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Environmental Damage Prevention through Digital Transformation on Tourism Industry in Bali, Indonesia

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***Abstract*—To control environmental damage due to over-booking homestays in tourist villages in Bali, a digital platform was built. In this study, a platform called dewiku was developed to evaluate and integrate all stakeholders that have a shared responsibility for environmental conservation. dewiku was developed using the concept of E-Commerce involving the standard concept of green tourism villages to prevent environmental damage in Bali. dewiku involved four actors: the Government, Developers, Partners, or Business Actors in homestays and green tourist attractions and tourists. The four actors have a major role in preventing environmental damage due to the comprehensive integrated supervision of the dewiku platform. Partners who will register dewiku E-commerce platform must meet the Green Village (GreenV) standards set and supervised by the Bali Tourism Office. GreenV's questionnaire was taken from previous research and shared with the tourism business owners in Bali, which the village government monitored. This platform was tested using the System Usability Scale (SUS), with respondents at least 15 years interested in traveling to Bali. Survey questions were distributed online through social media, Facebook, and WhatsApp, and the questions were shared using the provided link. This study used a quantitative survey approach. The result indicated an average test of 62, meaning the platform was good enough to be applied in the field. The test results showed that the SUS platform test was quite effective and expected to introduce the dewiku platform to the wider community who will travel to Bali.**

***Keywords*—Green village; platform; E-commerce; dewiku; system usability scale.**

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I. INTRODUCTION

Bali is one of the regions in Indonesia that provides the largest foreign visit from the tourism sector. Bali's popular attractions include the natural beauty, culture, and various Balinese culinary tours. Some of the tourism potentials on the island of Bali are beaches, rice fields, forest and lake areas, mountains, waterfalls, artificial tourism areas such as tourist villages, and arts [1], [2]. The high number of domestic and foreign tourist arrivals causes the expansion of hotels in Bali to be overloaded. This has led to a new trend and change in living habits for Balinese people and tourists staying in the countryside [3]. This has become a severe problem for tourism in Bali related to damage to the rural environment in Bali [4].

Before tourism was closed due to COVID-19, Bali already had an over-supply of hotel rooms, reaching 146,000, so the Bali Provincial Government considered it necessary to have a moratorium policy on hotel construction throughout the island whose authority does not have to be at the provincial level but can be in the regency/city [5]. Statistical Bureau Center (BPS) Bali noted that in the last decade before COVID-19, there was an increase in the number of foreign tourists coming to Bali by 243.59%, from 2,576,142 in 2010 to 6,275,210 tourists in 2019, but it turned out that hotel rooms in urban areas were not filled and tourists shifted to the countryside and stayed in tourist cottages (homestays) [6]. This triggers environmental

damage in Bali, thus becoming a threat to Bali's natural sustainability [7].

The concept of a green tourism village is a settlement that prioritizes environmental sustainability and is environmentally friendly in the context of design, construction, and daily operations, as well as empowering local communities with products referring to the principles of preserving the local natural, economic, and socio-cultural environment. Satola et al. conducted a study to identify rural types in India based on a semi-systematic approach that examines government initiatives and policies [8]. This policy refers to several concepts: smart village, eco-village, green village, and digital village. However, the results show that too many things need to be considered, including the need for government cooperation and interference in rural management. Furthermore, clear indicators are required for developing tourism villages in rural areas to provide convenience in the planning and managing of Village Development [8]. According to Shen and Chou [9], China prioritizes sustainable rural tourism by implementing long-term strategic planning to revitalize rural infrastructure. The growth of rural tourism plays a crucial role in addressing economic sustainability. The development of Xiamei Tea Tourism was initiated through a comprehensive investigation of tea tourism as a distinctive local culture and industrial attribute, which was subsequently integrated into the sustainable tourism framework. Technology integration plays a crucial role in the advancement of Xiamei Tea tourism, aiming to enhance the socioeconomic benefits for the local communities. This is primarily achieved by augmenting local values, fostering a sense of identity, and generating revenue opportunities [9]. Mihardja et al. [10] proposed the concept of green natural tourism, explicitly focusing on promoting the Batur Geopark in Kintamani, Bali, Indonesia, as a destination for mental recreation tourism. "Forest bathing" refers to a natural therapeutic practice that might enhance immunological function in a non-medical manner using natural stimuli, enabling individuals to attain a state of physiological calm. This practice is one of the offerings provided by Geopark Batur, located in Kintamani, Bali. This activity can enhance emotional well-being by connecting the mind and the natural environment. Bathing in the forest has been found to have dual benefits, serving as a means of protecting the forest ecosystem and fostering greater involvement from the local community [10]. Coros et al. [11] conducted a study in the rural region of Mărginimea Sibiului in Romania. The primary objective of this research is to investigate the correlation between territorial development and rural tourism, encompassing the analysis of tourist behavior and preferences. Villages comprise various elements such as unique characteristics, recreational amenities, sources of food, opportunities for spiritual development, environmental attributes, and cultural aspects. The main objective of this study is to examine local entrepreneurs' contributions to fostering creative ideas and promoting sustainable practices. Mărginimea Sibiului is a rural locality with national and international acclaim for effectively utilizing its natural and cultural heritage. It has achieved this by providing agro-tourism boarding houses and thriving rural guest houses. These establishments have proven sustainable and garnered significant appeal as successful business ventures [11].

