The Impact of the Covid – 19 Pandemic on Runway Service Life

(Case Study: Soekarno Hatta International Airport)

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Abstract: Government policies that carry out large-scale social restrictions during the Covid-19 period have had an impact on reducing air traffic both for landings and takeoffs, which will have an impact on the life of runway services. Service life is the strength of road pavement in standing the repetition of permit loads before experiencing failure, by knowing that the service life can be directly used to determine the right time for runway maintenance. The purpose of this research is to determine the impact of the Covid-19 pandemic on the life of runway services. The method used in this research is the FAA method with the help of FAARFIELD software, this software calculates the service life based on the CDF value of each aircraft. The data used is secondary data in the form of aircraft type data, CBR ground, and existing pavement data. From the results of the research, it is known that the COVID-19 pandemic has a positive impact on the life of runway service by increasing the life of runway service by 4 years, where in the condition of covid-19 conditions it has a CDF value of 0.20 with a service life of 19 years and in normal conditions the CDF value is 0.22 with a service life of 15 years. The results of this research contribute to decision-making in carrying out maintenance and repairs on the runway of Soekarno Hatta International Airport so that the runway can operate sustainably in accordance with performance requirements throughout the life of the plan, to maintain flight safety and comfort.

Keywords: Covid-19, FAARFIELD, CDF, Service Life

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Introduction

The Covid-19 pandemic that has occurred since March 2020 has affected all aspects life includes the transportation sector, especially air transportation (Arianto, 2021). Research on the Impact of the Covid-19 Pandemic on Air Transportation has been researched by (Arena & Aprea, 2021). In his research, he said that the Covid-19 pandemic situation has caused many changes in the world sector. Large-scale social restrictions or lockdowns carried out by governments of countries around the world have had a major impact, especially on the transportation sector. Research on the impact of the Covid-19 pandemic has also been researched by (Thoharoh & Albanna, 2022) with the title Analysis of the Impact of the Covid-19 Pandemic on Air Transportation on Susi Air Airlines. The study stated that the Covid-19 pandemic had an effect on the number of Susi Air passenger flights with a significance value in the run test of 0.000. The research aimed to find out the influence of Covid-19 on the number of passenger and cargo flights and how Susi Air stabilized the number of flights during the Covid-19 pandemic using two types of data, namely primary data in the form of observation data in the field, and secondary data in the form of time series data on the number of Susi Air flights at Nusawiru Cijulang Airport and interview data. Research on Cumulative Damage Factor (CDF) has been carried out based on Cumulative Damage Factor (CDF) has been carried out by (Hariyami D, Setiawan A, 2024), in his research on the evaluation of pavement thickness on the runway of Syukuran Aminuddin Amir Luwuk Airport. The results of the evaluation of the thickness of the runway pavement which has a CBR value of 15%, with a pavement thickness of HMA Surface 215 mm, Crushed Aggregate 152 mm, and Uncrushed Aggregate 200 mm with a service life of 20 years in 2040 obtained a Subgrade CDF value of 0.00 and HMA CDF of 0.86. The results of the test with FAARFIELD software changed the pavement thickness for the base layer to 152 mm (minimum value) from the value of 100 mm. So, the planning of the pavement thickness requires an additional layer of 52 mm. The research (Fatikasari et al., 2022) has also examined the pavement on the runway in its research on Planning the Thickness of the Flexible Pavement of the Soekarno-Hatta Airport Runway Using FAARFIELD Software and COMFAA said that the thickness of the evaluation and the value of PCN are highly determined from the equivalent factor of each pavement layer. The research aims to design the thickness of the flexible pavement of the Soekarno-Hatta Airport Runway using secondary data from PT Angkasa Pura II.

An airport requires good and efficient planning and maintenance, especially its facilities, especially the ground side and the air side. The runway is one of the most important airside facilities and must have standards, both strength and dimension (Alabi et al., 2021). Therefore, the condition of the runway is the most important air side facility that must always be considered to support and maintain the security, continuity, and comfort of airport operation.

