

Formulation of Operational Risk Management Strategy For Lava Tour Merapi Yogyakarta

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Abstract

Yogyakarta is a tourist destination in Indonesia with a significant contribution to the development of Indonesian tourism performance, which is increasingly recognized worldwide. As one of Yogyakarta's tourism icons, the Merapi Lava Tour has emerged as a special interest tourism destination with its adrenaline-pumping characteristics, very suitable for the tastes of risk-seeking tourists. This tour provides the experience of exploring the former eruption area of Mount Merapi by jeep, offering a unique and memorable attraction that attracts the attention of domestic and international tourists. Despite its charm of enjoying the beauty of the peak of Merapi by jeep on challenging terrain, Lava Tour Merapi is faced with operational risks that if not managed properly will impact its resilience and sustainability, especially in the era of the rise of social media users. This study aims to identify the operational risks of Lava Tour Merapi Yogyakarta and map them in a risk evaluation matrix. This study uses an exploratory research design in collecting cross-sectional data. Data taken using the concurrent triangulation strategy technique based on purposive sampling. Based on the identification and mapping that has been formed, this study formulates the operational risk management strategy for Lava Tour Merapi Yogyakarta based on operational risk triggers related to internal processes, human resources, systems, supporting facilities and infrastructure. The operational risk identification results indicate that for both low and high-frequency risk events, the impact is still relatively low, so the appropriate operational risk management strategies implemented by managers are the mitigate and keep strategies (risk handling).

Keywords: Lava Tour Merapi; Risk evaluation matrix; Operational Risk Management Strategy; Yogyakarta;

INTRODUCTION

Indonesian tourism is increasingly gaining recognition worldwide. The abundance of Indonesian tourist destinations is one of the main attractions that attracts many tourists to visit various tourist attractions, not only local tourists, but also foreign tourists (Lesmana, Henky & Sugiarto, 2021; Lesmana, Henky, et al, 2022; Lesmana, Henky, et al, 2023; Saputra & Eferyn, 2024). According to data from the World Economic Forum, Indonesia ranked 50th in the Travel & Tourism Competitiveness Index (TTCI) in 2015 (Crotti & Misrahi, 2015). This ranking continued to rise to 42nd in 2017 (TTCI, 2017), and again to 40th in 2019 (TTCI, 2019). After the TTCI evolved into the Travel & Tourism Development Index (TTDI) in 2021, Indonesia maintained its positive momentum, ranking 32nd (Uppink & Soshkin, 2022). Ultimately, in 2024, Indonesia shot up to 22nd in the world, reflecting significant progress in various aspects of tourism development, including policy, infrastructure, sustainability, and socio-economic impact (World Economic Forum, 2024).

Yogyakarta as one of the tourist destinations in Indonesia, contributing significantly to the development of Indonesian tourism (Hou & Wang, 2024; Dinas Kebudayaan Kota Yogyakarta, 2024; A. Riyadi, 2025; Irene Indri Dewi Astuti, et al., 2025). The Merapi Lava Tour is an alternative to the various tourist destinations in and around Yogyakarta. The Merapi Lava Tour has emerged as a special interest tour with its adrenaline-pumping characteristics, perfectly suited to the tastes of risk-seeking tourists (Azarmi, S. L., 2023). The Merapi Lava Tour is a jeep tour of the Merapi area affected by the 2010 eruption. During the Merapi Lava Tour, tourists can enjoy the natural scenery and cool air while exploring the sea of sand left by the eruption. This tour is followed by a fun and relaxing river swim. This tour includes a sightseeing tour of various locations affected by the eruption. Destinations on the Merapi Lava Tour include the My Remaining Treasures Museum, Triangulation

Hill, Kaliadem Bunker, and the Kalikuning River Water Maneuver.

The My Remaining Treasures Museum will transport visitors to the past, during the eruption of Mount Merapi. The Museum invites visitors to see some of the remaining objects left over from the eruption, such as livestock bones, household utensils, photos of victims of the eruption, and locations affected by the eruption.

Triangulation Hill is an amazing place that tourists can visit next, from here tourists can clearly see Mount Merapi, and not only that, here is also a hill that has been modified in such a way that as far as the eye can see there is always beauty in it and of course a variety of interesting spots here, such as a replica of a Giant Pumpkin, a Giant Palm, a Goblin House, and many others.

The Kaliadem Bunker is a designated shelter and hiding place, as well as emergency protection from the dangers of pyroclastic flows from Mount Merapi. Located in Kaliadem hamlet, approximately 5 kilometers from the summit, the bunker was buried under debris during the 2016 and 2010 eruptions. In the 2010 eruption, two volunteers who were isolating residents were buried and died inside. After the eruption, local residents reopened the bunker and made it a tourist destination.

