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BUSINESS INTELLIGENCE SYSTEM ADOPTION IN THE HOTEL INDUSTRY: IDENTIFYING BARRIERS AND ACTIONS

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ABSTRACT

Aim/Purpose	This paper aims to qualitatively analyze barriers to Business Intelligence (BI) system adoption in Indonesia's hotel industry from the technological, organizational, and environmental perspectives. This study is expected to thoroughly understand the adoption of BI systems in the hotel industry. Additionally, this study offers details that can assist public administrators or system developers in planning the implementation of BI systems in the hotel industry.
Background	There has been a significant increase in the study of the adoption and use of BI systems. However, our understanding of the adoption determinants within the hotel industry is still limited.
Methodology	This research uses the guidelines from the Technology, Organization, and Environment (TOE) framework because of its suitability to the context of this research, which was carried out not at the individual level but at the company level, considering environmental factors that exist in the hotel downstream supply chain ecosystem. We used semi-structured interviews with four tourism public administrators and experts, 20 hoteliers, and 10 managers of hotel distribution channels. Interview data were analyzed using thematic analysis in ATLAS.ti and categorized based on the TOE framework.
Contribution	This research enriches the current research by involving various stakeholders in the hotel industry to understand the obstacles and actions that can be taken to foster the necessary cooperation. We highlight three challenges in adopting a BI system in the hotel industry: the necessity for a digital platform, the

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	enhancement of data analytical skills, and the demand for an affordable solution for cooperation.
Findings	The findings reveal the current barriers to BI system adoption and the actions to take. The barriers are a lack of regulation, a lack of trust, a lack of data integration, a lack of accuracy, a lack of resources, and a lack of competence.
Recommendations for Practitioners	This research suggests a mapping of actions that can be undertaken to overcome the barriers. Practitioners and policymakers are advised to establish a regulatory policy on data collection, maintain data security by implementing data aggregation, hold regular training in data analytics, and provide a platform for data sharing and analytics.
Recommendation for Researchers	Based on the findings, researchers can conduct further exploration to enrich insight related to technology factors to ensure continuous commitment from stakeholders, enhance coordination, and automate data-sharing processes.
Impact on Society	This study thoroughly examines the adoption of BI systems in Indonesia and may apply to other emerging nations with comparable technological, regulatory, or cultural traits. Information from this study might help government officials or system developers plan and implement a BI system at the industry level.
Future Research	More representative insight should be conducted in this study on a larger sample of hospitality and tourism organizations that are geographically more dispersed. To enrich the result, a quantitative analysis is also advised to understand the findings better and gain more specific evidence of the barriers and actions that need to be established.

Keywords	hotel, business intelligence, barriers, adoption, TOE framework

INTRODUCTION

Organizations increasingly realize the importance of capturing and storing data to gain decision-making insights (Korte et al., 2013). Decision-makers spend excessive time evaluating the ever-growing data to "make the most optimal, value-creating business decision." An organization must integrate analytics into its decision-making procedures and provide the infrastructure for storing, processing, and using data (Grandhi et al., 2021). The hotel industry has begun to see its value, and it is vital for identifying trends and making effective decisions, as well as serving as a differentiation for their customers (Korte et al., 2013). As a highly competitive industry, it becomes crucial for organizations in the hotel industry to understand how they should gather, process, and evaluate information to provide strategic, operational, and tactical solutions and understand how and why businesses make decisions based on their competitive environment (Köseoglu et al., 2020). One of the primary uses of a Business Intelligence (BI) system is to help hoteliers maximize their revenue and optimize bookings by configuring optimal prices that will drive high occupancy rates (Korte et al., 2013). To perform optimal revenue management, hoteliers must analyze data based on internal data and competitor data, such as average room rate and occupancy rate (Ibrahim et al., 2022; Köseoglu et al., 2019).

BI system adoption has shown significant impacts on the hotel industry. The Inn at the Market in Seattle, for example, utilized Amadeus' BI tools to achieve an impressive return on investment (ROI) of over 500% and an average daily rate (ADR) increase of $48 between January and August 2023 (Amadeus, 2024). Ritz-Carlton, renowned for its exceptional customer service, has attributed a seven-point increase in customer service scores since 2004 to its effective use of BI in understanding and addressing guest issues (Korte et al., 2013). Furthermore, the Peabody Hotel estimates that using BI to understand why guests might not return has resulted in annual savings of approximately $120,000 in potential lost revenue (Korte et al., 2013).

Tourism practitioners and hoteliers must often collaborate and rely on each other in a tourism supply chain to improve their knowledge and increase competitiveness. They depend on information from both competitors and non-competitors to have accurate demand forecasts (Zhang & Song, 2018). Moreover, a study by Köseoglu et al. (2020) emphasized that current studies on competitive intelligence in the hotel industry are on the firm level, not the industry level. Research by Huang Yin et al. (2019) also explains that inter-organizational cooperation between stakeholders is needed to improve the tourism industry as a whole, such as cooperation among hotels, between hotels and distribution channels such as Online Travel Agents (OTAs), between OTAs and tourism authorities, or even between OTAs and their competitors by sharing knowledge of each other (Huang Yin et al., 2019).

There is a research gap in studies exploring the adoption of the BI system. The study by Ain et al. (2019) observed that a significant portion of the BI research in the field concentrates on generic organizational contexts rather than investigating the differences in BI adoption, utilization, and success across specific industries (e.g., healthcare, finance, manufacturing, retail). The comprehension of the impact of contextual factors, such as industry regulations, competitive dynamics, or data requirements, on BI outcomes is restricted by this absence of industry-specific focus. Another study by Ibrahim and Handayani (2022) emphasized the potential of BI to improve the competitiveness and decision-making of tourism organizations. It also emphasizes addressing technical, financial, and human resource challenges. Moreover, a study by Mariani et al. (2018) noted a gap in the limited exploration of how BI and big data can be integrated across different tourism industry sectors (e.g., hotels, travel agencies, and destination management organizations) to create cohesive, industry-level benefits, such as improved destination marketing or supply chain coordination. These gaps suggest a need for more studies that examine the systemic and cross-sectoral application of BI and big data to address industry-level challenges and opportunities. Based on the research gaps, this study examines barriers to BI system adoption in the hotel industry from technological, organizational, and environmental perspectives, using stakeholder collaboration as a key lens.

This study comprises six sections. The first section provides a background of the study and a literature review related to the topic in the second section. Following this, the research methodology utilized in the study is explained in the third section. After the findings are presented and discussed, a final section highlights emerging conclusions. Study limitations and suggestions for future research are also provided.

