

A Foresight Study of Internet of Things (IOT) on Tourism Industry in Malaysia

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Abstract

The Internet of Things (IoT) has transformed the hotel and tourism industries by integrating physical and virtual worlds through electronic devices. This evolution presents opportunities for new services, enhanced efficiency, and improved user experiences. Some organizations have already incorporated IoT into their operations, aiming to optimize client experiences. However, there are limited amount of information available about what is affecting the fast-growing of Internet of Things (IoT) in tourism industry. Therefore, this study will be conducted as a reference to know more details about factors related to Internet of Things (IoT) in tourism industry in Malaysia. The objective of conducting this study is to identify the challenges, trends, and issues and to determine the key drivers on implementing internet of things (IoT) on tourism industry in Malaysia. This study also aims to explore the future image of the implementation of internet of things (IoT) on tourism industry in Malaysia. Researcher has decided to conduct the survey at Petaling Jaya, Selangor. The target population of respondent for this study is employees of Malaysia's Ministry of Tourism, Arts, and Culture, Petaling Jaya (MOTAC). The study employed quantitative research approach to conduct the survey. A questionnaire was established and distributed to targeted employees. The data will be analysed by using Statistical Package for Social Science (SPSS). The results of this study are expected to provide valuable insights privacy concern and cybersecurity threats in the tourism sector.

1. Introduction

The Internet of Things (IoT) is a revolutionary information technology that has opened up new opportunities in the hotel and tourism industries (Raj *et al.*, 2023). The evolution of IoT from a simple network hub to a technological and development flow allows for the integration of the physical and virtual worlds with various electronic devices in a variety of public situations, hence bringing up new prospects for new services. The integration of smart devices and systems has resulted in lower prices, more power, and improved usability. Some travel and hospitality organisations have already implemented IoT into their backend operations and are investigating methods to improve client experience. As a result, IoT adoption poses both obstacles and opportunity for changing current organisational procedures (Singh *et al.*, 2023). IoT technologies may promote the progress of unique, innovative research in addition to educational gadgets, documentaries, data analysis, tourist services, and so (Dānishgāh-i Işfahān *et al.*, 2019). According to the 2020 SITA Air Transport Insights

Report, 97 percent of airlines intend to spend in applications for customer mobile services, and 86 percent want to spend in in-house digital and remote IT services. Technologies such as the Internet of Things (IoT) are growing in the tourist sector and have the potential to affect the whole business (IT INSIGHTS 2020 Enter, 2021).

Selangor's tourism industry is very competitive due to its popularity as a tourist destination. Businesses are continuously seeking innovative methods to enhance services and entice a larger number of customers. Implementing IoT technology in the tourism business has the potential to offer a distinct competitive edge by This technology is gradually creating a new world that is characterised by being cost-efficient, environmentally friendly, and focused on the needs of the client.(Car *et al.*, 2019) Numerous firms are allocating resources towards implementing Internet of Things (IoT) solutions, and this trend appears to be on the rise.

1.1 Problem Statement

The tourism sector in Selangor, Malaysia, is facing substantial obstacles as a result of the swift progress in technology, including the widespread use of Internet of Things (IoT). According to The Stars news, Selangor had the highest number of tourists among all states in Malaysia last year, with over 22 million arrivals. This statistic represents a 33.4% rise compared to the previous year (Selangor Tops 2022 Domestic Tourism Numbers with 22 Million Visitors _ The Star, 2023) The increase in Selangor's tourism sector underscores the importance of innovation in order to meet the changing needs and expectations of tourists.

The utilisation of Internet of Things (IoT) technologies confers numerous advantages to companies, with certain benefits being tailored to certain industries while others provide general benefits. The tourism industry has significantly benefited from the integration of IoT systems, which has led to a wide array of applications. Intelligent trains equipped with artificial intelligence systems have been introduced in several industrialised countries, offering a range of services. The services encompassed in this scope are furnishing passenger information, executing autonomous train control through AI systems or WiFi networks, facilitating predictive maintenance, overseeing traffic signalling and monitoring, and augmenting consumption efficiency(Dinu *et al.*, 2021a). Nevertheless, it is imperative to recognise the potential drawbacks linked to IoT devices in addition to their benefits. As the amount of data kept in a system increases, the probability of hackers attempting to get unauthorised access to sensitive information likewise rises. The main disadvantages generally pertain to the potential hazards associated with data, including concerns over security, safeguarding, reliability, precise analysis, and compatibility. Furthermore, there are concerns regarding secrecy, which include the lack of established standards, protocols, interoperability, and legal considerations.(Dinu *et al.*, 2021a) It is crucial to tackle these problems in order to guarantee the effective and safe deployment of IoT devices in different businesses.

The tourism sector in Selangor plays a crucial role in the regional economy, attracting a wide range of visitors with its unique attractions. The sector in Selangor is becoming more aware of the potential of IoT technologies to transform operations and enhance the tourist experience, given its reputation for distinctive services. However, in the particular context of Selangor, there is a distinct lack of extensive study that specifically examines the incorporation of Internet of Things (IoT) technology in the tourism industry. The integration of IoT technology into the local tourism business faces multiple hurdles across socio-cultural, ethical, and economic aspects. It is crucial to thoroughly examine the effects on the workforce, ethical problems regarding human-IoT interactions, and the resolution of issues around data security and equitable access to IoT technology in order to effectively implement these advancements in Selangor's constantly changing tourism industry.

Nevertheless, despite these hurdles, the use of IoT offers significant advantages to the tourism sector in Selangor.The current adoption of IoT systems in tourist attractions enables the monitoring of attractions within museums and the analysis of visitor reactions through data and sensors. Travel booking websites are equipped with sophisticated algorithms that enable the customisation of consumer preferences. Personalised offers are sent based on the user's IP address and other related equipment. The data processing algorithms track the online searches related to tourism and take into account the profile of past bookings to analyse the potential client's preferences.

