

Original Research Paper

# Smart Tourism Design in Karangasem District Using Design Science Research Approach

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**Abstract:** By analyzing user needs and covering issues facing the regional tourism sector, this research seeks to create a smart tourism system for the Karangasem Regency. Extensive research, including surveys and interviews with a range of stakeholders, including visitors, local companies, and government representatives, served as a direction for the system's design and development. The research findings had a significant impact on the development of the smart tourism module that was incorporated into the SEKAR PINTER platform. Important results from the survey showed that seeking and obtaining information on Karangasem's attractions presented considerable challenges for visitors. Furthermore, local company owners mentioned that it was difficult to market their services to visitors because there were not enough digital tools available to efficiently manage and market their offerings. The interviews made clear how much desire there was for an approachable system that could improve visitor experiences overall by bridging the gap between tourists and local service providers. These realizations had a direct impact on the creation of the smart tourism module, which now has an easy-to-use interface that allows travelers to explore locations and get up-to-date information. It also has company management features that help small businesses advertise their offerings, handle client relations, and boost the local economy. Karangasem's tourism industry is positively impacted by the SEKAR PINTER platform, which supports larger smart city initiatives by catering to the unique demands of both visitors and local companies.

**Keywords:** Smart Tourism, UML, User-Centered Design, Information Systems

## Introduction

### Research Background

The island of Bali is a well-liked travel destination for both domestic and international travelers. The Bali Provincial Tourism Office states. By taking home the Tripadvisor Traveller'Choice Award, a worldwide accolade, Bali defeated the City of London and other well-known travel locations including Dubai, Rome, Paris, Hanoi, and Bangkok to claim the title of most popular destination in the globe (Sulistyafani and Sastrawan, 2021).

About 1,333,234 tourists, or roughly 7% of all visitors, came to Karangasem Regency from September 2023 while 19,527,386 foreign and domestic tourists count in Bali, with Tirta Gangga receiving the greatest number of visits. This data led to the conclusion that neither the local nor the international communities have yet acknowledged Karangasem Regency. About

12% of Bali's tourist attractions are in Karangasem. These include the Tirta Gangga Water Park, Sukasada Park, Bali's largest and most expansive temple, Besakih Temple, and numerous other sites that are still open for visitors (Sulistyafani and Sastrawan, 2021).

Despite the region's rich natural and cultural resources, the Karangasem Regency's tourism industry has the potential to grow, but it still faces various challenges that prevent it from fully capitalizing on this opportunity. One of these is its geographical location. Situated within Bali's eastern region, the regency of Karangasem features rugged terrain that's characterized by its various natural features, such as Mount Agung and steep valleys. While these natural features are appealing to tourists, they can also be very challenging for local residents and businesses to manage. Due to its topography, it's hard to develop the necessary infrastructure to support large-scale tourism, which limits the area's accessibility.

Another issue that prevents the tourism industry from fully capitalizing on the region's potential is its geographical location. Due to its location, it's difficult for tourists to reach the area, which is why many of them avoid visiting the region. Besides its natural attractions, such as the Besakih Temple and the Tirta Gangga Water Palace, the regency also has a limited transportation system. This makes it difficult for tourists to reach these areas, which is why many of them avoid visiting the region.

The region is also prone to encountering natural hazards, such as eruptions from Mount Agung. These incidents frequently disrupt the lives of local residents and visitors. The most significant of these eruptions occurred in 2017. The number of people visiting the region decreased dramatically. This type of natural disaster can have a negative impact on the region's appeal and the operations of local businesses. The fear of the eruptions has caused potential visitors to stay away, which has affected the local economy. These hazards can have a lasting effect on the region's reputation as a safe destination for tourists.

These geographic, topological, and environmental challenges create a unique set of problems for Karangasem's tourism sector. Limited accessibility restricts the ability of tourists to explore the area fully and the constant threat of natural disasters adds to the difficulties of maintaining a consistent flow of visitors. Local businesses, particularly Small and Medium Enterprises (SMEs), which are central to the tourism economy, struggle to thrive under these conditions. Without the ability to effectively promote their services or manage operations efficiently, many of these businesses face severe limitations in reaching their full potential.