LITERATURE REVIEW

BUSINESS INTELLIGENCE SYSTEM

Business intelligence (BI) is the set of tools, methods, and plans that help companies gather, organize, analyze, and display business data to make decisions based on that data (Chen et al., 2012). Modern BI relies on real-time analytics, cloud-based tools, and AI-driven insights to turn unstructured data into knowledge that can be used (Eboigbe et al., 2023). Specifically, within a hospitality context, a BI system operates similarly by integrating data from various hotel-specific systems like Property Management Systems (PMS), Point of Sale (POS) systems, Revenue Management Systems (RMS), and Customer Relationship Management (CRM) platforms, as well as external sources such as online booking engines and social media. It analyzes this data to provide insights into guest behavior, booking trends, and market dynamics. It enables hotels to optimize revenue management, personalize guest experiences, improve operational efficiency, and make better marketing decisions (Madyatmadja et al., 2021).

ADOPTION OF BI SYSTEMS IN THE HOSPITALITY INDUSTRY

Studies highlight that BI system adoption in the hospitality industry aligns with strategic goals like improving guest satisfaction, optimizing pricing strategies, and streamlining resource allocation (Buhalis

& Leung, 2018). Based on previous studies, several factors influence BI system adoption, as shown in Table 1.

Table 1. Influencing factors of BI systems adoption

Category	Influencing factors	Findings	References
Organizational Availability	Resource Availability	Larger hotel chains and multinational corporations are more likely to adopt BI due to financial and technical resources. Smaller enterprises often face barriers like high implementation costs.	(Ibrahim & Handayani, 2022)
Organizational Availability	Management Support	Leadership's understanding of BI's value is critical. Organizations with data-driven cultures report higher BI success rates.	(Ibrahim & Handayani, 2022)
Technological Factors	Integration Complexity	Legacy systems (e.g., Property Management Systems) may lack compatibility with modern BI tools, necessitating middleware or upgrades.	(Sigala, 2018)
Technological Factors	Data Quality	Inconsistent or siloed data from disparate sources (e.g., CRM, POS) undermines BI effectiveness.	(Mariani et al., 2018)
Environmental Factors	Competitive Pressure	Hotels in saturated markets adopt BI to gain insights into competitor pricing and customer trends.	(Xiang et al., 2015)
Technological Factors	Regulatory Compliance	GDPR and data privacy laws necessitate secure BI frameworks for handling guest information	(Sigala, 2020)

Barriers to BI System Adoption and Actions to Overcome Them

The findings in the study by Fakier (2021) align with broader BI adoption challenges (e.g., cost, complexity, resistance) but emphasize the unique context of public administration in South Africa, where resource constraints and limited vendor support are prominent. The recommended actions (adopting cloud-based tools, securing management support, and improving training) are practical and consistent with general best practices for BI adoption. Moreover, a study by Martins et al. (2025) directly addresses actions to overcome BI adoption barriers, offering practical insights from a real-world pilot project. It complements Fakier's (2021) thesis by providing a sector-specific perspective (engineering and construction) and emphasizing actionable strategies like pilot projects, process standardization, and cloud-based solutions. The study's Critical Success Factors (CSF) framework aligns with the TOE framework used in Fakier's study, reinforcing the importance of organizational, process, and technological factors.

Theoretical Frameworks for Technology Adoption

A robust theoretical framework is essential to effectively analyze the BI adoption barriers within the hotel industry. The TOE framework presents itself as a potentially suitable lens to examine the adoption of BI systems in this specific context. The framework explains technological innovation adoption in organizations, which is composed of technological context, organizational context, and environmental context (Tornatzky & Fletscher, 1990). The TOE framework is the most well-known and popular in the scientific community for analyzing potential influences on how technological innovation is adopted in businesses, preventing potential risks that could result in the adoption project's failure (Bijker & Hart, 2013). The TOE framework is a suitable foundation for researching the adoption of the BI system within the hotel industry due to its comprehensive approach. Its strength lies in

its ability to simultaneously consider the interplay of technological attributes, organizational dynamics, and environmental factors that collectively shape an organization's decision to adopt new technology (Vu et al., 2023). This holistic perspective is particularly relevant for understanding the adoption of the BI system in the hotel industry, as it allows researchers to move beyond a narrow focus on the technology itself and consider the broader organizational and market context in which hotels operate. The TOE framework is also known for its flexibility and adaptability. It has been successfully applied to study the adoption of various technologies across various organizational contexts, including numerous studies within the hospitality sector (Papagiannids, 2022).

In particular, this research also uses the guidelines from the TOE framework because of its suitability to the context of this research, which was carried out not at the individual level but at the company level (Oliveira & Martins, 2010), considering environmental factors that exist in the hotel downstream supply chain ecosystem (Liu, 2019). This study used some factors drawn from the model developed by previous researchers that explore the implementation of competitive and BI practices in the hotel industry (Bao & Hua, 2016; Kharitonova, 2019; Köseoglu et al., 2019; Zhang & Song, 2018) and the technological, organizational, and environmental factors in the BI system adoption (Korte et al., 2013; Stjepić, 2017) as shown in Figure 1.

