

Digitalization of a Web-Based Aviobridge Utilization Services in Supporting Services at the Apron Movement Control (AMC) Unit at Mutiara Sis Al-Jufri Palu Airport

Lavenia Febrianti, Slamet Hariyadi, Paramita Dwi Nastiti
Politeknik Penerbangan Surabaya, Indonesia

Corresponding Author: Lavenia Febrianti
Air Transportation Management
Politeknik Penerbangan Surabaya, Indonesia
Email: laveniafebrianti7@gmail.com

Article History

Received April 1, 2025
Accepted May 22, 2025
Published June 2025

Keywords

Digitalization, Aviobridge Utilization Services, Apron Movement Control, Mutiara Sis Al-Jufri Airport, ADDIE.

Abstract

The Directorate of Operations through the Apron Movement Control (AMC) unit is an essential component of airside operations at Mutiara Sis Al-Jufri Airport in Palu. This unit previously carried out the recording of aviobridge utilization services manually using paper forms. Digitalization is considered to play a significant role in improving the efficiency of data recording and report generation, both in terms of faster access and more practical data management.

This study employed a Research and Development (R&D) method with the ADDIE approach (Analysis, Design, Development, Implementation, Evaluation). The website was developed based on the needs of the AMC unit to support the recording of Aviobridge Utilization Services in a digital format that can be easily accessed at any time.

The website development results have been tested for functionality and appearance. They include several supporting features and a simple and informative interface design.



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1 INTRODUCTION

The development of information technology has brought significant changes across various sectors, including the aviation industry. As the main hub of air transportation, airports are required to continuously innovate in order to improve operational efficiency and service convenience (Young, 1964). One of the essential facilities that support the smooth embarkation and disembarkation process for passengers is the aviobridge. At Mutiara Sis Al-Jufri Airport in Palu, the management of the aviobridge is handled by the Apron Movement Control (AMC) unit. However, the usage recording system for the aviobridge, which is still carried out manually, poses several challenges, such as delayed data input, the potential for human error, and limited access to information (Williams, 1993).

To address these challenges, this study proposes the development of a web-based aviobridge utilization service system aimed at digitizing the recording process, enhancing operational efficiency, and supporting more environmentally friendly work practices (Habi & Messer, 2021). Literature studies show that the integration of web-based digital systems in the air transport sector has had a positive impact on service speed and data management (Wigner, 1965; Hijmans & van Etten, 2012).

Previous studies conducted by Reber et al. (1988) and Fardel et al. (2007) also emphasize the importance of digitalization in both large- and small-scale work environments. However, most of these studies focus on passenger and logistics management systems. Research on the digitalization of aviobridge services remains limited, especially in regional airports such as Mutiara Sis Al-Jufri Palu. This highlights the need for contextual solutions based on local needs.

This study develops a web-based digital system specifically for aviobridge operations at the AMC unit of Mutiara Sis Al-Jufri Airport Palu. Based on the approach of system efficiency and digital transformation (Chen, 1993; Kawasaki, 1993), the study proposes two hypotheses: (H1) the implementation of a web-based system will significantly reduce recording time and data errors; and (H2) the system will improve user satisfaction due to ease of access and use. The implications of this research not only enhance the performance of the AMC unit but can also serve as a model for adoption by other airports in Indonesia (Comite & Pierdicca, 2021).

2 METHOD

This study employs the Research and Development (R&D) method using the ADDIE approach (Analysis, Design, Development, Implementation, Evaluation), as previously applied in information system development (Payne & Stern, 1985). This model is designed to produce a systematic and structured digital technology-based product (D'Martin & Soares, 2019). The research workflow is illustrated in a research flow diagram (see Figure 1), which outlines the development stages from needs identification to product evaluation.