### *Purpose of Research*

Since information technologies are essential to a city's ability to compete as a travel destination, cities and tourist organizations devote significant resources to smart system efforts (Lee *et al.*, 2020). Information and Communication Technology (ICT) advancements in general and cloud computing technologies in particular, encourage governments and tourism destination practitioners to use smart technologies to optimize business planning decisions and improve the visitor experience (Ye *et al.*, 2020). We suggested a solution by enhancing the functionality of the current application system, which solely offers details on how complaints from the public are handled, to include information about tourism in order to promote awareness of the Karangasem smart city and demonstrate how this application may impact and enhance the local economy in the tourism industry, we named it SEKAR PINTER.

### *Benefits of Research*

This design can offer application users fresh perspectives on visiting, investigating, and learning about

Karangasem. Offering chances for Small and Medium business owners in the Karangasem district's tourism industry to showcase their offerings to visitors via the Smart Tourism Karangasem application design. Increasing the Karangasem province's revenue in the economic field and providing opportunities to improve the Karangasem region's infrastructure for workers.

### *Related Work*

The study applies the Rational Unified Process (RUP) life cycle approach based on the Unified Modeling Language (UML) to the analysis, design, and implementation of an e-government observatory for rural Small and Medium Companies (SMEs). Through the proposed observatory, rural SMEs will be able to receive e-learning materials on how to use e-government services available in their area, in addition to finding out more about these services (Karetso *et al.*, 2011). Next, is to examine the issues associated with developing knowledge management software for SMEs using a mobile application. The purpose of these applications is to disseminate knowledge that already exists among SMEs and to record, regulate, preserve, and share knowledge with practitioners (Siregar and Aryanti Wardaya Puspokusumo, 2020).

### *Literature Review*

#### *Design Science Research*

Generating prescriptive knowledge about the design of Information Systems (IS) artifacts, such as software, methods, models, or concepts, is the goal of Design Science Research (DSR) (Vom Brocke *et al.*, 2020; Hevner *et al.*, 2004). A comprehensive strategy that blends relevance and rigor has been suggested: Design science (Dimov *et al.*, 2023; Hevner *et al.*, 2004).

The following are the stages or actions that must be completed in accordance with the DSR (Lawrence *et al.*, 2010; Peffers *et al.*, 2007):

- Problem identification and motivation: Highlighting the worth of the answer and identifying the unique aspect of the research challenge are crucial elements in ensuring a successful research project. The interaction between the researcher and the client will provide them with valuable insight into the problem and help them find the solution
- Define the objectives for a solution: The objectives of the solution can be determined based on the problem and your comprehension of how feasible and feasible it is. These can be quantitative, such as how the new solution will aid in improving the current issue, or qualitative, like describing how the artifact will support an earlier neglected one
- Design and development: The research artifacts that you create can be broadly defined and include

models, examples, procedures, or constructions. They can also take the shape of the objects that researchers created

- **Demonstration:** Exhibit the utilization of artifacts to solve specific problems. They can be utilized in simulations, experiments, proofs, and case studies
- **Evaluation:** To determine the effectiveness of the research artifact, one must analyze and evaluate its support for the solution. Doing so involves comparing the artifacts' objectives to the actual outcomes of the demonstration
- **Communication:** Reinforce the importance of the research artifact to key audiences, such as academics and practitioners, by exhibiting its utility, originality, design rigor, efficacy, and impact

### *Unified Modeling Language*

The quality and speed at which projects may be completed in modern software development are largely determined by the collaboration of developers. Models are a key component of software engineering discourse and communication. One of the most well-known general-purpose modeling languages in software engineering is the Unified Modeling Language (UML), along with its corresponding diagrams, which is often regarded as the "lingua franca" for software engineers. (Petre, 2013; Yigitbas *et al.*, 2023; Chen *et al.*, 2022).

According to Ciccozzi *et al.* (2019); Yigitbas *et al.* (2023) collection of UML diagrams is needed for software system modeling that is mandated by the analytical solution. The most frequently needed model representations are class, state machine, and activity diagrams, frequently in combination. When defining executable models, it is generally expected that both structural and behavioral models would be used.

