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Research Paper

An economic downfall: fragile data management systems a major security threat for sustainable tourism

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ABSTRACT

Sustainable tourism, a rapidly growing sector that significantly contributes to global economic development, especially in developing nations reliant on natural and cultural assets. While the tourism industry is considered as an economic powerhouse, contributing to GDP and employment, the tourism industry faces increasing security vulnerabilities due to digital technology and reliance on data management systems. Fragile data management systems not only expose the industry to compromise security but also jeopardize its long-term economic sustainability. This paper explores how vulnerable data management systems in tourism pose a critical security threat to the sustainable development of tourism, undermine economic viability and ability to maintain sustainable economic growth. This study also proposes strategies to strengthen data management systems in case of tourism sector's resilience. Through a review of case studies, industry reports, and theoretical insights this research aims to highlights also proposes actionable solutions as an urgent need for robust data governance, to secure infrastructure for mitigating security threat an inside cause of economic collapse.

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1. INTRODUCTION

Tourism is a cornerstone of global economic activity, one of the fastest-growing economic sectors, contributing over 10% to the world's GDP and employing more than 300 million people worldwide and in infrastructure development. Sustainable tourism, which is designed to minimize environmental impact, preserve cultural heritage, and ensure economic benefits for host communities. Sustainable tourism, According to the UN [1], the industry has increasingly embraced data-driven models for customer relationship management and service delivery through digitalization and technological advancements. However, this rise in digital technology also presents significant challenges, particularly regarding data management. [2], [3] are highly vulnerable to cyberattacks, ranking third in incident frequency according to the Trustwave 2020 Global Security Report. As attacks become more frequent and sophisticated, relying solely on compliance and post-incident investigations is insufficient. The sector's extensive communication with millions of consumers and the management of large volumes of personal data, often involving human error, necessitate proactive cybersecurity strategies rather than reactive spending. [4] As tourism operations increasingly rely on digital infrastructure for bookings, supply chain management, and customer interactions, fragile data management systems pose significant vulnerabilities.

Poor security protocols, outdated infrastructure, and inadequate data governance threaten not only individual businesses but also the overall economy. In an industry where trust and reliability are crucial, these weaknesses can lead to economic losses, operational disruptions, and reputational damage, potentially causing the collapse of entire companies and sectors. The digital transformation of the tourism industry, driven by big data, cloud computing, and artificial intelligence, also enhanced customer experiences and operational efficiencies through online booking systems, digital payments, and CRM tools. However, this shift has also exposed vulnerabilities in data management systems, creating significant risks to the sustainability of the tourism sector as it becomes increasingly reliant on data.

1.1 Research Objectives

This study aims to conduct an in-depth analysis-

a) To analyz the interconnection between data management, sustainable tourism and stable economy,
b) To create security vulnerabilities within the tourism sector and economic downfall the role of weak data management systems, and
c) To address the risks that associated with fragile data infrastructures along with outlining adoptable steps and strategies to ensure security for a sustainable tourism and economy.

1.2 Research Questions

The central research questions for this study are:

a) What are the reasons behind fragile data management system?
b) How do data management failure impact the tourism sustainability and economy? and
c) What can be done to mitigate the risks of data management failure for a secure sustainable tourism & economy?

2. RELATED WORK

In the digital age, efficient data management systems are crucial for maintaining the sustainability of the tourism sector. Digital data flows include sensitive information about travellers, financial transactions, and operational logistics. According to the [5], data management in tourism encompasses the collection, storage, processing, and analysis of data to optimize operations and enhance customer experience [6] One of the most pressing concerns for sustainable tourism is the vulnerability of data management systems to cyberattacks. Cybersecurity threats, such as phishing, ransomware, malware, and denial-of-service attacks,

have been on the rise globally. A report by [7] notes that cyberattacks in the tourism industry can lead to significant economic disruptions, causing data breaches, system outages, and compromised customer trust.

Inadequate security infrastructure and outdated data management systems make businesses more susceptible to these risks. Small and medium-sized enterprises (SMEs) in the tourism sector are particularly vulnerable because they may lack the resources or expertise to implement robust security measures. According to the World Economic Forum, 58% of cyberattacks target SMEs due to their weaker security controls [8].