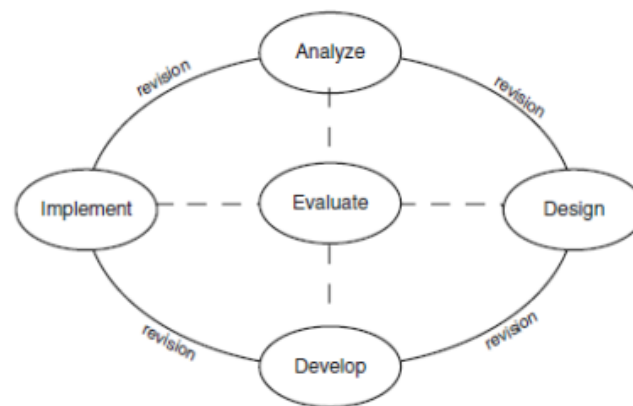


Figure 1. Research flowchart

The system development was carried out through several stages, including needs analysis, system and interface flow design, implementation, and evaluation based on user feedback. The website design was developed based on the identification of user needs through field observations and interviews, and was translated into wireframes and a system flowchart that illustrate the menu structure and the mechanism for filling out the digital form for aviobridge usage services. The design phase was conducted to align the user interface and database structure, taking into account the principles of information architecture, user navigation, and visual aesthetics. Illustrations of the menu flow and system workflow are presented in Figure 2 and Figure 3.

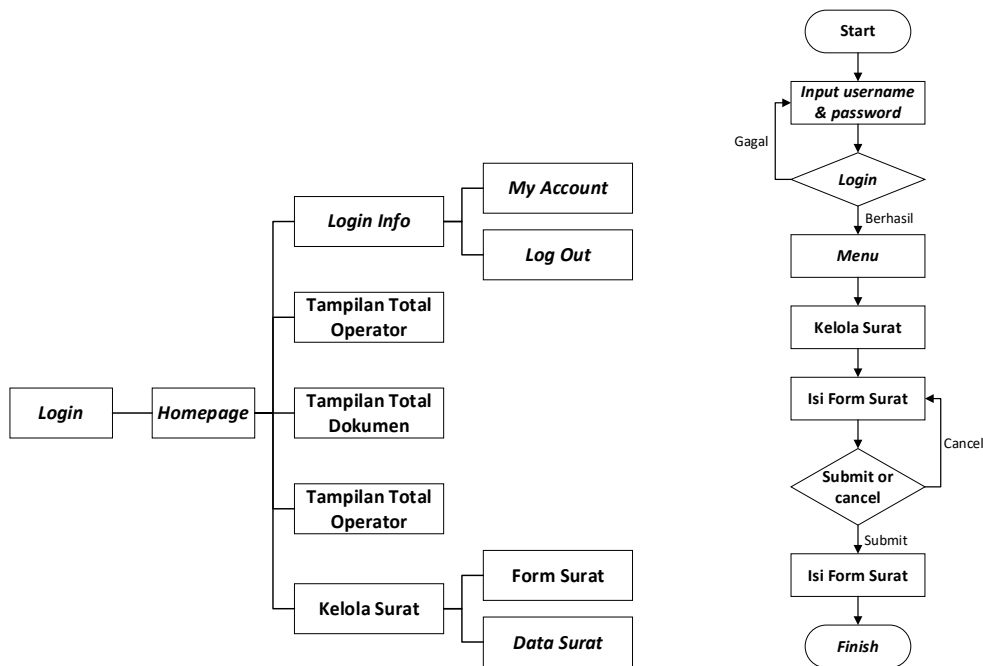


Figure 2. website Flow menu design (left); Flowchart fill in Aviobridge Utilization Service form (right)

Data collection was conducted through observation and in-depth interviews with AMC operators at Mutiara Sis Al-Jufri Airport in Palu. The interview process adopted the data elicitation techniques used by Reber et al. (1988) for user-based decision making. In addition, system validation was carried out using the Blackbox Testing method, as applied in software interface testing (Brahms, 1967).

Data analysis was conducted qualitatively by examining the interview results and evaluating the developed system. For system testing, the Blackbox Testing method was used to assess the application's functionality based on the output generated from specific inputs, without directly inspecting the program code. This method was employed to ensure that each feature operates according to the specifications and user requirements.

System development utilized hardware components such as CPU, GPU, RAM, and HDD, along with software tools including Visual Studio Code for web programming, Navicat for database management, and Laragon as a local server. The operating system used was Windows, due to its high compatibility with various web development applications and its familiarity among developers. The developed website was designed to store data, submit forms, and facilitate the digital management of aviobridge services.

