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RESEARCH ARTICLE

Analysis of VGDS and Marshaller Service Education: Comparison of Aircraft Parking Guidance Efficiency

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Abstract

From a transport safety education perspective, aircraft parker guidance ensures aircraft move safely in busy and confined areas. In aviation, technological developments can be seen in driving aircraft parking at airports. The technology is called VDGS, which automatically performs parking guidance. Aircraft parking guidance with VDGS and marshaller services has its advantages and disadvantages. This study aims to measure the efficiency of VDGS and marshaller services in the aircraft parking guidance process. The research method used was descriptive quantitative, collecting data on the distribution of questionnaires to the research respondents, namely AMC personnel and marshallers, totaling 40 people using total sampling. The results of this study show that VDGS is more efficient than marshallers, with an average value of 78.89% higher than marshallers, with a value of 74.7%. The efficiency level of VDGS and marshaller was measured based on seven research indicators: time, precision, satisfaction, coordination, disruption, availability, and poor weather conditions or low visibility. The indicators in this study are a reference for measuring the level of efficiency that can describe the advantages of VDGS and marshallers. The indicators of the success of this study can be seen in the measurable efficiency value of VDGS and Marshaller aircraft parking services as well as efforts to improve the efficiency of marshaller services by increasing personnel competence.

Keyword: Aircraft Parking Services, Marshaller, VDGS

Introduction

Aircraft parking guidance, or marshaling, is vital in maintaining air transport safety, especially at airports. [1]. From a transport safety education perspective, this function ensures aircraft move safely on a busy and confined apron. The parking guide provides visual cues that assist the pilot in directing the aircraft toward the correct parking space, avoiding collisions with vehicles, equipment, or other aircraft. In addition, this procedure also teaches the importance of coordination, accuracy, and clear communication between pilots and guides as part of the overall airport safety system. Through proper understanding and training, this aircraft parking guidance function contributes to preventing ground incidents, which is crucial in maintaining air transport safety.

Education is the primary key to the development of individuals and society; technological developments also bring significant changes when education is implemented. One of the impacts of technological developments can be felt in aviation. Air transportation is one of the youngest forms of transportation that has shown rapid development in aviation. Airports, which serve as a means of connecting countries, certainly benefit from the development of this technology.

Numerous airline firms are fighting to raise the standard and reputation of their operations in response to the rising demand for air transportation services [2]. Aviation safety must be achieved as a transport service [3]. The high movement of aircraft in movement areas at several airports requires good coordination between air traffic control, referred to as ATC, and apron movement control, now referred to as AMC operational officers [4]. Aircraft that have passed through the taxi area will be guided by the marshaller to park at the apron based on the parking stand position determined by AMC so that the aircraft parking arrangement is more orderly and according to applicable regulations [5]. Airports, as a node point for aircraft movement, require various supporting facilities and infrastructure for smooth flight operations [6]. AMC officers play an essential role in overseeing aircraft movement when they park towards the parking stand because there is no Lead in marking on the apron area [7], [8]. The apron is a facility at the airport that serves as a place for aircraft parking, loading and unloading passengers, loading and unloading goods, and intra and intermodal transportation movements [9]–[11].

Kualanamu Airport is the third largest airport in Indonesia [12]. Kualanamu International Airport is part of Angkasa Pura Aviasi, a strategic partnership established by Angkasa Pura II and GMR Airports Netherlands B.V. It has a busy flight schedule, so equipment that can replace human resources is very much needed. The process of guiding aircraft parking is one of the concerns regarding technology development at Kualanmu Airport. Marshaler, a Human Resource used in aircraft parking guidance services at each airport, provides manual guidance services with several personal protective equipments required for all marshaller personnel. Marshaller, also called visual communication, handles aircraft on the ground [13].

In addition to using marshallers, the process of guiding aircraft parking can also be done by the Visual Docking Guidance System (VDGS), which can replace the position of marshallers as aircraft parking guides at the airport. VDGS provides faster service than marshallers, because of bad weather that can disturb marshallers [14]. VDGS is a device the airport service provides to assist a pilot parked the plane in the right place [14], [15]. VGDS is needed with the increasing volume of air traffic worldwide and the need for information technological development; it has become essential to develop and adopt systems that will efficiently manage the ground movement of aircraft for docking in the airport; this is needed to improve safety, turnaround time and operational efficiency [16], [17].