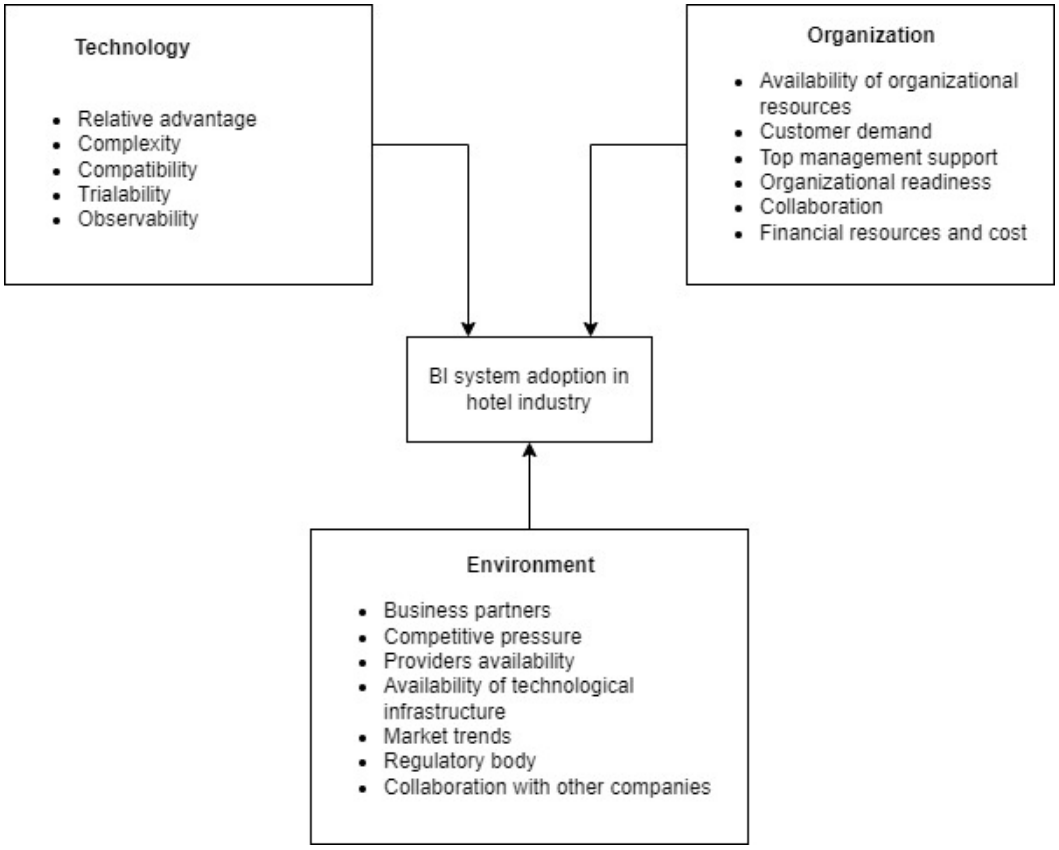

Figure 1. Research framework of BI system adoption in the hotel industry

RESEARCH METHODOLOGY

DATA COLLECTION

As key stakeholders strongly influence technology adoption (Leung, 2019), they must justify factors influencing BI adoption. For this aim, we conducted a semi-structured interview with multiple stakeholders (34 participants) of the hotel industry in Indonesia to obtain detailed information on their

experiences. To understand the issue better, interviews were conducted with participants with at least five years of experience in the accommodation sector who held managerial positions. Participants were not given questions before the interview to encourage their spontaneity in expressing opinions. Semi-structured interviews were chosen to collect qualitative, open-ended data, which explored participants' thoughts, experiences, feelings, motivations, and beliefs about the topic.

We chose the qualitative method over other potential methodologies because we aim to understand complexity, context, and human experience. BI system adoption involves complex social, organizational, and technological factors that may not be fully understood or quantified, especially in specific contexts like the tourism or hospitality sector. Qualitative methods are ideal for exploratory research, which aims to uncover underlying reasons, motivations, and barriers rather than testing predefined hypotheses. By interviewing multiple stakeholders, we aim to gather in-depth, contextual data that captures the "why" and "how" behind phenomena that are valuable for understanding organizational behaviors, cultural resistance, and diverse user perceptions in BI adoption, providing a holistic understanding of barriers and facilitators.

The demographics of interview respondents were determined by considering position, institution, type of company, gender, length of work experience, and geographical location. The interviews took place from April to November 2021. The interviews lasted 60-90 minutes, were conducted online, and were recorded using an online meeting platform. The selected participants are familiar with data analytics and have been responsible for making strategic decisions in their companies for over five years, such as owner, manager, and director. Each interviewee was asked to identify the challenges and obstacles that required more intervention to adopt and implement a BI system in the hotel industry to foster better decision-making and to propose specific actions to be undertaken by the different actors. Table 2 summarizes the profile of the interviewed stakeholders.

Table 2. Interview participants

No	Code	Position	Organization	Experience (year)
1	REG1	Director of Strategic Policy	Ministry of Tourism	18
2	REG2	Coordinator of the Center of Tourism Data & Information	Ministry of Tourism	20
3	REG3	Head of Industry Relations	Ministry of Tourism	20
4	REG4	Academician, Advisor to the Minister	University	18
5	ASO1	General Manager, Chairman of IGHMA	Hotel & Association	25
6	ASO2	General Manager, Head of Research of IGHMA	Hotel & Association	20
7	HTL1	Hotel General Manager	Hotel (5 Star)	14
8	HTL2	Hotel Distribution Manager	Hotel (5 Star)	7
9	HTL3	Hotel Revenue Manager	Hotel (5 Star)	9
10	HTL4	Revenue Manager	Hotel (5 Star)	9
11	HTL5	Hotel E-commerce Manager	Hotel (4 Star)	9
12	HTL6	Hotel Revenue Manager	Hotel (4 Star)	6
13	HTL7	Corporate Revenue Manager	Hotel (3 Star)	8
14	HTL8	Hotel E-Commerce Manager	Hotel (3 Star)	5
15	HTL9	Owner	Hotel (3 Star)	5

No	Code	Position	Organization	Experience (year)
16	HTL10	Hotel Sales Director	Hotel (2 Star)	13
17	HTL11	Hotel General Manager	Hotel (1 Star)	11
18	HTL12	Revenue Manager	Hotel (No star)	5
19	HTL13	E-commerce Manager	Hostel (No star)	5
20	HTL14	Owner	Guesthouse (No star)	8
21	HTL15	Owner	Guesthouse (No star)	6
22	HTL16	Owner	Vacation rental (3 Star)	5
23	HTL17	E-commerce Manager	Vacation rental (No Star)	5
24	HTL18	Owner	Vacation rental (No Star)	5
25	DCH1	Senior Market Manager	Distribution Channel	11
26	DCH2	Senior Market Manager	Distribution Channel	17
27	DCH3	Senior Market Manager	Distribution Channel	10
28	DCH4	Senior Market Manager	Distribution Channel	10
29	DCH5	Area Manager	Distribution Channel	20
30	DCH6	Country Manager	Distribution Channel	14
31	DCH7	Account Manager	Distribution Channel	7
32	DCH8	Head of Contracting	Distribution Channel	20
33	DCH9	Senior Contracting Manager	Distribution Channel	14
34	DCH10	Senior Contracting Manager	Distribution Channel	15

Table 3 shows the main interview questions asked of participants. The questions are based on the key issues we learned from previous publications in this field.

Table 3. Interview questions

No	Question	References
1	Does your company have a data-based decision support system/application (e.g., a competitive/BI system)?	(Stjepić et al., 2021; Zhang & Song, 2018) (Stjepić et al., 2021)
2	What challenges affected your decision to develop/implement/adopt/use the system?	(Kharitonova, 2019)
3	What actions need to be taken to overcome the challenges?	(Kharitonova, 2019)
4	What functionalities/features do you need in the system?	(Kharitonova, 2019)
5	Can you explain how you benchmark your performance with competitors? How do you get the data?	(Anttikoski, 2020; Bao & Hua, 2016; Zhang & Song, 2018)
6	What are the problems and challenges in collecting and processing the data?	(Bao & Hua, 2016; Zhang & Song, 2018)

DATA ANALYSIS

The focus of the data analysis was on the variables of BI system adoption in the organizational, technology, and environmental context. We use qualitative data analysis to explain, comprehend, and

analyze a situation or group of people being investigated (Wong, 2008). The Google Meet application records and collects responses in video and audio recordings. Subsequently, data were coded and analyzed to look for patterns and themes. Responses were transcribed using ATLAS.ti transcription.

Thematic analysis is beneficial for refining the critical elements of an extensive data set since it forces the researcher to apply a systematic approach to data processing, resulting in a well-structured final report (Braun & Clarke, 2006). The following steps were taken as part of the interactive thematic analysis process:

(i) Familiarizing ourselves with data details by reading and re-reading transcripts and taking notes on initial impressions or interesting quotes.