### *Usability Testing*

Usability is defined as "the effectiveness, efficiency, and satisfaction of specified users who achieve specified goals in a particular context of use" in the 1998 ISO 9241 standard, which also includes additional information from ISO/IEC 25010. Effectiveness in this context refers to how precisely and fully designated users are able to accomplish those objectives (Aiyegbusi, 2020; Kosch *et al.*, 2023):

- **Learnability:** The learnability Index measures the degree to which an individual can carry out simple tasks while interacting with a new design
- **Efficiency:** The efficiency of a user is determined by how fast they can perform various tasks after being introduced to a new design

- **Memorability:** The concept of mnemonic refers to the ease with which an individual can easily recall a certain design after a brief period of inactivity
- **Error:** The frequency of errors and how easily they can be fixed are considered when analyzing the level of satisfaction with a particular design
- **Satisfaction:** The level of enjoyment that users get from a particular design is also taken into account to determine its level of satisfaction

This study is focused on the usability of a system. It will examine how users can utilize it to achieve their goals. It will also look into its operability and appropriateness. Kamińska *et al.* (2022); Kosch *et al.* (2023); Peters and Aggrey (2020); Storm *et al.* (2021).

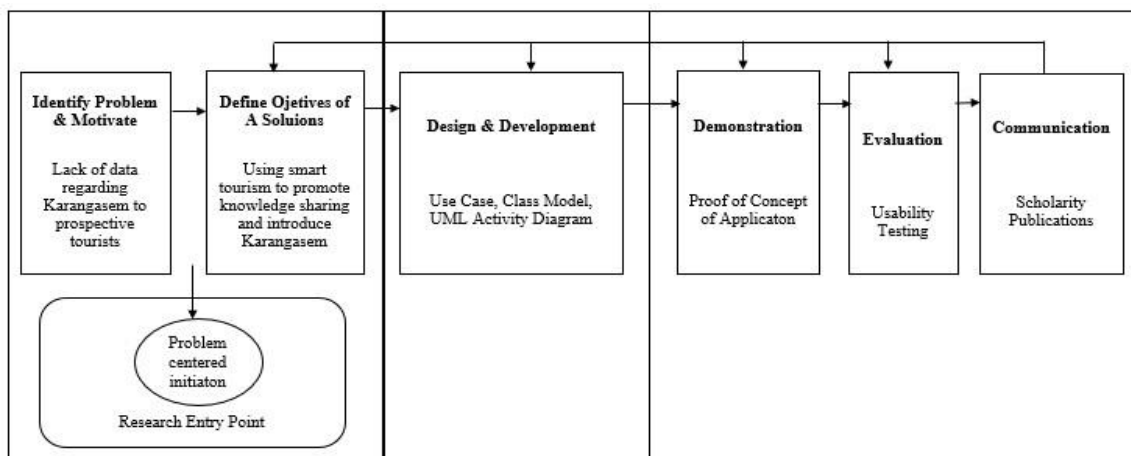
## **Materials and Methods**

The design strategy used for this study is based on the Design-Science Methodology (DSRM), a set of guidelines, best practices, and operational processes created by Ken Peffers and associates. To achieve its goals, research must incorporate this strategy on a regular basis. The Design Science Research Methodology (DSRM) was chosen for this study because it has proven to be an excellent tool for using technical innovation to solve complicated, real-world problems, especially in the tourism industry. DSRM is unique in that it uses an iterative process to create and improve artifacts, like the SEKAR PINTER platform, which makes it perfect for addressing dynamic issues like those in Karangasem.

The unique aspect of DSRM is its structure, which starts with problem identification and progresses to the development of assessment instruments tailored to the particular needs of the research. Unlike other approaches, it uses digital platforms to enhance results in addition to producing knowledge. The goal of the study is to create a tourism platform that benefits both local companies and visitors and DSRM aligns nicely with this goal. Moreover, DSRM is adaptable which means it can accommodate the needs of future users. The approach's emphasis on stakeholder interaction and rigorous evaluation helps it stand out from the crowd. It also ensures that the platform functions efficiently.

