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Comparative Study Of Airside Transit Turnaround Performance Of Airbus NEO And CEO Aircraft In A Typical Indian Airliner

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Abstract: This study presents the analysis of transit turnaround efficiency of Airbus (New Engine Options) NEO aircrafts- A321Neo, A320Neo compared to that of their CEO (Current Engine Options) Airbus models – A320, A321, A319 in a typical airline operation. The refined real data related to the transit turnaround is obtained using comprehensive timing reports from tech-logs and questionnaire sessions conducted with airside staffs of both engineering and commercial ramp team of a standard Indian airliner operating at one of the busiest airports of the country. The data was collected under normal operating conditions, and delay scenarios are deliberately excluded to provide a clearer idealization of aircraft ground performance. This study does a collective and graphical analysis in regard to key performance metrics, including but not limited to the main concerns of the study. Both practical operational advantages and challenges of NEO variants as opposed to their CEO counterparts are pointed out. It is concluded from the observations that NEO Airbus aircraft show higher turnaround efficiency, driven by more predictable Target Off Block Time (TOBT) for better operability. The results also depict the ideal compromise between operational efficiency and maintenance requirements for the purposes of airline performance optimization. The inferences from this work will prove highly beneficial to any commercial airlines contemplating fleet upgrade strategies to develop an effective ground handling process.

Index Terms **-** Ground Handling, Turnaround Efficiency, Airside Operations, Comparative Analysis, Indian Airliner Operations.

I. INTRODUCTION

In today's era of aviation, the turnaround time plays an important factor in determining the airline productivity in terms of TAT for aircraft-to-aircraft handling. A transit turn around aircraft may prove critical to different scenarios as beyond the prescribed time if the aircraft fails to depart then an additional standing amount should be paid by the airline to the concerned airport during the revenue briefings. It's evident that a quick turnaround is an indication of maximizing the utilization of aircraft with minimal ground time costs. The main safety focus is on passenger and asset aspect when it is associated with aviation operations. All the airside activities or the ramp activities are recommended based on the operational standards recommended by ICAO and standard aviation regulatory bodies which are primarily designed with respect to safety considerations**.**

This can be analyzed on the reduction in the count of fatal accidents occurred on certain years of operation. According to the NTSB report which was published for 2014-2024 [4], more fatalities with substantial damage of aircraft accompanied by crew and passengers with serious injuries. The Fig.1 depicts the count of fatal occurrences for the best competitors in the aircraft OEM sectors. For the year from 2023- 24 till date there are no fatal occurrences reported. These reports are very much essential for the airliners for deciding the type of

aircraft which may prove reliable and have efficient affinity towards safety. Due to this reason Airbus variants are chosen widely by the operators as safety is not a compromising factor in the aviation industry.