(ii) Creating initial codes from interview transcripts. In this step, we break data into smaller units and assign descriptive codes. For example, the sentence "We are willing to provide data as long as confidentiality is maintained" is initially coded into "data should be classified."

(iii) Looking for themes by grouping related codes into broader themes. For example, the code "data should be classified" is grouped into the "security and confidentiality" sub-theme and the "technological factor" theme.

(iv) Modifying themes to ensure they are coherent and data-driven. For example, we realize "data security" overlaps with "data confidentiality". Thus, we merge them into "security and confidentiality."

(v) Finding and defining themes to articulate the essence of each theme and its significance based on the TOE framework.

(vi) Validating themes to ensure themes are credible, representative, and grounded in data. We shared findings with several participants to confirm accuracy and discuss themes with colleagues to reduce bias. Two scholars examined the themes and agreed on the principal barriers and the implementable strategies.

(vii) Reporting the analysis. Finally, we created a final report in the results section by presenting themes, subthemes, and sample quotes and comparing them to previous studies in the Discussion section.

The emergent themes from this thematic analysis, namely Collaboration, Financial Resources and Costs, Government Support, Interoperability, Organizational Readiness, Security and Confidentiality, have undergone a rigorous validation process involving independent verification by a second scholar. Initially, Scholar A (the principal analyst) thoroughly examined the qualitative data, finding preliminary codes and progressively refining the aforementioned themes. Subsequently, Scholar B, a seasoned qualitative researcher proficient in qualitative procedures, independently examined a representative subset of the transcribed data and employed the identical steps and theme definitions established by Scholar A.

Disagreements were addressed and resolved by critical discussion and re-evaluation of the raw data until consensus was achieved, thus enhancing the robustness of the thematic interpretations. This collaborative validation method guarantees that the highlighted themes are not only subjective interpretations but are firmly substantiated by the data and are repeatable across independent analytical viewpoints.

The results of the interview coding are summarized and displayed in Table 4.

Table 4. Interview coding result and theme grouping

Coding results related to the problems faced (Stage 1)	Sources	Coding Stage 2 Results	Sub theme grouping	TOE theme grouping
Data can usually be obtained from the respective Online Travel Agent (OTA) extranets.	Hotel	Data sources from OTAs	Interoperability	Technology Factor
Data can be obtained from Smith Travel Research (STR) and the hotelier WhatsApp group (WAG).	Hotel	Data sources from STR and WAG	Interoperability	Technology Factor
We sometimes share STR data with other hotels and ask for data from other hotels.	Hotel	Data sources from STR and Hotels	Interoperability	Technology Factor
We get data more often from the OTA.	Hotel	Data sources from OTAs	Interoperability	Technology Factor
We have more benefits by getting data from OTA, especially for forecasting.	Hotel	Data sources from OTAs	Interoperability	Technology Factor
It is usually obtained from the hotel system other than the OTA.	Hotel	Data sources from hotel systems	Interoperability	Technology Factor
Fellow competitors usually make data reports daily for benchmarking.	Hotel	Data sources from competitors	Interoperability	Technology Factor
The corporate office shares reports for each hotel branch.	Hotel	Data source from the head office	Interoperability	Technology Factor
The Statistical Bureau only provides basic statistical data.	Hotel	Data source from BPS	Interoperability	Technology Factor
The process of data exchange is not easy.	Hotel	Confidential data exchange	Security and confidentiality	Technology Factor
Each government bureau has its interest, so sharing data is difficult.	Policy maker	Difficult to share data	Collaboration	Technology Factor
Interoperability is also problematic.	Policy maker	Interoperability issues	Interoperability	Technology Factor
The data structure is not standardized and cannot be easily integrated.	Policy maker	Data structures cannot be integrated	Interoperability	Technology Factor
The data sharing would be good if we could hide some parts/details.	Policy maker	Data must be kept confidential	Security and confidentiality	Technology Factor
The OTA will install restrictions so hotels only see their data.	Distribution channel	Data must be kept confidential	Security and confidentiality	Technology Factor
We must not reveal the hotel's name in the ranking list because confidentiality must be maintained.	Distribution channel	Data must be kept confidential	Security and confidentiality	Technology Factor
We use Smith Travel Research (STR). It is a paid tool and a third-party platform. It seems quite expensive too.	Hotel	Cost	Financial resources and costs	Organizational Factors
Providing this data for free to a hotel to avoid costs.	Hotel	Cost	Financial resources and costs	Organizational Factors

Coding results related to the problems faced (Stage 1)	Sources	Coding Stage 2 Results	Sub theme grouping	TOE theme grouping
Not all hotels track internal data correctly, so they cannot analyze it correctly.	Distribution channel	Hotel manager competencies	Organizational readiness	Organizational Factors
If it is a 3-star hotel or above, they can analyze it. If it is below that, it does not happen because they do not have data.	Distribution channel	Hotel manager competencies	Organizational readiness	Organizational Factors
It differs from high-star hotels because they already have the data and the knowledge. The managers are sophisticated and have gone to a special school.	Distribution channel	Hotel manager competencies	Organizational readiness	Organizational Factors
We have not used a computerized system. It is still manual.	Hotel	Hotel manager competencies	Organizational readiness	Organizational Factors
Now, it is all the same: it has to be IT. We go digital and inevitably have to invest in IT and people. If not, we can lose.	Hotel	Hotel manager competencies	Organizational readiness	Organizational Factors
Data-sharing practices are very common, but their completeness is problem-atic.	Distribution channel	Data sharing issues	Collaboration	Organizational Factors
There is no tool yet for sharing and processing data.	Hotel	Data sharing issues	Collaboration	Organizational Factors
We share data, but it is a lie (hidden in some parts). We share by calling other hotels to find out competitor data.	Hotel	Data sharing issues	Collaboration	Organizational Factors
We share, but 5-star hotels usually use their STR, so they do not share with smaller ones.	Hotel	Data sharing issues	Collaboration	Organizational Factors
The data sharing method is usually done manually through the chat group of receptionists.	Hotel	Data sharing issues	Collaboration	Organizational Factors
The Ministry of Tourism and Creative Economy plays more of a facilitator role, so it does not have the regulatory authority to force data collection.	Policy maker	Data collection by regulators	Government support	Environmental Factors
There is an industrial survey on tourism and creative economies every year.	Policy maker	Data collection by regulators	Government support	Environmental Factors
The revenue data survey is not conducted every month, so it is just an ad-hoc survey.	Policy maker	Data collection by regulators	Government support	Environmental Factors
The hotels do not have enough awareness to submit data independently. So, it still has to be pushed [by the government].	Policy maker	Data collection by regulators	Government support	Environmental Factors
We hope this government data center will be a data hub. The system or plat-form may be integrated with many data sources.	Hotel	Data collection by regulators	Government support	Environmental Factors

Table 5 shows the issues addressed by stakeholders during the interview. Hotels seem to have more stakeholders addressing concerns across multiple categories, especially the "Multiple data sources issue". It suggests that hotels face significant challenges with BI adoption. Policymakers are heavily involved in "Government support" and "Interoperability" issues, indicating their critical role in regulating and standardizing BI systems. The Distribution Channel primarily shows concerns related to "Collaboration," "Organizational Readiness," and "Security and Confidentiality," implying their focus on data exchange and internal capabilities.