The Kalikuning River Water Maneuver is the final and most challenging destination on the Merapi Jeep Tour, a truly adrenaline-pumping experience, as tourists navigate a watery track. The River Maneuver is a water off-road experience that involves diving directly into the river using a Jeep. The Merapi Jogja Jeep Tour will take tourists to Kalikuning, where they are challenged to descend the river while still riding the Merapi Jogja Jeep fleet. Tourists' adrenaline is tested and they are immersed in an unforgettable hysteria as they navigate the watery path. As tourists navigate this path while still riding the Merapi Jogja Jeep, the surrounding water will rise, drenching them, providing an exciting and thrilling experience.

Despite its charm of enjoying the beauty of the Merapi peak area using a jeep on challenging terrain, the Merapi Lava Tour is faced with operational risks (Sugiarto, 2023a; Sugiarto, 2023b; Hsu, J. L., & Sharma, P, 2023) which if not managed properly will impact its resilience and sustainability (Sugiarto & Herawan. T., 2022; Farsari, I. 2023; Ahmadi Zahrani, M. et al, 2025), especially in the era of the rise of social media users (Aprilia, F. & Kusumawati, A, 2021; Vieira, I., et al, 2024). Various news reports have suggested that the ongoing volcanic activity of Mount Merapi also poses a real threat that could disrupt the operations of the Lava Tour Merapi. The Klargon Hill and Kaliadem Bunker areas were temporarily closed in March 2022 due to the eruption. This situation demonstrates the need for an operational risk management approach to maintain the sustainability of the Lava Tour Merapi (Paulina Lo & Sugiarto, 2021; Gössling & Mei, 2025; Sugiarto, et al., 2024).

This study aims to identify the operational risks of the Yogyakarta Merapi Lava Tour and map them in a risk evaluation matrix. The novelty of this research is identifying and mapping the operational risks of Lava Tour Merapi in the main sub-pillars of operational risks including internal processes, human resources, systems, supporting facilities and infrastructure (Sugiarto, 2023a; Sugiarto, 2023b). Based on the identification and mapping formed, this research formulates the Operational Risk Management Strategy of Lava Tour Merapi Yogyakarta based on the operational risk triggers of internal processes, human resources, software systems, supporting facilities and infrastructure.

LITERATURE REVIEW

Risk Events and Risk Loss

Tourism business risks are triggered by risk events, namely various events that give rise to the potential for adverse outcomes that result in losses (Bong Soeseno; Sugiarto; D.M. Lemy; N. Adinoto, & S. Palupi, 2019; Sugiarto, 2023a; Sugiarto, 2023b). Losses that occur as a direct or indirect impact of a risk event are referred to as risk losses, which can be financial or non-financial (Sugiarto, 2023a; Sugiarto, 2023b; Sugiarto & Nursiana, Adinoto, 2021).

Operational Risk

Bong et al. (2019) classify tourism risks into Operational Risk, Market Risk, External Risk,

Regulatory Risk, Reputational Risk, Business Risk, and Financial Risk. Regarding the Merapi Lava Tour, operational risk is highly relevant to the safety, security, and assurance of tourists, as well as the convenience of tourists (Sugiarto & Herawan, T, 2022). Operational risk is the risk caused by the inability or failure of internal processes, human resources, systems, supporting facilities, and infrastructure to support business operations in the tourism industry. Operational risk events are distinguished by their frequency of occurrence and the severity of their impact (Sugiarto et al, 2024; Bong, Soeseno, et al., 2019; Sugiarto, 2023a; Sugiarto, 2023b). Frequency indicates the frequency of an event. A high frequency indicates a high likelihood of occurrence. A low frequency indicates a low likelihood. Impact indicates the magnitude of losses resulting from an event. A high impact indicates a high severity of impact. A low impact indicates a low severity of impact (Sugiarto, 2023b).

Operational Risk Mitigation Strategies

There are four operational risk mitigation strategies: avoid, transfer, mitigate, and keep (Sugiarto, 2023b). An avoid strategy involves a company not engaging in certain activities that carry undesirable risks. A transfer strategy involves transferring the risk from the tourism industry to another party willing to bear the risk in exchange for a premium. A mitigate strategy involves companies seeking to reduce the impact of the risk. A keep strategy involves companies intending to manage certain risks themselves, considering cost-effectiveness and having the capability and resources to manage the risk. A keep strategy is adopted based on the calculation that the tourism business can achieve a higher return than the risk borne, based on its cost-benefit profile. The choice of risk mitigation strategy (avoid, transfer, mitigate, and keep) can be guided by a risk evaluation matrix based on the frequency and severity of impact (Sugiarto, 2023a; Sugiarto, 2023b).