Economic sustainability in tourism is increasingly threatened by data breaches, which lead to both direct and indirect costs for businesses. Direct costs include regulatory fines, legal fees, and compensation for affected customers, while indirect costs involve loss of customer loyalty, diminished brand reputation, and decreased sales. For instance, a breach in a hotel's management system could disrupt reservations, payment processing, and traveller information, leading to a broader economic impact across the industry [9].

Several studies highlight the weaknesses in data management systems, including lack of encryption, outdated software, and insufficient access controls. These vulnerabilities expose businesses to risks such as data breaches, where customer information can be leaked or stolen, causing severe reputational damage and financial losses. According [10], data breaches in the tourism sector cost the global economy approximately $21 billion annually.

A single data breach can severely affect tourism businesses, leading to direct financial losses, regulatory fines, and long-term reputational damage. For example, the Marriott International data breach in 2018 compromised over 500 million customer records and resulted in a fine of £18.4 million by the UK Information Commissioner's Office. Such breaches erode consumer trust, leading to decreased bookings and reduced economic activity within the sector [11].

According [12] article on Consumer trust in tourism and hospitality: A review of the literature, Customer trust and the sustainability of tourism are strongly related. Sustaining trust is critical for expansion in a sector that uses personal data for customer experience optimisation and marketing. Failures in data security undermine this confidence and may cause a general aversion among customers to transact digitally with impacted businesses. Since tourism is essential to the stability of many local economies, this in turn has a knock-on effect on other local economies.

3. METHODOLOGY

This paper is mainly illustrated with the theoretical approaches specially the notion of consideration of both qualitative and quantitative approaches. Transformation and compressive data management and vulnerability employs reliance's sustainable growth consideration of Mixed Method. The explanatory design of vital proportional key components relied on productive data integration and optimization with multiple data sets. Purposefully for explaining longitudinal study this MMR research method suits to analyse real-time phenomenon and problem to solution [13]. The contributions set of Primary data is gathered through interviews with industry experts and stakeholders and Secondary data is analysed from annual reports, case studies of significant data breaches in tourism, and reports from organizations like the EU, UNWTO, and WTTC. This approach addresses both human and technical aspects of fragile data management systems in relation to economic stability in tourism. Visual aids, such as graphs and tables, are used to enhance understanding of how these vulnerabilities pose a security threat to sustainable tourism and contribute to economic decline [14].

4. RESULTS AND DISCUSSION

4.1 The Role of Data Management System in Sustainable Tourism

In sustainable tourism, Data is backbone as in modern tourism operations. A robust Data Management System (DMS) is vital for sustainable tourism, facilitating the collection, storage, analysis, and dissemination of data to enhance decision-making, policy formulation, and sustainability initiatives.

Key Data Management System Contributes to Sustainable Tourism

Efficient Data Collection and Integration

Centralized Data Storage: A DMS consolidates data from various sources, such as tourism operators, local businesses, environmental sensors, and government agencies. This centralized system allows stakeholders to access and use data for sustainability initiatives.

Real-Time Data Monitoring: Advanced DMS platforms enable real-time tracking of tourism metrics such as visitor numbers, resource usage (water, energy), and environmental impact (carbon emissions, waste generation). This continuous flow of data is crucial for making informed decisions in time-sensitive situations, such as responding to overtourism or environmental degradation [15].

Data-Driven Decision-Making

Tourism Flow and Impact Analysis: By integrating data on visitor behavior, spending patterns, and environmental impact, a DMS helps authorities and tourism operators manage the flow of tourists. For example, if a tourist site exceeds its environmental capacity, measures like visitor quotas or seasonal adjustments can be implemented.

Predictive Analytics: Modern DMS uses predictive analytics to forecast tourism trends, allowing stakeholders to plan for resource allocation, environmental protection, and the mitigation of negative social impacts. It also helps in preparing for climate change-related risks.

Sustainability Benchmarking and Performance Tracking

Monitoring Sustainability Goals: A DMS tracks progress toward sustainability goals by regularly measuring key performance indicators (KPIs) such as energy efficiency, water conservation, waste reduction, and the economic benefits to local communities. These metrics ensure that tourism activities align with sustainability standards.

