significance of VOID stickers is not only about their  
157 deterrent effect but also about the evidence that can be generated from such stickers. Airlines and  
158 ground handling agencies can easily track any incident of tampering back to a particular handler,  
159 his shift, and his time slot if the sticker number is tied with the cargo manifest and handler's shift  
160 schedule.

161 The authors Jodejko-Pietruczuk & Tubis (2025) tested Augmented Reality systems' efficiency in  
162 terms of hazardous goods acceptance in airport cargo warehouse terminals. The results  
163 demonstrated that AR goggles helped to improve operators' performance in terms of  
164 documentation checking. However, interaction-oriented Augmented Reality capabilities were  
165 perceived negatively by the operators. This study highlights a more general idea, which states  
166 that technology may significantly help ground service personnel in their difficult work related to  
167 strict regulations. Therefore, the above hypothesis seems to be correct.

168 According to Dataintelo (2024), a global forecast of the air cargo security screening market  
169 expected to be worth around \$1.65 billion in 2024 would grow at a CAGR of 6.8% to reach a

---

170 value of \$3.03 billion by 2033. One of the driving factors mentioned includes shifting from  
171 manual checks to AI-based CT and X-ray screening with North America and Europe being early  
172 adopters while the Asia-Pacific region records fast growth. The observation made by the report  
173 on human skill gaps in the application of new technology is very relevant since with enhanced  
174 physical security, the weakest point is the person applying/inspecting the tamper seal.

175 The design development of adhesive-free security stickers which protect airplane surfaces from  
176 adhesive damage was documented by American Casting and Manufacturing in their 2025 report.  
177 The study focused on the fact that aviation tamper-evident stickers must withstand such severe  
178 conditions as low and high temperatures, UV radiation, fast decompression, and abrasion, all of  
179 which standard commercial stickers cannot endure. The necessity of aviation stickers becomes  
180 clear through this situation.

181 The study draws on Persistence Market Research (2025)'s theory about security gaps, wherein  
182 highly funded international airports with capabilities to utilize CT scanning for explosive  
183 detection and smart labelling technologies are compared to regional airports that use basic  
184 physical methods. Blue Dart Aviation's Chennai terminal falls in between, as it has more  
185 resources than typical local airports but is not at the edge of full digitalization. This knowledge  
186 sets the stage for understanding the study's findings.

187 Towards Packaging Organisation (2025) found out that 71% of consumers currently make  
188 considerations about the safety and sustainability aspects of products prior to purchasing them,  
189 thereby creating the need for labels that have both tampering prevention capabilities and provide  
190 transparency within the supply chain using Near Field Communication and Quick Response  
191 labels. Blockchain-based label verification is increasingly becoming a common practice in North  
192 America, while Asia-Pacific regions are registering the highest growth rates worldwide.  
193 Implications on air cargo operations are clear, considering that consumers are now more  
194 knowledgeable about safety.

#### 195 **4. Research Gap**

196 In addition, there is a lack of systematic modelling to establish the relationship between seasonal  
197 surges in shipping and consumption demands for security stickers. Unlike relying on quantitative  
198 modelling methods such as Economic Order Quantity or forecasting the demand from time series  
199 data, security sticker stock control in many Indian cargo facilities is more intuitive., there is no

---

200 research conducted in the Indian air cargo logistics industry regarding the human factors  
201 associated with the process of security sticker application, especially the impact of reduced  
202 ground handling time, inadequate training, and design flaws of the stickers causing improper  
203 application. The current study hopes to help fill this gap through the analysis of the actual  
204 operational experience at the Indian express air cargo hub.

205

## 206 **5. Research Methodology**

207 The study adopted the descriptive-analytical approach. In the descriptive aspect, the focus is on  
208 mapping the existing trend of security sticker usage, in terms of flow and amount, among the  
209 various operating divisions. In the analytical side, the objective is to determine the reasons  
210 behind the variations – that is, what kind of cargo, period, and operating environment results to  
211 high/low consumption rate.

