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A Comparative Analysis of Aircraft Turnaround Time Between Full-Service Carrier (FSC) and Low-Cost Carrier (LCC): A Case Study

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Abstract

Aircraft turnaround time has been a crucial part of any airline operations at the airport and will impact the aircraft utilisation. This study attempts to investigate and understand the differences in aircraft turnaround time between Full-Service Carrier (FSC) and Low-Cost Carrier (LCC) and the contributing factors in the operational processes that led to the differences. Field observation at the selected airport has been conducted to collect turnaround time data for FSC and LCC flights. A total of eight narrow-body aircraft flights (four for each type of carrier), that spanned different times of the day are observed. The critical activities during turnaround time process were identified and analysed. The results suggest that the Turnaround Time (TAT) for LCC is shorter than FSC with differences in operational processes. These differences could possibly lead to better aircraft utilisation and impacting the financial results for the airlines.

Keywords; *Turnaround Time, Aircraft Turnaround Time, Ground Operations, Full-Service Carrier, Low-Cost Carrier*

I. INTRODUCTION

Turnaround time has been a crucial part of any airline operations at the airport. Aircraft turnaround operations are conducted within the scheduled turnaround time between two flights, which is fleet type and the service requirement dependent. According to the previous study [1], turnaround operation includes passenger handling (disembarkation and embarkation), cabin cleaning, crewing (crew change), routine visual maintenance checks, refueling, cargo handling (unloading and loading), and catering services (loading and unloading). The aircraft turnaround activities are often standardised to a strict timeline, and most airlines follow their own standard operating procedures (SOPs) or the ones provided by aircraft manufacturers [1]. For most activities, there are planned operating sequences in the SOP. For a domestic low-cost service of a B737 or A320, the turnaround time can be as short as 15 to 20 minutes. Airlines try to minimise turnaround time of aircraft in order to produce more revenue-making flight time [2].

Disruption in turnaround time could cause flight delays. Flight delay refers to the time difference between the scheduled departure-arrival time and the actual departure-arrival time of a flight on the day of operation. Flight delays are frequently cited by the industry and aviation research to be among the important factor which may significantly impact passenger satisfaction and repurchase intention in the future and even the market share or performance

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of an airline [2].

Making an efficient turnaround operation has become one of the keys to success for Low-Cost Carriers. Shorter turnaround time managed to capture higher yield and turn to profit year after year. In this study, the turnaround time for two different business models which are the Full-Service Carrier and Low-Cost Carrier will be investigated. The study is solely focused on the overall view of turnaround operation processes for the narrow-body aircraft. The aim of this study is to identify the differences in aircraft turnaround time between Full-Service Carrier (FSC) and Low-Cost Carrier (LCC) and the contributing factors in the operational processes that led to the differences.

II. AIRCRAFT TURNAROUND PROCESS

The process of turnaround begins when the aircraft reaches the parking position after landing and the chocks are set (‘on block time’) and ends when the aircraft is ready to leave and the chocks are removed (‘off-block times’) [3]. Turnaround time is defined as the time measured from the moment the aircraft parks at the correspondent stand until it is ready for taxing out towards the runway [4]. There are several processes regarding turnaround operation that airlines have to accomplish prior to the next flight [1]. The general processes in turnaround operations are:

- passenger handling (disembarkation and embarkation),
- cabin cleaning,
- crewing (crew change),
- routine visual maintenance checks,
- re-fuelling,
- cargo handling (unloading and loading),
- and catering services (loading and unloading).

The processes involved in turnaround time are [5]:

- boarding/deboarding of passengers,
- refueling,
- cabin cleaning,
- handling of catering,
- wastewater and potable water
- offloading and loading of baggage and freight containers (and line maintenance services).

All the processes during turnaround time are sequential and strongly connected. Depending on aircraft type, the number of passengers, amount of loaded and unloaded cargo and the business models of airlines [3]. All of the processes have to be examined and dependencies have to be analysed in order to reduce the turnaround time. The course of activities during turnaround processes follows a strict chronological order. Some processes can be executed concurrently, while others only sequentially [3]. For instance, an aircraft is refueled after the last passenger has left the aircraft, as according to requirements stated in EU-OPS 1.305 (FAR 121.50). Safety rules only allow refueling with passengers on board under certain conditions. Catering and cleaning process will be done before or after deboarding and boarding of passengers to avoid obstructions in the cabin and inconvenience of passengers [5] due to noise and comfort issues [3].