3 RESULTS

The Aviobridge Utilization Services website was successfully developed and tested for the Apron Movement Control (AMC) Unit at Mutiara Sis Al-Jufri Airport in Palu. The system adopts a user-needs-based design principle (Kopyt et al., 2016) and was validated using a digital system validation approach as conducted by Wensveen (2016) and Supriadi (2021).

In the initial phase, an analysis was carried out to identify problems in the existing system, which still relied on manual recording methods. It was found that the use of triplicate paper forms for recording aviobridge usage led to delays in data distribution, difficulties in retrieving historical records, and the risk of document damage or loss. Interviews with AMC personnel revealed that the manual system was no longer effective and needed to be replaced with a faster, more efficient, and environmentally friendly digital system. These findings reinforced the urgency of digitalization and served as the foundation for designing the new system.

In response to these needs, the Aviobridge Utilization Services website was developed with a simple, secure interface accessible across multiple devices. The system allows users to log in with their individual accounts, input flight data, record aviobridge usage, and submit reports automatically. User access is divided into two roles: admin and user, each with specific access rights based on their responsibilities. The workflows for both users and admins are visualized in diagrams shown in Figure 1 and Figure 2.

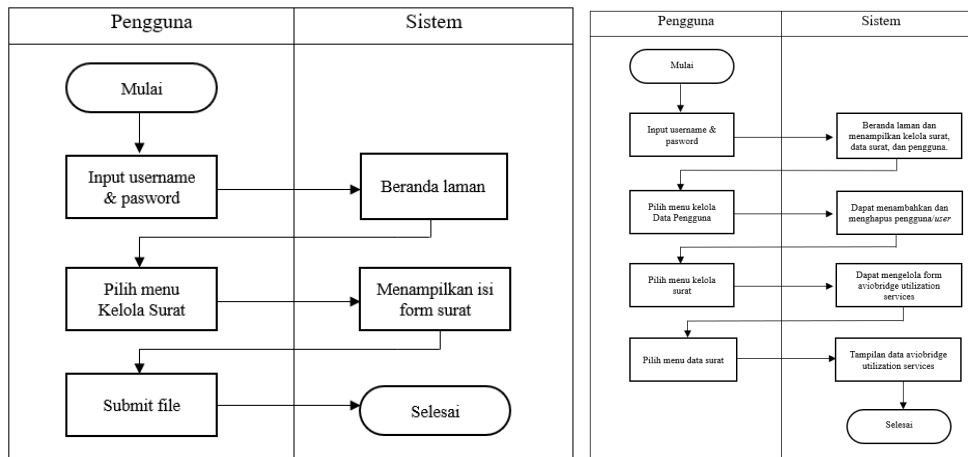


Figure 3. Flowchart of user work system (left); B. Flowchart of admin work system (right)

Key features such as user login, digital form submission, automatic report delivery via email, and PDF conversion have been tested by both internal and external validators, who confirmed that the system is ready for use without revisions (Duncombe, 1959; Gambarli & Dick, 1978). The system is also accessed using Windows-based devices, as recommended in the study by PROCESS Corporation (1996) regarding the efficiency of internal intranets in corporate environments.

The system was developed using Laravel with PHP and JavaScript programming languages, supported by a MySQL database, and hosted to ensure online accessibility at any time. All core features—including digital form submission, report history, and data export in PDF format—have been tailored to the needs of the AMC unit, encompassing the login page, menu display, input form, submission results, and reports successfully delivered via email.