This study will use a foresight technique to fill this research gap. Foresight is usually built on systematic, often interactive, inter- or transdisciplinary futures intelligence gathering and analysis by multiple actors involved in the challenges. It provides knowledge for uncertain, complex, and confusing long-term prospects.(Weber & Giesecke, 2020) This study provides insights and recommendations for Malaysia's tourist industry, governments, and stakeholders. A forward-looking study on IoT's integration in Selangor's tourism sector aims to master IoT technologies for sustained growth and competitive advantage.

Therefore, to achieve the research objectives the challenges, trends, and issues on implementing internet of things (IoT) on tourism industry is determined. Furthermore, the key drivers of the implementation of internet of things (IoT) on tourism industry also determined. Consequently, the future image of the implementation of internet of things (IoT) on tourism industry is identified.

1.2 Scope of Study

The objective of the thesis titled "A Foresight Study of Internet of Things (IoT) on Tourism industry in Malaysia" is to examine the potential impact and future prospects of IoT implementation in the Malaysian tourism industry. The research will evaluate a horizon of ten years, from the current year to ten years in the future. In order to acquire information about IoT and its applications in the tourism industry, a comprehensive literature review will be conducted using a variety of sources, including academic journals, conference proceedings, government publications, non-governmental organisations, and online research materials. This study's primary data will be collected through surveys and interviews with developers and consumers of IoT technologies in the context of tourism in Malaysia. Included among the selected respondents will be developers, technology providers, tourism operators, government agencies, and industry experts. To collect data for analysis, questionnaires will be distributed. The research will investigate the potential applications of IoT in promoting tourism industry, including resource management, energy efficiency, waste reduction, visitor experience, and destination management. The findings of the research will be analysed employing appropriate statistical and qualitative analysis techniques. On the basis of the analysis, strategic recommendations will be provided to policymakers, industry practitioners, and interested parties to guide the integration of IoT for sustainable tourism development in Malaysia.

1.3 Significant of Study

Multiple stakeholders such as government and private sector for tourism deem an Internet of Things (IoT) study on the industry of tourism in Malaysia to be of crucial importance. This study is essential to the tourism industry because it examines how IoT can improve industry practises and provides policymakers, industry professionals, and destination administrators with valuable insights. It guides them in the development of strategies that maximise resource utilisation, minimise environmental impact, and improve the visitor experience. In addition, the study benefits travellers by demonstrating how IoT-enabled services can enhance various aspects of their travel, empowering them to make informed decisions and contributing to sustainable tourism. In addition, it has far-reaching implications for environmental industry, paving the way for innovative solutions that minimise energy consumption, optimise waste management, and reduce tourism's ecological legacy. This research encourages the adoption of IoT technologies by stakeholders by facilitating discussions and collaborations, resulting in a more environmentally friendly and economically viable tourism sector in Malaysia.

2. Research Methodology

In this research, qualitative and quantitative methods were used to analyse and interpret the data. In this study, a quantitative technique dubbed STEEPV was used to analyse the future. STEEPV, which stands for Social, Technological, Environmental, Economic, Political, and Values, is a tool used globally to help people generate ideas and plan for the technological future. This methodology has been widely employed in future investigations across the globe. This chapter begins by discussing the research plan, which provides a summary of how the study was conducted. In the following sections, we will discuss the process of foresight, including how to select the population and collect samples. In addition, the analysis of the process, the instruments used, and the data collection methods are described. To ensure the accuracy of the collected data, a pilot test and additional research were conducted. This study aims to determine how the Internet of Things impacts the industry of Malaysia's tourism industry. It accomplishes this using both qualitative and quantitative methods as well as the STEEPV method. In the following sections, we will discuss in greater depth how to acquire data, how to analyse it, and what we discovered using this method.

2.1 Research Design

The research design's goal is to offer a proper framework for a study. The research approach chosen is an important decision in the research design process since it determines how relevant data for a study will be acquired; as a result, the research design phase comprises numerous integrated choices (Jilcha Sileyew, 2020). Descriptive research using a quantitative approach is the research design employed in this study. Research that provides a qualitative or quantitative portrait of a situation, activity, or group is referred to as descriptive research. The quantitative methodology was chosen for this study because it is quick and flexible enough to be utilised in a variety of contexts and locations to gather the sample required to represent the population. To achieve the goal of this study, data were gathered via a questionnaire survey.

This study necessitated a greater number of respondents and investigates information regarding future opportunities to meet requirements as well as a future opportunity. To interpret the data, a mixed method incorporating qualitative and quantitative data was adopted. Future trends, uncertainties, and challenges of a foresight study of internet of things (IoT) on tourism industry in malaysia will be analysed through the foresight process using a mixed-based method. This foresight process emphasises evidence-based future thinking by

employing a mixed-method approach to examine a foresight of internet of things (IoT) on tourism industry in Malaysia.

2.2 Research Flow Chart

Fig. 1 represents the process flow for conducting a study, beginning with the identification of the problem statement. This flowchart assists the researcher in conducting this study and gaining a deeper comprehension via the flowchart's summary.