Figure 1 shows the layout at a gate position for a narrow-body aircraft. After the chocks are placed before the wheels, the ground power supply is connected to allow the engines and auxiliary power unit (APU) to be turned off. APU has to be turned off because most airports hate the sharp annoying noise of the APU and most airlines hate the costs of the extra fuel the APU burns. Then a passenger boarding bridge will be typically docked at the front left side door at the terminal parking position. Passenger disembarking will begin along with the unloading of cargo and baggage once the doors are opened. Also at this time, the potable water is replenished. The aircraft will be refueled after the

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last passenger has disembarked. In the meantime, the flight crew can start preparing for the next flight, check the airworthiness of aircraft with a walk around, set up the flight computers, and execute system checks [3].

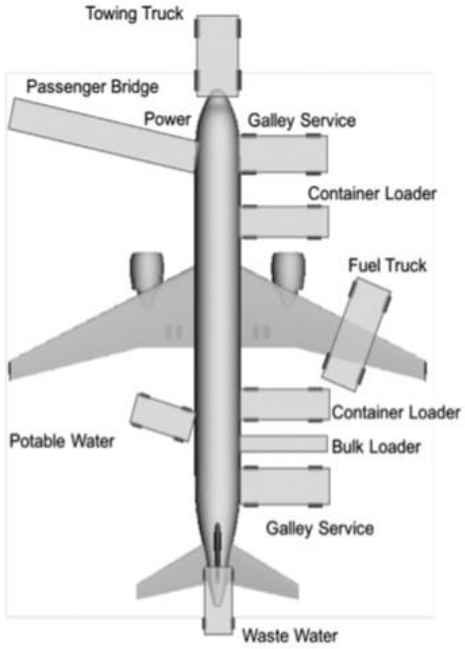

Fig.1. Typical ramp layout at a gate position for a narrow-body aircraft [3]

The cabin crew examines general cabin condition and cabin emergency equipment [6]. The catering provider in the aircraft cabin will exchange the trolleys, clean the cabin interior and prepare for the next flight. The loading of cargo and baggage for the next flight can begin once the unloading is completed. After the fuel has been replenished, passenger can begin to embark on the aircraft and a final head count is performed before leaving the parking position. Electrical power switches from the ground power supply to APU [3], the chocks are then removed, and pushback is required.

A. Critical Path

The critical path is the longest length of time to complete the turnaround process. An activity is said to be critical when the occurrence of any delays in the activity results in the entire process being delayed [1]. In this study, the critical path will be regarded as the factors that will determine the duration of the turnaround time. Previous studies [3,5] agreed that the critical path of turnaround time is during passenger processes, catering, and refueling. [1] stated that the most critical path of the turnaround process is during boarding of passengers, deboarding of passengers and cabin cleaning. Both studies agreed that passenger processes will affect turnaround time performance, whether delayed or otherwise. This is relevant as the aircraft must not move until all passengers are seated. The boarding process could only begin once the aircraft has been cleaned completely and finished refueling [3,5]. The process cannot be done until all passengers are disembarked.

As shown in Fig.2 deboarding of passengers will take about 10 to 15 minutes, cabin cleaning will take 15 to 20 minutes and for boarding usually, only 10 minutes are reserved. But overall, up to 30 minutes are required. Hence, the faster the passengers disembarked, the quicker the cleaning process can be performed and the sooner the passengers can embark on the aircraft. Cabin cleaning will affect turnaround time [3]. The cabin cleaning process will go simultaneously with the catering and refueling. However, it is found that from the process of deboarding, then fuelling catering or cleaning and finally boarding shows that the frequency of occurrence on the critical path for fuelling and catering is more significant than cleaning (8%) which are 57% and 35% consecutively [7]. There are two important points that can be observed in Fig.1. Firstly, some activities are conducted sequentially on the timeline. Second, the service time of activities determines the total required time for turning around an aircraft, meaning the shorter the individual service time of each activity, the shorter the total aircraft turnaround time is.