RESEARCH METHODS

This study employed an exploratory research design to gather cross-sectional data from Lava Tour Merapi users, managers and employees of the operators, and the local community, as well as a review of relevant news reports. Data were collected using the Concurrent Triangulation Strategy technique, integrating communication and observation techniques to collect data from both primary and secondary sources. Data collection from Lava Tour Merapi users was conducted using a questionnaire and confirmed using interviews. Using questionnaires distributed to 223 respondents, this study explored tourists' perceptions of the risks involved at the tourist destination. Primary data sources included managers and employees of the operators, and the local community. Secondary data sources included relevant news reports and risk event records from Lava Tour Merapi operators. Data collection employed a purposive sampling technique. Risk events were identified based on operational risk triggers, including internal processes, human resources, systems, supporting facilities, and infrastructure.

Table 1. Respondent Profile

Profile	Description	Explanation
Gender	Male (56%) Female (44%)	Based on gender, the majority of respondents were male. However, male tourists are roughly equal to female tourists.
Origin of respondents	- Yogyakarta (21%) - Jakarta (18%) - Various cities and other areas (61%)	Based on the type of respondent's origin, it was found that most of the respondents were local tourists from Yogyakarta. Other cities that are dominant are tourists from Jakarta.
Respondent age	≤20 = (14 %) 21 - ≤25 = (28 %) 26 - ≤ 30 = (31 %) 31 ≤ 35 = (18 %) 36 ≤ 40 = (1 %) ≥41= (8%)	Most respondents were between 21 and 30 years old, representing the millennial segment. Adventure tourism enthusiasts are relatively young

Respondent education	- Bachelor (53%) - Diploma (22%) - Senior high school (16%) - Master degree (9%)	Based on education, most respondents have a bachelor's degree, so the lava tour consumer segment is a group with sufficient education
Visiting frequency	- First time: 21% - Second time: 49% - Third time: 27% - Fourth time: 3%	Based on the frequency of visits, the majority of lava tour enthusiasts are repeat visitors, or tourists who have visited before. This could indicate that lava tours are a popular attraction. Many tourists are loyal to this attraction.
Motivation to visit	Family Trip (44%) Fun & Leisure (37%) Visiting Friend Relative (19%)	Based on the motivation for visiting, most visits are for family trips or family holidays, some are for fun and some are part of a series of visits to relatives.
Visiting companion	Family (52%) Friend (48%)	Most respondents visited the lava tour with their families. This may indicate that the Lava Tour is part of a family tourism attraction that can involve all ages

Based on the identification and mapping of the frequency of incidents and their impacts, an Operational Risk Management Strategy for Lava Tour Merapi Yogyakarta was formulated using the Risk Evaluation Matrix as shown in Table 2 (Sugiarto, 2023b).

Table 2. Risk Evaluation Matrix

		Impact	
		Low	High
Frequency	High	Reduce Risk	Avoid Risk
	Low	Retain Risk	Transfer Risk

RESULTS AND DISCUSSION

Lava Tour Merapi Yogyakarta's operational risks arise from various internal factors that should be managed within the Lava Tour Merapi Yogyakarta business. Lava Tour Merapi Yogyakarta's operational risk management involves not only recording past operational risks and predicting future losses, but also mitigating the likelihood of operational risk events and mitigating their potential impact.

Table 3. Identification and mapping of the frequency of incidents and their impacts

Frequency	Impact	
	Low	High
Low	The jeep driver's communication device malfunctioned. The jeep's route was changed due to road repairs on the usual route.	A Mount Merapi eruption occurred. A jeep accident resulted in a crash, resulting in casualties.
High	Public facilities are below standard in terms of cleanliness. Employees and drivers are not yet certified. Vegetation around the tour track is a hiding place for wild animals that could harm visitors. Tourist users' failure to comply with applicable regulations Long queues at some photo spots Dust can cause a little discomfort because it can make tourists cough and can also make their eyes sore.	Unpredictable weather changes. Overtourism and overcrowding cause a buildup of jeeps and risk causing conflict between tourists and jeep operators. In addition, overtourism can also threaten environmental sustainability The suitability of the vehicle used for the tour before starting the Merapi Lava tour

The results of an exploration conducted with Lava Tour Merapi users, managers and employees of the operators, and the local community, as well as a review of relevant news reports, indicate that tourists generally believe that the impact of risks posed by nature, animals, humans, plants, epidemics, and other triggers related to Lava Tour Merapi will not deter them from returning and repeating the exciting adventure of Lava Tour Merapi. The strategies formulated are based on the identification of findings classified on the basis of internal triggers for processes, human resources, systems, supporting facilities and infrastructure. The operational risk identification results indicate that for both low and high-frequency risk events, the impact is still relatively low, so the appropriate operational risk management strategies implemented by managers are the mitigate (risk reduce) and keep (risk manage) strategies (Sugiarto, 2023b). The information in Table 1 shows that, based on the frequency of visits, the majority of lava tour enthusiasts are repeat visitors or tourists who have visited before. This information confirms that respondents' perceptions of the risks faced when participating in a Merapi lava tour are still tolerable.