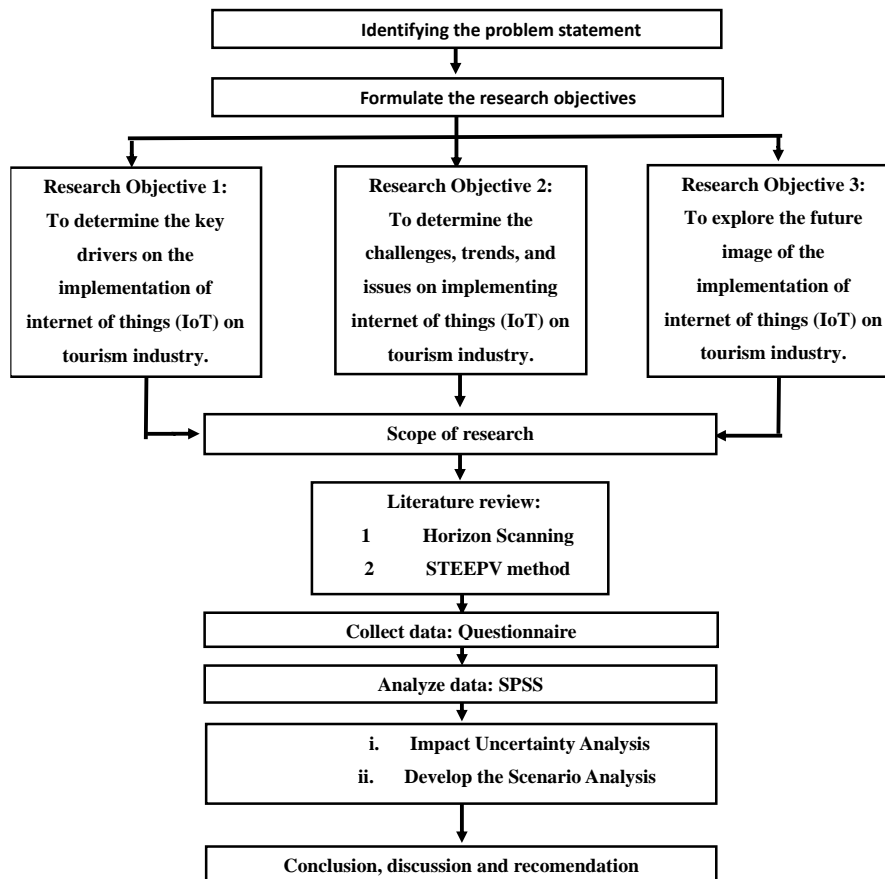


Fig. 1 Research Flow Chart

2.3 Foresight Process

The primary purpose of Foresight and Horizon Scanning (HS) activities is to better anticipate future opportunities or hazards, as well as to identify issues in the present that are crucial for potential futures. Both activities create contestable spaces, sparking discussions about alternative futures to assist organisations in understanding what is most pertinent to their aspirations and concerns (Cuhls, 2020). The foresight process consists of a few stages, beginning with horizon scanning, data analysis using the STEEPV method, and identifying the drivers that alter the impact of internet of things (IoT) on Malaysia's tourism industry.

Horizon scanning is utilised in future studies and predictions. The process entails identifying dangers, opportunities, changes, and other possibilities. Horizon scanning aims to identify these events and arrange for their occurrence. Horizon scanning helps create better futures and outcomes. Horizon scanning isn't about predicting the future or threats. Instead, the practice identifies hazards to a company or project and develops mitigation strategies.

STEPPV study assesses risks and provides a baseline for decision-making by revealing the firm's ecological impacts (Grima *et al.*, 2020). This study found Social, Technological, Economic, Environmental, Political, and Values trends, issues, and problems. STEPPV analysis can foretell the future. STEPPV helps researchers examine, uncover, and organise all the IoT's long-term implications on tourism. This study employed qualitative data methodologies including STEPPV analysis to identify the Internet of Things (IoT)'s drivers, difficulties, challenges, trends, and future images on tourism.

2.4 Data Collection

Data collection is the systematic acquisition and analysis of exact data from many sources to address research challenges and evaluate findings. It sheds light on concepts, patterns, and probabilities. Academic, government, and commercial research need systematic observation and measurement to get personal information and unique ideas (Simplilearn, 2023; Bhandari, 2023).

This study used journals, articles, newspapers, books, websites, and online/offline databases for secondary data. This technique was chosen to gather and evaluate data on the Internet of Things (IoT) and its impact on the tourism sector to identify problems and growth drivers. Secondary data, generally collected from primary data sources, are preferred as extra resources since they give exact information from past studies.

2.5 Population and Sampling

The target population for this study will be the staff of Malaysia's Department of Tourism. The Ministry of Tourism, Arts, and Culture of Malaysia, Petaling Jaya (MOTAC), which is responsible for managing tourism in Malaysia, employs 469 people at all managerial levels. The official websites were consulted for the data. In this study, the Krejcie and Morgan table will be used to estimate the size of the sample. The number of participants in this study is 210, according to Krejcie & Morgan (1970).

2.6 Research Instrument

The questionnaire that will be distributed to the Department of Tourism employees in Malaysia. Four sections will make up the Ministry of Tourism, Arts, and Culture of Malaysia, Petaling Jaya (MOTAC): Section A, Section B, Section C, and Section D.

Table 1 Section in questionnaire

Section	Content
Section A	Respondents' demographic
Section B	3 The important drivers in influencing the Internet of Things (IoT) sustainability in tourism in Malaysia
Section C	The impact to your decision to Internet of Things (IoT) sustainability in tourism in Malaysia
Section D	The drivers cause uncertainty in your decision to Internet of Things (IoT) sustainability in tourism in Malaysia

2.7 Data Analysis

Descriptive analysis uses score distribution to infer data and explain the trend. This research analysed gender, age, years of experience in the tourism industry, involvement in the ministry of tourism and art and culture Malaysia, familiarity with IoT in tourism, whether they have implemented IoT-related initiatives in the Malaysian tourism industry, and whether they are responsible for making decisions about IoT technology adoption in the tourism sector. To make data analysis easy to grasp, bar charts and pie charts will be used. The analysis will return findings in the form of frequency and percentage, as well as mean and standard deviation, when run through SPSS. Scenario development began after impact-uncertainty analysis, based on data analysis mean values. The impact-uncertainty analysis was focused on reducing variables by significance, impact, and uncertainty. For scenario analysis, the two variables with the greatest influence and uncertainty were chosen.