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At Kualanamu Airport, the aircraft parking guidance process has used VDGS and marshaller services. The parking guidance process with both services has its advantages and disadvantages. Marshaller, as manual parking guides, is flexible, so they can guide according to different conditions or situations. The pilot task is still assisted by a marshaller whose aim is to guide the movement of the aircraft to the parking [18]. However, marshallers must guarantee the ability and competence of each of their personnel so that accidents do not occur due to human error in the aircraft parking guidance process.

On the other hand, VDGS, an automatic aircraft parking guidance technology, can provide services with a high level of accuracy compared to manual guidance. VDGS will be sensitive if the sensor connected to the device cannot detect the movement of the aircraft but other vehicles around it.

The observation was conducted at the AMC unit of Kualanamu Airport for two weeks, from 17 January to 31 January 2024. On 31 January 2024, VDGS experienced a docking failure due to an aircraft input error from the AMC unit, so VDGS could not continue the aircraft guidance process. This disruption in VDGS was overcome by switching VDGS to *marshaller* as a manual parking guide. In addition to *human error*, VDGS can experience technical disturbances, such as the passage of foreign objects or vehicles in the *parking stand* area that will be used for aircraft parking guidance with VDGS. Handling these disturbances also requires that marshallers replace VDGS, so *marshallers* must always be *on standby* when the parking guidance process is carried out.

Marshaller is also an aircraft parking guide used for a long time. Guiding with *marshallers* is part of human resource utilisation, which depends on the competence of each *marshaller* personnel. *Marshallers* have advantages and disadvantages when performing guiding services. The advantage of *marshallers* is the flexibility of human resources. Still, *marshallers* can also experience errors, just like VDGS, namely guiding delays that occur due to changes in *parking stands* and not precisely positioning the aircraft in the correct *stop position*. Based on discussions with AMC personnel during the observation, the personnel had supervised the *marshaller* activities. On 22 February 2023, there was an incident where the *marshaller* delayed the aircraft parking guidance service due to a change in the *parking stand*. This caused the pilot to wait several minutes to enter the designated *parking stand*. To overcome this, *marshaller* personnel must be quick and responsive if there is a change in the *parking stand* at Kualanamu Airport. Based on the observations above, the author made a comparative analysis of VGDS and *marshaller* services on the efficiency of the aircraft parking guidance process at Kualanamu Airport so that efforts can be made to improve aircraft parking guidance services.

Literature Review

Efficiency

According to the *Kamus Besar Bahasa Indonesia,* efficiency is defined as the right way to carry out a business or work, in carrying out something without wasting a lot of energy, time and money . According to [19], [20] efficiency is the lowest input to achieve the maximum output. Efficiency in this study can be interpreted as a measuring tool to determine which tool or object is more appropriate to use according to its tasks and functions.

According to Sriyastasya [21], efficiency is a tool to measure a company's performance using a general concept. In aircraft parking guidance, efficiency can be used to measure the usefulness of VDGS and marshallers appropriately during the operational process, according to [22]. The efficiency of tool work can be measured through several things, namely capability, maintenance, planning, weather conditions, and tool implementation methods. Based on this citation, the efficiency level to be measured will be developed into research indicators in time, availability, and weather conditions. These research indicators will be the basis of the questionnaire in this study.

VDGS is a valuable tool for automatically providing visual guidance to the parking stand on the apron [14]. The guidance system with VDGS helps to perform guidance automatically without requiring assistance from marshaller personnel. This system provides instructions or directions facing the pilot so that the pilot can guide easily.

Before the VDGS, the pilot, as the aircraft driver, guided the aircraft parking with assistance from a marshaller so that the pilot could move to the correct parking position [14]. In developing this technology, the airport wants to show the availability of technology that can replace human resources in the flight operational process, especially in the aircraft parking guidance process. The VDGS tool is a form or proof of the availability of this sophisticated technology. VDGS is designed to ensure the safety and security of aircraft passengers.

The VDGS display contains information on the type of aircraft that will enter the parking stand, information on the distance of the aircraft to the stop position, the direction left or right according to the center line, and the display moves straight towards the stop position. This VDGS is fully automatic, based on a laser scanning technique system, and tracks both the lateral and longitudinal positions of the aircraft [23]. The technique allows the system to identify the incoming aircraft and check it against the operator's selected aircraft to ensure that the pilot is given the correct indication to stop the aircraft.