B. Narrow Body Aircraft

FSC uses B737-800 for its domestic flights. There are two versions of the seating configuration in B737-800 for FSC; the first version is with 150

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Economy Class seats and the second version is with 144 Economy class seats [8]. Usually, on short-haul flights, the first version is mostly used. Apart from 150 Economy Class seats, it also equipped another 16 seats of Business Class. In total, there are 166 seats.

Fig.2 shows the average turnaround time taken for B737-800 for a premium airline. On average, it takes 31 minutes to complete the turnaround process. It can be seen that the critical path is at deplaning, cabin servicing, refueling, and enplaning passengers took the longest time. The deplaning of passengers took an average of 18 pax per minute (roughly a total of 8 minutes) before the cabin servicing and refueling can be done simultaneously. Cabin servicing and refueling take 9-10 minutes minimum. Once the tasks are accomplished, at minute 19 of turnaround time, passengers will start enplaning the aircraft at the rate of 12 pax per minute which is roughly 12 minutes in total.

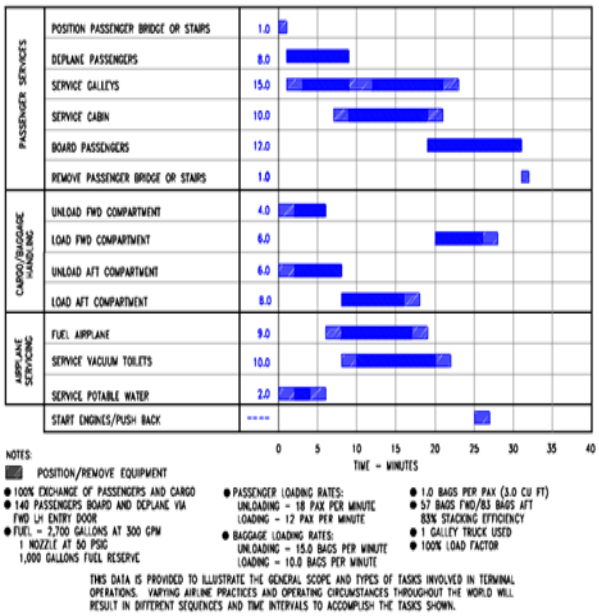

Fig.2. Turnaround Operations - B737-800 [9]

Airbus A320-200 of LCC is operated in a single class configuration for the short-haul flight. There is a total of 180 seats in the aircraft [10]. Fig.3 shows the turnaround operations of A320-200. On average, 23 minutes are required to complete the whole turnaround process for short-haul flights. The critical path of the turnaround process is at deboarding of passengers, refueling, and boarding of passengers. Since the boarding and deboarding of passengers use the forward and aft doors (considering the load factor of aircraft is 100%), the process can speed up. At the rate of 18 pax per minute using both doors, the 5 minutes of deboarding of passengers can be achieved. Refueling of aircraft takes up 7 minutes before the passengers can board the aircraft again. Again, by using both doors, at the rate of 15 pax per minute, all passengers are assumed to board the aircraft in 6 minutes time.

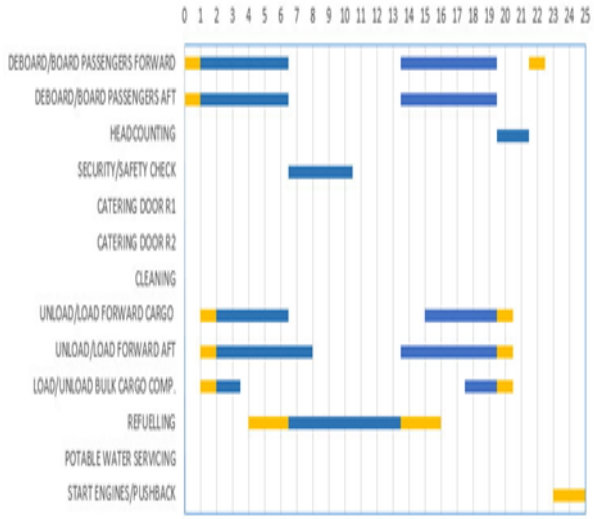

Fig.3. Turnaround Operations - A320-200 [11]

III. METHODOLOGY

Field observations were performed in every operation carried out during the turnaround processes for FSC and LCC flights. The observations were carried out at Penang International Airport (PEN) for both FSC B737-800 and LCC A320-200 flights (four flights for each type), at two different days and timing, as shown in Table 1. The field observation was conducted on two consecutive days due to time limitations, weather, and visibility restriction. The flights were chosen randomly, and the flight time such as morning, evening, peak hour, and non-peak hour

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were taken into consideration.