Lastly, based on the top two factors found in the impact uncertainty analysis, the study on the Internet of Things' (IoT) influence on tourist business presented four potential scenarios. These scenarios show IoT-related results and trends, beneficial or negative. Empirical data analysis from 2023 to 2033 will inform the research's conclusion and suggestions. Strategic management systems will be created to resolve and reduce bad consequences and maximise good results. Strategic planning guidelines will ensure IoT's long-term survival in the tourist industry regardless of the circumstance.

3. Literature Review

Research requires a literature study to assess existing understanding. It helps researchers understand basic ideas, methods, and research gaps. Chapter One: Definition and Review of Relevant Past Research, Including IoT Trends We will gather crucial material from books, diaries, and records. To build a good research theory, synthesise the main components from this chapter. A solid theory can help the researcher achieve Chapter 1's aims. We will also examine IoT's potential in tourism sustainability and its drivers using STEEPV analysis. A summary of previous IoT research will finish the chapter. Merging important keyword drivers yielded twenty-one drivers. This will be in data gathering questionnaires. Table 2 consolidates 21 drivers.

Table 2 Key terms

No.	Drivers
1.	Cybersecurity Threats
2.	Privacy Concerns
3.	Security Breach Risk
4.	System Error Management
5.	Sensor Failures
6.	Effective Data Retrieval
7.	Essential Power Supply
8.	Compliance Challenges
9.	Time-Saving Technology
10.	Human Element Consideration
11.	Influential Adoption Factors
12.	Job Displacement Risks
13.	Technical Skills Necessity
14.	User Understanding Quality
15.	Connectivity Issue
16.	Integrated System Design
17.	Application Absence Concerns
18.	Energy Efficiency Concerns
19.	Air Pollution Monitoring
20.	Cost Implications
21.	Global Crisis Impact

3.1 The STEEPV Analysis

Factors are particular elements or considerations that contribute to or influence the adoption and implementation of IoT. These elements can be viewed as catalysts or obstacles that influence the development and success of IoT initiatives.

Table 3 Key issues and drivers

	Issues, Challenges and Trends	Key Terms
	Safety of data will be affected by cyberattacks and vulnerabilities in security (Verma & Shukla, 2019)	Cybersecurity Threats
	Security and privacy concerns regarding personal data when utilising IoT systems (Dinu <i>et al.</i> , 2021).	Privacy Concerns
Social	A hacker attack on a smart home might lead to a catastrophic loss of security and safety for the homeowner. Hackers may cause data loss and data hacking, counterfeiting, denial of service, eavesdropping, buffer overloading, malicious alterations, password-based assaults, and other risks (Rangaiah, 2020).	Security Breach Risk
Technological	Due to the complexity of a commercial aircraft's processes and components, potential errors and their associated costs have been addressed by Airbus (Verma & Shukla, 2019)	System Error Management

	Actuators or sensors fail from the start or are harmed as a result of programmer obsolescence, abrupt disconnection, or short circuit (Rangaiah, 2020)	Sensor Failures
	Data management is one of the issues, since information Centric Networking (ICN) provides effective assistance in the retrieval of rich content as well as access to services. This looks to be as valuable as providing access, moving, and maintaining data.	Effective Data Retrieval
Environmental	Power supply is crucial for IoT devices, particularly in the logistics field (Rangaiah, 2020)	Essential Power Supply
Political	IoT installations frequently function inside strict regulatory frameworks, particularly when sensitive areas such as government or military applications are involved. Compliance with relevant legislation and standards becomes critical, and security measures must fit with regulatory requirements.	Compliance Challenges
Values	Consumer perception that IoT technology saves time and increases productivity (Dinu <i>et al</i> , 2021). Since IoT technology relies on humans as its primary interaction platform, it is important to consider the human element. The acceptance of new technology, such as IoT, by consumers is what constitutes its adoption.	Time-Saving Technology Human Element Consideration
	The impact of family, acquaintances, coworkers, and the media on the adoption of IoT products and services by consumers (Dinu <i>et al</i> , 2021).	Influential Adoption Factors
Social	It is anticipated that as IoT evolves, it will gradually replace humans in a variety of mundane and repetitive duties. This will result in job loss for the society that is presently performing these menial tasks.	Job Displacement Risks
	Installing, integrating, and managing an IoT network required functional and advanced technical skills. Technicians in machine learning and professionals in the field of algorithms are required to transform collected data into useful information (Kong, 2019)	Technical Skills Necessity
	The quality of consumer knowledge and comprehension regarding IoT technology (Dinu <i>et al</i> , 2021)	User Understanding Quality
	Due to the construction site's location in a suburban area with low internet penetration, data delivery may be delayed (Rangaiah, 2020)	Connectivity Issue
Technological	For the specific application, the IoT system's architecture will be integrated. Scalability, accessibility, and dependability in all environments are fundamental requirements for this design. It should enable straightforward, scalable, and cross-domain integration, as well as IoT automation (Sachin <i>et al</i> , 2019)	Integrated System Design
	Another problem is that the country doesn't have any enterprise IoT apps. The sensors used in businesses will last longer, maybe 3-5 years or even longer.	Application Absence Concerns
Environmental	The significant proportion of spent energy that is attributable to waste and unrestrained usage (Cakaputra Komsary <i>et al</i> , 2020)	Energy Efficiency Concerns
	The Internet of Things enables users to regulate numerous parameters to examine and measure the quality of the air inside their environment. To clarify, we are discussing air pollution.	Air pollution
Economic	The financial consequences of adopting and utilising IoT products and services, including both direct and indirect costs (Dinu <i>et al</i> , 2021)	Cost Implications
	The COVID-19 pandemic drastically reduced the year-over-year development of visitor arrivals (Travel and Tourism in Malaysia-Statistics & Facts, 2022)	Global Crisis Impact