Once the runway is completed and then used to take off and land the aircraft for a certain period of time, the movement of the aircraft on the runway many times will result in an exhaustion of the surface structure of the runway (Karma, 2021). The amount of damage caused by each type of aircraft is expressed by a Cumulative Damage Factor (CDF). Cumulative Damage Factor (CDF) is the amount of structural fatigue life of pavements that have been used up. The structural condition of the runway pavement is determined by its remaining service life (Widianto et al., 2023; Aurellia et al., 2024).

(Bayoumi et al., n.d.) has researched the change in load that will be received by the runway in his research entitled The Impact of the Addition of New Large Aircraft (A380-800) on Airport Flexible Pavement. This study conveys that airports that have a basic land with a CBR value of more than 6%, can allow New Large Aircraft (A380-800) to operate with annual departure growth of no more than 3% without losing more than 30% of the planned runway service life. This study aims to evaluate the effect of New Large Aircraft (A380-800) on airport flex pavement on service life. The data collection method uses secondary data. Research on changes in annual departures has been carried out by (Rini et al., 2020) in her research on Re-Analysis of Wiriadinata Airport Runway Using the FAA Method said that the increase in the number of passengers, annual aircraft arrivals, planned aircraft are factors that affect the need for a re-analysis of the length and thickness of the pavement on the Wiriadinata Airport runway. The research aims to replan the thickness of the flexible pavement of the runway at Wiriadinata Airport using the FAA method. The data collection method uses secondary data from PT Angkasa Pura II. (Purwanto & Sunandar, 2019) also used FAARFIELD software in their research entitled Review of the Development of the Runway of Kasiguncu Airport, Poso Regency. The study states that the schedule for runway maintenance is planned every 20 years of the plan life with a runway maintenance period every 5 years. This study aims to evaluate the suitability of maintenance and resurfacing schedules to the growth of aircraft movement. In this study, an evaluation was carried out on the suitability between the maintenance schedule and the growth of aircraft movement. The data collection method uses secondary data in the form of aircraft data, temperature data, slope data, elevation data, wind, ground CBR, and air traffic. The calculation and evaluation of the thickness of the airport runway pavement in this study used FAARFIELD and COMFAA software.

Although many studies have discussed the service life of runways (Bayoumi et al., n.d.) and the impact of the covid-19 pandemic (Thoharoh & Albanna, 2022), most focus on major aircraft changes and a decrease in the number of flights. Therefore, the impact of the covid-19 pandemic on the lifespan of runway services is less explored. This study aims to determine the impact of the Covid-19 pandemic on the service life of runways so that they can operate

sustainably in accordance with performance requirements throughout the life of the plan, to maintain flight safety and comfort

Research Method

Research Location

This research was conducted at Soekarno Hatta International Airport on the runway 3 which is located at the Jakarta International Soekarno-Hatta Airport Building 601, PO. BOX 1245 BUSH, Jakarta, 19101, Kab. Tangerang, Banten.

Figure 1 Soekarno Hatta International Airport Runway Location

Specifications for Runway 3 of Soekarno Hatta International Airport:

▪ Runway Dimensions: 3000 x 60 m

• Pavement surface material: Asphalt Concrete

• Pavement Strength: PCN = 89 F/C/X/T

Stages of Research Implementation

In general, the implementation of this research is divided into several stages, such as seen in Figure 2.

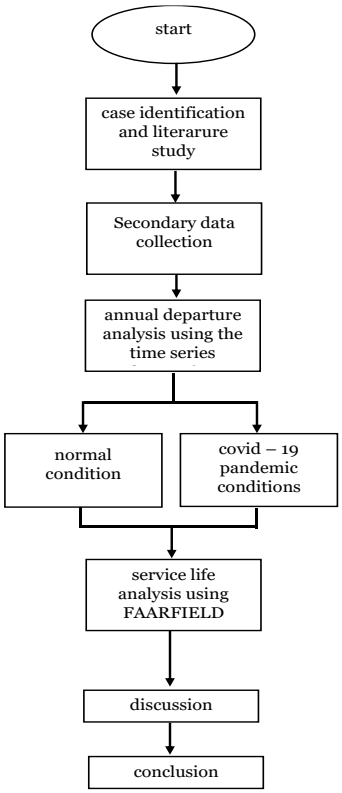


Figure 2 Research stages

The explanation of the stages of research implementation is as follows:

Case Identification and literature Study

This research was conducted to determine the impact of the Covid-19 pandemic on the service life of the runway at Soekarno Hatta International Airport using the FAA method. For this reason, study the literature This research focuses on the service life of airport runways, methods FAA, and forecasting methods.