The Mitigate (risk reduce) strategy is adopted by the Lava Tour Merapi management company to reduce the impact of risks. By implementing a Mitigate strategy, the Lava Tour Merapi management consciously accepts the impact of a risk. Through risk management, the company strives to minimize the likelihood of the risk occurring and reduce the magnitude of the risk's impact if it does materialize. The Keep (risk manage) strategy is adopted by the Lava Tour Merapi management as demonstrated in practice to manage certain risks themselves, considering cost-effectiveness and the company has the capability and adequate resources to manage the risk. The implementation of this strategy is carried out by calculating a higher return on the risk taken, based on a cost-benefit profile. The mitigate (risk reduce) and maintain (risk manage) strategies formulated based on the identification of findings classified on the basis of internal triggers for processes, human resources, systems, supporting facilities and infrastructure are as follows.

Category I. Supporting facilities and infrastructure.

Risk Event: The Merapi Lava Tour is located in a mountainous area that is prone to natural disasters such as volcanic eruptions.

Mitigation strategies:

- a. Provide evacuation routes
- b. Emergency response training for staff
- c. Equip the resort with a 24-hour security system, install CCTV at several strategic points, and maintain tight security at the entrance.
- d. Map all routes according to hazard classification (green, yellow, and red zones), and restrict access to the red zones.
- e. Create an early warning system based on information from the Center for Volcanology and Geological Hazard Mitigation (PVMBG), which is directly connected to the Lava Tour Merapi management control center.
- f. Provide safe and coordinated alternative routes that can be used during road repairs, but tourists should be informed beforehand to avoid misinformation.
- g. Develop an early warning system and a clear evacuation plan for tourists and tour operators.
- h. Conduct regular disaster management simulations to help improve preparedness in the event of an emergency.
- i. Provide clear and easy-to-understand signage for tourists regarding evacuation points so that tourists can quickly find a safe place in the event of an emergency.

Risk Event: The sensation of an exciting off-road tourist attraction, traveling around in an off-road jeep on rocky and sandy paths provides a different adrenaline sensation from ordinary tours. Dust can cause a little discomfort because it can make tourists cough and can also make their eyes sore

Mitigation strategies:

- a. Establish rules and provide protective helmets.

- b. Management provides reliable drivers who are familiar with the terrain of the off-road tourist attraction.
- c. Management requires drivers and tour participants to wear protective helmets from the start of the tour.
- d. Establish rules and provide protective masks or dust protection glasses

Risk Event: The condition of the roads used is not entirely under the authority of the management but involves village areas and protected forests. Reliance on unstable public infrastructure also exacerbates these external risks.

Mitigation strategies:

- a. Managers establish good cooperation with village and protected forest officials.
- b. Conduct joint maintenance with village and protected forest officials regarding the condition of roads and public infrastructure.
- c. Establish regular communication forums between driver groups, village officials, and local government to align policies.
- d. Develop a fair and transparent fare system and ensure mutually agreed upon distribution of fees.
- e. Prioritize improvements to road access to tourist areas so that tourists can reach destinations more safely and comfortably.

Category II. System

Risk Event: Complaints from tourists on the Lava Tour Merapi tour package

Mitigation strategies:

- a. Lava Tour Merapi management establishes management procedures, implements, and enforces clear standard operating procedures (SOPs), from check-in and check-out to handling guest complaints.
- b. Develops and implements a well-organized booking and reservation system, both online and offline.

Risk Event: The area around Mount Merapi boasts pristine vegetation, a potential hiding place for venomous snakes and other wildlife. Travelers walking on trekking trails or rocky terrain risk being bitten by venomous snakes or other wildlife if they are not careful. In some areas, such as the vegetation around the Kaliadem Bunker, there is a population of long-tailed macaques that frequently approach tourists in search of food. Under certain circumstances, these interactions can turn aggressive if the macaques feel disturbed or threatened. The presence of ground snakes is also a serious concern, especially during the rainy season when these reptiles emerge from their nests.

Mitigation Strategies:

- a. Develop a Wild Animal Security System
- b. Install information boards in locations prone to wildlife interactions, particularly prohibiting feeding or touching wild animals.
- c. Provide tourists with brief wildlife education while traveling.
- d. Prepare a simple first aid kit for bites or injuries resulting from accidental animal interactions.

Risk Event: Tourist activities that can damage the natural environment. Tourists who come and enjoy the Merapi Lava Tour have varying levels of environmental awareness. In addition to those who are aware, there are often tourists who lack this awareness. Although not motivated by the intention of damaging the beauty and natural environment, their actions have an impact on the environment along the Merapi Lava Tour track. Some off-road or trekking routes can have large tree roots protruding, increasing the risk of tripping or falling. In these conditions, tourists have been found to remove obstacles indiscriminately by cutting them down, resulting in damage to the natural environment of the Merapi Lava Tour.