Table 1. FSC and Lcc Flights Observation Time

Airline	Flight	Date	Time (hours)
FSC	1 MH 1155	26/3/2019	1723
	2 MH 1162	26/3/2019	1946
	3 MH 1143	27/3/2019	1010
	4 MH 1145	27/3/2019	1145
LCC	5 AK 6125	26/3/2019	1415
	6 AK 6242	26/3/2019	1604
	7 AK 6423	26/3/2019	1904
	8 AK 6113	27/3/2019	1046

IV. RESULTS AND DISCUSSION

The results of the turnaround time for each process for all the eight flights are presented in Table 2.

Table 2.Turnaround Process & Duration

No	Process	Duration							
		F1	F2	F3	F4	F5	F6	F7	F8
1	Airplane Arrival	-	-	-	-	-	-	-	-
2	Connect wastewater car	-	-	-	-	-	-	-	-
3	Pumping	-	-	20	-	-	-	-	-
4	Disconnect wastewater car	-	-	-	-	-	-	-	-
5	Connect potable water car	-	-	-	-	-	-	-	-
6	Pumping	-	-	19	-	-	-	-	-
7	Disconnect potable water car	-	-	-	-	-	-	-	-
8	Connect dispenser	-	-	-	-	-	-	-	-
9	Fuel quality check	-	2	1	-	1	1	1	-
10	Refueling	-	13	4	-	9	9	5	-
11	Fuel quality check	-	3	1	-	1	1	1	-
12	Disconnect dispenser	-	-	-	-	-	-	-	-
13	Connect boarding bridge	-	-	-	-	-	-	-	-
14	Deboarding of passengers	10	7	7	5	5	5	5	12
15	Cabin cleaning	7	5	7	9	-	-	-	-
16	Boarding of passengers	11	11	5	10	7	7	12	14
17	Disconnect boarding bridge	-	-	-	-	-	-	-	-
18	Connect catering	-	-	-	-	-	-	-	-
19	Offloading catering	-	-	-	-	2	2	-	-
20	Loading catering	-	-	-	-	8	8	-	-
21	Disconnect catering	-	-	-	-	-	-	-	-
22	Opening freight door	-	-	-	-	-	-	-	-
23	Offloading baggage/freight	4	12	5	11	11	11	2	7
24	Loading baggage/freight	11	10	9	9	2	2	2	6
25	Closing freight door	-	-	-	-	-	-	-	-
26	Airplane departure	-	-	-	-	-	-	-	-
	Total turnaround time	36	35	44	43	24	29	31	30

A. Turnaround Time for FSC and LCC Flights

Flight 1 took 36 minutes to complete the turnaround time. Once the aircraft has been chock-on, the boarding bridge is connected to aircraft's door. Another activity that took place at the same time is the opening of the freight door. Deboarding of passengers took 10 minutes while boarding of passengers took 11 minutes. The cabin cleaning process is performed during turnaround time. In this case, it occurs between deboarding and boarding of passengers to prevent obstructions in the cabin and inconveniencing passengers. The cabin cleaning took 7 about minutes to be completed. Unloading of baggage and freight occurs at the same time as passenger disembark but only for 4 minutes. On the other hand, the unloading process took almost twice which is 11 minutes. Activities such as refueling service, wastewater, and potable water, and catering did not occur during the turnaround time of this flight. This particular flight operation managed to carry out the turnaround time within the airline standard. The shortest process taken is to unload the baggage/freight container which only took 4 minutes. The reason behind this is because the ground handler is set up early prior to the arrival of aircraft and there are also many ground handler staffs (15 staffs) at the terminal. For the baggage handling section specifically, there are three to four workers that are responsible for the process. Apart from that, the automated conveyor belt is used to unload the baggage which made the process is easier and faster. Oppositely, the unloading of baggage and cargo took longer time, almost 11 minutes. With a number of five staffs, the cabin cleaning process took place for 7 minutes. Cabin cleaning is performed after all passengers have disembarked from the aircraft. The deboarding of 141 passengers is completed within 10 minutes and for the boarding of passengers, 11 minutes.