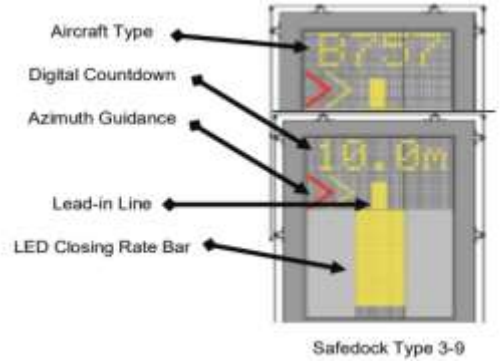

Fig 1. Display of Visual Docking Guidance System

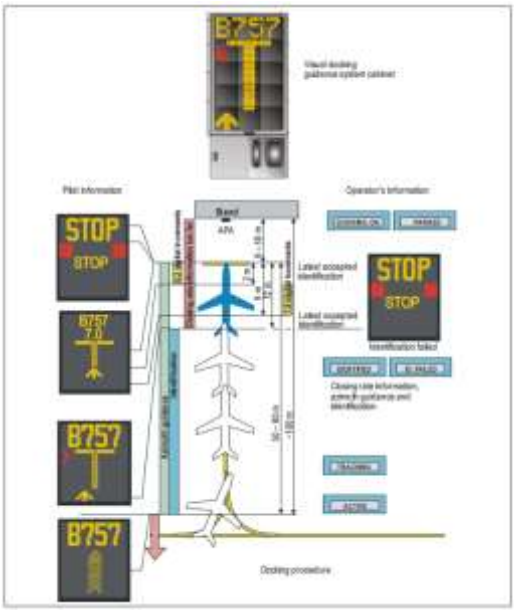

Fig 2. FDisplay and Working Procedure of Visual Docking Guidance System
Source: Doc 9157 Aerodrome Design Manual Part 4 [24]

Marshaller

Marshaller is responsible for parking the aircraft, while marshaling is the aircraft parking guidance [25]. Manual marshaling is carried out if the VDGS is not functioning or at the request of the airline concerned. Marshaller is the personnel who is tasked with carrying out aircraft guidance both when turning it on and when wanting to guide parking on the apron, using commands according to the provisions in Annex 2 ICAO and CASR part 37 and SKEP 302/V/2011.

If the marshaller personnel do not have a license or certificate of competence, it will pose a danger to flight safety services. When carrying out the aircraft parking guidance process, the marshaller must know the dimensions and specifications of the aircraft to be parked. The marshaller also has personal protective equipment by domestic and international regulations, such as safety shoes, vests, earmuffs, bats, flashlights, wheelchairs, and glasses. In contrast to VDGS technology, marshallers must carry out manual aircraft parking guidance which requires their personnel to provide directions and instructions to the pilot through standard signal signs with the help of the tools provided.

Aircraft Parking Guidance

An airport is an area on land or water that is used as a place for aircraft to land and take off, board passengers, load and unload goods, and a place for intra and inter-mode transportation transfers equipped with flight safety and security facilities, as well as basic facilities and other supporting facilities [26]. The airport as a place for aircraft to land and take off, including parking guidance, is the responsibility of several units, namely ATC (Air Traffic Controller), AMC (Apron Movement Control), and Ground Handling.

One of the AMC's tasks is supervising aircraft movements on the airside and determining aircraft parking after receiving an estimate from the ADC (Aerodrome Control Tower) unit. After determining the aircraft parking position, the AMC unit immediately communicates the information to the tower [27]. The AMC will instruct the ground crew and marshallers, responsible for the aircraft parking guidance process [28].

When the aircraft lands at an airport, the aircraft will perform parking guidance and stop at the parking stand at the airport. A parking stand is a place used to park aircraft at an airport. To indicate the number on the aircraft parking lot, there is a yellow sign with a black outline in the form of numbers and letters [29]. After landing, the aircraft will taxi (the aircraft moves/walks on the ground) from the runway to the parking stand area; the marshaller and VDGS, as a guide, will provide parking guidance services when the aircraft begins to enter the parking stand area.

Method

Research Design

In research, an activity plan is needed to process activities, analyze, and present data to solve the problems that are the objectives of the research. This study uses a descriptive method with a quantitative approach. The quantitative descriptive method uses numbers and is explained in sentences [30]. In quantitative research, the research method is based on the fact that everything can be measured; this method can be used in researching a specific population and sample [31]. The purpose of quantitative descriptive research is to review, describe, and see the benefits of researching objects with numbers about the phenomena that occur when the research is conducted and then conclude [32].

Sampling Technique and Population

The author determined that the population in this study is AMC personnel as operators of VDGS and supervisors of flight operations and aircraft movements and marshaller personnel as aircraft parking guides on the apron. At Kualanamu Airport, AMC personnel consist of 16 personnel and 24 marshallers. According to [33], population is the scope of generalization, subjects or objects studied, and conclusions drawn to produce specific qualities and characteristics that researchers will apply.