Secondary Data Collection

Secondary data in this research was obtained from PT Angkasa Pura II.

Table 1 Research data

No	Data Type	Data Source
1	Existing Runway Pavement	PT. Angkasa Pura II
2	Annual Departure Aircraft	PT. Angkasa Pura II
3	Aircraft Type	PT. Angkasa Pura II
4	CBR	PT. Angkasa Pura II

The data obtained from PT Angkasa Pura II includes Existing Runway Pavement, Annual Departure Aircraft (2016-2020), Aircraft Type, and CBR.

Annual Departure Analysis Using the Time Series

There are several methods or forecasting techniques for airport planners. The choice of this method depends on the availability of data and the usefulness of the forecast (Silvia et al., 2021) This analysis is carried out to predict the number of flights for each aircraft the next few years with the following two scenarios :

A. Normal Condition

This scenario is to see annual departure under normal conditions in the few years.

B. Pandemic Covid – 19 Condition

The Covid pandemic is expected to cause changes to annual departures in the next few years.

Runway Service Life Analysis Using FAARFIELD Software

Soekarno Hatta International Airport runway service life analysis will be using the FAA Method with the help of FAARFIELD software. Input from FAARFIELD software is existing pavement (including CBR data, existing data, and aircraft movement data annual. After inputting the data, a running process is carried out on the FAARFIELD software. The output that will be obtained is the service life of the two scenarios. Furthermore, A comparison of the service life of the runway pavement was carried out in these two conditions. In general, the steps for using FAARFIELD software for runway service life analysis in this research are divided into several stages as follows:

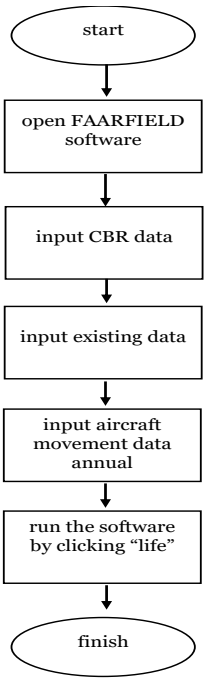


Figure 3 FAARFIELD software flowchart

The steps to analyze the age of the runway pavement service with FAARFILED software are as follows:

1. Name the job and select the life function (for service age analysis)
2. Choose the type of pavement according to the plan and type of pavement to be analyzed
3. Determine the pavement structure of each layer according to the type of pavement selected
4. Enter the type of aircraft in the traffic list from the Aircraft Library
5. FAARFIELD Running Software (Pavement service life)
6. Finish

Result and Discussion

Forecasting Annual Departure

The first step is to forecast the annual departure data from two scenarios to obtain annual growth per type of existing aircraft. The data forecasting method that will be used is the time series type. Data analysis is carried out with the help of statistical software with regression. In the figure 4 and figure 5 is shown an example of Timeseries Forecasting for the annual departure of the Airbus 320 200.