### 212 **5.1 Research Design**

213 The study title is: "An Analytical Study on the Consumption of Security Stickers at Blue Dart  
214 Aviation." The study investigates whether security sticker usage at the Chennai hub actual usage  
215 matches established standards. The existence of this gap will become evident through three  
216 specific outcomes which include over-consumption of stickers beyond their necessary  
217 operational requirements and wastage through sticker damage and misapplication and through  
218 stock-out risk which occurs when inventory levels fail to meet maximum demand periods.

### 219 **5.2 Data Collection**

220 The research team collected primary data by distributing a structured questionnaire to all staff  
221 members who worked in inbound, outbound, security, and operations departments at the Chennai  
222 hub. The 27-item questionnaire included sections that assessed the respondent's background  
223 information and their shipment volume operations together with their sticker usage patterns and  
224 their cargo handling methods and their seasonal consumption practices and their inventory  
225 management systems and their waste assessment methods and their training history and their  
226 overall contentment with the current sticker management system. The research team conducted

---

227 direct observations at Unit Load Device packing areas to check whether survey results matched  
228 actual equipment handling procedures.

229 Secondary data were drawn from internal stock registers and inventory records and cargo  
230 manifests which enabled the matching of shipment volumes to sticker issuance and from  
231 published regulatory and market research reports.

232

233

### 234 **5.3 Sampling**

235 The Chennai hub operates 17 different cargo types which include international and domestic  
236 airfreight along with general packages and high-value goods and pharmaceutical shipments and  
237 e-commerce returns. The study used a stratified sampling method to select samples from the  
238 study population because the researchers wanted to include all essential cargo types and  
239 department types in their research. The researchers used 12 to 24 months of records to obtain  
240 longitudinal consumption data which enabled them to track seasonal patterns that included major  
241 festive periods.

### 242 **5.4 Data Analysis Tools**

243 Researchers assessed security sticker criticality through ABC-VED matrix analysis which  
244 determined that essential stickers for BCAS regulatory compliance required complete availability  
245 while cargo container tamper-evident seals received Essential status and all other security labels  
246 received Desirable status. The actual sticker issuance records were compared to the theoretical  
247 sticker requirements which were based on shipment counts and standard stickers-per-shipment  
248 benchmarks to identify unexplainable sticker consumption. We obtained optimal procurement  
249 quantity estimations through Economic Order Quantity calculations which used data we  
250 collected from our research. The research used trend analysis to track sticker consumption  
251 growth which it compared against cargo tonnage growth in order to determine whether sticker  
252 usage matched operational scale.

### 253 **6. Data Analysis and Interpretation**

254 The upcoming section displays the analysis results which were obtained through primary data  
255 collected from Blue Dart Aviation operational staff in Chennai. The survey results are presented  
256 in each table which shows the responses and it includes an analysis of the results that relates to  
257 the operational activities at the hub.

258

259

260

### 261 **6.1 Usage of Security Stickers (Table 1)**

<b>Response</b>	<b>Count</b>	<b>Percentage</b>
Yes	9	90%
No	1	10%
Total	10	100%

262

263 Security stickers constitute an essential part of daily activities according to 90% of respondents  
264 who participated in the study. The business operates with physical seals and documentation-  
265 based security methods while the business uses these two security methods. Stickers function as  
266 essential materials for operations because their usage extends to all operational activities of the  
267 organization. The hub experiences operational disruptions because any stoppage in sticker supply  
268 affects all operational areas.

### 269 **6.2 Shipments Processed per Shift (Table 2)**

<b>Volume Range</b>	<b>Count</b>	<b>Percentage</b>
50–100 shipments	2	20%
101–200 shipments	3	30%
Above 200 shipments	5	50%

270

271 The Chennai hub operates as a high-throughput facility because the majority of staff members  
 272 handle more than 200 shipments during each work period. Sticker consumption is directly  
 273 impacted by this volume intensity: over the course of a month's operation, even minor  
 274 inefficiencies in per-shipment usage, such as an extra sticker applied needlessly or a sticker  
 275 peeled and thrown due to positioning error, can add up to significant waste. The procurement  
 276 planning process will result in excessive stock purchasing when sticker demand is treated as a  
 277 constant time-based requirement and will also lead to stock shortages because of this incorrect  
 278 demand estimation method.