Certification and Compliance: Data management systems support tourism businesses in obtaining sustainability certifications, such as those from the Global Sustainable Tourism Council (GSTC). By regularly inputting and reviewing sustainability data, businesses can demonstrate compliance and adjust practices accordingly.

Resource Optimization

Efficient Use of Resources: Data from a well-managed DMS allows tourism destinations to optimize the use of natural resources like water and energy. This ensures that tourist activities do not exceed the carrying capacity of the environment, thus preserving ecosystems while sustaining tourism growth.

Smart Tourism: DMS tools, integrated with Internet of Things (IoT) sensors and other smart technologies, help track resource use in real-time. For instance, hotels and resorts can reduce energy consumption by automatically adjusting lighting or air conditioning based on occupancy data [16].

Visitor Experience and Local Community Benefits

Personalized and Sustainable Offerings: Data management systems enhance the visitor experience by offering personalized recommendations for eco-friendly activities, sustainable accommodations, and locally sourced products. This helps visitors make responsible choices, supporting local economies and reducing the environmental impact of tourism.

Community Engagement: A well-designed DMS allows local communities to contribute data and insights into the tourism experience. This ensures that tourism benefits are distributed equitably and that community needs and priorities are met in sustainable tourism planning.

Data Sharing and Collaboration

Collaboration between Stakeholders: DMS platforms allow for seamless sharing of data among tourism businesses, government bodies, NGOs, and researchers. This ensures that everyone involved in the tourism ecosystem has access to the information needed for making evidence-based decisions that prioritize sustainability.

Open Data Initiatives: Data sharing across borders and regions, facilitated by DMS, can provide global insights into sustainable tourism trends. Open data initiatives can also promote transparency and accountability in the tourism industry.

4.2. Sustainable Tourism Impact on Economy

Sustainable tourism is crucial for economic growth, particularly in developing nations, generating billions through activities like ecotourism and cultural tourism. By balancing economic growth with environmental and cultural preservation, sustainable tourism contributes and ensure long-term sustainability.

Key Economic Impacts of Sustainable Tourism

Job Creation and Income Generation: Sustainable tourism contributes to employment generation, particularly in rural and underserved areas. By promoting eco-friendly tourism practices, local communities often benefit from direct employment (tour guides, hospitality workers) and indirect opportunities (local crafts, food production).

Costa Rica has embraced sustainable tourism, where 8.2% of the GDP is generated from tourism, with a focus on eco-friendly practices. This has resulted in job creation, particularly in rural areas, while protecting its biodiversity.

Infrastructure Development: Investment in sustainable tourism often leads to the development of infrastructure, including transport, communication, and public services. These improvements not only benefit tourists but also improve local standards of living.

Bhutan's high-value, low-impact tourism model ensures that infrastructure development is aligned with sustainability goals, while enhancing visitor experiences and local benefits.

Revenue Generation and Foreign Exchange: Sustainable tourism encourages longer stays and higher spending by tourists who value authentic, eco-friendly experiences. This contributes to national income, foreign exchange earnings, and reduces economic leakages, as profits are often reinvested into the local economy.

In the Maldives, eco-tourism initiatives such as marine conservation and sustainable resorts are major contributors to the national economy, accounting for a significant portion of the country's GDP.

Cultural and Heritage Preservation: Tourism that focuses on sustainability helps preserve cultural and heritage sites by providing funds for conservation and raising awareness about their importance.

In Peru, sustainable tourism around Machu Picchu has led to efforts to protect the site from the impact of mass tourism, balancing preservation with the local economy's dependency on tourism.

Long-Term Economic Resilience: Sustainable tourism practices foster resilience by ensuring that tourism does not degrade the very resources it relies on.

New Zealand's focus on eco-tourism in its national parks contributes to long-term sustainability, ensuring that both natural ecosystems and tourism revenues remain viable.

4.3 Default Data Management Systems in Tourism and Economic Fallout

Default Data Management Systems in tourism businesses can lead to the direct theft of funds, the loss of customer confidence, and even the disruption of national economies in countries heavily dependent on tourism.