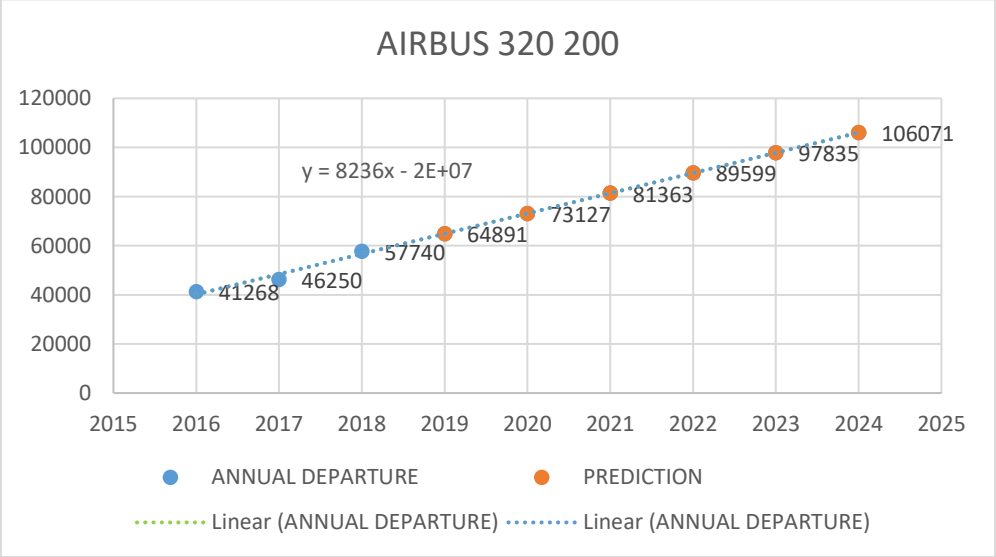


Figure 4 Forecasting Airbus 320 200 (Normal Conditions)

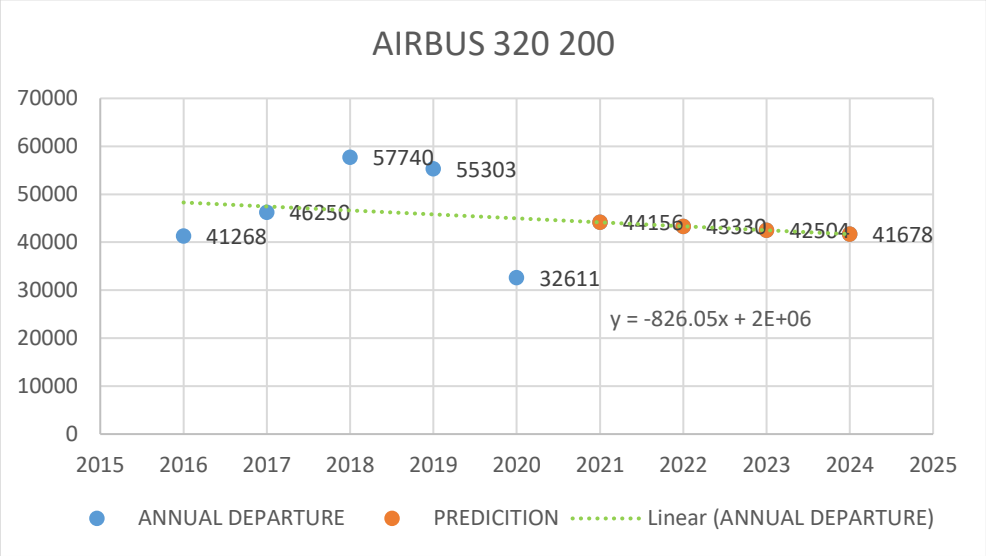
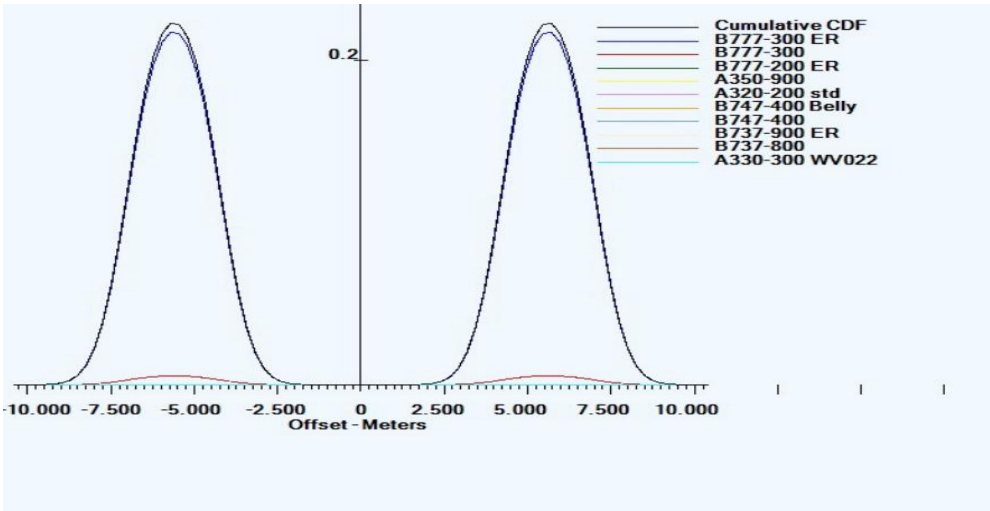