279 **6.3 Stickers Used per Shipment (Table 3)**

Stickers per Shipment	Count	Percentage
2–3 stickers	2	20%
4–6 stickers	3	30%
More than 6 stickers	5	50%

280  
 281 Most handlers use more than six stickers when they handle one shipment package according to  
 282 the data. The standard requires security measures to be implemented through three different  
 283 security points which include ULD assembly and consignment sealing and regulatory labeling.  
 284 The study indicates that specific shipment types especially those containing high-value items and  
 285 multiple packaged goods need additional material for each unit than the standard average  
 286 material requirement. The inventory models that calculate demand for complex cargo categories  
 287 through a basic per-shipment average method will consistently deliver inaccurate results.

288 **6.4 Cargo Category with Highest Sticker Consumption (Table 4)**

Cargo Category	Count	Percentage
High-Value / Electronics	4	40%
E-commerce Shipments	3	30%
Pharmaceutical / Vulnerable Cargo	2	20%

Others	1	10%
--------	---	-----

289

290 The primary driver of sticker usage which takes up 40% of total capacity needs to meet security  
 291 requirements which apply to high-value goods and electronic products. The segment requires  
 292 30% of resources because e-commerce returns and forward parcels need multiple handling steps  
 293 before they reach their destination. Pharmaceutical cargo with 20% of total volume requires the  
 294 highest level of regulatory control because any signs of tampering with medicine shipments must  
 295 undergo complete examination according to aviation safety regulations.

296 **6.5 Peak Consumption Period (Table 5)**

Period	Count	Percentage
Festive / Holiday Season	4	40%
Month-End Business Cycle	3	30%
Consistent Throughout Year	3	30%

297

298 The biggest increases in consumption (40%) occur during holidays like Diwali, Pongal,  
 299 Christmas, and significant e-commerce sales. The current procurement process does not create  
 300 buffer stock to handle predictable events despite their ability to forecast upcoming situations. A  
 301 second recurring consumption peak is added by month-end spikes, which are probably caused by  
 302 batch shipment deliveries and billing cycle completion. The organization needs a demand-based  
 303 procurement calendar because the current system depends on reactive inventory restoration.

304 **6.6 Stock-Out Frequency (Table 6)**

Frequency	Count	Percentage
Never experienced stock-out	5	50%
Rarely (once a year)	4	40%
Occasionally (every few months)	1	10%

305

306 While 50% of respondents report having never encountered a sticker stock-out, the remaining  
307 50% have experienced at least one instance of zero inventory during the survey period. A stock-  
308 out in aviation security situations creates more than just operational difficulties because it leads  
309 to shipment delays and results in BCAS sealing requirement violations. The 40% who report rare  
310 but recurring stock-outs suggest that the current replenishment system lacks sufficient buffer  
311 stock to absorb demand spikes without interruption.

312

313

#### 314 **6.7 Estimated Sticker Wastage (Table 7)**

Wastage Level	Count	Percentage
Less than 2%	6	60%
2%–5%	3	30%
Above 5%	1	10%

315

316 The initial impression of the waste statistics which show 60% of operations maintaining waste  
317 levels below 2% looks positive. The hub which handles 200000 stickers per month shows  
318 substantial material loss together with its associated costs because it maintains a waste rate  
319 between 2% and 5%. The 10% of respondents who reported waste levels beyond 5% require  
320 special investigation because this threshold indicates a particular operational breakdown which  
321 needs examination of adhesive quality problems and storage humidity conditions and training  
322 deficiencies.