Table 5. Issue addressed by stakeholders based on theme grouping

Sub-theme grouping	Issue	Statements addressing the issue		
		Distribution channel	Hotel	Policy maker
Collaboration	Data sharing issue	1	4	1
Financial resources and costs	Cost		2	
Government support	Data collection by regulators		1	4
Interoperability	Data structure and integration issues			2
	Multiple data sources issue		9	
Organizational readiness	Hotel manager competencies	3	2	
Security and confidentiality	Confidentiality in data exchange	2	1	1

RESULTS

Table 4 shows that all parties agree on improving collaboration and security to overcome data sharing and exchange issues. However, the hotels themselves encounter challenges in data management due to the influx of information from multiple sources and platforms, coupled with a lack of adequate expertise to perform analyses that facilitate data-driven decision-making. While policymakers recognize the necessity of data collection, they express concerns regarding the industry's ability to share, exchange, and integrate information in a secure and controlled manner. Hotel distributors appear to encounter fewer challenges than other stakeholders, attributed to their superior technology and adeptness in data management. Our findings found no conflicting stakeholder requirements or viewpoints regarding the need for a BI system to enhance their competitiveness in the industry.

The findings are presented as significantly emerging themes and subthemes derived from the data analysis in the previous section. The results are discussed using the TOE framework developed by Tornatzky and Fletscher (1990) to investigate the factors and determinants for successful BI system adoption in the hotel industry. Regarding technology, we found that interoperability problems and data security were barriers to adopting BI systems in the hotel industry. Regarding organizational factors, the hotel industry is still experiencing problems with competent human resources to manage data, problems in data collaboration with fellow hotel managers, and the high cost of implementation. Regarding environmental factors, regulators' lack of support and encouragement regarding data management in the hotel industry is also an inhibiting factor in the adoption and implementation.

TECHNOLOGY FACTOR

Interoperability

The interoperability of various tools and applications used by hotels to obtain data is one of the obstacles to adopting a BI system in the hotel industry. In practice, hotel managers still carry out manual data collection and comparisons from various sources, both internal data (spreadsheets, property

management systems), external data (OTA extranets, third-party data provider websites), and social media (WhatsApp groups). This condition certainly makes it difficult for hotel managers to analyze because no platform/system can unify data in one place, as stated by the following participants:

> The common way is through the OTAs, which have complete data. Sometimes, we share data with other hotels and ask for data from other hotels. So, I must manually check occupancy, average room rate, revenue, and others. Sometimes I share via WhatsApp, and sometimes I meet directly with other hotel staff. (HTL2)

> Data is needed for analysis and evaluation, and I usually obtain it from the internal hotel system and OTAs. When I need sales control, I usually share the data with others. We usually share data daily with competitors to check if we are head-to-head in occupancy. (HTL10)

Regulators can play a role in developing standardization of hotel data and providing a data repository platform, especially those related to hotel revenue management data, such as occupancy rate, average daily rates, and revenue per available room. This data can complement the standardization of one data policy developed by the Indonesian government because the available data is more focused on tourism statistics data obtained from the statistical agency. Suppose the regulator can provide this data repository platform. In that case, it can be a reasonable basis for developing a BI system that integrates all available data to support the hotel industry in optimizing its revenue management. The following is a statement from the source of the Ministry of Tourism:

> The sectoral statistical data are the responsibility of each ministry. Thus, exchanging data is not an easy process. All ministry agencies create data for the sake of their respective institutions, not for others' interests, making it hard to share. Interoperability is also a problem. We still have problems regarding metadata and data structure, so it cannot be integrated easily. (REG1)

Security and confidentiality

Data security and confidentiality must be prioritized when implementing a BI system in the hotel industry because they can affect the level of trust of hotel managers in using the system. Hotel managers are generally willing to share data with competitors collaboratively. This practice is common among hotel managers who manually share data daily through social media platforms. However, there is a weakness in the practice. The data is often manipulated before distribution, with the numbers added or increased for prestige reasons. This weakness can be minimized if the data collected is not presented on a hotel basis and uses data aggregation instead, as stated by the following participants:

> The shared data is good if it is hidden in some way. (HTL8)

> Data providers must restrict what data can be seen by a hotel because confidentiality must be maintained. For example, in one region, the competitiveness ranking of the hotels can be displayed among others without revealing the name of the hotels. (DCH1)

Organization Factor

Organization readiness

Most small, domestic (local), and independent hotels do not have reliable resources for optimal revenue management practices. They do not have sufficient information technology expertise when managing data to maximize their revenue. For hotels that do not yet have a system, hotel managers often do not record data consistently and correctly internally (for example, when guests check in, data is not collected). The use of data provided by business partners (such as OTA) still depends on everyone's acceptance of technology. For those who are technologically savvy, hotel managers can view data independently through the extranet provided by OTA. However, hoteliers who are not technology-savvy still manually request data from the OTA market manager via email/chat, as explained by these participants:

> Not all hotels track internal data correctly, so we cannot analyze it. (DCH4)
>
> They can probably manage the data for a 3-star hotel and above, but this is not true for smaller ones. It differs from high-star hotels because they already have the data and the knowledge. The General Manager (GM) is sophisticated, got into a special school. (HTL11)
>
> We do not have a system to maintain and analyze the data yet. We have not used a computerized system; it is still manual. (HTL16)

To be able to analyze data properly, hotel managers need to prepare an information technology infrastructure and adequate human resources so that they can remain competitive in the market, as explained by this participant:

> Everything must use IT, especially with the current pandemic. I feel like I am in a dark tunnel. We must have the tools and a management system, and invest in a digital platform. If not, you can lose. (ASO2)

Collaboration

Data collaboration is a common practice for hotel managers every day. However, the data obtained cannot be fully trusted because the collaboration is done manually, especially for small/medium-sized hotels. This manual collaboration is one of the obstacles to adopting a BI system in the hotel industry. For that, we need a system that allows data collaboration to be carried out regularly, where hotel managers can report the requested data. These participants explained this issue clearly:

> The practice of sharing data is prevalent. The completeness of the data is problematic. It is impossible to share the exact details of the data. So, every night shift at the hotel, the front desk calls the hotel next door. We do not give total occupancy. For example, when the occupancy reached 70%, I would say 90% instead. (DCH1)
>
> We exchange occupancy and average rate data, but lie. It is usually the salesperson who checks other data. We usually call between hotels to find out competitor data. (DCH4)