The DSRM is a process model that can be used for designing and evaluating research. It has six steps that are focused on problem identification, motivation, design and development goals, evaluation, communication, and demonstration as in Fig. (1).

This study explores the experiences of users and evaluates the system's effectiveness through interviews and questionnaires. The objective is to find out how the platform can help support the tourism industry in Bali's Karangasem region.



**Fig. 1:** DSR for sekar pinter

An instrument consisting of thirteen questions was used in the study to gather data regarding the characteristics of the system as well as thoughts regarding its overall efficacy. Among the queries posed were the significance of incorporating a search option for neighboring sites and a QR code scanning tool for providing users with local knowledge. Through a 5-point rating system, participants were able to indicate which characteristics of the system were most helpful to the researchers.

The survey was sent out through the Internet to a wide audience, which included individuals aged 17 and above. The researchers were able to collect data from a randomly chosen group of 96 participants. The study's efficiency was attributed to how it was conducted online, which allowed the researchers to reach a bigger target audience in a short amount of time.

In addition to the questionnaire, the researchers conducted interviews with nine individuals, including local business owners and tourists who have visited Bali. These sessions delved into the system's features such as the QR code scanning function, facility details, and recommendations. These findings reinforced the importance of including a feature that lets users look for nearby attractions. Interviews allowed the researchers to gain a deeper understanding of how the system helped people plan their trips to Bali. They also focused on the system's ability to provide relevant information.

## Results

### *Problem Identification and Motivation*

The main challenge identified for the development of SEKAR PINTER is the lack of recognition of the region's attractions, especially within the international and domestic markets. Even though it has numerous natural and cultural attractions, it is not widely recognized. The

lack of visibility of the region's tourism potential has been attributed to the lack of a system that can effectively promote the area. Also, the lack of information about the various services and facilities in the area has left visitors with limited resources to explore it.

Small and medium-sized enterprises within the tourism industry encountered challenges in managing their customer engagement and promoting their services. The previous generation SEKAR PINTER did not have the necessary features to help these businesses market their offerings to a wider audience, which restrained their growth potential.

The previous system failed to provide a user-friendly experience, which discouraged people from using it. Its lack of an intuitive design also made it hard for users to access the information they needed. The platform did not integrate various smart city initiatives, which could have helped the tourism industry develop.

### *Define the Objectives for Solutions*

To realize a smart city in Karangasem, modules with a smart tourism theme are being designed for the SEKAR PINTER application. The role of smart technology in travel has grown in significance from the viewpoint of tourists (Pai *et al.*, 2020; Zhang *et al.*, 2022). Travelers utilized ICT primarily for decision-making and searching for trip information in the beginning.

This application serves to provide tourists with new experiences when touring Karangasem City by using surveys and interviews to determine the needed features based on. Next, we develop administration tools to make business management easier for managers of tourist attractions and entrepreneurs in the tourism sector, as well as marketing modules to increase revenue and clientele. Finally, a user-centered design approach was put into practice by surveying users about the prototype using a questionnaire to gauge their opinions and the success of the design.

The new SEKAR PINTER is an improved version that addresses many of the issues identified in the previous system. It features new functionality to help local businesses and tourism in Karangasem flourish. The previous version mainly handled public complaints and provided basic administrative data. But, it did not have the necessary tools to help promote the area's tourism potential or engage tourists.

On the other hand, the updated version adds a smart tourism module that provides comprehensive, interactive information on nearby tourist destinations, amenities, and activities, thus improving the experience of visitors. Travelers can now more easily explore the sites of Kamrangasem and make more efficient travel plans, something that was not feasible with the previous method.

This new system features a number of new tools that allow Small and Medium-Sized Enterprises (SMEs) to manage their operations and market their services directly. These tools significantly improve the previous version's support for tourism-related businesses. The new SEKAR PINTER has a user-friendly design, which

makes it more accessible and intuitive for both locals and tourists. Its integration with smart city concepts can also help the tourism industry develop and align with the urban planning process.