For Flight 2, all main activities for turnaround time

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were carried out except for wastewater and potable water servicing and catering handling. Flight 2 has the quickest turnaround time of FSC flight in this study, which only took 35 minutes to complete, exactly as per the airline's standard. After the arrival of aircraft, the deboarding process took 8 minutes, followed by cabin cleaning 5 minutes and continued with the boarding of passengers for 13 minutes. The refueling process which occurs right after the aircraft arrive at terminal lasts for 18 minutes until the dispenser was disconnected. 12 minutes was taken to offload the baggage and freight and 10 minutes was taken to loading the next flight's baggage and freight. The longest activity is the refueling process (13 minutes) followed by unloading of baggage and cargo (12 minutes) and boarding of passengers (11 minutes). The turnaround time for this flight operation was efficient as the ground handler is already stand by at the apron 10 minutes prior to the arrival of the aircraft except for the bowser that is used to deliver fuel to aircraft at the airport. There could be technical problem happened that caused the refueling service took the longest time but even so, the late arrival of the bowser did not affect the turnaround time of the flight. The cargo/baggage offload was the second longest activity recorded due to the higher number of goods carrying from the previous sector. The boarding and deboarding of passengers show that the activity occurs at an ample time.

Flight 3 took the longest turnaround time to complete (44 minutes). The whole process of deboarding of passengers to cabin cleaning and back to onboarding of passengers is 27 minutes; 9 minutes for deboarding, 7 minutes for cabin cleaning, and 11 minutes for onboarding. The refueling process took 6 minutes to complete. Unloading of baggage and freight took 10 minutes while the loading took 2 minutes longer (12 minutes). The turnaround time of the flight was affected by the process of handling wastewater and potable water. The longest activity is servicing of wastewater and potable water. Both activities took 39 minutes to finish because these two processes were handled by two different ground handlers. The next activity that took the longest was the loading of baggage/container which was 9 minutes. With a higher load of cargo going to KUL, it requires the ground handler to place the goods in accordance with the weight and aircraft balancing. The rest of the activity took place at the standard duration of time. Overall the turnaround time of the flight was 9 minutes longer than the standard turnaround time of the FSC.

Turnaround time for Flight 4 is 1 minute faster than Flight 3. The longest activity is during boarding of passengers (10 minutes). Oppositely, deboarding of passengers is the shortest activity (5 minutes), followed by cabin cleaning (9 minutes), unload the baggage and freight (11 minutes) and loading (9 minutes). The wastewater and potable water servicing, refueling servicing, and catering handling are not performed during the turnaround time. The longest time taken is the loading of baggage/freight, followed by the boarding of passengers, cabin cleaning, and loading of baggage/freight container. It can be generalized that the offloading of baggage and cargo contributed to the longer time for this flight. Overall the turnaround time for this flight is in accordance with the airline's standard of turnaround time

The turnaround time of Flight 5 is 24 minutes, which is the quickest turnaround time as compared to other FSC flights in this study. Even though the process of deboarding of passengers and unloading of baggage and freight happened simultaneously, both activities are not affecting each other. Disembarkation of passengers took 5 minutes while embarkation of passengers took 12 minutes. Meanwhile for offloading of baggage and freight took 8 minutes and the loading of baggage and freight took 8 minutes. For LCC flights, it is unlikely common to see the cleaning activities take place during the observation. It is probably because

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cabin crews are in charge to do the cabin cleaning during every domestic flight. The quickest activities are deboarding of passengers and loading of baggage/freight container on the aircraft. Both activities took 4 minutes to complete. It is because, during the turnaround time, ramp stairs are used and attached to the front and back of the aircraft, made the process of disembarking passengers more efficient and faster. As for the baggage/freight loading, it is safe to assume that the shorter time is due to the efficient ground handler managing the cargo to be fitted into the aircraft. In this particular turnaround operation, the boarding of passengers took the longest time (8 minutes). There are many possibilities that could interfere the embarking process as it could be passengers' late check-in, late turn up, gate changing and many more in which could lead to the longer time taken for this activity to be handled.