Mitigation Strategies:

- a. Management Develops a Plant Protection System
- b. Management Educates tourists about not damaging the environment along the Lava Tour Merapi trail
- c. Management Maintains natural vegetation and minimizes environmentally damaging development
- d. Maintains and preserves the Natural Environment
- e. Regularly trims vegetation that obstructs the trail, such as tree roots that can cause accidents

Risk Event: The Lava Tour Merapi tourist area is surrounded by many trees and cool air, which is one of the main attractions for tourists, who enjoy both the jeep ride and the pristine environment. Despite the beauty, thorny, poisonous, or irritating plants are not uncommon.

Mitigation Strategies:

- a. Install warning signs in areas with thorny, poisonous, or irritating plants.
- b. Design alternative routes to avoid areas with large tree roots that could cause jeeps to slip.

Risk Event: Maintaining the Aesthetics of the Site. The Merapi Lava Tour is designed to blend in with the natural surroundings. Its landscape, featuring numerous hills and trees, is a unique attraction for tourists. Visitors can enjoy views of Mount Merapi and the beauty of the pristine pine forest. There are also viewing points for photos. Visitors focused on the beauty of the area can sometimes forget about safety, taking photos in dangerous and poorly protected areas, which can lead to accidents. While visiting tourist attractions like the Kaliadem bunker, many tourists climb onto fragile structures for selfies without considering their stability and potential collapse. The lack of guides at some tourist spots also allows tourists to explore unsupervised. This increases the potential for accidents due to unfamiliarity with the inhospitable terrain.

Mitigation Strategies:

- a. Design and provide safe, exotic, yet low-risk photo spots.
- b. Establish signs to discourage tourists from taking photos that emphasize the beauty and uniqueness of the photo spot, even though the location itself poses a high level of danger.
- c. Establish a photo duration to prevent crowding of tourists.

Risk Event: Spread of Viruses and Bacteria. Travelers from different regions or countries are at risk of bringing and spreading infectious diseases, such as COVID-19, bird flu, or tuberculosis.

Mitigation Strategies:

- a. Develop a Health Security System
- b. Provide handwashing facilities and basic sanitation facilities at every tourist stop
- c. Educate tourists and visitors about the risks of disease from mud, stagnant water, or animals, especially during the rainy season.
- d. Provide information and education to tourists about wearing masks and goggles to avoid dust that can reduce comfort.
- e. Sanitation facilities must be inspected and cleaned regularly to ensure they remain suitable for use by visitors.
- f. Health Risk Management Provision of masks, hand sanitizers, and other health protocols to suppress the spread of infectious diseases during a pandemic or certain seasons

Risk Event: Asset Maintenance System: A group of tourists is preparing to embark on a Merapi Lava Tour using off-road jeeps. They are excited to explore the rocky trails and see the remains of Mount Merapi's eruption. However, during the trip, several operational risks may occur, for example: One of the jeeps used apparently did not receive regular maintenance. While passing through steep terrain, the vehicle's brakes suddenly failed, causing the jeep to roll out of control. Although the driver tried to control the vehicle, the jeep eventually fell onto the side of the rocky road. Several tourists suffered minor injuries from the impact.

Mitigation Strategies:

- a. Conduct regular maintenance and checks
- b. Provide and use communication equipment that meets standards for outdoor areas
- c. Provide backup communication equipment to facilitate travel in the event of disruptions.
- d. Conduct a mandatory vehicle roadworthiness test before starting the tour
- e. Use a jeep driver who is familiar with the vehicle and the terrain

Risk Event: The lack of an affordable business insurance system tailored to the needs of adventure tourism increases financial vulnerability in the event of an accident involving tourists on the Lava Merapi tour. If a tourist accident occurs, the operator could face liability costs without legal protection or financial support. Many operators lack proper bookkeeping or systematic records of income and expenses, making it difficult to access financing from banks or formal credit institutions.

Mitigation Strategies:

- a. Always monitor information published by the Geological Disaster Technology Research and Development Center (BPPTKG) and conduct training related to Standard Operating Procedures for evacuations.
- b. Establish a reserve fund by regularly setting aside income to anticipate unforeseen accidents.
- c. Establish accurate bookkeeping or systematic records of income and expenses.
- d. Implement a scheduled preventive maintenance system, establish standby mechanical teams at strategic locations, conduct technical and safety training for drivers, and, importantly, conduct regular audits and evaluations.

Risk Event: Evacuation to prevent panic and help maintain tourist interest after the incident.