Overall, the new SEKAR PINTER transforms from a basic administrative tool into a dynamic platform that enhances tourism, supports local businesses, and contributes to Karangasem's economic development, making it a key driver of the region's smart city vision. In essence, SEKAR PINTER now serves as a dynamic platform that benefits both tourists and local businesses while supporting the region's economic and urban development.

### Design and Development

In this phase, researchers create a database that is used in this application and refine the application prototype. The process can be explained simply by looking at the steps involved in developing an application.

In this case, we use 16 class diagrams and their relationships as in Fig. (2).

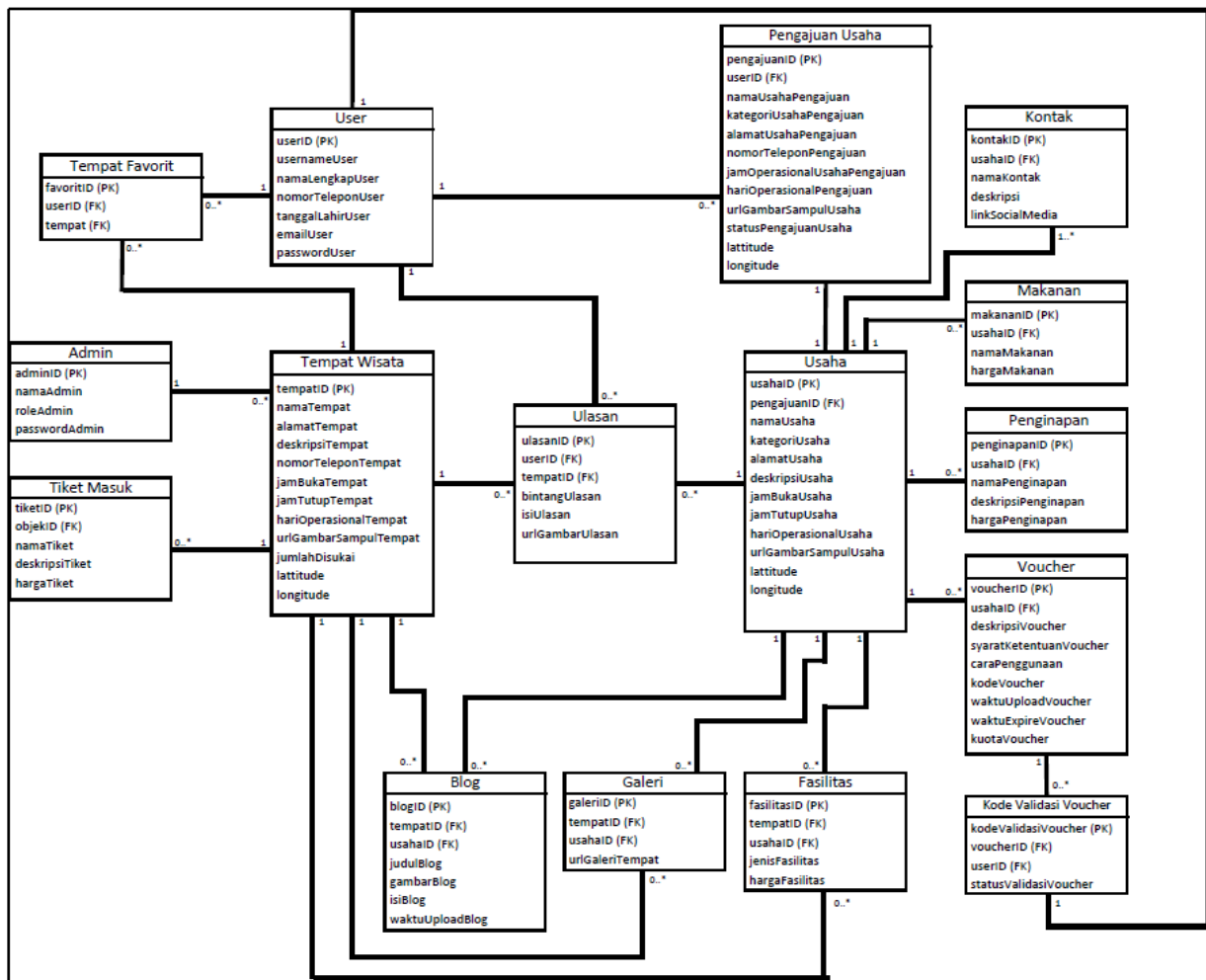


Fig. 2: Sekar pinter class diagram

A full system including users, businesses, and reviews is shown by the class diagram. Connecting to other components like reviews, favorite locations, and business submissions, the User class serves as the hub. With the use of the Tempat Favorit class, each user can manage one or more favorite tourist destinations. The Ulasan class, which links to both businesses (Usaha) and destinations (Tempat Wisata), allows users to give reviews for these destinations.

Key features including name, category, and location are held by businesses, which are detailed in the Usaha class. These businesses are associated with entities such as food (Makanan), accommodations (Penginapan), vouchers, and galleries (Galeri). Company owners use the *Business Submissions* class to apply to their companies for approval. Discounts are offered using vouchers, which are handled in the Voucher class and validated by the Kode Validasi Voucher class.

Tourist spots are organized in the Tempat Wisata class, which contains descriptions, operating hours, and location details. These places, like businesses, allow reviews and give entrance tickets (Tiket Masuk). In addition, tourist destinations and companies can be included in galleries and blogs (blogs), which enhances the content of the system.

The system manager, Admin, and Kontak, which houses company contact details, are also included in the diagram. The connections among these classifications create a carefully coordinated framework for overseeing and evaluating tourist destinations and establishments.

### Demonstration

Two mobile app windows with a simple, easy-to-use interface for looking up locations and reading blog entries are shown in the image of Fig. (3). Six large icons are arranged in a grid style on the first screen, Cari Tempat (Search for Places) on the left side of Fig. (3), which has an easy-to-use structure. The following icons stand for various categories of locations that users can explore: Pom Bensin (gas station), Penginapan (accommodation), Tempat Wisata (tourist spots), Restoran (restaurants), Money Changer, and Minimarket (convenience store). Users can conduct direct searches for particular locations using the search bar at the top of the screen. Bright orange icons and soft blue headers add to the overall minimalist style, which makes the user interface visually appealing and simple to use.