Developing the dewiku system in Bali to manage tourist cottages is crucial and urgent. This aims for hotelization not to occur in the countryside, which will damage the sustainability of the rural environment [12], [13], [14]. The development of Bali's local digital platforms is essential in Bali tourism to increase income for the people and government of Bali. In the management of dewiku e-commerce, part of the income is paid by tax for the development of facilities in Bali. Several of the information that can be accessed in the dewiku system for tourists in planning visits are bookings, reservations, payments, transportation, and accommodation while traveling [15], [16], [17], [18]. The development of digital platforms is essential in the world of tourism, including the convenience of access for tourists to find information [19], [20]. The ease of obtaining information is the primary consideration for tourists when planning visits, bookings, reservations, payments, transportation, and accommodation.

Several research about digital platform tourism, one of them is Al-Ruzouq et al. [21] reported that a geographic information system (GIS) is being undertaken to identify and monitor archaeological sites, thereby safeguarding historical and cultural assets susceptible to human-induced damage. The present system can integrate the specific data for managing and preserving archaeological sites. The present study integrates airborne and close-range photogrammetry techniques with ground-penetrating radar (GPR) technologies to acquire essential geospatial and geophysical data to ascertain the existence of historical sites. The aforementioned technological system was implemented at the Qaser Amra archaeological site, a historic fortress in the arid region of Jordan. This approach produces a diverse range of comprehensive three-dimensional components that can be observed horizontally and vertically within an integrated three-dimensional archaeological model. Furthermore, this technology can record and oversee archaeological endeavors [21]. Additional research has been conducted in several nations, such as Canada [22], Iran [23], and Turkey [24]. Vieira et al. [25] propose developing an integrated information system for many tourist agents operating in the Portuguese Douro region. This system serves as a medium for managing tourism information and facilitates connectivity among diverse tourism agents. The model represents a technological solution that plays a crucial role in the advancement and sustainable administration of geographical typologies. The methodology is comprised of three distinct phases. Initially, a comprehensive examination of tourism assets was conducted, focusing on the urban center of Douro and several categories of noteworthy sites. Additionally, before it enters into the system, the data undergoes a process of standardization and validation. Furthermore, web services are provided to facilitate the creation of third-party applications. The system mentioned above is a technological solution designed specifically for tourists, functioning as a tool to effectively manage and distribute information about tourism in the Douro region of Portugal [25]. Ivars-Baidal et al. [26] revealed that the development of an integrated system encompassing multiple destinations in Valencia, Spain. This system aims to monitor various smart city-based destinations

by employing eight fundamental dimensions of smart cities. The smart city indicator was established in 2017 through a collaboration with the public organization INVAT.TUR. This initiative aims to offer technical support to smart destinations that have undergone prior evaluation. The creation of this smart city tourist system incorporates indicators such as governance, sustainability, innovation, accessibility, connectivity, intelligence, information, and online marketing. Nevertheless, due to its adaptability to local characteristics and the specific circumstances of regional destinations, the utilization of this indicator has experienced modifications in its implementation in Valencia, Spain. Nevertheless, the existing framework continues to face several obstacles and deficiencies as a result of insufficient backing from both the community and the government [26].

This paper presents the development of a digital wiki system to manage green tourism villages in Bali. The system consists of two objectives: Greenv standards testing for Bali's green tourism villages and Bali's local E-Commerce, specifically Bali's green tourism villages and green attractions.