Mitigation Strategies:

- a. Strengthening monitoring and early warning systems
- b. Developing multi-scenario contingency protocols, as emergency plans must cover a range of scenarios, from small eruptions to heavy rains to road damage. Each scenario should have clear procedures, including evacuation points, alternative routes, and assigned roles for each personnel.
- c. Regular simulations with villagers and security forces will ensure smooth coordination in the event of an emergency.
- d. Crisis communication management is essential, as fast, clear, and accurate information is crucial for maintaining tourist confidence.
- e. Management can establish a communications team that manages social media, the official website, and customer service to provide updates on conditions on the ground. Conveying positive yet transparent messages will prevent panic and help maintain tourist interest post-event.

Risk Event: Managing weather and natural conditions also presents challenges in implementing the Sapta Pesona program on the Merapi Lava Tour. As a nature-based tourist destination, sudden weather changes can impact tourist safety and comfort. For example, heavy rain can make the tourist trails slippery and dangerous for the jeeps used on the tour.

Mitigation Strategy:

- a. Early warning systems and weather information are needed to help tourists and managers anticipate unfavorable natural conditions.
- b. Prepare raincoats that tourists may need in case of sudden rain.
- c. Prepare medical supplies and first aid for accidents.

Category III: Internal Process

Risk Event : the use of old jeeps which often experience sudden breakdowns while carrying tourists.

Mitigation Strategies:

- a. Create and enforce regulations regarding vehicle and tourist safety standards that must be adhered to to ensure a safe and comfortable tour.

- b. Upgrade vehicles to improve tourist safety and security.
- c. Conduct regular evaluations of the age and suitability of vehicles so that timely upgrades can be planned and the necessary funds allocated for these upgrades can be allocated.

Risk Event: Not all operators have standby mechanics or emergency replacement equipment, so if a technical problem occurs in the middle of the route, the evacuation process takes a long time.

Mitigation Strategies:

- a. Equip each vehicle with safety equipment, such as a complete set of mechanics' gear.
- b. Equip each vehicle with a helmet.
- c. Equip each vehicle with a professional documentation package for emergency documentation.

Risk Event: The lack of digital records of vehicle service schedules makes fleet management less precise. Consequently, the potential for accidents increases as vehicles are forced to operate in less than optimal condition.

Mitigation Strategies:

- a. Record vehicle service schedules and create a reminder system to ensure each vehicle receives service on time and avoids delays.
- b. Regularly service your vehicle to ensure it remains in prime condition.

Risk Event: Visitors do not maintain order and safety regulations when driving a jeep.

Mitigation Strategy:

- a. Management provides clear information and regulations to visitors to maintain order and comply with safety regulations when driving a jeep
- b. Management provide education regarding the potential risk of accidents if visitors do not comply with the established rules of order.

Risk Event: Carrying capacity problems due to inadequate arrangements

Mitigation Strategies:

- a. Limiting the number of jeeps per day to prevent overtourism and overcrowding.
- b. Providing different routes to the same spot

Risk Event: Issues related to the management of beauty, environmental sustainability, cleanliness, and waste. In the Merapi lava tour tourist area, tourists are often found to be unaware of the importance of maintaining cleanliness and order. Although management and the community have attempted to provide trash bins at various locations, trash is still frequently found scattered around due to visitors' lack of discipline in disposing of their waste properly.

Mitigation Strategies:

- a. Conduct more extensive education to raise tourist awareness about environmental protection.
- b. Provide trash bins at various locations.
- c. Conduct educational campaigns on the importance of maintaining cleanliness and order through social media, information boards, and interactive programs involving tourists.
- d. Use eco-tourism concepts, such as providing reusable bottles and reducing the use of single-use plastics, to maintain cleanliness and environmental sustainability.
- e. Routinely clean tourist routes so tourists can enjoy the panorama without being disturbed by trash or other elements that spoil the view.
- f. Management employs dedicated staff for cleaning.
- g. Maintain the cleanliness of facilities such as bathrooms, dining areas, and public facilities by regularly cleaning them.
- h. Establish and implement a reforestation program aimed at preserving the natural environment around the Merapi Lava Tour area.

Risk Event: Availability of public facilities for visitor convenience

Mitigation Strategies:

- a. Providing more adequate public facilities such as toilets, places of worship, and rest areas will improve tourist comfort during their visit.
- b. Collaborating between the government, the private sector, and local communities to raise funds to improve the availability of public facilities for visitor comfort.
- c. Empowering local communities must be continuously strengthened. Local communities should be given greater opportunities to participate in tourism management, both through small and medium enterprises (SMEs) in the culinary and souvenir sectors, as well as in managing tourist facilities. With active community involvement, they will feel a sense of responsibility for the sustainability of tourism in their area.

Risk Event: Fraud and Overpricing. Tourists may be charged unreasonable prices by unscrupulous tourism service providers, especially if there are no strict regulations regarding service fees.

Mitigation Strategy:

- a. Establish strict regulations regarding service rates

Category IV: Human Resources

Risk Event: The ability of Lava Tour Merapi staff in handling emergency response conditions

Mitigation Strategy:

- a. Improve human resource quality by providing training to drivers and guides on excellent service, first aid, and disaster risk awareness.
- b. Establish legality and business protection by obtaining official permits, business and vehicle insurance, and collaborating with local governments for legal protection and regulatory support.