Financial resources and costs

The limited financial resources to finance the implementation of a BI system are one obstacle hotel managers face, mainly in domestic, non-five-star, and independent hotels. Until now, the practice of monitoring performance compared to competitors in the surrounding area has only been carried out by big hotels (5-star or global chains) using third-party data platforms, such as STR, as stated by this participant:

> Global chains have used the Smith Travel Research (STR) tools. It is a paid third-party platform. It seems that the subscription price is relatively high, too. (OTA1)

Due to the limited financial resources, hotel managers need a data-sharing platform that can integrate various data and can be used at affordable costs, even free of charge, as explained by these participants:

> If a company provides the data and platform for free, the hotel may want to use it. So, as long as it does not add to my operational cost, I am willing to submit and share data. (HTL10)
>
> Currently, there is no integrated system. There should be a dashboard to highlight the market conditions. There is no such thing yet, so we have just been guessing all this time. The problem is that it is expensive, so not all hotels can afford it. (ASO2)

From the government's perspective, the problem of investment costs for BI system development is also a challenge because the Ministry of Tourism in Indonesia has more duties towards carrying out policy formulation, coordination, and synchronization functions. As a result of this scenario, the state budget for tourism is not as large as other ministries that are more focused on national development

goals, such as the Ministry of Education, Defense, or Health. This circumstance necessitates investment collaboration between the public and private sectors, as stated by this participant:

> Developing a BI system is also a problem for the tourism ministry because they need money to build infrastructure, technical capacity, and human resources. We frankly do not have enough funds. We should involve the private sector in investment cooperation. (REG4)

Environment Factor: Government Support

Currently, in Indonesia, no regulation or central government policy explicitly regulates hotel industry data management or BI implementation in the hotel industry. In general, the tourism ministry has more of a role as a coordinator (not a regulator) because the authority of the tourism industry is more owned by the respective local (provincial) governments. This condition also causes obstacles to infrastructure development in terms of government funds, as described in the previous section, so a legal umbrella is needed to implement government cooperation with the private sector. These conditions are explained clearly by these participants:

> The Ministry of Tourism and Creative Economy is a ministry whose function is more of a coordinating function, so it is not a ministry that can issue binding regulations. (REG1)

> We must also be careful when formulating an investment cooperation model between the government and the private sector because this is a data issue. Data may be opened to the public, and some may not. What is clear is that the first thing that needs to be addressed is the regulatory aspect, lest it violate the regulations. In terms of budgeting, the regulations must be in place first, and then the budget and cooperation schemes can follow. (REG4)

The government collects data only in the form of a survey. It is not routinely carried out, so the data collected cannot be analyzed regularly because the purpose is more likely to be profiling, not to support revenue management and competitiveness of the hotel industry. In addition, the government has not required all hotels to submit data, so the data collected is potentially incomplete, as explained by this participant:

> We [the Ministry of Tourism and Creative Industry] conduct surveys for the hotel industry. A survey was conducted to see their income from the previous year. The statistics agency also conducted the survey directly in hotels. If I am not mistaken, it was two years ago. They developed an online application for each hotel to be able to input the required data. However, we must push the hotels to use it because they do not have enough awareness to participate. (REG2)

Figure 2 summarizes the barriers identified for each technology, organization, and environmental factor in this study.

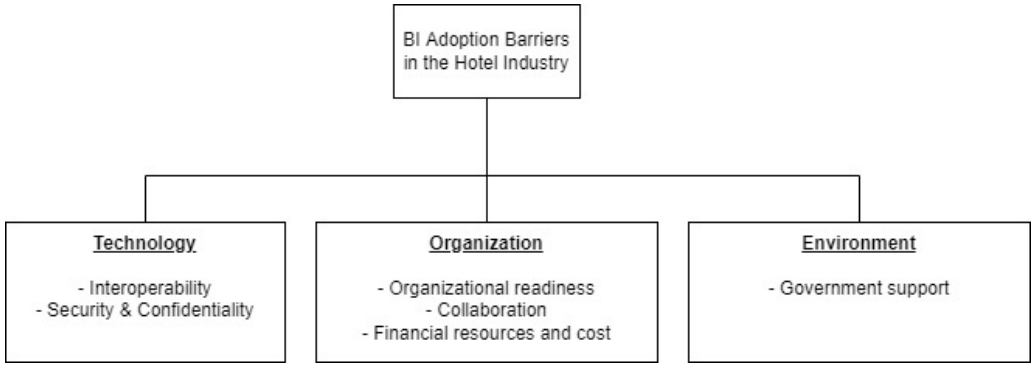

Figure 2. The barrier to the adoption of BI systems in the hotel industry

ACTIONS

This qualitative research study aimed to explore the barriers to adopting the BI system in the hotel industry in Indonesia and suggest recommended actions to overcome the issues by stakeholders, as shown in Figure 3. When we asked further questions about the actions that can be taken to overcome the barriers, the respondents mentioned six major themes, as presented in Table 6.

Table 6. Actions and illustrative quotes to overcome barriers

Actions	Illustrative quotes from participants
Regulation enforcement	• The first thing that needs to be addressed is the regulatory aspect. • We know that this may be our challenge in the government regarding data. • There is no precise regulation regarding data submission from the regulator.
Continuous commitment	• We are willing to share data continuously if it is not detailed. • There is an industry survey, not every month, so it is only one. However, the awareness of the hotel is also not good, so their commitment must be pushed, too.
Coordination and relationship enhancement	• We always think about competing and sometimes do not think about increasing competitiveness by collaborating. • We are given the mandate to collaborate or coordinate with other ministries. • Industrial managers must have a more innovative character and be willing to collaborate because that makes them better able to survive in a pandemic. • This pandemic is like an eye-opener that collaboration is the key to success in all industries. • To get to that level, small players must collaborate with big players. Then the government should also be able to facilitate it. If not, then they stop there, right? Maybe during regular times, they rise again, but when there is a shock, the fall is so severe that they can even go out of business.
Data sharing automation	• We need it because Indonesia has no data exchange platform provider, as the technology is quite sophisticated. • I consider it more effective to use online data so that the accuracy of the data is more precise. It is good to combine data from OTA and hotels so that the data can be more accurate. Over time, technology has supported data collection with one or two people. If there is an application, it will be even better.
Decision support system	• We need to know how to make a platform to help revenue management because many companies need to implement it now. • If there were a system where I could cover all information, I would be well informed as a GM or owner. Currently, we are using a system from another country that makes the projections wrong because they do not understand the depth of our market, provide wrong price recommendations, and perform wrong hotel benchmarking.
Skill enhancement	• The manager must be trained, and the leader must know that we must change ourselves. • There is a knowledge gap. 5-star hotels can do it independently. However, the story is different from 3-star hotels and below. • We want to have a good sales analyst because we do not know the steps ahead if we do not know the data.