II. Material and Method

A. Proposed Framework

The research steps in this study consist of five steps, including:

1) Step I: Collect data on GreenV standards to assess green homestays and attractions in Bali.

2) Step II: Implement GreenV standards into a digital platform as a digital assessment medium for all tourist homestays and green attractions in Bali.

3) Step III: E-commerce platform development that can accommodate and promote green homestay and tourist attraction packages in one platform. The platform is dewiku and can be accessed from dewiku.co.id.

4) Step IV: Build a mobile-based E-Commerce platform as an effort to facilitate services for potential end users dewiku.co.id

5) Step V: Conduct User Acceptance Test (UAT) for prospective users dewiku.co.id both in terms of green cottage businesspeople and green attractions as well as to prospective visitors. The entire research step is presented in Fig. 1.

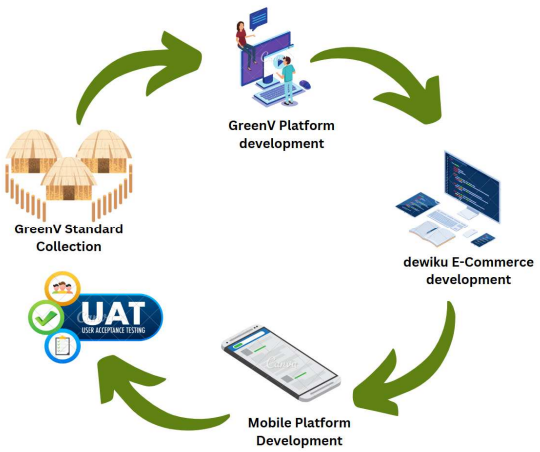

Fig. 1 Proposed framework

Fig. 1. presents the stages of development in the dewiku, including:

1) GreenV standard collection: This stage is the data collection stage in the form of GreenV standards used by standards on the dewiku platform. Halim adopted this standard [27].

2) GreenV platform development: This platform is built as an evaluation feature for partners who will join the dewiku platform. On this dashboard, prospective dewiku partners must answer and fill in several questions. These prospective partners are homestay business owners and green attractions throughout the province of Bali. GreenV evaluation serves to provide an assessment using computerized standards. From the results of this evaluation, a recommendation value will be given. The standards placed on dewiku are presented in Table I.

TABLE I
STANDARD CATEGORY GREENV DEWIKU

Minimal Standard		Green tourism category value		
		Kalpataru 3	Kalpataru 4	Kalpataru 5
GreenV	81	81-106	107-11	>111
Society Participation	60	60-70	71-80	>80
Sustainability participation	30	30-33	34-37	>37

Table 1 explains three categories, or three standards, based on the wiki's standard assessment: Kalpataru 3, 4, and 5. Kalpataru is the term for the level of judgment set by the wiki. This value is determined by calculating the linked scale used to evaluate and observe the wiki feature.

3) dewiku e-commerce development: The third feature is the dewiku e-commerce dashboard, which contains e-commerce or marketing of homestays and tourist attractions that have met the standards of the dewiku feature evaluation. This e-commerce feature is almost identical to other e-commerce applications: booking tourist cottages, paying for transactions, and booking tourist attractions in one dashboard. Partners who do not meet the standards of dewiku must conduct training and mentoring organized by various related parties, including the government and the community. This feature is also equipped with a feature of cooperation contract agreements between dewiku partners, namely homestay business owners and tourist attractions in Bali with the dewiku platform. This sheet will show if the partner or business owner of Homestay and tourist attractions has met Dewiku's standards. The standard is calculated based on surveys and questionnaires they filled out in the previous feature. This authorization sheet must be filled in by the partner when the partner wants to cooperate with the dewiku and this authorization sheet must also be authorized by the village head or related parties as a form of accountability for environmental conservation. This model was built to integrate and collaborate between business owners, tourists, and the government in preserving the environment in Bali.

4) dewiku mobile platform development: The dewiku promotion dashboard is an e-commerce-based promotion platform for tourists. This platform will be accessible to tourists from all regions, domestically and abroad. dewiku is a platform that sells homestays, green tourist huts, and green

tourist attractions in Bali that can be booked on one platform. The advantage of this platform is that it provides positive value for the community, especially homestay business owners, tourism village communication forums, village tourism Forkom in Bali, and the Bali Provincial government. The architecture of dewiku is presented in Fig. 2.