Risk Event: Quality of service to tourists and setting Long queues at some photo spots.

Mitigation Strategies:

- a. Lava Tour Merapi staff are trained to be friendly and professional in serving guests.
- b. Each guest is warmly welcomed and provided with comprehensive guidance throughout the activity.
- c. Management encourages social interaction between visitors through joint activities between guides and tourists.
- d. Tour guides must receive training in good communication techniques to interact more friendly and informatively with tourists.
- e. Create a welcoming atmosphere for the local community to be more active in welcoming tourists with a warm and polite attitude.
- f. Develop community-based programs to increase community involvement in tourism management so they contribute to creating memorable experiences for tourists.
- g. Formulate Long queues at some photo spots regulations.
- h. Determine the duration of the photo so that there is no buildup.

Risk Event: the driver's attitude of not caring about the safety of the tour.

Mitigation Strategy:

- a. Management should regularly educate drivers about the safety of tour participants.
- b. If a tour participant is found not wearing a protective helmet due to inattention during the briefing or intentionally violating established rules, the driver should not remain silent without reprimanding or informing them about the safety standards.

Risk Event: Lack of training for drivers will increase the likelihood of accidents or poor service, which can damage the business image.

Mitigation Strategies:

- a. Every driver is required to undergo off-road safety training.
- b. Every driver is required to have a competency certificate.

Risk Event: Lack of knowledge of tour guides

Mitigation Strategies:

- a. A certification program for tour guides to ensure they have adequate knowledge of the history, culture, and safety aspects of the Merapi Lava Tour.

CONCLUSION

The results of an exploration conducted with Lava Tour Merapi users, managers and employees of the operators, and the local community, as well as a review of relevant news reports, indicate that tourists generally believe that the impact of risks posed by nature, animals, humans, plants, epidemics, and other triggers related to Lava Tour Merapi will not deter them from returning and repeating the exciting adventure of Lava Tour Merapi. The operational risk identification results indicate that for both low and high-frequency risk events, the impact is still relatively low, so the appropriate operational risk management strategies implemented by managers are the mitigate and keep strategies (risk handling). The formulated strategy is based on the identification of findings classified based on the drivers of internal processes, human resources, systems, supporting facilities, and infrastructure.

Acknowledgements

A more comprehensive formulation of a risk mitigation strategy than the operational risk mitigation strategy will be more comprehensive if it is supplemented with studies of Market Risk, External Risk, Regulatory Risk, Reputational Risk, Business Risk, and Financial Risk. To obtain more comprehensive study results, research based on the Tourism Risk Event Model as formulated by Sugiarto (2023b) can be considered.

REFERENCES

- Ahmadi Zahrani, M., Ziaecian, M., & Bamakan, S. M. H. (2025). The metaverse and sustainable tourism: Opportunities, challenges and future trends. *Sustainable Futures*, 10, 0–40. <https://doi.org/10.1016/j.sftr.2025.101006>
- Aprilia, F. & Kusumawati, A. (2021). Influence of electronic word of mouth on visitor's interest to tourism destinations. *Journal of Asian Finance, Economics and Business* Vol 8 No 2 (2021) 0993–1003. doi:10.13106/jafeb.2021.vol8.no2.0993.
- A.Riyadi. (2025). Yogyakarta Jadi Ibu Kota Budaya Indonesia, Rakernas JKPI 2025 Titik Balik Pusaka Bangsa. *Times Indonesia*, 1. Retrieved from https://timesindonesia.co.id/peristiwa-daerah/549378/yogyakarta-jadi-ibu-kota-budaya-indonesia-rakernas-jkpi-2025-titik-balik-pusaka-bangsa?utm_source=chatgpt.com
- Azarmi, S. L. (2023). Sustainable Tourism Development in Border Regions: A Case Study of Kermanshah Province. *International Journal of Kurdish Studies*, 183(2), 153–164.
- Bong, Soeseno; Sugiarto; Lemy, D. M; Nursiana, Adinoto & Arianti, Santi. P. (2019). *Manajemen Risiko, Krisis & Bencana untuk Industri Pariwisata yang Berkelanjutan*. Jakarta, Indonesia: PT. Gamedia Pustaka Utama.
- Crotti, R., & Misrahi, T. (2015). The Travel & Tourism Competitiveness Index 2015: T&T as a Resilient Contribution to National Development. *The Travel & Tourism Competitiveness Report 2015*, 13, 3. <https://www.weforum.org/reports/travel-and-tourism-competitiveness-report-2015>
- Dinas Kebudayaan Kota Yogyakarta. (2024). *Laporan kinerja instansi pemerintah Dinas Kebudayaan (Kundha Kabudayan) Kota Yogyakarta*.