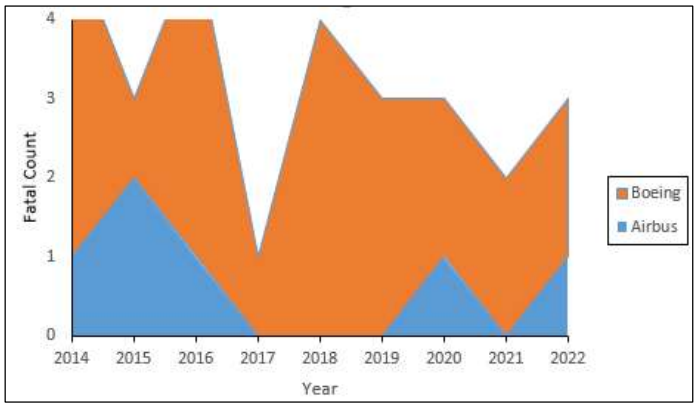

Fig. 1. NTSB Report on fatal accidents occurrences from 2014-2024

By measuring and comparing turnaround times, airlines can identify which aircraft type (NEO or CEO) performs more efficiently during transit. Faster turnaround times mean that an aircraft spends less time on the ground, allowing for more flight cycles, increasing overall fleet utilization and profitability. Currently there is always an operational significance related to Airbus aircrafts as their most airline orders and current status reveals that their variants are highly recommended view with other manufacturing competitor. [1],[2]. This is as shown in Fig.2. These planes have implemented a systematic comprehensive Safety Management Systems (SMS) that help to enable the identification of safety risks in a proactive manner and take measures to control them, which has continually enhanced their safety record [5],[6]. The Airbus product lines with newer improvements in design and technology provides certain advantages in long-term maintenance costs [2], [3]. When aircraft gets more utilized when it has proved its frequency of achieving reliability and safety performance to airlines and passengers in turn reducing the overrun costs in all aspects.

Fig. 2. Average Aircraft delivery orders by manufacturers [1,2].

II. METHODOLOGY

The study is more prioritized on to airside operations as they are highly sensitive over terminal side because there requires a careful sequencing of tasks [9]. The processes involved in carrying out the study is as shown in Fig .3. Now let's examine the phases involved in the methodology of the study.

2.1 Data Collection

This process involves the collection of real time data which shall be recorded based on airline engineering techlog and commercial ramp records. A productive questionnaire session was also conducted with 10 experienced staffs per shift to get a real time feedback on turnaround operational performance of Airbus Neo (New Engine Options) aircrafts - A320Neo, A321Neo, and CEO (Current Engine Options) variants -A320, A321, A319 as shown in fig.4. A deliberate idealization has been made for performing the analysis in a systematic way. Data has been taken for peak load passenger conditions [8] in the airport with an averaged 100samples per size, which implies averaged values of 100 on time actual push back timings were taken into consideration for each aircraft with a number of sample size as 10 to evaluate the turnaround performance as shown detailed in table.1. The samples for turnaround time (TAT) are mainly the number of flight departures. For each aircraft operational cycle is taken as 2 per day under normal operating conditions without any delay pertained to commercial and engineering activities.

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Table 1: Samples and Sizing

Number of Samples size for each aircraft	Total Aircrafts considered for Evaluation	Number of Samples collected for Actual TAT	Average Range of Scheduled TAT
10	5	100	40-43

2.2 Data Cleaning and Processing

As we know, a dataset cleaned and well-processed allows the computation of more accurate turnaround times. This will provide a more reliable and meaningful comparison of the performance times between Airbus NEO and CEO aircraft, thus supporting better-operational insights. It will only consider relevant ground activities, such as refueling, boarding, and maintenance specific to narrow-body aircraft. This ensures that the turnaround time metrics reflect real operational efficiency and are not skewed by unrelated downtime or non-transit activities. The data is cleaned once collected to remove inconsistencies, errors, and irrelevant information. Otherwise, without data cleaning, you may have irrelevant factors, including catering delays or off-schedule maintenance, which would drive the result. Proper processing ensures that only in/transit-related ground times are considered, avoiding misinterpretation of aircraft performance. Then, the data is categorized based on multiple parameters: aircraft type NEO, CEO; tasks performed for operation-boarding, refueling, cleaning; and factors related to maintenance. This will actually make sure that all of the information is put together to provide the right analyses [12]. It's important to review thoroughly to ensure that the data quality is good enough and relates to the objectives of the study. It's important to identifying and rectifying inaccuracies, such as incorrect entries in numerical fields (e.g., turnaround times that are unreasonably short or long). Long and medium halt aircraft ground time values are not relevant in this study as its crossing the normalized range limit of 40 to 43mins taken for transit ground time evaluation.