Table 1. Economic Fallout Due To Inefficient Data Management in Tourism

Economic Impact Area	Cause of Inefficiency	Estimated Loss (%)	Monetary Impact ($M)
Over-tourism	Poor visitor tracking systems	20-30%	$500 million annually
Resource Mismanagement	Inaccurate energy and water monitoring	15-20%	$200 million annually
Lost Revenue from Poor Experience	Lack of personalization, data silos	10-15%	$150 million
Compliance Costs	Failure to meet sustainability criteria	5-10%	$50 million
Missed Collaboration Opportunities	Fragmented data systems	5-7%	$100 million

The above Table 1 highlights economic losses attributed to inefficient data management systems, leading to over-tourism, resource mismanagement, and lost revenue. In 2018, a data breach at British Airways exposed the financial and personal details of nearly 500,000 customers, resulting in a £20 million fine, reputational damage, and significant revenue losses. The breach led to a decline in consumer trust and negatively impacted the company's earnings in subsequent quarters. In countries where tourism is a significant part of the GDP, such breaches can reduce tourist arrivals and investor confidence, potentially harming the national economy.

As Figure 1 illustrating the relationship between Global Tourism Revenue in USD and worldwide Data Breaches Incidents from 2010 to 2023. The red line represents the increasing number of data breaches over time, highlighting the growing cybersecurity threats in the tourism sector. The blue dashed line shows due to data breaches increase the ratio of global tourism revenue fluctuation and eventually decline rate. This graph demonstrates how rising fragile data management system can threats negatively and make downturn curves in the world economic sustainability of the tourism industry. The Marriott data breach is a landmark case of data security failure in the tourism industry. Hackers accessed sensitive customer information, including credit card details, passport numbers, and travel data, due to weak data management systems. The breach resulted in regulatory penalties, loss of customer trust, reduced bookings, and a drop in stock prices. It highlights the critical need for stronger data protection measures across the tourism sector [17].