Table 4 Table with key terms of issues and drivers

Social	Technological	Environmental	Economic	Political	Value
Cybersecurity Threats	System Error Management	Essential Power Supply	Cost Implications	Compliance Challenges	Time-Saving Technology
Privacy Concerns	Sensor Failures	Energy Efficiency Concerns	Global Crisis Impact		Human Element
Security Breach Risk	Effective Data Retrieval	Air Pollution Monitoring			Consideration
Influential Adoption Factors	System Error Management				
Job Displacement Risks	Sensor Failures				
Technical Skills Necessity	Effective Data Retrieval				
User Understanding Quality					

3.2 Table with Merged Drivers

Following the merger of important keywords drivers, a total of twenty-one drivers were created. This will be included in the questionnaires used to collect data. Table 5 displays the table with the merged twenty-one drivers.

Table 5 Table with merged drivers

No.	Drivers
1.	Cybersecurity Threats
2.	Privacy Concerns
3.	Security Breach Risk
4.	System Error Management
5.	Sensor Failures
6.	Effective Data Retrieval
7.	Essential Power Supply
8.	Compliance Challenges
9.	Time-Saving Technology
10.	Human Element Consideration
11.	Influential Adoption Factors
12.	Job Displacement Risks
13.	Technical Skills Necessity
14.	User Understanding Quality
15.	Connectivity Issue
16.	Integrated System Design
17.	Application Absence Concerns
18.	Energy Efficiency Concerns
19.	Air Pollution Monitoring
20.	Cost Implications
21.	Global Crisis Impact

4. Literature Review

In this chapter, the researcher explained the results of a survey on Malaysia's tourist sustainability and the Internet of Things (IoT) sent to MOTAC by email. The data analysis method was explained in this chapter. SPSS was used to evaluate and describe all the data to meet Chapter 1's goal.

4.1 Results

a) Pilot Test

To test research dependability, a pilot study was done. Pilot testing verified questionnaire dependability. Thirty questionnaires were randomly distributed to thirty participants before distribution. To test the questionnaire's dependability, 30 MOTAC members were randomly selected to complete and return it. To determine reliability, SPSS was used to analyse the data. Table 6 shows pilot test results.

Table 6 Pilot test

Section	Cronbach's Alpha	N of Items	N of Respondents
B	.93	21	30
C	.927	21	30
D	.907	21	30

b) Survey Rate

About 469 people work at MOTAC Putrajaya. The study requires 210 people, according to Krejcie and Morgan (1970). This study sent questionnaires from October to December 2023. Email distribution was used to reach 210 questionnaire respondents during data collection. However, only 176 genuine and completed questionnaires were received. Table 7 shows the 86.29% survey return rate.

Table 7 Feedback rate

Population	469
Sample size	210
Questionnaire Distribute	210
Valid Questionnaire Returned	177
Percentage (%)	86.29%

c) Demographic analysis

Biographical information about respondents was discussed. The respondents were asked about their gender, age, years of experience in the tourism industry, involvement in the Ministry of Tourism and Art and Culture Malaysia, familiarity with IoT in tourism, whether they have implemented IoT-related initiatives in the Malaysian tourism industry, and whether they make decisions about IoT technology adoption in the tourism sector. The graphic depicted respondents' profiles. These indicate population characteristics that must be considered during research design and survey response presentation.

Table 8 Frequency of gender

		Frequency	Percent	Valid Percent
Valid	Male	86	48.9	48.9
	Female	90	51.1	51.1
	Total	176	100.0	100.0

The gender of the respondents is presented in frequency and percentage form in Table 8 respectively. The present study comprised 86 male participants and 90 female participants. The data suggests that 51.14 percent of the respondents were female and 48.86 percent were male who participated in the study.

Table 9 Frequency of age

		Frequency	Percent	Valid Percent
Valid	18-24	19	10.8	10.8
	25-34	39	22.2	22.2
	35-44	41	23.3	23.3
	45-54	33	18.8	18.8
	55-64	27	15.3	15.3
	65+	17	9.7	9.7
	Total	176	100.0	100.0

Table 9 show respondents' ages by percentage and frequency. Five age categories were found when classifying respondents. Before that, there are 18–24, 25–34, 35–44, 45–54, 55–64, and 65+ age categories. The largest group of responses was 35–44, at 23.3%. 39 of 176 respondents, 22.2%, aged 25–34. 18.8% of respondents (33), were 45–54 years old. In the 55–64 age range, 27 people (15.3%) responded. However, 19 (18-24) respondents (10.8%) were present. Only 17 people aged 60 and older responded, or 9.7%.

Table 10 Frequency of years of experience in tourism industry

		Frequency	Percent	Valid Percent
Valid	Less than 1 year	73	41.5	41.5
	1-5 years	50	28.4	28.4
	6-10 years	33	18.8	18.8
	11-15 years	16	9.1	9.1
	More than 15 years	4	2.3	2.3
	Total	176	100.0	100.0

Table 10 show respondents' Malaysian Ministry of Tourism, Arts, and Culture experience. In all, 73 (41.5%) have less than one year of experience. 28.4% of the 50 people are 1-5 years old, while 18.8% of the 33 are 6-10 years old. 9.1% of the 16 respondents have 11-15 years of experience, while 2.3% of the 4 have over 15 years. Participants' reported experience levels are summarized in this breakdown.