5) User Acceptance Test data collection: In this development, metric testing was used, namely the System Usability Scale (SUS). SUS is a test conducted using a questionnaire distributed to prospective users to determine the capabilities and capabilities of the dewiku system [28]-[30]. SUS contains ten questions using a scale of 1–5 to find out user assumptions about the system we build. A range of values of 1 means strongly disagree, and 5 means strongly agree with the statement. The questionnaire was distributed online via social media for six days from October 10 -16, 2023, by uploading a Google form link via Facebook and WhatsApp. The respondents of this test are at least 15 years old and interested in traveling to Bali. The results were obtained by 50 audience members who simultaneously answered and tried the dewiku system.

6) dewiku architecture: Fig. 2 below shows the architecture of dewiku built using the concept of Business Client E-Commerce. Fig. 2 is the architecture of dewiku built with the concept of e-commerce.

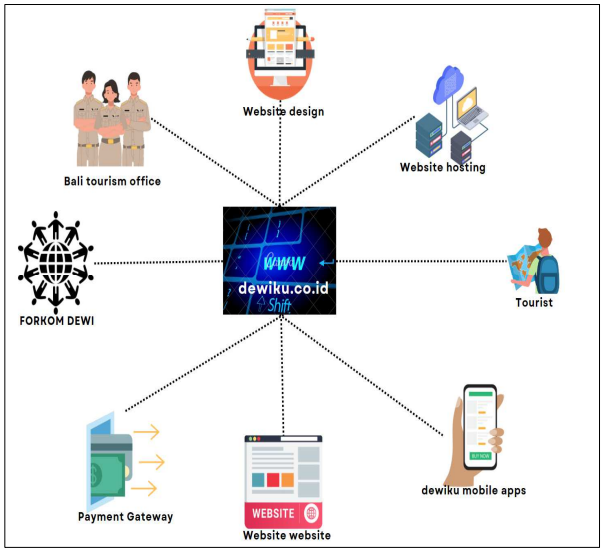

Fig. 2 dewiku architecture

dewiku has features that can be accessed by various users including tourists, partners, admins, and the government. At first, the user is divided into several levels that have their access rights. All users can access dewiku through the website. Data is stored in the cloud and accessed using each user's account. The government can only monitor data on the number of tourist villages and attractions stored in the dewiku database. This aims to assist and evaluate tourism villages in the province of Bali. Furthermore, partners can upload data through the partner dashboard and be checked by the admin. In this case, the admin is Forkom Dewi, who can look at the data, process the data, and present the tourism village data to other users for specific purposes. Furthermore, dewiku platform is also accessed in a mobile form. This application is explicitly given to tourists to make it easier to access the needs of visiting and booking tourist cottages and attractions in Bali. Tourists can also make payments to the finance department of dewiku, and partners and Forkom Dewi can access this menu. Payment for reservations is made through gateway payment used by dewiku.

III. Result and Discussion

A. dewiku use case

There are several users on the dewiku platform: tourists, the government, Bali Tourism Officer, Forkom Dewi, and Partners, as well as tourism villages and homestay business owners and financial admins. Each user has different access rights, including:

- The government has access rights to monitor tourism villages or tourism actors who have not met GreenV standards to assist all tourism village business actors in receiving training and assistance for the village's progress.
- Forkom Dewi has access rights as an admin and checks the data uploaded by the partner or tourism village concerned.
- Tourism village partners have access rights to upload data related to reservations for tourists, check reservations from tourists, and check payments from tourists. However, partners cannot receive payments directly, must be admin-financed, and will be distributed according to the agreed agreement.
- Travelers can log in to the reservation dashboard and make reservations.
- Finance validates and finalizes to travelers and partners.

The use case of dewiku is presented in Fig. 3.