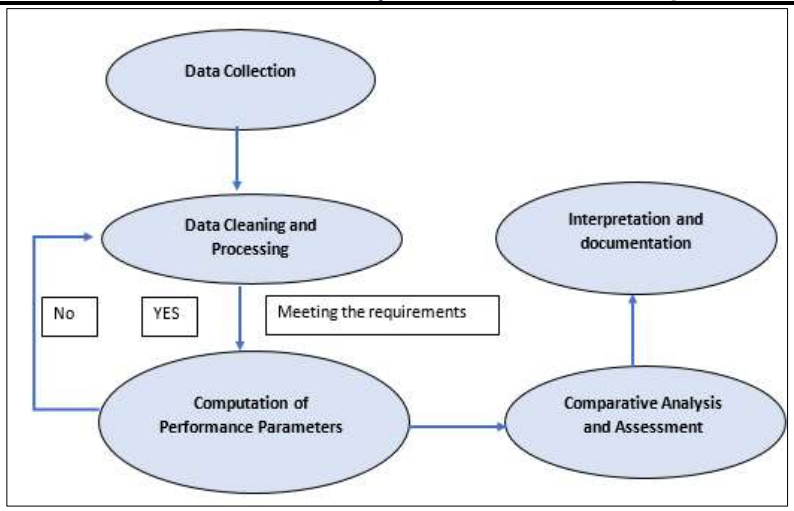

Fig. 3. Process Methodology

2.2 Computation of Performance Parameters

The computation process mainly involves to assess the performance parameters of both airbus variants based on the available input data. A -CDM Manual. etal (2023) explains the importance of Target Off block Time (TOBT) to predict the departure characteristic of each aircraft based on the ramp operational effectiveness [8]. When commercial operations are specified normally the ramp staffs address fine TOBT [10],[11] timings within the limit of ±4 mins of Actual Ready Departure Time (ARDT) [10],[11] which is also called as ‘’Door close Time’’ in layman words, which is crucial for Airport Operations professionals in allotting the parking stands for various aircrafts. Sometimes aircraft may depart early or can be delayed due to some operational or miscellaneous reasons, on this persepective the TOBT prediction is very much important in evaluating the transit time to allocate the next asset to occupy the parking stand or bay. The airside transit turnaround efficiency is an important parameter in evaluation of ramp effectiveness of A320Neo and current engine optional variant. This is given by the below simple relation (1).

$$\text{Turnaround Efficiency} = \frac{\text{Actual Off Block Time (AOBT)}}{\text{Scheduled Off Block Time (SOBT)}} \times 100\% \quad (1)$$

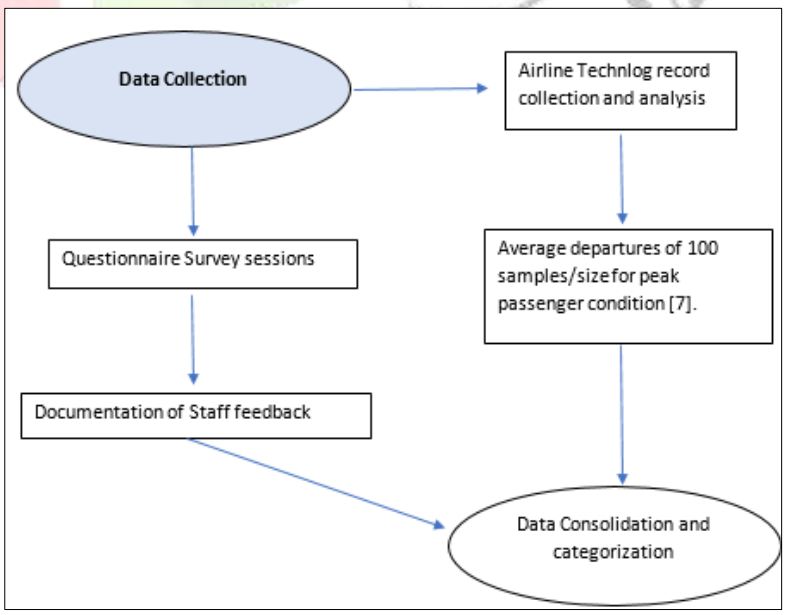

Fig. 4. Data Collection Process

Likewise, the relationship between TOBT and ARDT can be obtained as given below in (2)

$$\text{TOBT} = \text{ARDT} \pm \text{x Mins} \quad (2)$$

The value of 'x' may lie between 3 to 5mins depending upon the airside operational scenarios, for better transit performance the value is taken 4 mins usually. For effective data visualization and analysis each performance paramters can be plotted graphically against the airbus variants.