Figure 5 Forecasting Airbus 320 200 (Covid-19 Pandemic Conditions)

From figures 4 and 5, it can be seen that the Airbus 320 200 aircraft under normal conditions experienced an average growth of 13% while during the covid-19 pandemic conditions experienced a decrease in which the average growth was 3%. This method is also carried out on every type of aircraft operating at Soekarno Hatta international airports, from these results it was found that under normal conditions the average growth of each aircraft experienced an increase with the largest increase being the Boeing 737 Max 8 with a value of 10% and in the conditions of the Covid-19 pandemic the average growth of each aircraft decreased with the largest decrease was the Airbus 319 100 with a value of -10%. We can conclude that the condition of the Covid-19 pandemic greatly affects the growth of the movement of each aircraft, which in the conditions of the Covid-19 pandemic has decreased quite drasticall, In line with the research (Utari & Prakosawati, 2022) which stated in its research that the Covid-19 pandemic affected the number of flights of Wings Air airlines, causing a drastic decrease of up to 90% due to many flight routes being closed due to the Covid-19 pandemic. Then the annual growth average data of each aircraft will be used for input on the FAARFIELDsoftware to predict the remaining service life of the runway by looking at the CDF value of each aircraft.

Analysis Service Life With FAARFIELD

The analysis of the remaining runway service life at the international airport is based on the CDF value obtained from the FAARFIELD software output, which in obtaining the output of the CDF value needs to enter data in the form of annual departure data, aircraft annual departure average data, soil CBR, and airport runway pavement data.



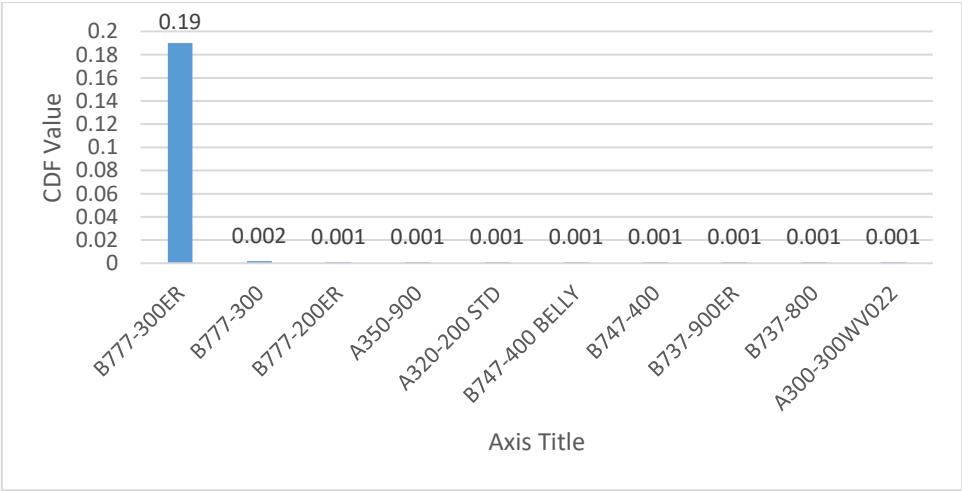


Figure 6 Output FAARFIELD (Normal Conditions)

It can be seen that with the frequency of departure, the B777-300ER aircraft has the highest CDF value than any other in the CDF calculation of 0.2. The reason is because the CDF Calculation on FAARFIELD is also based on conventional FAA calculations that frame the calculation with the departure frequency parameter, where the B777- 300ER is one of the most frequently operated aircraft.

Figure 6 shows a graphical calculation of the results of CDF contributions to the flexible sidewalks of existing runways with mixed traffic departure frequency data at the airport. The results of the CDF contribution calculation using FAARFIELD showed that 2 aircraft had the most impact on the CDF value, namely the Boeing B777-300ER had the highest CDF value of 0.2 and the Boeing 777-300 with a CDF value of 0.012, then the other aircraft contributed to the CDF value of 0.001.

The CDF value of mixed traffic at Soekarno Hatta International Airport under normal conditions is 0.22 with a service life under normal conditions of 15 years. This means that Soekarno Hatta International Airport is still able to accommodate aircraft movements for the

next 15 years. CDF value graph the results of the FAARFIELD software calculation in the conditions of the Covid-19 pandemic can be seen in figure 5.