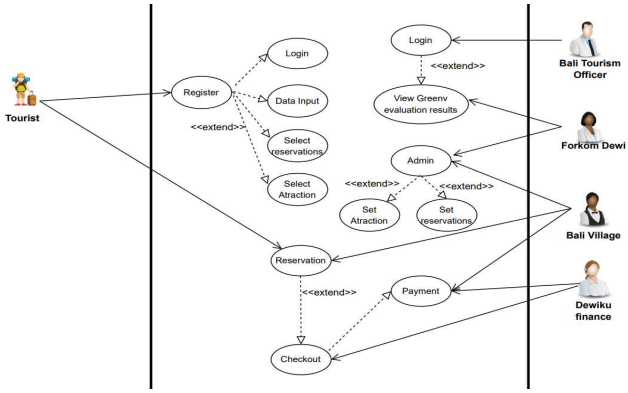

Fig. 3 dewiku use case

B. dewiku Flowchart

The flowchart system of dewiku can be seen in Fig. 4. Fig. 4. is the flowchart for the partner, which shows the assessment process before registering at the dewiku platform. The flowchart in Fig. 4. is the assessment process before registering the dewiku platform. The initial stage is a GreenV assessment. After being declared by GreenV standards, partners will be given an authorization sheet or cooperation agreement that the relevant village officials must approve as a form of responsibility for the willingness to preserve the environment. The cooperation sheet can be downloaded and filled in to be uploaded again on the menu provided. The admin will check the cooperation sheet to be approved and

sent back to the partner. After getting the agreed cooperation sheet, partners can upload data on the dewiku e-commerce platform.

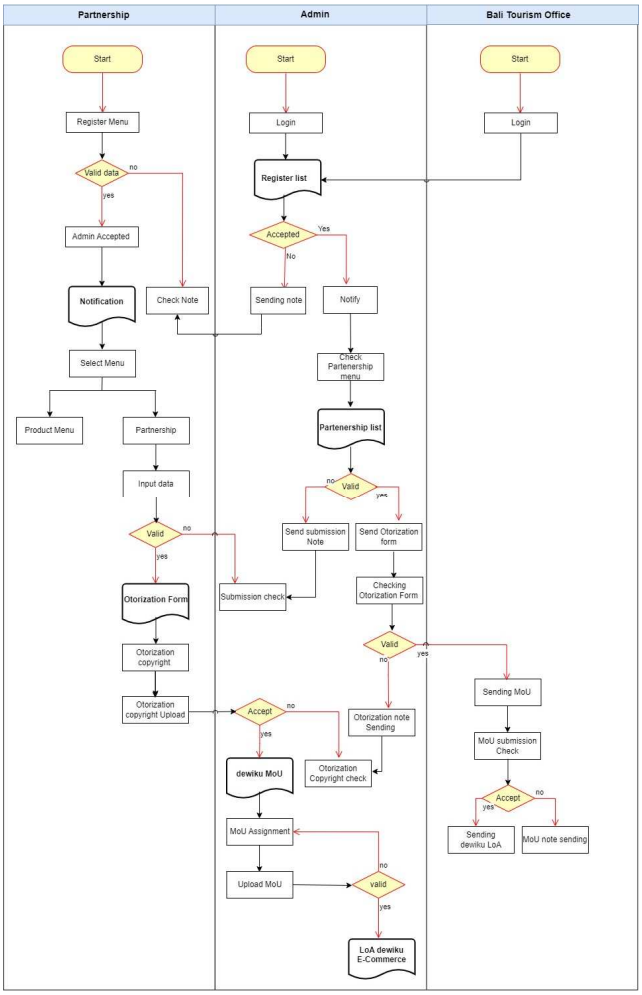

Fig. 4 dewiku partnership flowchart

C. *dewiku Source Code*

The development of this dewiku uses the Javascript programming language and database SQL server presented in Fig. 4, 5, 6, and 7.

```php
<?php

namespace App\Http\Controllers;

use Illuminate\Http\Request;
use App\Query\TemplateQuery;

class AboutController extends Controller
{
    private $aboutPageId = 14;
    public function index(Request $request)
    {
        $lang = $request->get('lang');
        $templateData = TemplateQuery::getTemplate(
            $this->aboutPageId
        );
        $templateValue = [];

        if ($lang == 'en') {
            foreach ($templateData as $item) {
                $tempArray = [];
                $tempArray['name'] = $item->name;
                $tempArray['content'] = $item->content_en;
                $templateValue[] = $tempArray;
            }
        } else {
            foreach ($templateData as $item) {
                $tempArray = [];
                $tempArray['name'] = $item->name;
                $tempArray['content'] = $item->file ?? $item->content;

                $templateValue[] = $tempArray;
            }
        }
        // dd($templateValue);

        return view('about')->with(
            'data',
            $templateValue
```