Table 11 Frequency of years of experience in Ministry of Tourism, Arts and Culture Malaysia

		Frequency	Percent	Valid Percent
Valid	Less than 1 year	73	41.5	41.5
	1-5 years	50	28.4	28.4
	6-10 years	33	18.8	18.8
	11-15 years	16	9.1	9.1
	More than 15 years	4	2.3	2.3
	Total	176	100.0	100.0

The table shows the frequency of responders in each category and their years of experience at Malaysia's Ministry of Tourism, Arts, and Culture. 73% of responders (41.5%) have less than one year of experience. Several respondents responded. The "1-5 years" category accounts for 28.4% with a frequency of 50, while the "6-10 years" category accounts for 18.8% with 33. 16.1% of respondents have "11-15 years" experience, or 16 occurrences. 2.3%, or 4 respondents, have "More than 15 years" of experience.

Table 12 Frequency of direct involvement in Tourism Planning and Development in Malaysia

		Frequency	Percent	Valid Percent
Valid	Yes	83	47.2	47.2
	No	93	52.8	52.8
	Total	176	100.0	100.0

Table 12 show that 47.2% of the 176 respondents claim they participated directly in tourism planning and development, while 52.8% say they did not. The data shows the proportion and distribution of members involved in Malaysian tourism planning and development.

Table 13 Frequency of familiarity with the use of Internet of Things (IoT) in the context of tourism

		Frequency	Percent	Valid Percent
Valid	Very familiar	52	29.5	29.5
	Not very familiar	79	44.9	44.9
	Not familiar at all	45	25.6	25.6
	Total	176	100.0	100.0

This table shows respondents' IoT knowledge in tourism. Data is classified as "Very familiar," "Not very familiar," or "Not at all familiar." Inclusion of frequencies and percentages provides familiarity distribution insights. To illustrate, 79 (44.9%) respondents say they are "Not very familiar" with IoT in tourism, while 52 (29.5%) say they are "Very familiar." Additionally, 25% (45 individuals) say they are "Not familiar at all."

Table 14 Frequency of implementation of IoT-related initiatives in Malaysia's tourism sector

		Frequency	Percent	Valid Percent
Valid	Yes	71	40.3	40.3
	No	105	59.7	59.7
	Total	176	100.0	100.0

This table displays the responses regarding the implementation of IoT-related initiatives in Malaysia's tourism sector. There are two possible classifications for the data: "Yes" and "No." 61 respondents, or 40.3%, have reportedly implemented initiatives related to the Internet of Things; the remaining 105 do not have such initiatives in place.

Table 15 Frequency of decision-making authority for IOT technology adoption in Malaysian tourism

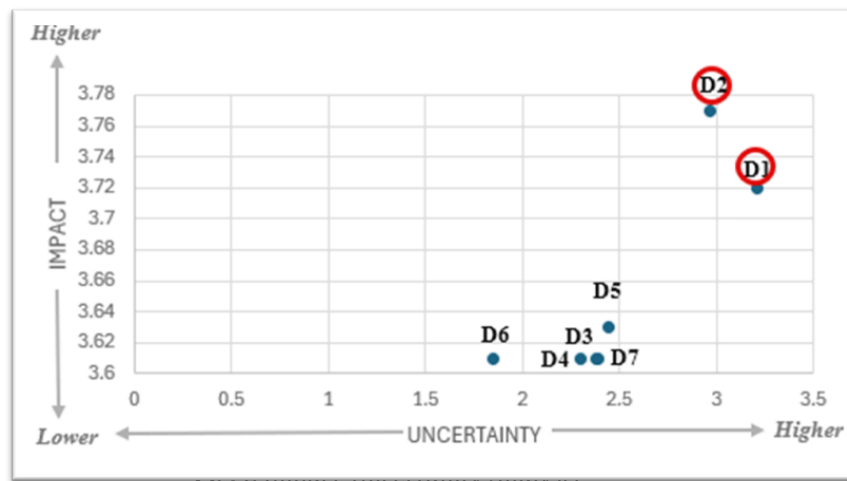
		Frequency	Percent	Valid Percent
Valid	Yes	77	43.8	43.8
	No	99	56.3	56.3
	Total	176	100.0	100.0

Malaysian tourism decision-makers for IoT adoption are listed in the table percent, or 99 people, of the 176 respondents claim responsibility for such decisions, whereas 43.8 percent, or 77 people, disagree. This distribution shows the surveyed group's decision-making power on Malaysia's tourism industry's IoT adoption.

d) Impact-Uncertainty Analysis

Table 16 Mean of the 10 leading drivers on level of impact and uncertainty

No	Issues and drivers	Mean	
		Uncertainty	Impact
D1.	Privacy Concerns	3.21	3.72
D2.	Cybersecurity Threats	2.97	3.77
D3.	Sensor Failures	2.38	3.61
D4.	Effective Data Retrieval	2.30	3.61
D5.	Essential Power Supply	2.44	3.63
D6.	Air Pollution Monitoring	1.85	3.61
D7.	Compliance Challenges	2.39	3.61
D8.	Security Breach Risk	3.10	3.61
D9.	Human Element Consideration	2.47	3.63
D10.	Energy Efficiency Concerns	2.16	3.69



Impact and uncertainty mean values have been calculated. Table 16 showed the mean difference in the two aspects before the impact-uncertainty study. The impact-uncertainty analysis used Table 16 data to determine the prospects' most impactful and uncertain factors. Analysis results are in Fig. 2. The top two drivers with the most impact and uncertainty will be picked. D2 (2.97, 3.77) and D1 (3.21, 3.72) were chosen because D2 has the most influence and D1 the most ambiguity. It drives 'privacy concerns' and 'cybersecurity threats'. Thus, these two drivers were chosen as the top drivers for Chapter 5 scenario building analysis.

4.2 Discussion Based on the First Research Objectives

The first objective of this study is to determine the challenges, trends, and issues on implementing internet of things (IoT) on tourism industry. In order to establish this goal, a STEEPV analysis has been employed. In this study, the gathered data pertaining to the integration of the internet of things (IoT) into the tourism business is classified into social, technological, environmental, economic, political, and values components. The information has been gathered from several sources, including journals, government-related articles, the internet, and reports from non-governmental organisations. The STEEPV analysis yielded a total of 21 outputs, with the highest number of outputs falling under the technological element. This was followed by the social factor, economic factor, value factor, and finally the political factor.