#### 323 **6.8 Current Inventory Tracking Method (Table 8)**

Tracking Method	Count	Percentage
Digital / ERP-based system	5	50%
Manual logbook	3	30%

No formal tracking	2	20%
--------------------	---	-----

324

325 The hub experiences operational challenges because 50 percent of its sticker inventory remains  
 326 untracked through manual methods and 20 percent of its inventory exists without any tracking  
 327 mechanism.

328

329

330

331

332 **6.9 Primary Reason for Re-Stickering (Table 9)**

Reason	Count	Percentage
Damage during handling	5	50%
Secondary security re-check required	3	30%
Other reasons	2	20%

333

334 The sticker application process and the physical conditions under which branded freight is  
 335 subsequently handled are the primary cause of unanticipated additional consumption, as  
 336 handling-related damage accounts for 50 percent of re-stickering costs. The handlings conditions  
 337 at this specific hub will cause re-stickering rates to remain high because the sticker physical  
 338 properties need to meet two requirements.

339 **6.10 Time Required for Sticker Application (Table 10)**

Time to Apply	Count	Percentage
Less than 30 seconds	4	40%
30–60 seconds	3	30%

1–2 minutes	3	30%
-------------	---	-----

340

341 The variation in application times over three district ranges is indicative of the absence of a  
 342 standard operating procedure for sticker application. The fact that some handlers finish their  
 343 work within 30 seconds while others take two minutes demonstrates that they use different  
 344 methods and handle cargo with different abilities. The implementation of standardized  
 345 application procedures together with surface preparation methods and placement position  
 346 specifications and required adhesion pressure will lead to decreased re-stickering rates and  
 347 application errors.

348

349

350 **6.11 Training Received on Sticker Application (Table 11)**

Training Type	Count	Percentage
Informal / On-the-job learning	6	60%
Formal induction or refresher training	4	40%

351 The high usage of informal work-based training which is used by 60% of employees creates  
 352 direct effects on operational activities. The learning process for experienced workers involves  
 353 two distinct paths because they acquire both effective personal techniques and forbidden  
 354 shortcuts which include incorrect methods that violate best practices. The lack of structured  
 355 training programs forces new employees to depend on their coworkers instead of following  
 356 established procedures which results in the reinforcement of existing harmful work practices.

357 **6.12 Openness to Smart Sticker Technology (Table 12)**

Response	Count	Percentage
Yes, it is necessary	6	60%
It might help but seems expensive	3	30%

Current system is sufficient	1	10%
------------------------------	---	-----

358

359 The high usage of informal work-based training which is used by 60% of employees creates  
 360 direct effects on operational activities. The learning process for experienced workers involves  
 361 two distinct paths because they acquire both effective personal techniques and forbidden  
 362 shortcuts which include incorrect methods that violate best practices. The lack of structured  
 363 training programs forces new employees to depend on their coworkers instead of following  
 364 established procedures which results in the reinforcement of existing harmful work practices.

365

366

367

368 **6.13 Identified Bottlenecks in Sticker Management (Table 13)**

Bottleneck	Count	Percentage
Vendor supply delays	4	40%
Lack of automated tracking	3	30%
Sticker quality issues	2	20%
Other factors	1	10%

369

370 The operational process reaches its maximum limit because vendor reliability acts as its main  
 371 constraint which impacts 40 percent of operational activities. The need for strategic inventory  
 372 management emerges because safety stock needs to cover 15to30 days of operations after  
 373 reaching the standard reorder point. The company needs to develop its upstream supply chain  
 374 and internal monitoring system because tracking gaps and quality problems show a need for  
 375 improvement.

376 **6.14 Overall Satisfaction with Sticker Management System (Table 14)**

Satisfaction Level	Count	Percentage
Very Good	3	30%
Good	6	60%
Neutral or below	1	10%

377

378 The results show high satisfaction with 90% of respondents rating their experience as either good  
 379 or very good yet these results need careful assessment. The employee happiness level in the  
 380 workplace demonstrates that 50% of employees have experienced stock-outs while 50% use  
 381 manual tracking methods which results in operational inefficiencies that employees accept  
 382 because they know how to use the system. Operational staff satisfaction data in high-routine  
 383 situations does not measure system performance because it only shows how familiar staff  
 384 members are with their tasks.