Fig. 5 dewiku website source code

```dart
import 'package:flutter/material.dart';
import 'package:flutter_screenutil/flutter_screenutil.dart';
import 'package:layout/layout.dart';
import 'features/page/splashscreen/view_splashscreen.dart';



class App extends StatefulWidget {
  const App({Key? key}) : super(key: key);

  @override
  _AppState createState() => _AppState();
}

class _AppState extends State<App> {
  // AuthBloc authBloc = AuthBloc();

  @override
  Widget build(BuildContext context) {
    return ScreenUtilInit(
      builder: (BuildContext context, child) =>
          MaterialApp(
            debugShowCheckedModeBanner: false,
            title: '',
            builder: (context, widget) {
              ScreenUtil.init(context);
              return MediaQuery(
                data: MediaQuery.of(context).copyWith(textScaleFactor: 1.0),
                child: widget!,
              );
            },
            themeMode: ThemeMode.light,
            theme: ThemeData(
              primarySwatch: Colors.cyan,
            ),
            home: Layout(child: ViewSplashScreen()),
          ),
    );
```

Fig. 6 dewiku mobile source code

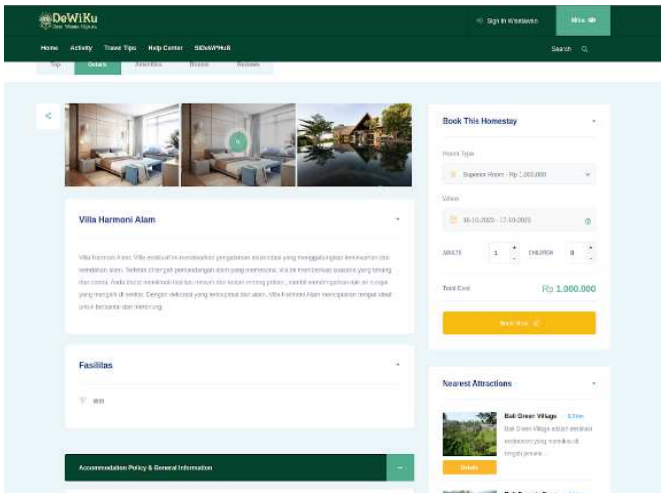

Fig. 7 Screen display of dewiku website

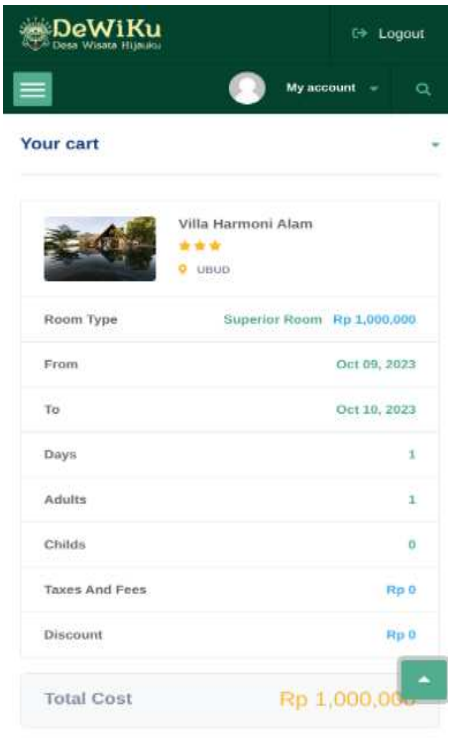

Fig. 8 The screen display of dewiku mobile

D. The Results of the Test Using SUS

In the test, 50 respondents' data were produced, and several tests were carried out to see the results of testing the dewiku system significantly. The first is a data normality test to see the distribution of respondents' data and whether it has been distributed normally or not. The Kolmogorov-Sminorv test is used to test the normality of this data. The result of testing normality data is presented in Table II.

TABLE II
ONE-SAMPLE KOLMOGOROV-SMIRNOV TEST

N		50
Normal Parameters	Mean	28.66
	Std. Deviation	7.769
Most Extreme Differences	Absolute	0.166
	Positive	0.108
	Negative	-0.166
Test Statistic		0.166
Asymp. Sig. (2-tailed)		0.001c
Exact Sig. (2-tailed)		0.113
Point Probability		0.000

In Table II, a significance value of 0.113 is obtained. This value is compared to the confidence level of 95%; the alpha value is 0.05. The significant value is 0.113>0.05, which means the data is normally distributed. Furthermore, validity tests and data reliability tests are carried out to find out whether the questions tested are correct or not. The results of the data validity and reliability tests are presented in Tables III and IV.