4.3 Discussion Based on the Second Research Objectives

The second goal is to identify the main drivers of IoT in tourism. The challenges, trends, and obstacles discovered in the first goal will be used to build the components that will lead to the desired outcome. Consolidate drivers, problems, trends, and challenges. Identifying the causes of the merging issue, trend, and challenge is important since it may affect tourist IoT uptake and use. The combined issue, trend, and challenge yield 21 drivers: Cybersecurity Threats, Privacy Concerns, Security Breach Risk, System Error Management, Sensor Failures, Effective Data Retrieval, Essential Power Supply, Compliance Challenges, Time-Saving Technology, Human Element, Influential Adoption Factors, Job Displacement Risks, Technical Skills Needed, User Understanding Quality, Connectivity Issue, Integrated System Design, Application Absence, Energy Efficiency Concerns Air pollution monitoring, costs, global crisis impact Drivers will produce questionnaires for stakeholders, including MOTAC personnel in Petaling Jaya, Selangor, Malaysia. The outcome will be used to assess the average relevance, effect, and unpredictability of IoT in tourism. Impact-uncertainty analysis will use average impact and uncertainty estimates. This study found staff dynamics and personalisation to be the most important elements.

4.4 Discussion Based on The Third Research Objectives

The third research aim is to examine how IoT deployment may affect Malaysia's tourist business. The goal is to identify catalysts for future advancement and assess their impact on the future environment and tourism IoT integration. This graphic is generated by analysing four potential scenarios using the two variables from the impact-uncertainty study. This scenario covers four possible future events. Four situations are shown in Fig. 3. The regulatory landscape, public knowledge and perception, public-private partnership, and upcoming technologies and innovations were exhibited and debated for their ramifications. Whether the time horizon returns favourable or negative results, the scenario will be reviewed.

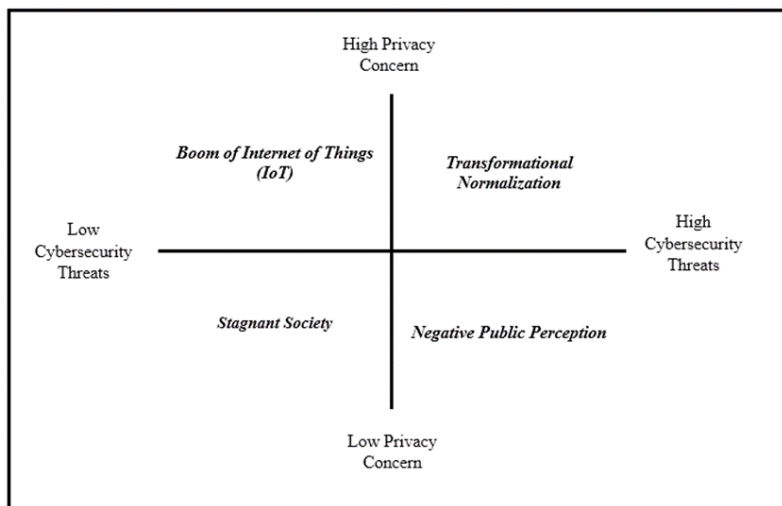


Fig. 3 Four alternative scenario

4.4.1 Scenario 1: “Transformational normalization”

The first scenario involves strong privacy concerns and cybersecurity hazards. This will foster the internet of things as the tourist sector's main media, resulting in a revolutionary normalisation state. The term "transformational of normalisation" denotes a situation in which the tourist industry views the Internet of Things (IoT) as commonplace.

In this circumstance, where privacy concerns and cybersecurity dangers are prevalent in the tourist business, IoT deployment may improve and expand the sector. Privacy issues inspire systematic and cautious thinking, which increases cybersecurity vulnerability awareness and thorough examination. Prioritising privacy considerations forces stakeholders to implement strong security measures, hence this conscientious attitude prevents cybersecurity attacks (Akmal Husaini Bin Haris *et al.*, 2023) When implementing the Internet of Things (IoT) for tourism, heightened privacy awareness and stringent cybersecurity procedures help anticipate and mitigate potential threats. Users are better at recognising and avoiding phishing, malware, computer viruses, and online fraud due to the privacy-conscious attitude (Akmal Husaini Bin Haris *et al.*, 2023) This protects against cybersecurity risks.

When smart technology transforms the tourist industry's operating cycle, the Internet of Things (IoT) becomes increasingly important for tourism destinations. All tourism stakeholders, including vacationers and industry management, see the IoT's disruptive potential. They see it as a crucial part of modern tourism, not just a technological marvel. The Internet of Things will boost tourism by meeting travellers' expanding needs (Nekooeezadeh *et al.*, 2022). Smart technology is increasingly essential in tourism destinations.

Selangor's tourism sector's successful usage of the Internet of Things (IoT) addresses privacy and cybersecurity concerns and shows a methodical and thorough approach. This strategy encourages privacy awareness and strict cybersecurity, creating an atmosphere that anticipates and addresses problems. IoT is key to this scenario, providing tourism locations considerable potential. The example shows how privacy awareness, cyber security, and the Internet of Things are interconnected. Selangor tourists and industry stakeholders will benefit from smart, secure, and integrated experiences. These encounters show a forward-thinking strategy that shapes regional tourist destinations.

4.4.2 Scenario 2: "Stagnant Society"

Lack of privacy awareness and minimal cybersecurity dangers indicate a stagnant civilization. Due to the perceived low cybersecurity concerns, society may feel there is no need for reform. Thus, individuals may reject these events as unimportant. Since society is unwilling to accept new technology to replace existing techniques, especially when compared to IoT, this viewpoint hinders tourist growth.