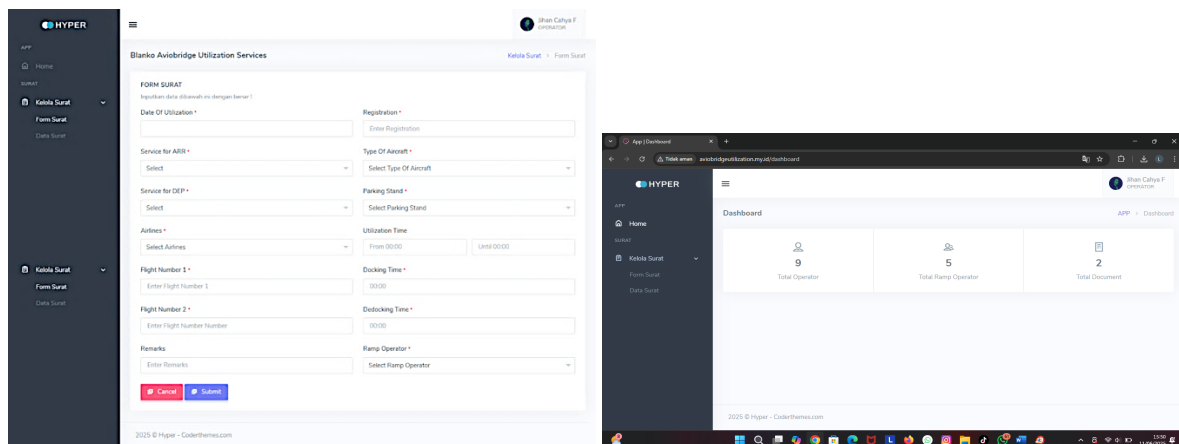


Figure 4. Form view (left); menu view (right)

System testing was conducted using the black box testing method, which focuses on evaluating functionality without examining the internal code structure. The test results indicated that the system performed as expected, with no errors or functional disruptions. Validation was also carried out by two experts: an IT specialist and a subject matter expert from the AMC unit. The assessments from both validators, as shown in Table 1, concluded that the system is suitable for use without requiring any revisions.

User testing results indicated that the system is easily accessible, intuitive, and helps accelerate the operational recording of aviobridge usage. This aligns with the findings of Habi & Messer (2021), which demonstrated that user-friendly and real-time system interfaces have a positive impact on work performance in the public service sector. In this case, the efficiency gained not only benefits the AMC unit but also supports ground handling services and airlines (Transmission Systems for Communications, 1985).

In addition to technical validation, implementation was also carried out directly by AMC operators in the field. The website began limited trial use on July 16, 2025. Respondents, consisting of four AMC personnel, provided feedback indicating that the system is user-friendly, has an intuitive design, and significantly supports daily operations.

PENGUJIAN BLACK BOX WEBSITE AVIOBRIDGE UTILIZATION SERVICES

No	Pengujian	Skenario Uji	Hasil yang Diharapkan	Hasil Uji
Halaman Log in				
1	Halaman terbuka	Menampilkan halaman log in yang terdiri dari email dan password	Tampilan halaman log in terdapat email dan password	✓
2	Tombol email disentuh	Menampilkan pengisian email	Dapat mengisi email	✓
3	Tombol password disentuh	Menampilkan pengisian password	Dapat mengisi password	✓
4	Tombol log in disentuh	Menampilkan halaman beranda	Menampilkan halaman beranda	✓
Halaman Beranda				
1	Halaman beranda terbuka	Menampilkan tampilan beranda	Tampilan halaman beranda	✓
2	Tombol user disentuh	Menampilkan tampilan data profil akun operator	Tampilan data profil akun operator	✓
3	Tombol simpan profil disentuh	Menampilkan halaman beranda	Menampilkan halaman beranda	✓
Halaman Kelola Surat				
1	Tombol kelola surat disentuh	Menampilkan blanko avio-bridge utilization services	Tampilan blanko avio-bridge utilization services	✓
2	Tombol date of utilization disentuh	Menampilkan tanggal pemakaian	Tampilan date of utilization	✓
3	Tombol service for ARR disentuh	Menampilkan input maskapai saat kedatangan	Tampilan service for arrival	✓
4	Tombol service for DEP disentuh	Menampilkan input maskapai saat keberangkatan	Tampilan service for departure	✓
5	Tombol airlines disentuh	Menampilkan nama maskapai	Tampilan nama maskapai	✓
6	Tombol Flight number 1 disentuh	Menampilkan input flight number 1	Tampilan Flight number 1	✓
7	Tombol Flight number 2 disentuh	Menampilkan input flight number 2	Tampilan flight number 2	✓
8	Tombol registration disentuh	Menampilkan registrasi pesawat	Tampilan registrasi pesawat	✓
9	Tombol Type of aircraft disentuh	Menampilkan input jenis maskapai	Tampilan type of aircraft	✓
10	Tombol Parking Stand disentuh	Menampilkan penggunaan avio-bridge	Tampilan Parking Stand	✓