TABLE III
VALIDITY TEST RESULT

Variable	r score calculate	r score table	Comparison results
Q1	0.526**	0.2787	Valid
Q2	0.535**	0.2787	Valid
Q3	0.658**	0.2787	Valid
Q4	0.598**	0.2787	Valid
Q5	0.559**	0.2787	Valid
Q6	0.684**	0.2787	Valid
Q7	1	0.2787	Valid
Q8	0.580**	0.2787	Valid
Q9	0.577**	0.2787	Valid
Q10	0.587**	0.2787	Valid

Table III is the result of comparing the value of r Table with r Calculate. Where r Table is df(N-2, 0.05), then the value of r Table is 0.2787. The entire test result states the value of r Calculate >r Table, then all question variables are valid. Next is the reliability test presented in Table IV. Reliability tests are used to test whether the questions on each variable meet the principle of reliability or not. In this study, Cronbach's Alpha value limit > 0.6 was used. This means that all question results will be compared with that value.

TABLE IV
RELIABILITY STATISTICS

Cronbach's Alpha	N of Items
0.773	10

The Cronbach's Alpha value in the reliable test is 0.773, compared to r Table, which is 0.2787. So, the value of Cronbach's Alpha > the value of r Table means that all questions are reliable. Furthermore, we will see the descriptive statistics of respondent result data presented in Table V.

TABLE V
DESCRIPTIVE DATA

Question	Mean
Intensity of application use	3
Application Complexity	2
Ease of Application	4
Technician needs to use the application	2
Suitability of application functions	4
Application inconsistencies	2
Ease of use	3
Confusing system	2
There are no obstacles to using the system	3

Table V presents the average results of answers from dewiku respondents. The final score of the test using SUS is presented in Table VI.

TABLE VI
FINAL RESULTS OF THE SUS TEST

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUM	Result
1	0	3	3	4	4	4	3	3	4	0	28	70
2	2	4	4	2	4	4	4	4	4	1	33	83
3	2	1	3	1	2	2	3	2	4	0	20	50
4	0	2	2	2	2	2	2	2	2	2	18	45
5	1	3	1	3	1	3	1	3	1	3	20	50
…	…	…	…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…	…	…	…
45	3	1	3	3	3	2	2	2	3	1	23	58
46	3	1	3	4	3	3	3	3	3	3	29	73
47	3	1	3	1	3	1	3	1	3	1	20	50
48	1	4	3	3	2	0	1	0	3	3	20	50
49	2	2	3	3	4	2	3	4	3	1	27	68
Average of grades												**62**

Table VI is the results of the assessment using SUS, where the rules used in the final assessment of this SUS are: Odd number question, respondent's assessment result reduced by 1; For even number questions, the Likert scale value 5 is subtracted from the respondent's assessment results; Then, all the question results are added and multiplied by 2.5, and the average is calculated.

Based on all the SUS calculations above, 62 is obtained, meaning the platform is quite good and easy to use. The limitation of this study is that it is difficult to get an assessment from respondents when testing the platform. Not all respondents desire to travel to Bali for reasons constrained by costs. However, overall, this platform has been tested a lot by users, and the results are presented in the final results of this SuS test.

IV. CONCLUSION

To control environmental damage due to over-booking green tourism village homestays in Bali, a platform called dewiku was built. It aims to evaluate and integrate all components with a shared responsibility for environmental conservation. dewiku is a platform developed with the concept of E-Commerce involving the standard concept of

green tourism villages to prevent environmental damage in Bali, dewiku involves four actors, namely the government, developers, partners, or business actors in the field of homestays and green tourist attractions and tourists. The four actors have a major role in preventing environmental damage due to the comprehensive, integrated supervision of the wiki platform. Partners joining the dewiku E-commerce platform must meet the GreenV standards that the Bali government and Tourism Office set and supervised.

Therefore, the government can monitor and assist tourism business actors to continue to pay attention to environmental sustainability. This platform was tested using the System Usability Scale (SUS), and the test results were 62, which means that this platform is good enough to be implemented. The limitation of this study is that it is difficult to get an assessment from respondents when testing the platform. Because not all respondents have the desire to travel to Bali for reasons constrained by costs. Overall, this platform has been tested a lot by users, and the results are presented in the final results of this SuS test. In the future, research will be carried out on developing dewiku version 2.0, adding MSME features to the dewiku platform. This feature serves to provide space for MSME products in Bali to be able to sell all their products on the dewiku platform.

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