Although IoT devices provide a unique blend of digital and physical capabilities, most consumers choose not to use them (Kemper -, 2018).Users may avoid Internet of Things devices if they think their data is at risk. Lack of encryption makes privacy issues worse since unauthorised parties can access personal data (Preeti, 2022). Thus, tourism growth is hindered by this standstill. Society's indifference to privacy and cybersecurity risks hinders technological adoption. Most individuals don't need an IoT gadget to survive. Many Internet of Things devices have underwhelming value propositions, which contributes to this. Internet of Things devices do not solve daily problems for people (Kemper -, 2018).The lack of urgency or requirement for improvement prevents the adoption of novel technology that may transform tourist operations.

Selangor's tourist industry confronts enormous challenges in a "Stagnant Society" where privacy issues are little understood and cybersecurity threats are low. Tourism operations continue to use outdated methods due to society's unwillingness to accept technologies like the Internet of Things (IoT). This stagnation hinders efficiency, customer satisfaction, and the industry's innovation and global competitiveness. An indifference to technological advancement wastes a possibility, preventing Selangor's tourism business from adopting modern technology and developing in the ever-changing tourism environment.

4.4.3 Scenario 3: "Boom of Internet of Things (IoT)"

High privacy concern and minimal cybersecurity dangers create a unique dynamic in the third situation. This scenario starts with a huge increase in tourist industry IoT utilisation. This rise is due to consumer privacy awareness. People are aware of cybersecurity risks and take precautions. The predominance of minor cybersecurity vulnerabilities means that these concerns do not become major issues, enabling tourist IoT rollout without disruption. Strong privacy concerns and minimal cybersecurity risks foster IoT integration. These technologies are more appealing to consumers due to their knowledge and perceived low risk. This strong acceptance stems from the idea that IoT can improve and optimise many tourism company processes, improving the visitor experience.

The confluence of the Internet of Things (IoT) with travel is changing how people plan and start their trips (Vidal, 2019). In an environment where privacy is paramount, the Internet of Things (IoT) may improve travel experiences while prioritising data security. The tourism industry's rapid adoption of the Internet of Things is due to increased privacy awareness and reduced cybersecurity concerns (Vidal, 2019). Google Travel found that 74% of travellers use the internet to plan their trips, showing that the digital realm is the preferred travel planning tool. The advanced functions of the Internet of Things (IoT) seamlessly integrate with travel experiences while protecting against security incursions, easing privacy worries.

Scenario 3, "Booming of Internet of Things (IoT)," in Selangor's tourist sector emphasises privacy and minimises cybersecurity hazards. This unusual mix boosts IoT utilisation. IoT solutions are readily adopted by privacy-aware and security-conscious consumers, facilitating tourist industry integration. Selangor's mix of privacy and cybersecurity makes it suitable for IoT-driven tourism. Effective IoT adoption has made the tourist business technologically advanced. IoT solutions that are safe and personalised have improved every visitor experience. Selangor's innovative approach assures that IoT will improve tourist operations and boost the region's reputation as a leader in intelligent and safe destination experiences.

4.4.4 Scenario 4: Negative Public Perception

Malaysia as a tourism destination has suffered from the cybersecurity hazards and low privacy concerns. Recent news pieces in credible media like The Star reveal a major damage to Malaysia's reputation and worldwide tourism attractiveness. In the third quarter of 2023, Surfshark, a prominent cybersecurity organisation, ranked Malaysia sixth in data breaches. The third quarter of 2023 saw 494,699 compromised accounts—an alarming pace of four Malaysian user accounts every minute—an increase of 144% from the previous quarter. Surfshark ranks Malaysia seventh in incursion density. As 5,436 accounts are hacked daily, this ranking has major repercussions for the country's cybersecurity (Angeline, 2023).

Foreign travellers avoid Malaysia due of the negative reputation. This is mostly due to concerns about IoT security and data breach in the tourist business. This avoidance hurts Malaysian tourism-dependent nations' economies beyond reputational damage.

In Scenario 4, Selangor confronts "Negative Public Perception," which entails high cybersecurity risks and low privacy concerns. This seriously impacts the state's tourist industry. According to Surfshark, data breaches have increased, hurting Malaysia's tourism. IoT security issues are hurting Selangor's tourist industry. This perspective has discouraged international tourists, who are vital to the region's tourism business. Selangor must develop robust cybersecurity measures to recover tourist trust and safely integrate IoT technology. This challenge requires a strategic cybersecurity approach. This protects Selangor's reputation and ensures a bright future for its tourist sector.

5. Literature Review

In summary, this research has effectively accomplished its two specific objectives: to identify challenges, trends, and issues related to the implementation of the Internet of Things (IoT) on industry in the tourism industry; and to forecast future trends in the IoT implementation on tourism. In addition, this foresight study will aid Internet of Things (IoT) technology developers and consumers in gaining a greater understanding, recognition, and consciousness of the economic sector's future uncertainty. Subsequent scholars or programmers may consult this research as a reference, as it furnishes data pertaining to the impact and unpredictability associated with the integration of the Internet of Things (IoT) into the realm of sustainable tourism. As a result, subsequent developers or researchers will be able to maximise the positive impacts of the Internet of Things (IoT) on the

industry of the tourism industry while minimising the negative ones. Ideally, the implementation of the Internet of Things (IoT) in the tourism sector can occur promptly in the future, contributing to the global advancement and modernization of industries and generating numerous benefits for society at large.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

*The authors confirm contribution to the paper as follows: **study conception and design: N.N.F.B., and F.H.; data collection: N.N.F.B.; analysis and interpretation of results: N.N.F.B.; draft manuscript preparation: N.N.F.B., and F.H.** All authors reviewed the results and approved the final version of the manuscript.*

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