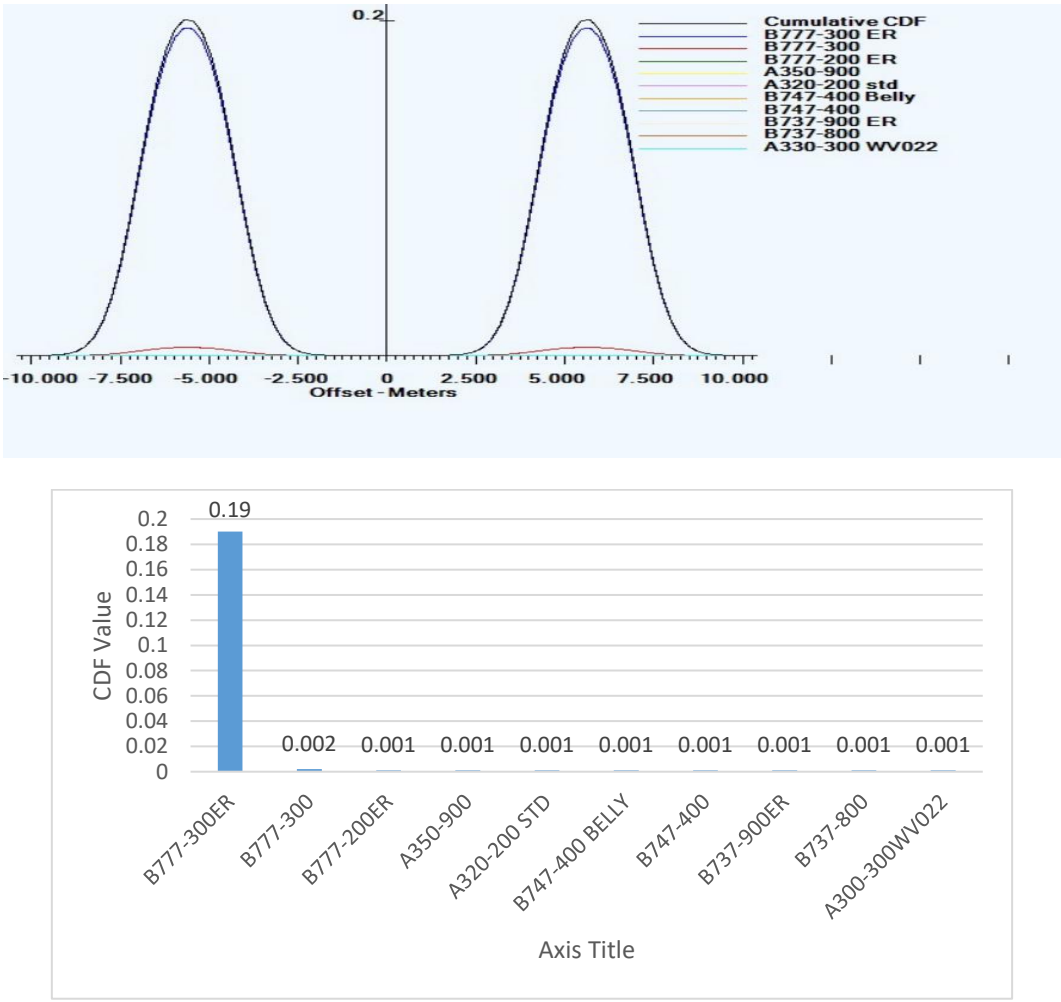


Figure 7 Output FAARFIELD (Covid-19 Pandemic Conditions)

The CDF value graph of the FAARFIELD software calculation results in the conditions of the Covid-19 pandemic can be seen in figure 7. Still the same as normal conditions, it is noticeable that the frequency of departure, the B777-300ER aircraft has the highest CDF value compared to others. The resulting CDF in the calculation is 0.20. CDF calculations on FAARFIELD are also based on calculations with departure frequency parameters, of which the B777- 300ER is one of the most frequently operated aircraft. The results of the calculation of CDF contributions on the flexible sidewalks of existing runways with mixed traffic departure frequency data at Soekarno Hatta International airport show that the largest CDF contribution was Boeing 777-300ER aircraft of 0.19 then Boeing 777-300 aircraft of 0.002 and each other aircraft contributed a CDF of 0.001.