III. RESULT AND DISCUSSION

A comprehensive graphical study has been made based upon the refined data from techlogs and the questionnaire surveys from experienced professionals performed to complete the comparative analysis and performance for NEO and CEO variants.

3.1 Performance Data Analysis

The fig.5 shows the relationship between the operational timings across the early departures for different variants, and it's evident that based on 100 samples, the relation depicting the average early departures comparison between NEO and CEO variants tells a clear distinctiveness in terms of operational efficiency. More, the Actual Ready Departure Time (ARDT) of NEO variants like A320NEO and A321NEO would be constantly lower and more efficient than classic ones. This indicates an increased consistency between ARDT and the Target Off-Block Time (TOBT) [10],[11], for the NEO aircraft and hence allow them to take off earlier with increased predictability. The classic CEO models have greater ARDT values, meaning the process is more onerous in keeping abreast with the times on any kind of operation. This would be easily attributed to the older aircraft technology on the CEOs, which necessitates fuller maintenance at least or takes longer when it comes to ground handling. Delays result from such, meaning readiness to leave the ground in general is further occasioned inefficiency trickling down to subsequent flight schedules.

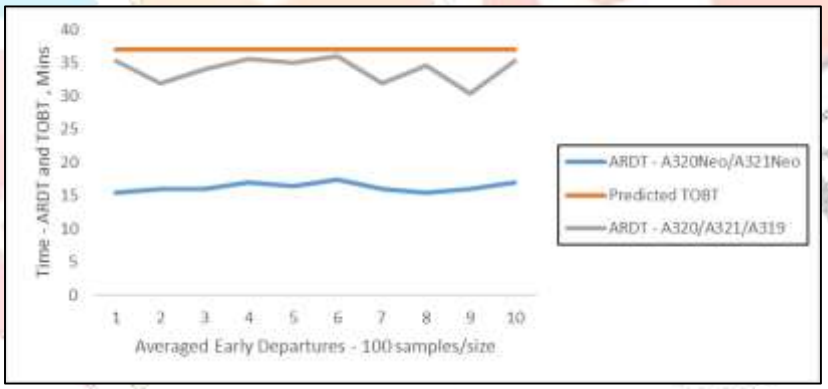

Fig. 5 ARDT and TOBT variation for NEO and CEO models

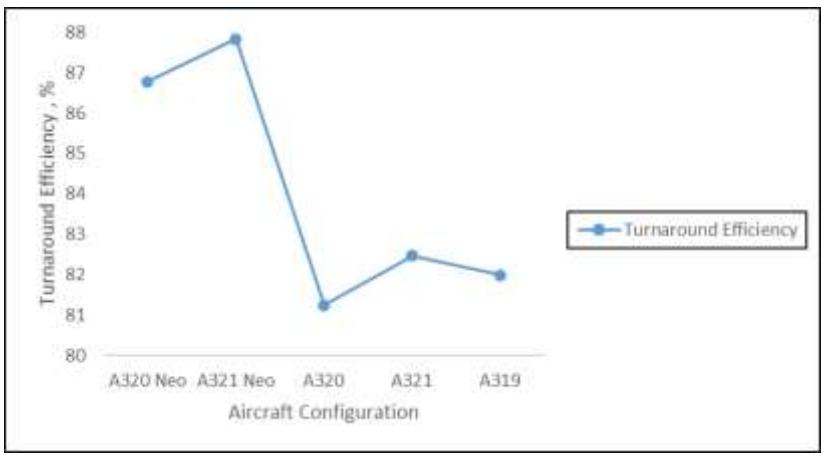

Fig. 6 Variation of Turnaround efficiency with Aircraft Configuration

The Turnaround efficiency also plays an important role is transit performance assessment of the aircraft configuration. The fig. 6 illustrates the turnaround efficiency of various Airbus configurations, including A320NEO, A321NEO, A320, A321, and A319. It clearly differentiates between the NEO variants and the CEO. Its turnaround efficiency in both A320NEO and A321NEO is way higher than their respective CEOs and thus points to an important operational benefit these newer aircraft offer over older models. This improved efficiency is probably due to the design upgrades, especially having more fluid maintenance procedures and optimizing ground handling processes, while at the same time, it has all the technological upgrades that NEO aircraft have.