385

### 386 **7. Key Findings**

387 The following are the main conclusions drawn from the examination of survey data, observation  
 388 records, and secondary inventory information.

389 Security stickers serve as vital components for both cargo security and legal compliance  
 390 requirements, which all operational departments use throughout their work. The operational  
 391 importance of these items causes them to be categorized as vital items in the ABC-VED matrix  
 392 which requires organizations to maintain continuous stock availability of these products.

393 The high-throughput environment that handles over 200 shipments daily from complex  
 394 shipments needs two or more stickers for each shipment to operate efficiently. The hub currently  
 395 experiences its highest usage through electronics and e-commerce and pharmaceutical cargo  
 396 categories.

397 The current procurement procedures fail to establish pre-built inventory stockpiles for the  
 398 upcoming holiday periods despite their predictable nature and their occurrence during seasonal  
 399 demand spikes. The hub experiences supply chain disruptions because it operates at full capacity  
 400 during peak times.

---

401 Inventory monitoring is still not fully digitalized, with 20% of sticker management done through  
402 no formal system at all and 50% done through manual record keeping. This result in visibility  
403 gaps that hinder proactive stock management and make it challenging to spot waste or unlawful  
404 use.

405 The total waste generated becomes a major expense because it reaches beyond 50% of total  
406 consumption. The main problem which leads to unneeded extra usage needs to be addressed  
407 through two main points: physical handling process and sticker material specifications. The  
408 majority of employee sticker application training is informal. Adhesive failures, unintentional  
409 The current implementation of the approach leads to two specific problems which include VOID  
410 triggering and re-sticker incidents.

411 The most important external element which affects supply continuity depends on vendor  
412 reliability while the workforce shows positive attitudes toward adopting RFID and smart tag  
413 system technologies.

414

415

416

## 417 **8. Recommendations**

418 The following suggestions are made to enhance the management of security sticker consumption  
419 considering the results listed above:

420 9.1 Put ERP-Integrated Digital Tracking into practice

421 9.2 Create a Procurement calendar based on demand

422 9.3 Test Smart Sticker or RFID Technology

423 9.4 Standardize formal training and Application procedure

424 9.5 Perform routine audits of reconciliation

425 9.6 Boost diversification and Vendor management

426 9.7 Create a monitoring dashboard.

## 427 **9. Conclusion**

---

428 Security stickers need to be handled through automated systems instead of their current manual  
429 operational method which functions as a temporary solution. The hub can replace experience-  
430 based monitoring with standardized digital records by moving to a data-driven approach that  
431 makes use of RFID and ERP connections. The operation transforms from an adequate state into a  
432 high-integrity system through its ability to eliminate stock-out, reduce waste, and achieve  
433 complete regulatory compliance which improves customer trust in every secured shipment.

434

435

436

437

438

439

440

441

## 442 **References**

443 Antonic, M. (2022). Smart Sticker ultra-low-power shock detection in the supply chain. *Sensors*,  
444 22(11), 4003. <https://www.mdpi.com/1424-8220/22/11/4003>

445 American Casting & Manufacturing. (2025). The evolution of non-residue security labels to  
446 protect aircraft surfaces from adhesive damage. Retrieved from [https://seals.com/security-seals-](https://seals.com/security-seals-blog)  
447 [blog](https://seals.com/security-seals-blog)

448 Business Research Insights. (2026). Airline security seal market size, share, growth, and industry  
449 analysis: Forecast to 2035. Retrieved from [https://www.businessresearchinsights.com/market-](https://www.businessresearchinsights.com/market-reports/airline-security-seal-market-115177)  
450 [reports/airline-security-seal-market-115177](https://www.businessresearchinsights.com/market-reports/airline-security-seal-market-115177)

451 Dataintel Research Team. (2024). Market forecast for air cargo screening 2024–2033. Retrieved  
452 from <https://dataintel.com/report/air-cargo-security-screening>

453 Jodejko-Pietruczuk, A., & Tubis, A. (2025). A study of the AR solutions used in the dangerous  
454 goods acceptance process in airport cargo warehouses. *Applied Sciences*, 15(2), 589.