We group the issues faced by stakeholders into five categories: "lack of regulation," "lack of trust," "lack of data integration," "lack of accuracy," "lack of resources," and "lack of competence." As discussed in the previous sections, the issues are grouped into technological factors, organization, and environment. Actions that have been identified also correspond to these five categories. Figure 3 illustrates the mapping of each issue and barrier experienced by stakeholders with the actions that stakeholders are expected to take. In particular, the statement regarding the "lack of regulatory" support is a top issue. Therefore, stakeholders expect regulation, policy, and enforcement. If this is not addressed correctly, then the data integration problem in the hotel industry will be challenging to resolve. A legal umbrella is also needed to overcome the "lack of trust" between stakeholders, maintain industry players' commitment to collaborate in providing data, and ensure its security and confidentiality. One of the solutions to overcoming data confidentiality is to use data aggregation, percentage, and area clustering so that users do not have to worry about raw data that competitors can see. Based on the perspective of hoteliers, the following are some examples of practices to minimize data confidentiality issues: (1) hotels are given sales ranking information according to their area without knowing the name of the hotel; (2) view the ADR based on the average hotel around; (3) show percentage of hotel sales compared to all hotels in the area; and (4) other hotel data is hidden as a form of confidentiality, so hotel managers can only see their hotel statistics.

Furthermore, the practice of collecting, analyzing, and making data decisions needs to be improved through capacity building for human resources skills ("lack of competence") and automation through a cloud-based system ("lack of data integration"). For this reason, the participants in the interview agreed that it is necessary to develop a free platform (due to "lack of resources") that they can use together to share data and perform analysis in it, so that they no longer need to do it manually ("lack of accuracy").

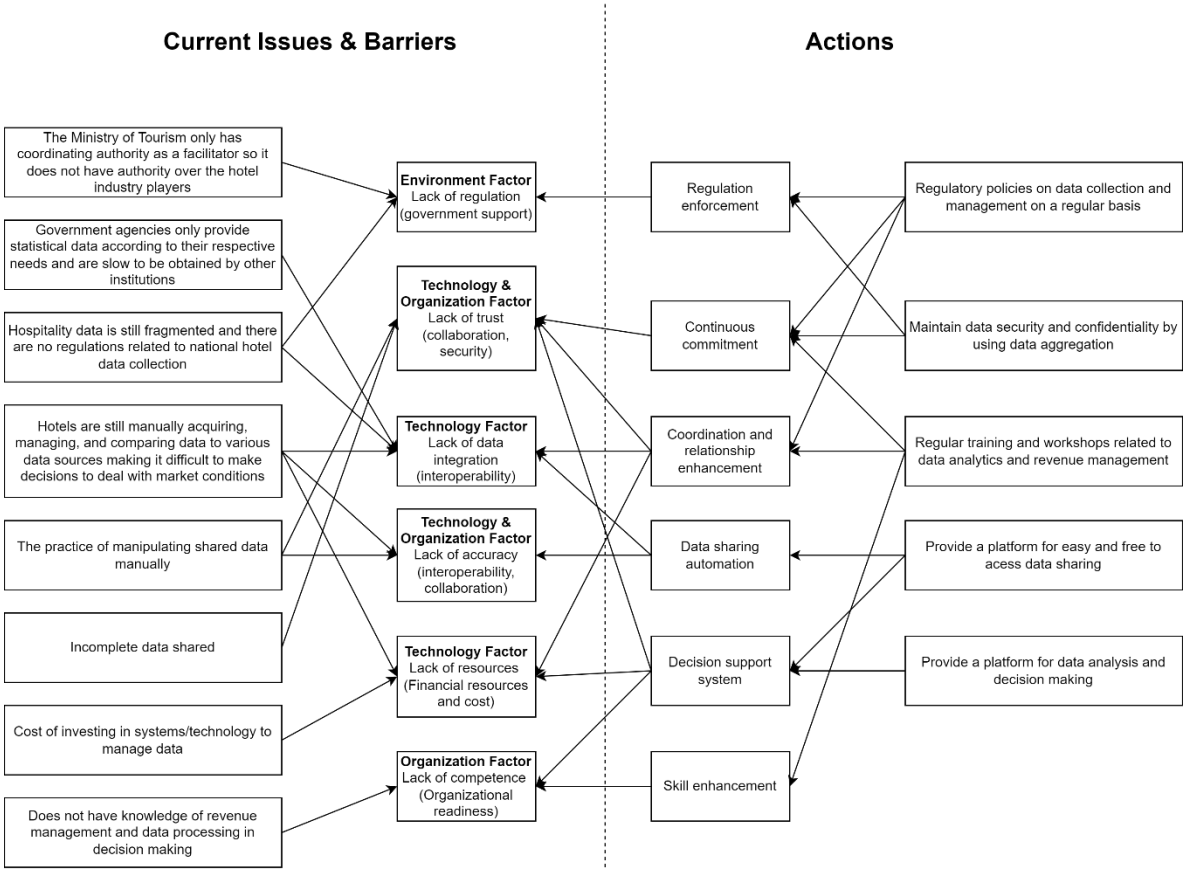

Figure 3. Actions to overcome the barriers to the adoption of BI systems in the hotel industry

DISCUSSION

Understanding the constraints and barriers can lead to best practices for adequately adopting a BI system and enhancing decision-making success in the hotel industry to generate value for all stakeholders and sustain a competitive advantage. We found three technological barriers (interoperability, security & confidentiality, and financial resources & cost). In addition, there are two barriers (organizational readiness and collaboration) regarding organizational factors. Furthermore, we found one barrier (government regulation) in the environmental factors.

The stakeholders surveyed for this research emphasized three challenges in particular, which are as follows: (1) the requirement for creating a digital platform for collaboration between businesses, governments, and organizations in the hotel industry; (2) the need to improve data analytical skills in the hotel industry continuously, and (3) the requirement to create creative technical solutions that are secured and affordable by collaborating with and involving public and commercial sector stakeholders. This study categorized these actions into three pillars for further discussion.

The first pillar refers to creating a digital platform and ecosystem to support the growth of all stakeholders. Partnership-based strategies are required to develop business models and promote collaboration to move on this path. In this regard, it emphasizes the significance of technology and infrastructure development in promoting collaboration and the flow of information, creating inter-organizational interactions between stakeholders, and aligning with a study by Huang Yin et al. (2019). This partnership will involve hoteliers collaborating with other hoteliers at the same level and with large hotels, such as global chain hotels or international online travel agents, increasing their knowledge and insight.