- Farsari, I. (2023). Exploring the nexus between sustainable tourism governance, resilience and complexity research. *Tourism Recreation Research*, 48(3), 352–367. <https://doi.org/10.1080/02508281.2021.1922828>
- Gössling, S., & Mei, X. Y. (2025). AI and sustainable tourism: an assessment of risks and opportunities for the SDGs. *Current Issues in Tourism*, 3500, 1–14. <https://doi.org/10.1080/13683500.2025.2477142>
- Hou, W., & Wang, K. (2024). Research on Modeling of Influencing Factors of New Eco-tourism Management Based on Economic Fluctuation Prediction. *Procedia Computer Science*, 243, 1179–1188. <https://doi.org/10.1016/j.procs.2024.09.139>
- Hsu, J. L., & Sharma, P. (2023). Disaster and risk management in outdoor recreation and tourism in the context of climate change. *International Journal of Climate Change Strategies and Management*, 15(5), 712–728. <https://doi.org/10.1108/IJCCSM-10-2021-0118>
- Irene Indri Dewi Astuti, I Nyoman Sudirman, Sugiarto, Adinoto Nursiana, Fongnawati Budhijono. (2025). Evaluasi dampak integrasi tata kelola dan sapta pesona Heha ocean glamping Gunung kidul, Yogyakarta. *Jurnal Bina Manajemen* . 13 (2). 66–72
- Lesmana, Henky & Sugiarto. (2021). Formulating a competitive advantage model for tourism destinations in Indonesia. *Journal of Asian Finance, Economics and Business* , 8 (3), 0237–0250
- Lesmana, Henky; Sugiarto Sugiarto; Christiana Yosevina & Widjojo, Handyanto. (2022). A competitive advantage model for indonesia’s sustainable tourism destinations from supply and demand side perspectives. *Sustainability*, 14 (16398).
- Lesmana, Henky; Sugiarto; Christiana Yosevina Ratna Tercia & Widjojo, Handyanto. (2023). *Model keunggulan bersaing destinasi pariwisata Indonesia*. Yogyakarta: Penerbit Andi
- Paulina Lo & Sugiarto. (2021). Strategic planning in SMEs: A Case Study in Indonesia. *Journal of Asian Finance, Economics and Business* , 8(2), 1157–1168.
- Saputra, R., & Eferyn, K. (2024). Pengaruh Daya Tarik Wisata Citra Destinasi Dan Sarana. *Jurnal Review Pendidikan Dan Pengajaran*, 7(3)
- Sugiarto. (2023a). *Investasi dan Risiko Pariwisata*. Jakarta: Penerbit Universitas Terbuka
- Sugiarto.(2023b). *Esensi Manajemen Risiko Pariwisata*. Yogyakarta: Penerbit Andi
- Sugiarto; Budhijono, Fongnawati; Muhammad Fuad; Susanto, Dwiyono Rudi; Kiswanto, Amin; Nur Rohman. (2024). Strengthening Indonesian tourism resilience based on tourism operational risk management. *Journal of Resilient Economies*, 4,1,
- Sugiarto & Herawan. T., (2022). The Influence of Operational Risk Management on Intention to Revisit and Intention to Recommend by Using Satisfaction as a Mediating Variable: A Study of Homestay Users in Dieng Plateau, Central Java, Indonesia. *Quality-Access to Success*, 24(192).
- Sugiarto & Nursiana, Adinoto. (2021). *Manajemen Keuangan Pariwisata*. Tangerang Selatan: Penerbit Universitas Terbuka
- TTCI. (2017). The Travel & Tourism Competitiveness Report 2017. In *Tourism*. <http://www.weforum.org/reports/travel-tourism-competitiveness-report-2009>
- TTCI. (2019). The Travel & Tourism Competitiveness Report 2019. In *The World Economic Forum*. <http://www.fitzroy.cl/wp-content/uploads/2013/05/Travel-and-Tourism-Competitiveness-2013-Fuente-WEF.pdf>
- Uppink, L., & Soshkin, M. (2022). Travel & Tourism Development Index 2021: Rebuilding for a Sustainable and Resilient Future. *World Economic Forum (Insight Report May 2022)*, 91. https://www3.weforum.org/docs/WEF_Travel_Tourism_Development_2021.pdf

Sugiarto (2025).

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Vieira, I., Alén, E., Fernandes, D., & Rodrigues, A. P. (2024). Navigating uncertainty: The role of perceived risks in supporting sustainable tourism development in low-density territories. *Journal of Destination Marketing and Management*, 32(April). <https://doi.org/10.1016/j.jdmm.2024.100895>

World Economic Forum. (2024). *Travel & Tourism Development Index 2024*. Insight Report, May 2024.

https://www3.weforum.org/docs/WEF_Travel_and_Tourism_Development_Index_2024.pdf