The blog area on the right side of Fig. (3), located on the second page, lets visitors read articles about Tempat Wisata (tourist spots), Restoran (restaurants), or a mix of the two. The blog content in this part is filtered according to the specified category using a tab structure that is horizontal. Each blog entry has an image, a title, and a

brief synopsis of the content. The list of blogs is displayed as a vertical feed. The blog entries address things like evaluations of local events, eateries, and tourism destinations. Users may easily skim the information fast and select topics of interest because of the straightforward organization and effective use of graphics. The color scheme stays the same from the first screen, upholding a unified user experience and strengthening brand identity.

The place details page showcases two mobile app screens displaying details about Tirta Gangga, a tourist destination. The layout and design are clean and visually appealing, with a consistent use of orange and blue accents throughout the interface.

An expansive picture of one tourism destination named Tirta Gangga is prominently shown at the top of the opening screen, providing a visually captivating introduction to the location. Below the picture, there's a label for Tirta Gangga along with a button that says "Arahkan" (Guide), which is probably meant to be a navigation or guide to the place. Three buttons, named Ringkasan (Summary), Fasilitas (Facilities), and Operasional (Operational), are located beneath this, enabling users to switch between various information areas. The facilities section of this screen separates Fasilitas Gratis (Free Facilities) from Fasilitas Berbayar (Paid Facilities). While the premium facilities offer costs for activities like renting a pavilion and pelampung (floats), the free facilities include amenities like Musholla and Pengecasan Elektronik (Electronic Charging).



Fig. 3: Tourism menu



The second screen on Fig. (4) has a similar structure, but operating data is highlighted. Users can check the contact information, which includes a phone icon for convenience, and the opening hours (Monday through Sunday, 10:00-22:00) here. Pricing details for the various ticket types are given below. Tiket Domestik Anak-Anak (Children's Ticket) is priced at Rp 25,000, Tiket Mancanegara (International Ticket) at Rp 50,000 and Tiket Domestik Dewasa (Domestic Adult Ticket) at Rp 35,000. Users can easily navigate and get vital details thanks to the uniform design and well-organized structure.