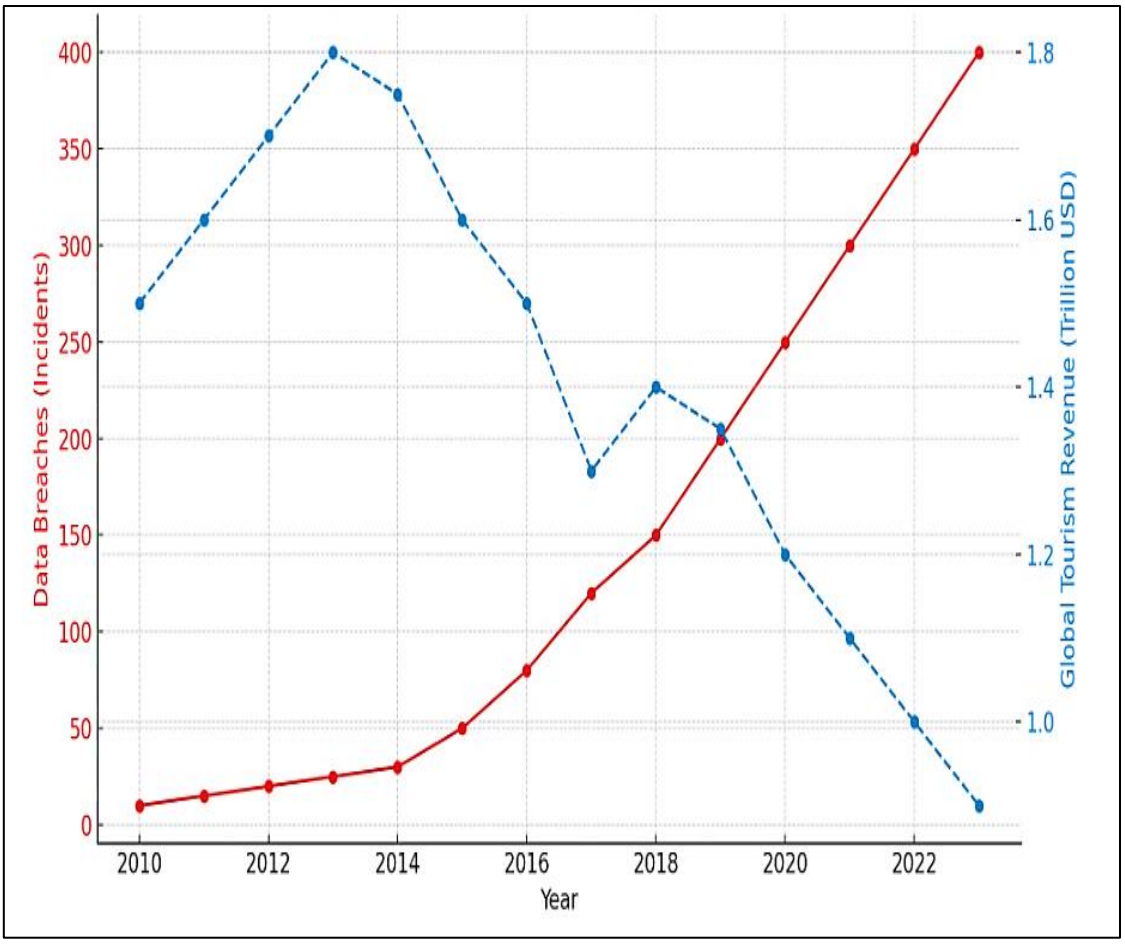


Figure 1. Tourism Revenue vs. Data Breach Incident (2010-2023)

4.4 Reasons behind Fragile Data Management Systems in Tourism

Tourism businesses handle sensitive information, including customer personal data, payment details, and business intelligence. The nature of the tourism industry-global, dynamic, and often decentralized makes it particularly susceptible to cyber-attacks and data breaches.

Lack of Cybersecurity Awareness

Many small to medium-sized tourism businesses often overlook data security due to limited resources or expertise. They rely on outdated software and lack essential protections. A data breach can result in financial losses, legal issues, and reputational damage, which may even force them out of business.

Weak Infrastructure and Vulnerabilities

Many tourism organizations use outdated and underfunded data management systems, making them vulnerable to cyberattacks. A Deloitte study found that nearly 75% of global hospitality and tourism companies face data breach risks. These fragile systems are often unsupported or lack regular updates, exposing them to evolving cyber threats.

Some Common Threats in Tourism Data Systems

Cyberattacks and Ransomware: In these attacks, the goal is to block the company's access to its own data rather than steal it. The ransomware targets critical data, corrupts backups, creates system vulnerabilities for future attacks, and encrypts the data.

Insider Threats: In tourism organizations, employees may unintentionally or maliciously expose sensitive data due to inadequate training or weak security protocols. Insider threats, often caused by human error, negligence, or fraud, have become a major challenge in data management. These threats can lead to system shutdowns, financial losses, and data breaches.

Data Loss and Downtime: Poor data backup strategies can result in system failures or accidental deletions, causing irreversible data loss. In the tourism sector, these disruptions can severely impact customer service, revenue, and reputation, creating a domino effect on overall operations.

Botnet / DDoS Attacks: Botnet attacks utilize networks of compromised devices, such as computers, smartphones, or smart devices, infected with malware to execute malicious activities. These devices, controlled by attackers, provide the processing power to carry out mass spam attacks, malicious login attempts, or disrupt entire networks.

Wi-Fi Network / Website Compromise: Major hotel and airline websites often disclose sensitive guest booking information such as names, addresses, mobile numbers, passport numbers, and partial credit card details to data aggregators and social media platforms during the booking process or after the customer logs into their reservation page [18].

Attacks on Third-party Service Providers: Threat actors also target digital partners and external service providers of organizations. According to the 2018, IBM X-Force Threat Intelligence Index, Attackers view these individuals' employees, managers, and third-party providers as "weaker links" in the network, making them prime targets for accessing valuable organizational data [19].

Table 2. Comparison of Default Data Management Systems in Tourism

System Type	Features	Advantages	Limitations
Spreadsheet Systems	Manual entry, static analysis	Inexpensive, easy setup	Prone to errors, hard to scale
Cloud-Based Systems	Real-time data storage and access	Scalable, accessible, collaborative	Requires internet, potential data leaks
CRM Systems	Customer data tracking, automation	Customizable, detailed reporting	High cost, complex implementation
IoT-Integrated Systems	Sensors for real-time data collection	Resource-efficient, automation	Expensive, technical knowledge required
Sustainability-Specific DMS	Tracks sustainability metrics	Focused on eco-friendly operations	Requires integration with other systems

This Table 2 illustrates the different types of DMS used in tourism, their key features, benefits, and limitations.