Flight 6 shows a total turnaround time of 29 minutes. The activities that occur simultaneously are refueling (13 minutes), deboarding of passengers (6 minutes), and offloading of baggage and freight (15 minutes). Right after passenger disembarkation activity, followed by embarkation of the passenger (7 minutes). The loading of baggage and freight took 5 minutes to complete. The last activity that affects the turnaround time for this flight is the handling of the catering process (11 minutes). As mentioned in the earlier part, cabin crews are in charge to do the cabin cleaning during every domestic flight, unlike FSC where they have dedicated crew to do cabin cleaning during turnaround time. Therefore, there is no recorded time for cleaning activity for all LCC flights. The longest activity is baggage/freight unloading (11 minutes). Unlike the ground handler provider for FSC, LSC had to unload the cargo manually. On top of that, LCC's ground handler is lesser than of FSC's ground handler at every flight operation. Hence, the time taken to unload the baggage and cargo took longer time. Other activities during the turnaround process were done in ample timing. Thus from the overall observation, the turnaround time for this flight is 29 minutes.

Flight 7 took the longest time to complete the turnaround time (31 minutes). Deboarding of passengers took 6 minutes however the boarding of passengers took 21 minutes. It may due to not all passengers have yet arrived at the gate and gate

agents had to make several announcements by specifically calling out the names of those passengers, asking them to immediately proceed to the gate. Unloading and loading of baggage and freight took 7 minutes and 3 minutes respectively. The activity that contributed to the turnaround time is the boarding of passengers (12 minutes) opposite to deboarding of passengers which only took 5 minutes.

Flight 8 took 30 minutes to complete the turnaround activities. Out of all turnaround activities, wastewater and potable water servicing, refueling service, and catering handling are not carried out. The boarding of passengers took the longest time (14 minutes), followed by deboarding (12 minutes), baggage/freight offloading (7 minutes) and baggage/freight loading (6 minutes). It can be generalized that the boarding and deboarding process contributed to the longer turnaround time.

B. Comparison of Turnaround Time Between FSC and LCC

The turnaround time for eight flights (4 FSC, 4 LCC) is presented in Table 3.

Table 3. Turnaround time for fsc&lcc

FSC	LCC
MH 1155 (36 minutes)	AK 6125 (24 minutes)
MH 1162 (35 minutes)	AK 6242 (29 minutes)
MH 1143 (44 minutes)	AK 6423 (31 minutes)
MH 1145 (43 minutes)	AK 6113 (30 minutes)

As shown in Table 3, it can be seen that flights from FSC seem to have a longer turnaround time compared to LCC flights. From 26 activities (refer to Table 1), nine activities are found to be significant during turnaround time. However, only

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five activities are carried out by all four flights which are deboarding of passengers, cabin cleaning, boarding of passengers, unloading of baggage/freight container and loading of baggage/freight container. As depicted in Fig.4, the duration for loading of baggage/freight container showed the highest leading factors that affecting FSC turnaround time followed by the boarding of passengers, offloading of baggage/freight container, deboarding of passenger and cabin cleaning.

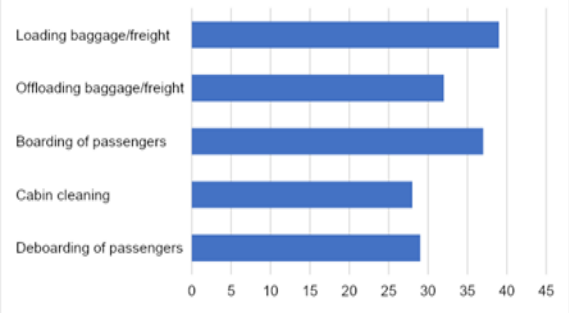

Fig.4. Duration FSC Flights Turnaround Time

Analysis of the turnaround time for four LCC flights showed that from all 26 activities observed, eight were found contributing to the turnaround process. Out of eight activities, only four activities were carried out by all four flights, which are deboarding of passengers, boarding of passengers, offloading of baggage/flight container, and loading of baggage/container.

As depicted in Fig.5, the highest leading factors that affect LCC turnaround time is the boarding of passengers, followed by both deboarding of passengers and unloading of baggage/freight container and lastly, loading of baggage/freight container.