From an admin perspective shown in Fig. (5), Service administrators utilize the Submission page to examine and approve business applications that users submit through the SEKAR PINTER application. If the administrator finds something wrong with the submission, he has the authority to reject it or approve it.

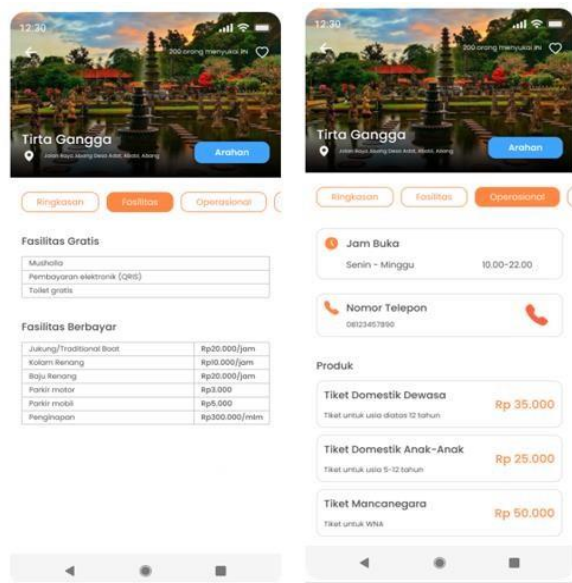


Fig. 4: Tourism detail information

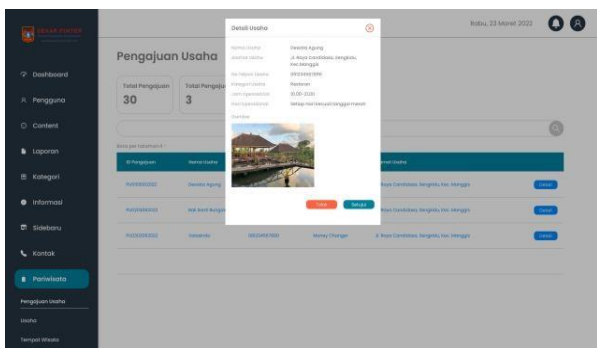


Fig. 5: Admin privilege

## Evaluation

The usability testing of the SEKAR PINTER smart tourism module was carried out to assess its design effectiveness and overall user satisfaction. A key component of evaluating digital tools is ensuring that they meet the expectations and needs of users. To this end, a thorough usability study was conducted, employing a survey of 35 participants from diverse backgrounds, all aged 17 and older. The main objective of the project was to find out how the new system could help users complete certain tourism-related tasks.

One of the primary aspects of the usability evaluation was effectiveness. It emphasizes how users can engage with the system to precisely and totally accomplish their goals. The results of the testing showed that most respondents (65.7%) thought the SEKAR PINTER interface was user-friendly and appealing. The User Interface (UI) design's intuitiveness is highlighted by this feedback, which effectively aids users in navigating the system without difficulty or aggravation. Moreover, the low proportion of indifferent replies (only 2.9%), highlights how widely the design is accepted.

Efficiency is the second crucial factor and SEKAR PINTER showed promise in this area. This was especially clear from the speed at which users became accustomed to the features of the system. A startling 82.9% of participants concurred that the system's functionalities made it easy for them to look up locations by utilizing user-friendly search categories and filters. Thus, the system makes it easier for users to finish tasks quickly, saving them time and effort. This is an essential feature for any tool used in the tourism industry, as users frequently need quick access to information.

User comment on the overall experience and the application's ease of use was used to measure satisfaction, which was another important component of the evaluation. Respondent satisfaction was very high, with 71.4% strongly agreeing that the SEKAR PINTER business management tools were both user-friendly and sufficiently fulfilled their demands. This is especially crucial for small and medium-sized businesses (SMEs) operating in the regional tourist industry since these resources offer vital assistance with marketing and company management.