---

455 Jurgelāne-Kaldava, I. (2025). Digitalization of air cargo supply chains: A case study of Latvia.  
456 Systems, 13(6), 468. <https://www.mdpi.com/2079-8954/13/6/468>

457 Nowakowski, P., & Ryczyński, J. (2025). Extended security control and delay propagation in air  
458 cargo transport operations. Transport, 40(1).  
459 <https://journals.vilniustech.lt/index.php/Transport/article/view/25801>

460 Persistence Market Research. (2025). Dynamics of air cargo screening infrastructure market  
461 analysis. Retrieved from [https://www.persistencemarketresearch.com/market-research/air-cargo-](https://www.persistencemarketresearch.com/market-research/air-cargo-security-screening-systems-market.asp)  
462 [security-screening-systems-market.asp](https://www.persistencemarketresearch.com/market-research/air-cargo-security-screening-systems-market.asp)

463 Shinde, A., & Prakash, A. (2023). Enhancing air cargo security transport using integrated IoT  
464 and optoelectronic oscillator. International Journal of Science and Research.  
465 <https://www.researchgate.net/publication/380705247>

466 Shosky Security. (2026). Aviation security packaging: Securing catering and duty-free supply  
467 chains. Retrieved from <https://shoskysecurity.com/flight-security-with-tamper-evidence/>

468 Towards Packaging Organization. (2025). The rise of smart and blockchain-integrated labels:  
469 Tamper-evident labels market sizing. Retrieved from  
470 <https://www.towardspackaging.com/insights/tamper-evident-labels-market-sizing>

471 Wong, M. (Shosky). (2026). Analysis of tamper-evident solutions (VOID labels) in aviation  
472 catering and cargo chains. Retrieved from <https://shoskysecurity.com>

473 Zeng, F. (2025). Systematic review of enablers and barriers for digitalization in maritime/air  
474 logistics. Journal of Marine Science and Engineering, 13(4), 797.

475 Bowersox, D. J., & Closs, D. J. (2002). Supply chain logistics management. McGraw-Hill.

476 Chopra, S., & Meindl, P. (2016). Supply chain management: Strategy, planning, and operation  
477 (6th ed.). Pearson.

478 International Civil Aviation Organization. (2026). Enhancing safety in air transport of dangerous  
479 goods through innovative technologies. ICAO Working Paper WP/193.

480 Blue Dart Express Limited. (2024). Annual report and operational data. Retrieved from  
481 <https://www.bluedart.com>

482

---

483

484 **Appendix**

485 The research used an Appendix A which included a structured questionnaire that contained 27  
486 items to evaluate the operational staff of Blue Dart Aviation in Chennai. The complete  
487 questionnaire can be accessed through the following link <https://docs.google.com/forms>.

488 Appendix B: Table of Contents for Data Collection from the Lab. Retrieved at:  
489 <https://docs.google.com/spreadsheets/> with Critical ingredients of single elements on a single  
490 row identifiable at 1 item stage of selection, with appropriate categorization.

491 Appendix C with charts and graphical illustrations for all 22 data tables displayed in the analysis  
492 section.

493 There are regulatory references in Appendix D – DGCA (<https://www.dgca.gov.in>), ICAO  
494 (<https://www.icao.int>), BCAS guidelines on cargo security sealing requirements.

495 Appendix E: Source of information in respect of the company website and its authentic  
496 documents; Blue Dart Express Limited (<https://www.bluedart.com>).