Total sampling is a method in which the sample is taken entirely from the research population because the population used is relatively small, less than 100 people [34]. The sample in this study is the same as the research population, namely 16 AMC and 24 marshaller personnel, totaling 40 personnel.

Method of Data Analysis

The researcher used a descriptive quantitative technique with a survey approach in this study. Quantitative descriptive research involves explaining, researching, and describing what has been learned and the phenomena whose conclusions can be observed with numbers [35].

Results and Discussion

In this study, the author distributed questionnaires to AMC personnel and marshallers at Kualanamu Airport, totaling 40 personnel, as a data collection method. The questionnaire distributed contained 24 questions with 40 respondents according to the sample in this study, with Likert scale measurements. According to [36]. Likert scale measurements can be calculated with a number interval. The following are the results of the questionnaire calculated based on the number interval analysis as follows:

Table 1. Likert Scale Research Interval

Likert Scale	Score	Number Interval
Strongly Disagree	1	0% - 19,99%
Disagree	2	20% - 39,99%
Neutral	3	40% - 59,99%
Agree	4	60% - 79,99%
Strongly Agree	5	80% - 100%

To calculate the index of the score of each statement is:

Index (%) = (Total Score / Maximum Score) x 100

Maximum Score = Number of respondents x Highest Likert scale score Maximum Score = 40 x 5 = 200

The statements in the questionnaire will be calculated with a Likert scale number interval based on the formula described above. The research sample will answer the statement, which will produce answers to the level of efficiency of aircraft parking guidance with both VDGS and marshaller services.

The questionnaire contains 24 statements, which were filled in based on 7 research indicators: time, precision, satisfaction, coordination, disruption, availability, bad weather, or low visibility. Each statement is described based on a comparison of 14 statements on marshaller services and 14 statements on VDGS services.

Scoring on statement 1, respondents 'Agree' that the aircraft parking guidance process with marshallers takes less than 1 minute with a number interval of 70.5%. Statement 2, respondents 'Strongly Agree' that the aircraft parking guidance process with VDGS takes less than 1 minute.

In statement 3, respondents 'Agree' that marshallers never experience delays when conducting aircraft parking guidance with a number interval of 72.5%. Statement 4, respondents 'Strongly Agree' that VDGS never experiences delays when conducting aircraft parking guidance with a number interval of 81%. In statement 5, respondents 'Agree' that aircraft parking guidance with marshallers can guarantee the accuracy of aircraft parking positions with a number interval of 74.5%. Statement 6, respondents 'Strongly Agree' that aircraft parking guidance with VDGS can guarantee the accuracy of aircraft parking positions with a number interval of 82%.

In statement 7, respondents Agree that marshaller services are more precise when conducting aircraft parking

guidance compared to VDGS, with a number interval of 66.5%. Statement 8, respondents 'Strongly Agree' that VDGS service when guiding aircraft parking is more precise compared to marshaller with a number interval of 84%. In statement 9, respondents 'Agree' that marshaller provides convenience in the aircraft parking guidance process with a number interval of 79.5%. Statement 10, respondents 'Strongly Agree' that VDGS provides convenience in the aircraft parking guidance process with a number interval of 84%.

In statement 11, respondents 'Agree' that marshaller can be used without requiring coordination from various parties with a number interval of 65.5%. Statement 12, respondents 'Agree' that VDGS can be used without requiring coordination from various parties with a number interval of 71%. In statement 13, respondents 'Agree' that marshaller can carry out aircraft parking guidance services with fast coordination with a number interval of 70.5%. Statement 14, respondents 'Strongly Agree' that VDGS can carry out aircraft parking guidance services with fast coordination with an interval of 85%.

In statement 15, respondents 'Strongly Agree' that marshallers never experience technical problems while carrying out the aircraft parking guidance process. Statement 16, respondents 'Agree' that VDGS never experiences technical problems while carrying out the parking guidance process. In statement 17, respondents 'Agree' that marshallers never experience problems due to human error. Statement 18, respondents 'Agree' that VDGS never experiences problems due to human error. In statement 19, respondents 'Agree' that marshallers are always available and ready to be used when needed to guide aircraft parking. Statement 20, respondents 'Strongly Agree' that VDGS is always available and ready to guide aircraft parking.