The NEO ones are made to be more fuel efficient and have fewer complications in operation, hence it appears it outperforms the old A320, A321, and A319 as those classic models show relatively lower turnaround efficiency as shown in fig. 7. Older version aircraft models, like the A320 CEO models, will likely require longer checks and servicing processes, which in turn prolong turnaround times. These differences underline further how the two generations of aircraft operate on different levels of operational effectiveness-the NEO variants, allowing airlines to minimize ground time and hold on tight schedules. Increased turnaround efficiency also contributes to cost savings, but more importantly, it implies higher turnover rates, thus allowing airlines to deliver more flights to the market, enhancing their fleet utilization capacity. In this regard, NEO aircraft configurations give an airline a significant competitive advantage over other fleets, which are still made up of old CEO models, in terms of improved turnaround performance.

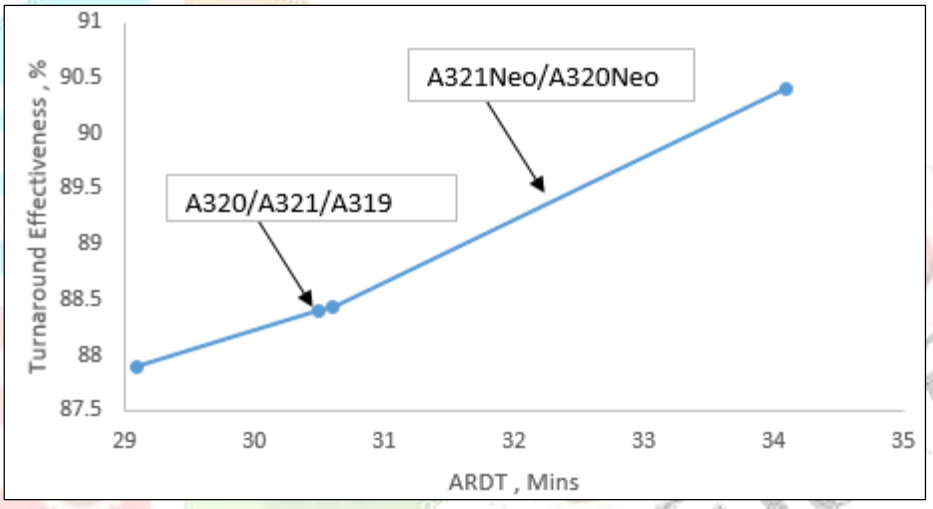

Fig. 7 Variation of Turnaround efficiency with Aircraft Configuration

When it is associated with engineering ramp operations the transit maintenance time taken by the NEO variants are remarkable as this is a direct indication of operating efficiency are due to sophisticated technologies, stronger materials and systems that lend better for maintenance and servicing. The CEO variants, such as the A320, A321, and A319 have longer maintenance time periods, and this could be a result of older systems being more complicated and needing longer inspection time periods and more servicing. For the given airport reference the engineering transit time is observed well within the actual turnaround time (TAT).