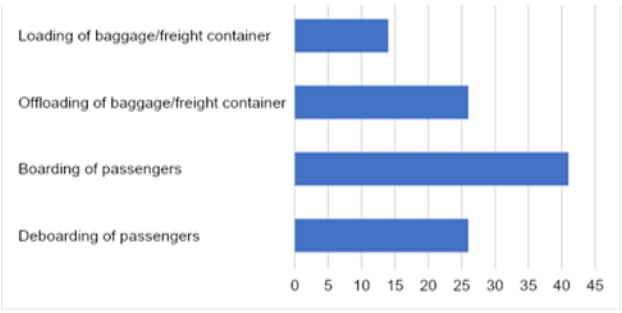

Fig.5. Duration of LCC Turnaround Time

The difference in factors for FSC and LCC operational processes in turnaround operations is shown in Fig.6.

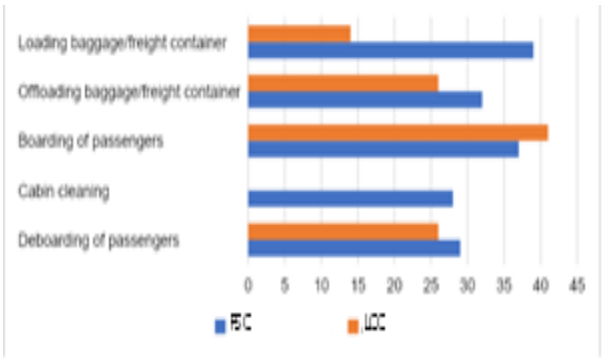

Fig.6. Operational Differences between FSC and LCC

FSC has slotted a special duration to do cabin cleaning. That is the reason FSC requires longer turnaround time as cabin cleaning can only be done when all passengers have been disembarking from the aircraft completely. Even though only an average of 7 minutes, if the process is not completed on time, it will affect the consequent activity which is boarding of passengers. Both processes cannot occur at the same time as it will cause inconvenience to both cleaning workers and passengers, and might cause blockage in the aisle.

The difference between FSC and LCC is in terms of completing the activity of loading baggage/freight container into aircraft, FSC took longer time as compared to LCC. Same goes with the process of unloading the baggage/freight container into aircraft where FSC took longer than LCC. From the observation during data collection, it can be seen that the number of ground handler responsible for each activity during turnaround time is lower for LCC which is only around 5 to 6 staffs at one time as compared to FSC which has a higher number of staffs, around 15 ground handler at every turnaround operation. Even though the higher number of the ground crew would shorten down the service time of some activities, but if poorly managed, it would incur more cost. In this case, even though the turnaround time for FSC is longer than LCC, it is

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still within their airline standard (FSC 53 minutes, LCC 25 minutes). Each flight requires a certain number of workers and equipment. In optimizing the turnaround time process, the effort making the ground crew to be on ramp even before aircraft reaches the gate should be done. This is one of the reasons LCC could achieve a shorter turnaround time.

FSC takes longer time in deplaning the passengers while in enplaning the passengers, LCC took longer time than FSC. LCC took a shorter time because they use ramp stairs on front and rear door of aircraft. Meanwhile, FSC only uses aerobridge to deplane and enplane passengers. Other contributing factors could be due to the passenger's issues such as late turn-ups to the gate because of certain reasons like habitual, confusing signage, lack of awareness and immigration and security congestion. Therefore, good communication and handling between airline representatives from the customer service department, passenger handling, and others are very important to mitigate this problem by guiding passengers with clear information, directives and other imperative ways as to reduce the inefficiency.

V. CONCLUSION

There are five factors that affect the turnaround time of Full-Service Carrier (FSC) and four factors for the Low-Cost Carrier (LCC). The factors that affect the turnaround time of FSC are loading baggage/freight containers, boarding of passengers, offloading baggage/freight containers, deboarding of passengers and cabin cleaning. The factors that affect the turnaround time of LCC are boarding of passengers, deboarding of passengers, offloading baggage/freight containers and loading baggage/freight containers. A different factor between FSC and LCC is cabin cleaning. The number of ground crews handling the activities during cargo loading/offloading process and the use of ramp stairs versus aerobridge also contributed to the difference in turnaround time for both carriers.

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