4.5 Impact of Fragile Data Management System on Sustainable Tourism

Fragile data management systems can lead to immediate economic disruptions and long-term setbacks in the tourism sector by eroding trust. Moreover, governments and tourism boards may need to redirect resources to address the fallout, diverting funds from sustainable development and conservation initiatives.

Financial Losses and Economic Impact

Data breaches and system failures can result in significant financial losses even bankruptcy for tourism businesses specially for SMEs. The Ponemon Institute reports stated that the average cost of a data breach in 2023 was approximately $4.45 million. These costs encompass business disruption, lost revenue, reputational damage, and fines associated with regulatory non-compliance.

Security Risks in Personal and Organizational Level

Weak data management systems pose a major threat to the tourism industry, making it a prime target for cyberattacks due to its extensive personal and financial data. A single data breach can lead to substantial financial losses, exemplified by the 2018 Marriott International breach, which compromised over 500 million customer records.

Operational Disruptions and Loss of Productivity

System downtime due to data breaches or cyberattacks can severely affect a company's productivity and lead to operational failures. For example- disruptions in booking systems, payment gateways, or customer service can result in lost sales, service delays, and dissatisfied customers, undermining sustainable operations. In tourism-dependent regions, these disruptions can have devastating economic effects, resulting in job losses and reduced income.

Erosion of Consumer Trust and Reputational Damage

Trust is cornerstone in the tourism industry, underpinning sustainable tourism. Travelers rely on tourism operators with their personal and financial information, and a single data breach can significantly harm an organization's reputation. This loss of trust can result in long-term brand damage, particularly in an industry reliant on word-of-mouth and online reviews. Additionally, businesses that fail to safeguard consumer data may face legal consequences [20].

Environmental Impact of Data Breaches

Although the link between cybersecurity and environmental sustainability may not be obvious, data breaches can negatively impact sustainability efforts in the tourism industry. For example, a decline in tourism revenue due to a data breach may force destinations to reallocate resources from conservation programs or sustainable infrastructure projects.

4.6 The Importance of Secure Data Management System for Sustainable Tourism

For tourism to remain sustainable, the sector must implement strong data security practices. Sustainable tourism encompasses not just environmental and cultural preservation, but also the industry's resilience to economic challenges. Effective data management enhances decision-making, customer experience, and operational efficiency, driving economic growth. However, inadequate security of these systems can expose the industry to risks in personal and organizational even in verge a country’s economic level. Governments play a crucial role in protecting the tourism sector from risks associated with weak data management systems. Regulations like the General Data Protection Regulation (GDPR) in the EU establish high data protection standards. However, many tourism-dependent regions, especially in the developing world, lack comprehensive regulatory frameworks, leaving them more vulnerable to threats.

According to 2023 International Travel Security Conference, Effective data management systems are crucial for protecting sensitive information in the tourism industry, particularly due to prevalent threats like phishing and ransomware. Phishing attacks make up about 45% of data security incidents in this sector, underscoring the need for advanced security measures. Implementing sophisticated data management systems with threat detection and prevention technologies can significantly reduce vulnerabilities to cyberattacks, safeguarding customer data and ensuring operational integrity. As per [21], the financial

impact of data breaches in the tourism sector differs significantly, with airlines averaging losses of $12 million per breach and hotels about $7 million. These figures highlight the costly consequences of insufficient data security. Investing in secure data management systems can help mitigate these risks, making it essential for tourism businesses to consider the cost of such systems against potential breach losses. Effective data management not only reduces financial risks but also bolsters overall financial stability for these businesses.

4.7 Recommendations

To mitigate the economic threats posed by fragile data systems, the tourism industry must prioritize data security. Below are several recommendations for strengthening data management systems:

Sustainable Data Management Practices

Implementing sustainable data management practices goes beyond upgrading technology; it necessitates a comprehensive approach that includes data governance, staff training, and collaboration among industry stakeholders and governments. Adopting internationally recognized cybersecurity standards, like ISO/IEC 27001, can offer a structured framework for ensuring secure data management.