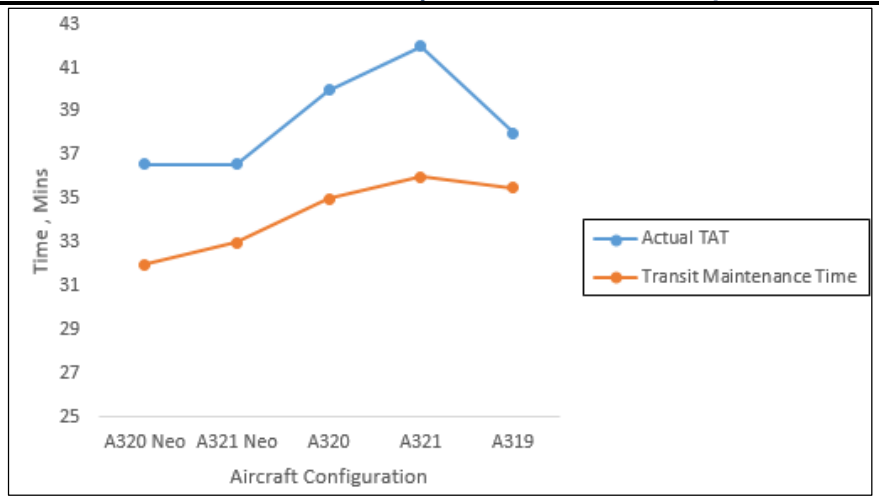

Fig. 7 Variation of Transit Maintennace Time with Aircraft Configuration

3.2. Questionnaire Survey Feedback

The results of the questionnaire conducted with about experienced commercial ramp and engineering staff members per early departure shift timings and during the passenger peak load conditions provided a considerable indication that the NEO variants offer much higher preference than the CEO models as shown in fig. 8. Both groups, integral to the smooth turnaround and maintenance of aircraft, indicated that the NEO variants have overall operational advantages. From the engineers' perspective, reduced complexity and shorter timescale for maintenance are among the factors preferred when it comes to the NEO aircraft.

Commercial ramp crews preferred NEO variants, largely on the grounds of the more streamlined processes that these aircraft allow. Better ground operations, both in loading and unloading, were said to be encountered in NEOs, where fewer disturbances or challenges arose while on the move. Handling was easy, and the improvement in coordination between ground services and flight crews added impetus toward faster turnaround and greater overall reliability. Ramp and engineering agreed that NEO variants operate more consistently and within margin closer to scheduled departure times, allowing them a smoother ride and less lost time for the airlines.

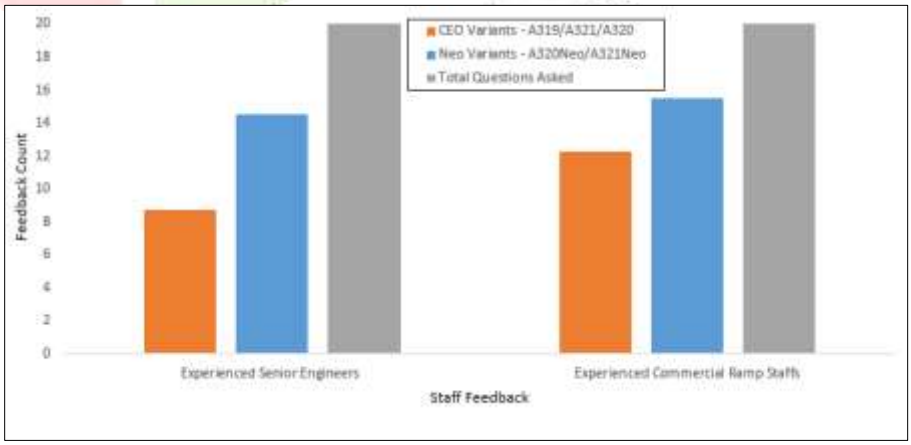

Fig. 7 Questionnaire Survey Feedback Report (Total Prodcutive Questions-20)

IV. CONCLUSION

The study presented a layout of the demand for NEO airplanes, which represents a rather widespread acknowledgment of their operational advantage. The productive feedback from the airline staff clearly indicates an overall advantage related to technical reliability as well as ground efficiency, supporting the trend that gets NEO variants adopted in the industry at large. It makes both maintenance and ramp operations more efficient and makes airlines more predictable and cheaper. The data points out an operational divergence between NEO and CEO models that continues to increase, with the former providing a relatively smoother and time-saving experience, which is more appreciable to the airline and its staff. The current study has taken into account early on-time departures, neglecting flight delays and events, but as a future scope, the work can be extended to analyze the transit performance with delays into account. There is general expectation that for the next couple of years the CEO variants may be replaced to a certain extent by NEO product lines.

V. ACKNOWLEDGMENT

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