The Indonesian government must foster collaboration in terms of providing a platform for data collection, as stated by Vajirakachorn and Chongwatpol (2017). Regulators must act as sponsors of BI projects. A regulatory policy is required to push hotel managers to collect/submit data periodically (e.g., monthly) so that a complete analysis can occur at any time in all regions. This platform can help them collaborate regularly with other hotel managers in real-time/online, not manually, as in the current situation. The ideas align with a case study by Fraihat et al. (2021), who proposed designing such a collaboration framework for the real estate market. This platform will integrate available data internally (hotel sales data) and externally (market data from OTA and statistical data from regulators). As an output, this platform is expected to provide insight into its revenue performance by comparing its competitors' conditions and price recommendations, and predicting market demand at a specific time. This expectation aligns with the framework (Zhang & Song, 2012) proposed to carry out hotel industry forecasting activities that integrate tourism demand forecasting methods with practitioners' knowledge and facilitate information sharing between practitioners.

The second pillar emphasizes creating a blend of cultural and technical competencies to enhance data analytical skills and revenue management capabilities, especially among hotel industry players. This study emphasizes the significance of developing training programs and workshops to enhance talent to sustain economic growth and foster competitiveness, as Brunetti et al. (2020) mentioned. Regulators or industry associations may act as the sponsors of the activities. Activities like this are expected to improve hotel managers' competence and encourage continued commitment to contributing to the project. Activities like this are still very much needed, especially for developing countries, as Khan et al. (2010) stated.

The third pillar emphasizes the constraints brought on by financial commitments to technological solutions and concerns regarding the security and confidentiality of data that competitors should not know. In this respect, it focuses on the significance of technology and infrastructure advancement, which must be complemented by increased security protection of such data and information and general awareness of the dangers resulting from their irresponsible usage, as Brunetti et al. (2020) argued. The lack of trust among fellow hotel managers in data disclosure can lead to a lack of

commitment to collaborating with other managers. This situation should be overcome by ensuring data security and confidentiality. The data shared will not be visible to other parties, but is displayed in the form of data aggregation so that everyone cannot see their competitor's data. In this respect, hotel managers can commit to continuing to share data for the common good without worrying about the data being seen by competitors directly. For hoteliers, the cost of the BI system is a significant issue (Caseiro & Coelho, 2019; Zhang & Song, 2018). One option to address the cost issue is to provide qualified users with free access so that, rather than requiring a fee, they must agree to disclose information to use the system. The BI system should be a cloud-based application as the Internet has become the most cost-effective communication platform (Hamidinava et al., 2023; Zhang & Song, 2018).

This study distinguishes itself from earlier investigations by addressing the gap in hotel industry-level scope, in contrast to previous studies that generally focused on specific organizations and small and medium enterprises (SMEs). For example, Daryaei et al. (2013) examined the adoption of BI at a single hotel resort. Previous studies also show that many industry studies on BI system adoption have focused on SMEs, not hotels. For example, an exploratory firm-level study by Puklavec et al. (2014) examined the determinants of BI system adoption in Slovenian SMEs, which would inform framework development and testing. Another study by Stjepić et al. (2021) used the Technology-Organization-Environment Framework to analyze the risks of adopting BI in Croatian SMEs.

The findings of this study correspond with the BI adoption issues identified in the research by Fakier (2021) and Martins et al. (2025), while highlighting the distinct context of the sector that encompasses various stakeholders. The study enhances both by delineating actionable measures, including regulatory enforcement, sustained commitment, coordination enhancement, and automation of data exchange.

CONCLUSION

This study successfully analyses the barriers to BI system adoption in the hotel industry through technological, organizational, and environmental perspectives, emphasizing stakeholder collaboration as a critical lens. The barriers are delineated in Figure 2: interoperability, security and confidentiality, organizational readiness, collaboration, financial resources and cost, and government support. A corresponding action diagram has also been developed to address these barriers, as illustrated in Figure 3. This diagram includes regulation enforcement, continuous commitment, coordination and relationship enhancement, data sharing automation, decision support systems, and skill enhancement.

This research provides a broader perspective from multi-stakeholders at the industry level, in contrast to existing studies mentioned in the literature review that focus on the organizational level within the hospitality sector (Table 1). Thus, this study contributes to the existing literature in three ways. First, it identifies the challenges and barriers faced by stakeholders in the hotel industry in adopting the BI system using the TOE framework approach. We found that government support was the most crucial environmental factor. Second, this study outlines the value of understanding the multi-stakeholders' perspective to analyze actions that organizations and public administrators can undertake to successfully face the challenges of BI system adoption and implementation. Thus, this study reaffirms that inter-organizational cooperation between stakeholders is needed to overcome the challenges and improve the tourism industry (Huang Yin et al., 2019). Third, this study outlines that the success of any system depends on people. Only through investment in the people who work daily can the BI system enhance their organizations' productivity, thus promoting the sustainable development and competitiveness of the country as a whole (Brunetti et al., 2020).

This exploratory study also provides practical implications for managers and policymakers to face the challenges of BI system adoption. We expect our results to provide a deeper understanding of the barriers to BI system adoption in the hotel industry. Through this study, stakeholders are expected to better understand that collaboration is needed to increase their competitiveness and the industry. In

general, the results of this research suggest a mapping of actions that can be undertaken to overcome the barriers. Industry players must understand that they need to improve their knowledge and skills so that their organizations are ready to adopt technological innovations that can improve their competitiveness. They are also required to maintain a commitment to collaborate with other stakeholders, including competitors, to increase the value of the BI system implementation at the industry level. Government officials can learn what the industry player considers crucial challenges in the sector before initiating and planning BI system development.

Based on our findings, the following points may guide stakeholders in the hotel industry for practical recommendations:

1. The development of the government's regulatory framework is essential for developing a national BI system within the hotel industry.
2. Strengthening government-private sector cooperation. This encompasses funding sources and business models that can sustain the operational viability of the BI system.
3. Infrastructure preparation encompasses hardware, software, databases, data warehouses, and networks.
4. Created a BI system and identified multiple stakeholders for pilot projects for data collection.
5. Mandating data collection from all data producers, including OTAs, hotels, and government entities.

Limitations and Future Studies

This study identified barriers to BI system adoption in the hotel industry in Indonesia using the TOE framework, involving multiple stakeholders such as hoteliers, hotel distribution channels, and public administrators in the tourism sector. This study thoroughly examines the adoption of BI systems in Indonesia and may apply to other emerging nations with comparable technological, regulatory, or cultural traits. Information from this study might help government officials or system developers plan and implement a BI system at the industry level.

Although this study adds to the body of research on adopting BI systems, it should be emphasized that it has several limitations. First, the study's sample size includes only the hotel industry's stakeholders from the same country. Therefore, more representative insight should be conducted in this study on a larger sample of hospitality and tourism organizations that are geographically more dispersed. Second, only qualitative methodologies are used to analyze this research. A quantitative analysis is also advised for future studies to understand the findings better and gain more specific evidence of the barriers and actions that need to be established.

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