The CDF value of mixed traffic at Soekarno Hatta International Airport under Covid-19 Pandemic conditions is 0.20 with a service life under normal conditions of 19 years. This

means that Soekarno Hatta International Airport is still able to accommodate aircraft movements for the next 19 years.

The result of calculating the remaining service life of the runway Soekarno Hatta International Airport pavement under normal conditions is 15 years with a CDF value of 0,22, while the remaining service life of the pavement runway Soekarno Hatta International Airport under covid-19 conditions is 19 years with a CDF value of 0.20. There was an increase in service life that occurred by 4 years. This increase in service life proves that there is a real impact caused by the Covid-19 pandemic on air transportation as researched by previous research (Andaka, 2020; Arena & Aprea, 2021; Thoharoh & Albanna, 2022). Changes in the volume of air traffic per year (annual departure) which in this case is caused by the Covid-19 pandemic causes changes in the load received by the runway so that it also has an impact on its service life, this is in line with previously conducted research (Bayoumi et al., n.d.; Wei & Guo, 2022; Prahara & Rachma, 2020). The service life of the airport runway can be seen from the CDF value, the higher the CDF value, the shorter the remaining service life and the lower the CDF value the more long remaining service life (Efendi, 2021). Based on the results of the study, the COVID-19 pandemic that occurred from 2019 had a significant impact on the service life of the runway. There was an increase of 4 years under normal conditions. By knowing that this addition is expected to be made adjustments in terms of runway maintenance in the future when the pavement has expired its service life. It is expected to facilitate operational runway management. The study focuses only theoretically on the load received by the runway, the effects of fatigue, and the movement from the surface layer to the subbase for several years. Other factors in the form of weather, rubber deposits, technical errors at the time of construction implementation are not taken into account. The expected benefit of this study is that when we can determine the remaining service life of a runway, we can determine the right time to carry out maintenance.

Conclusions

From the above results, it can be concluded that the impact of the covid-19 pandemic has a positive impact on the life of the runway by increasing the life of the runway by 4 years, where in covid-19 conditions it has a CDF value of 0.20 with a service life of 19 years and under normal conditions a CDF value of 0.22 with a service life of 15 years. This research is expected to provide consideration in decision-making to maintain and repair the runway of Soekarno Hatta International Airport so that the runway can operate sustainably in accordance with performance requirements throughout the life of the plan, to maintain flight safety and comfort. The limitations of this research are only using secondary data and data processing. In addition, the cases raised are examples of new cases. So, there is still a lack of literacy, so

several other methodological adaptations are needed in the research. Further research suggestions need to be more detailed and add aircraft movement data into forecasting and theoretical lifetime comparison with software with field analysis.

References

Alabi, B. N. T., Saeed, T. U., Amekudzi-Kennedy, A., Keller, J., & Labi, S. (2021). Evaluation criteria to support cleaner construction and repair of airport runways: A review of the state of practice and recommendations for future practice. In *Journal of Cleaner Production* (Vol. 312, p. 127776). https://doi.org/10.1016/j.jclepro.2021.127776

Andaka, D. (2020). Dampak Pelarangan Mudik Akibat Pandemi Covid19 Terhadap Bisnis Angkutan Udara Di Indonesia. *Journal of Civil Engineering and Planning*, *1*(2), 116. https://doi.org/10.37253/jcep.v1i2.807

Arena, M., & Aprea, C. (2021). Impact of Covid-19 Pandemic on Air Transport: Overview and Implications. *Advances in Environmental and Engineering Research*, *2*(1). https://doi.org/10.21926/aeer.2101002

Arianto, B. (2021). Dampak Pandemi COVID-19 terhadap Perekonomian Dunia. *Jurnal Ekonomi Perjuangan*, *2*(2), 106–126. https://doi.org/10.36423/jumper.v2i2.665

Aurellia, S. H., Studi, P., Sipil, T., Kaler, C., Bandung, K., Barat, J., Widianto, B. W., Studi, P., Sipil, T., Kaler, C., Bandung, K., & Barat, J. (2024). *RUNWAY BANDARA INTERNASIONAL JUANDA SURABAYA DENGAN PERUBAHAN JENIS PESAWAT PENERBANGAN HAJI*. *11*(2), 325–334. https://jurnal.unej.ac.id/index.php/PFSTPT/article/view/49581