11	Tombol Utilization Time disentuh	Menampilkan input waktu penggunaan	Tampilan utilization time	✓
12	Tombol Docking time disentuh	Menampilkan waktu saat pemasangan avio-bridge	Tampilan docking time	✓
13	Tombol Dedocking Time disentuh	Menampilkan waktu saat melepas avio-bridge dari pintu pesawat	Tampilan dedocking time	✓
14	Tombol remaks disentuh	Menampilkan catatan dari user	Tampilan Remaks	✓
15	Tombol Ramp operator disentuh	Menampilkan nama operator ramp	Tampilan ramp operator	✓
16	Tombol cancel disentuh	Kembali pada halaman beranda	Tampilan halaman beranda	✓
17	Tombol submit disentuh	Menampilkan data berhasil disimpan dan tersampaikan	Tampilan laporan data yang sudah terkirim dan tersampaikan	✓
18	Tombol lihat Riwayat disentuh	Memanggil draft data laporan	Tampilan draft data laporan	✓
19	Tombol Kembali ke form disentuh	Menampilkan halaman kelola surat	Tampilan form kelola surat	✓
Halaman Hitory Pelaporan				
1	Tombol download PDF disentuh	Menampilkan file PDF	Tampilan PDF avio-bridge utilization services	✓
2	Tombol detail disentuh	Menampilkan draft data laporan	Tampilan draft data laporan	✓

Surabaya, Juli 2025

Penguji Aplikasi



Dedi Chandra Yudho Pranoto, S.Pd

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Figure 5. IT expert validation

LEMBAR VALIDASI AHLI MATERI

Digitalisasi Avio-bridge Utilization Services Berbasis Website dalam Menunjang Pelayanan Pada Unit Apron Movement Control (AMC) di Bandar Udara Mutiara Sis Al-Jufri Palu

Judul penelitian : Digitalisasi Avio-bridge Utilization Services Berbasis Website dalam Menunjang Pelayanan Pada Unit Apron Movement Control (AMC) di Bandar Udara Mutiara Sis Al-Jufri Palu

Peneliti : Lavinia Febranti

Pembimbing : Dr. Slamet Hariyadi, S.T., M.M.

Paramita Dwi Nasti, S.S.T. MS. ASM.

Dengan Hormat,

Terkait dengan pelaksanaan penelitian yang berjudul "Digitalisasi Avio-bridge Utilization Services Berbasis Website dalam Menunjang Pelayanan Pada Unit Apron Movement Control (AMC) di Bandar Udara Mutiara Sis Al-Jufri Palu", saya mohon kesediaan Bapak/Ibu untuk memberikan penilaian terhadap website yang telah saya kembangkan melalui lembar validasi ini. Masukan dari Bapak/Ibu sangat berarti dalam proses evaluasi dan penyempurnaan website, agar penyajian informasi menjadi lebih tepat guna dan mudah diakses oleh pengguna. Saran, kritik, dan tanggapan dari Bapak/Ibu akan saya jadikan acuan dalam melakukan perbaikan terhadap media dan sistem yang dirancang. Saya mengucapkan terima kasih atas waktu dan bantuan yang telah Bapak/Ibu berikan.

A. Petunjuk Pengisian

Saya mohon Bapak/Ibu untuk memberikan tanda centang (✓) pada kolom skor penilaian yang sesuai dengan Bapak/Ibu, dengan ketentuan nilai sebagai berikut :

- Skor 1 : Sangat Kurang (SK)
- Skor 2 : Kurang Baik (KB)
- Skor 3 : Cukup Baik (CB)
- Skor 4 : Baik (B)
- Skor 5 : Sangat Baik (SB)

B. Aspek Penilaian

No	Kriteria Penilaian	Penilaian				
		1	2	3	4	5
		SK	KB	CB	B	SB
Fungsionalitas Sistem						
1	Alamat website avio-bridge utilization services Bandara Mutiara Sis Al-Jufri http://avio-bridgeutilization.my.id/ benar (sesuai)					✓