In statement 21, respondents 'Strongly Agree' that the marshallers at Kualanamu Airport already have sufficient numbers to facilitate the aircraft parking guidance process. Statement 22, respondents 'Agree' that VDGS at Kualanamu Airport already has a sufficient number to facilitate the aircraft parking guidance process. In statement 23, respondents 'Strongly Agree' that marshallers are better used when visibility is low than VDGS. Statement 24, respondents 'Strongly Agree' that VDGS is better used when visibility is low than marshaller.

The answers and results of calculating the number of intervals in these statements are described and can be seen in Appendix C of this final assignment. After the calculation is carried out, the results of the number interval with the percentage and answers of respondents who answer the accuracy of the research indicators that have been determined and can measure the efficiency level between VDGS and marshaller services.

Based on the described results, the following is a diagram of the efficiency measurement of VDGS and marshaller based on research indicators. The percentages in the diagram are taken from the average of each statement in the distributed questionnaire.

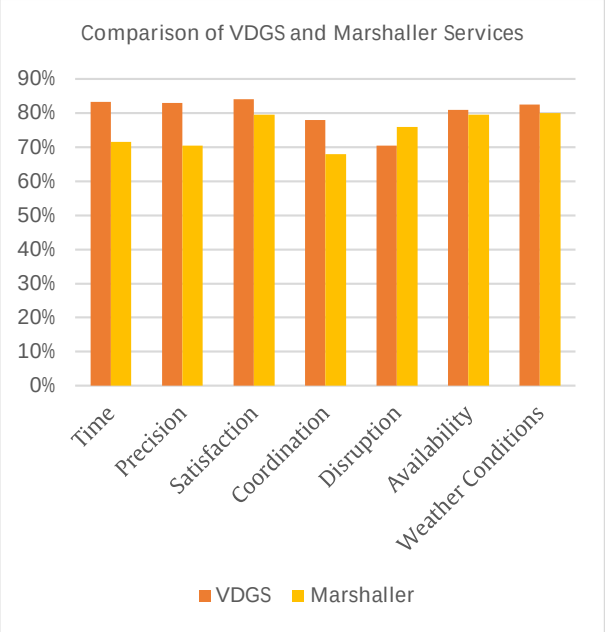

Fig 3. Questionnaire Result Bar Chart

The diagram above illustrates that in the time indicator, VDGS, with a value of 83.25%, is superior to the marshaller, with a value of 71.5%. The time referred to in this indicator is that the process of aircraft parking guidance services carried out by VDGS, which is faster than the marshaller.

The precision indicator, VDGS, with a value of 83%, is superior to the marshaller, at 70.5%. The accuracy of the parking position guaranteed by VDGS and the marshaller is the reference for this indicator. The satisfaction indicator, VDGS, with a value of 84%, is superior to the marshaller, with a value of 79.5%. The level of satisfaction when VDGS and marshaller services are taking place can be felt by AMC personnel and marshaller, which makes VDGS superior because of its convenience.

The coordination indicator, VDGS, with a value of 78%, is superior to the marshaller, with a value of 68%. VDGS does not require coordination from various parties when preparing for aircraft parking guidance services. At the same time, the marshaller needs to coordinate with the ground handling party, who will send one of its personnel to be a marshaller. The disturbance indicator, VDGS, has a value of 70.5%, which is lower than marshaller, which has a value of 74%. In the disturbance indicator, marshaller is superior to VDGS because marshaller can conduct guidance according to the competence of the marshaller itself, which can be guaranteed through the license they have. The availability indicator, VDGS, has a value of 81%, superior to marshaller, with a value of 79.5%. VDGS has a sufficient number compared to marshallers at Kualanamu Airport. The weather condition indicator, VDGS, with a value of 82.5%, is superior to marshaller, with a value of 80%. VDGS helps guide aircraft parking during bad weather conditions and low visibility. The VDGS display facing directly into the cockpit helps guide aircraft parking in certain conditionsResults of the research consisted of descriptive statistics, test results of the assumptions and hypothesis testing results are then analyzed critically (maximum 20% of the entire page script) presented sequentially or integrated. Exposure to the results section contains the results of data analysis. If there is a table/chart/picture that contains exposure to the results of the analysis that is already meaningful and easily understood its meaning quickly. The table/chart/picture does not contain raw data that they can or should be processed.

Conclusions and Recommendations

Based on the research results obtained, it can be concluded that VDGS is more efficient than marshaller in aircraft parking guidance services at Kualanamu Airport. This is evident from the

average value of the VDGS research indicator, which is 78.89%, which is higher than the marshaller's value of 74.7%.

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