Bayoumi, M., Osman, O., & Gadallah, A. (n.d.). Impact of New Large Aircraft on Airport Flexible Pavements. In *core.ac.uk*. https://core.ac.uk/download/pdf/234678472.pdf

Efendi. (2021). Analysis Surface Structure Improvement of Runway Threshold 07-25 Using FAARFIELD. *Teknik: Jurnal Ilmu Teknik Dan Informatika*, *1*(2), 52–62. https://doi.org/10.51903/teknik.v1i2.56

Fatikasari, A. D., Aryaseta, B., & Cahya Wardhani, P. (2022). Thickness Analysis of Runway Pavement Construction at Zainuddin Abdul Madjid Airport to Accommodate Boeing 777-300ER. *MATEC Web of Conferences*, *372*, 08003. https://doi.org/10.1051/matecconf/202237208003

Hariyami D, Setiawan A, A. S. (2024). *Tebal, Evaluasi Pada, Perkerasan Bandara, Runway Aminuddin, Syukuran Luwuk, Amir Failure, Cumulative Damage*. *03*, 25–37. https://doi.org/https://doi.org/10.55114/siparstika.v3i2.689

Karma, M. (2021). Sistem Manajemen Pemeliharaan Perkerasan Landasan Di Bandar Udara. *Warta Ardhia*, *46*(2), 133. https://doi.org/10.25104/wa.v46i2.381.133-146

Prahara, E., & Rachma, H. A. (2020). The effect of cumulative damage factor value on existing

runway life service. *IOP Conference Series: Earth and Environmental Science*, *426*(1). https://doi.org/10.1088/1755-1315/426/1/012034

Purwanto, H., & Sunandar, A. (2019). Analisa Perencanaan Runway Taxiway Dan Apron Pada Bandara Sultan Mahmud Badaruddin Ii Palembang Menggunakan Metode Faa (Federal Aviation Administration). *Jurnal Deformasi*, *4*(1), 20. https://doi.org/10.31851/deformasi.v4i1.2971

Rini, F. D. K., Herianto, H., & Hendra, H. (2020). Analisis Ulang Runway Bandar Udara Wiriadinata Menggunakan Metode Faa. *Akselerasi : Jurnal Ilmiah Teknik Sipil*, *2*(1). https://doi.org/10.37058/aks.v2i1.2046

Silvia, S., Suparma, L. B., & Utomo, S. H. T. (2021). Analisis Pengembangan Geometrik Runway Bandar Udara Fatmawati Soekarno Kota Bengkulu. *Journal of Civil Engineering and Planning*, *2*(2), 120. https://doi.org/10.37253/jcep.v2i2.5201

Thoharoh, S., & Albanna, F. (2022). Analisis Pengaruh Pandemi COVID-19 terhadap Transportasi Udara pada Maskapai Susi Air. *Jurnal Indonesia Sosial Sains*, *3*(3), 428–442. https://doi.org/10.36418/jiss.v3i3.552

Utari, A., & Prakosawati, E. E. (2022). Analisis Penurunan Jumlah Penerbangan an Penerapan Strategi Pemasaran Wings Air Dalam Masa Pandemi Covid – 19 Di Bandar Udara Douw Aturure Nabire Papua. *Reslaj : Religion Education Social Laa Roiba Journal*, *4*(6), 1587–1593. https://doi.org/10.47467/reslaj.v4i6.1177

Wei, B., & Guo, C. (2022). Predicting the Remaining Service Life of Civil Airport Runway considering Reliability and Damage Accumulation. *Advances in Materials Science and Engineering*, *2022*. https://doi.org/10.1155/2022/6494812

Widianto, B. W., Audiwahyu, R. C., & Basuki, E. M. (2023). Model Penurunan Umur Layan terhadap Perubahan Nilai Parameter Desain Perkerasan Lentur dan Perkerasan Kaku Runway Bandar Udara. *RekaRacana: Jurnal Teknil Sipil*, *9*(2), 80. https://doi.org/10.26760/rekaracana.v9i2.80