Investment in Advanced Infrastructure

Tourism businesses must invest in modern data management infrastructure that can handle large volumes of information securely and efficiently. This includes cloud-based systems, encryption technologies, and regular software updates to protect against emerging threats.

Data Management Training and Awareness Programs for Employees

Data breaches often result from human error, making ongoing data management training for employees essential. By educating staff about the latest threats and best practices for data protection, tourism businesses can significantly reduce vulnerabilities and minimize the likelihood of breaches due to negligence.

Collaboration and Information Sharing

Industry-wide collaboration and information sharing are essential for mitigating risks. Tourism businesses should work together to share intelligence on emerging threats and vulnerabilities, fostering a more resilient industry as a whole.

Government Lead Initiatives

With stricter regulations governments should lead, implement and enforce standardizing data management protocols and law especially focusing on cybersecurity for the tourism industry. This could include mandatory encryption standards for online transactions and fines for businesses that fail to adequately protect customer data.

Investment in Data Management System as a Sustainability Strategy

Securing fragile data management systems is essential for long-term sustainability in tourism. Strategies like the Marriott/Starwood 2018 Data Breach Communication Strategy can serve as effective models for enhancing sustainability and strengthening data management systems in the industry.

Table 3. Marriott/Starwood 2018 Data Breach Communication Strategy

Public Reporting	A news release and notification banners on Marriott's websites, as well as the Marriott and Starwood Preferred Guest apps, were used to inform the public of the event.

E-mail Notifications	E-mail notifications on a rolling basis to guest who had valid email addresses in the databases.
Dedicated Website Service	Dedicated website to provide information and updates about for any quarry in different language where information about how potentially affected guest can monitor and have access to protect their data and details on web monitoring service.
Dedicated Call centres	Dedicated call centres have to operate 24/7, to answer guest's question also have to be able to answer in multiple language.
Personal Data Monitoring Service	Effective personal data monitoring services are essential for visitors potentially impacted by data breaches. Two free options are available: 1. Web Watcher for US, UK, and Canadian guests, which provides fraud loss reimbursement and unlimited fraud consultation for at least one year. 2. Experian, available for other countries, offers identity monitoring through its Global Internet Surveillance Product.
Claim Processing	A process for guest to submit individual claims of fraud related to any incident.

Adopt Technological Solutions: A Path Forward

Emerging technologies like blockchain, artificial intelligence (AI), and encryption tools can significantly enhance security in tourism data systems. Blockchain enables secure, decentralized data storage, lowering the risk of centralized cyberattacks. AI-driven cybersecurity tools can proactively identify and mitigate threats, ensuring more secure and sustainable operations in the tourism industry.

Public-Private Collaborative Security Networks

Collaboration between Tourism companies, governments, and technology providers to share threat intelligence and develop industry-wide could be a best practices for data security, which may include subsidized cybersecurity tools for smaller tourism business.

Regular Security Audits

Regular auditing of data management systems can help identify vulnerabilities before they are exploited. Independent cybersecurity audits should be part of an organization's strategy to ensure ongoing compliance with the latest security standards.

5. CONCLUSION

Sustainable tourism is a powerful driver for economic development, particularly in developing countries, relying not only on environmental conservation but also on robust data management systems. However, Fragile data management systems pose major security threat to the sustainability of the global tourism industry as the sector becomes increasingly reliant on digital technologies, with risks data breaches and cyber-attacks threatening consumer confidence, financial stability and economic growth. Without adequate investment in infrastructure, staff training, and regulatory oversight, the industry will remain vulnerable to economic downturns precipitated by cyberattacks and operational failures. To ensure long-term sustainability, the tourism sector must prioritize government policies, private investment, cross-sector collaboration, robust data security practices, have to prioritize data security of tourism industry as an integral part of broader sustainability strategy. As securing data management systems is not just a technical necessity; it is a strategic imperative for the future of sustainable tourism, restoring and strengthening the economy.

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Conflict of Interest Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Maliha Meharin Busra	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

The study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki and approved by the relevant institutional authorities.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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