The usability evaluation also included additional crucial metrics:

- Participants (82.9%) considered the system's features easy to master, particularly while navigating for the first time
- Users found the system's interface and functionalities easy to remember even after inactivity, showing strong memorability
- The error rate was low, with most users easily correcting mistakes, indicating a forgiving and supportive approach to recovery

- Overall satisfaction: 85.7% of users rated SEKAR PINTER smart tourism as outstanding or very good, indicating positive feedback

The usability testing results indicate that SEKAR PINTER is well-suited for the Karangasem tourism business since it delivers a functioning and user-friendly platform. These findings show that the application can effectively achieve its dual goals of improving the tourist experience and assisting local company operations. Users found the system useful for trip planning, destination location, and effective business management.

## Discussion

The overall goal of these enhancements is to offer a more seamless and interesting user experience. The SEKAR PINTER app is made more practical and helpful for both visitors and residents by combining improved design with increased support for neighborhood businesses. This revised system not only adds new features but also makes sure that existing ones, like MSME lists, emergency contacts, Karangasem Regency information, and public complaints, stay current and relevant. As a result, consumers can keep using this service more effectively.

With the addition of smart tourism features, users may more quickly discover tourist destinations and obtain up-to-date information. The creation of an interface that is easier to use and more intuitive is one of the primary modifications. Users can now locate the information they need more quickly and use the app more easily thanks to the redesigned design. Digital maps and virtual tours are examples of interactive features that enhance the user experience by adding depth and making exploration more engaging and educational.

Future studies should concentrate on creating better personalization elements, like recommendations based on user preferences and integration with social media platforms to boost user involvement, in order to improve SEKAR PINTER's efficacy. Furthermore, more research on the financial effects of these applications on nearby SMEs may shed more light on how these apps contribute to the local economy.

## Conclusion

Design science is becoming increasingly popular as a study paradigm in the field of Information Systems (IS). E-government research looks at IT tools that aim to improve the quality and efficacy of public services and administration (Carter *et al.*, 2022). Using a DSRM strategy can provide proposals that are more focused and capable of effectively responding to this research problem.

The construction of the SEKAR PINTER smart tourism system represents a significant step forward for

Karangasem Regency, solving long-standing issues such as geographic isolation, limited accessibility, and vulnerability to natural calamities. The insights gained via questionnaires and interviews with travelers, local companies, and government officials revealed that the region needed a more dynamic and integrated approach to fully realize its tourism potential. The new system effectively addresses these objectives by providing a user-friendly platform that improves both the tourist experience and the operating capability of local companies.

One of the system's most notable achievements is its increased accessibility for tourists. In an area where physical access to information about attractions and services has historically been limited, SEKAR PINTER provides a comprehensive, real-time digital solution. This feature not only allows guests to easily explore and interact with Karangasem's rich cultural and natural assets, but it also helps to increase the region's visibility and appeal as a tourist destination. By removing the restrictions that previously hampered visitor involvement, the system is positioned to boost tourism and economic activity. Another significant achievement of the system is its ability to empower small companies. Prior to SEKAR.

PINTER, small and medium-sized businesses in Karangasem failed to reach and serve the tourism market successfully because of the region's geographical limits and a lack of digital infrastructure. The integration of business management tools into the system now enables small businesses to market their services, manage bookings, and communicate with consumers in previously unavailable ways. This enhanced exposure and operational efficiency help to revitalize the region's economy.

This research provides the following contributions: Results Improve the existing tourism information dissemination model by innovating the use of technology and increasing the empowerment of the business world in its role in promoting and preserving culture in Karangasem, Bali. Further advancement in this research can include the addition of technical aspects such as 3D and Virtual Reality to improve the user's experience.

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## Author's Contributions

**Hendro Nindito:** Lead research project, coordinated developer, experiment, instructor, and data analysis, and wrote the manuscript.

**Evaristus Didik Madyatmaja:** Advise research project, design the application, and data analysis.

**Johan Hadi Wijaya:** Mobile and web developer.

## Ethics

The authors confirm that this manuscript has not been published elsewhere and that no ethical issues are involved.

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