2	Alamat website avio-bridge utilization services Bandara Mutiara Sis Al-Jufri http://avio-bridgeutilization.my.id/ mudah diakses					✓
3	Informasi penggunaan avio-bridge dapat diakses dengan cepat dan mudah					✓
4	Tampilan antarmuka blanko avio-bridge menarik, konsisten dan sesuai dengan tampilan saat manual					✓
Pengujian Antarmuka dan Kemudahan Penggunaan						
5	Website mudah digunakan dan tidak membingungkan					✓
6	Peletakan sub-menu, ikon, dan tombol mudah dipahami dan sesuai dengan fungsi					✓
7	Informasi data (Operator avio-bridge, operator ramp, dokumen blanko penggunaan) ditampilkan dengan jelas dan mudah dibaca					✓
8	Secara keseluruhan sistem bekerja dengan stabil, fungsional, dan layak digunakan oleh pengguna bandara					✓

C. Kritik dan Saran

D. Kesimpulan

Digitalisasi Avio-bridge Utilization Services berbasis Website Bandara Mutiara Sis Al-Jufri Palu dinyatakan :

- (✓) : Layak digunakan tanpa revisi
- () : Layak digunakan dengan sedikit revisi
- () : Belum layak digunakan

*Centang salah satu

Palu, 14 Juli 2025
Ahlil Materi

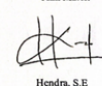

Hendra, S.E.

Figure 6. Validation by material experts

The findings of this study address the research question posed in the introduction regarding how digitalization can improve the effectiveness of avio-bridge usage reporting. Results showed that the use of a digital system accelerated the recording process, minimized paper usage, and enabled real-time data access. The website also provides features for form submission history and report summaries that can be exported as PDF files—functions that were not possible with the manual system.

When compared to previous studies, it is evident that this system has advantages in terms of flexibility, access speed, and data accuracy (Motorola Semiconductor Data Manual, 1989; U.S. Department of Health and Human Services, 2013). However, for future development, security enhancements such as data encryption and two-factor authentication are necessary, as recommended by IEEE Criteria for Class IE Electric Systems (1969).

Overall, the Avio-bridge Utilization Services system developed in this study has proven effective in replacing manual recording methods. With further development, this system has the potential to become part of a broader and more integrated airport service digitalization initiative.

ACKNOWLEDGEMENTS

The author expresses praise and gratitude to God Almighty for His abundant grace, guidance, and blessings, which have enabled the author to successfully complete this Final Project entitled "Digitalization of Avio-bridge Utilization Service Based on Website to Support Services in the Apron Movement Control (AMC) Unit at Mutiara Sis Al-Jufri Airport Palu". This Final Project is one of the requirements for obtaining the Associate Degree (A.Md) in the Diploma III Program in Air Transportation Management at the Surabaya Aviation Polytechnic.

The author extends heartfelt thanks to his beloved parents, Mr. Teguh Raharjo and Mrs. Sunarni, for their endless love, prayers, and unwavering support. Deep appreciation is also given to Mr. Ahmad Bahrawi, S.E., M.T., Director of the Surabaya Aviation Polytechnic, and Mrs. Lady Silk Moonlight, S.Kom., M.T., Head of the Air Transportation Management Study Program, for their guidance and support throughout the study period.

The author also expresses his highest gratitude to Mr. Dr. Slamet Hariyadi, S.T., M.M., as Supervisor I, and Mrs. Paramita Dwi Nastiti, S.S.T., M.Si., ASM., as Supervisor II, for their valuable guidance, suggestions, and motivation during the preparation of this Final Project. Sincere thanks are also addressed to the examiners for their constructive feedback and critiques during the seminar and final project defense.

Furthermore, the author would like to acknowledge all lecturers, instructors, and staff at the Surabaya Aviation Polytechnic for the knowledge and assistance provided. The author also extends appreciation to fellow students of the 8th Batch of the Air Transportation Management Program and juniors for their encouragement, prayers, and cooperation throughout the academic journey. Lastly, the author offers thanks to everyone who contributed, directly or indirectly, to the completion of this Final Project, whose names cannot be mentioned one by one.

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