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The Effect of Small Particulate Matter on Tourism and Related SMEs in Chiang Mai, Thailand

Phisek Srinamphon [1], Sainatee Chernbumroong [2,*] and Korrakot Yaibuathet Tippayawong [1,3]

[1] Faculty of Engineering, Department of Industrial Engineering, Chiang Mai University, Chiang Mai 50200, Thailand; phisek_sr@cmu.ac.th (P.S.); korrakot@eng.cmu.ac.th (K.Y.T.)
[2] Faculty of Business Administration, Department of Management and Entrepreneurship, Chiang Mai University, Chiang Mai 50200, Thailand
[3] Supply Chain and Engineering Management Research Unit, Chiang Mai University, Chiang Mai 50200, Thailand
* Correspondence: sainatee.c@cmu.ac.th; Tel.: +66-95-1390-8409

Abstract: In northern Thailand, the problem of small particulate matter arises every year, with the primary source being agricultural-weed burning and wildfire. The tourism industry is strongly impacted and has been in the spotlight for the past few years. Thus, this study aims to investigate the effect of small particulate matter on tourism and related SMEs in Chiang Mai, Thailand. The data were collected from 286 entrepreneurs in the tourism and related SMEs sectors. The data were analyzed using data mining and association-rule techniques. The study revealed that small particulate matter has a considerable impact on customer factors, especially when the number of customers has decreased. Operational factors and product/service factors are also affected by the dust in the form of adjustments to keep the business running and the protection of the health of employees and customers. Certainly, financial factors are affected by the small particulate matter situation, both lower revenues and higher costs.

Keywords: tourism and related; SMEs; small particulate matters; association rules; data mining

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1. Introduction

Chiang Mai is one of the world's most beautiful and romantic cities, renowned for its stunning features, distinct atmosphere, and creative spirit. Mountains, rivers, waterfalls, lush rainforests, and other natural treasures surround the city. Chiang Mai is best visited between November and January when the weather is pleasant and cool. Nevertheless, Chiang Mai experiences small particulate matter that exceeds the general atmospheric air quality standard every year, especially from January to April. SPM has many negative impacts on health, the environment, the economy, and especially the tourism sector. Tourists are particularly concerned about the aesthetics of the travel destination; small particulate matter impairs visibility, which reduces the beauty of tourist attractions. The low visibility from small particulate matter causes travel delays and cancellations. Perceived health threats affect the willingness of tourists to visit certain places and cause tourists to change their travel destinations. It causes the number of tourists to decrease significantly.

Tourism is tremendously important to Thailand economically. Tourism brings significant income to the country, as evidenced by the 38.3 million foreign tourists in 2018, generating more than 2 trillion baht in revenue. While for domestic tourism, 226 million Thai visitors generated 1.1 trillion baht in tourism revenue in 2018, which accounted for approximately 16% of gross domestic product [1], with many businesses involved, especially in the form of SMEs. These SMEs reduce unemployment, help alleviate poverty problems that affect the country and encourage the production of local products, such as souvenirs and services that are unique to the local area. This also contributes to cultural preservation.

However, tourism businesses are susceptible to unusual events that are beyond their control, such as economic problems, political events, disasters, and disease, all of which affect tourists' decisions.

The effects of small particulate matter were studied in relation to many aspects, such as health effects [2,3], environmental effects [4,5], and economic effects [6,7]. For tourism, some aspects were investigated, such as tourists' travel decision-making when small particulate matter occurs [8], and the potential of small particulate matter in reduced domestic tourism in China [6], which focuses on the study of the impact on tourists. Conversely, some studies showed the role of tourism sectors that contribute to small particulate matter [9], although small particulate matter is more frequent and more severe in Thailand, and this pollution problem is a serious concern for the government and civil society sectors. Until now, there is little study that has been conducted on the evaluation of the effects of air pollution on various components of the tourism industry. As a result, there is no conclusive evidence of the effects of small particulate matter on tourism and related SMEs. This missing data are crucial evidence in relation to the impact of air pollution on businesses in the tourism sector. It is also significant information for entrepreneurs in order to plan their business in accordance with the current environment. Moreover, providing this missing information will raise awareness among government sectors and highlight the urgency to address the small particulate matter problem. Therefore, this study aims to investigate the effect of small particulate matter on tourism and related SMEs in Chiang Mai, Thailand.

2. Literature Review

Tourism businesses and tourism SMEs—Tourism is very important to Thailand, especially in terms of the economy. Tourism brings income into the country, creating jobs, alleviating poverty, and encouraging the production of indigenous products, souvenirs, and services that are unique to the local area and which contribute to cultural preservation [1]. Factors influencing tourism consist of motivation [10], destination characteristics [11], convenience, and accessibility [12–14]. The World Tourism Organization describes tourism activities as comprising of accommodation and restaurants, transportation, travel agencies, and recreational activities. From the above activities, The Office of SMEs Promotion categorizes businesses into three categories: i) supporting businesses, such as transportation businesses; (ii) main businesses, such as accommodation and restaurants; (iii) related businesses, such as entertainment businesses and souvenir businesses. The tourism sector and its supply chain are made up of many SMEs. SMEs form the basis of tourism development, and through such enterprises, both tour operators and tourism service providers create an extensive network that helps to widely distribute the economic returns of tourism [15]. Thus, this research focuses on the accommodation business, souvenir business, travel agency business, entertainment business, and restaurant business.

Factors related to SMEs. This research presumes that the impact of small particulate matter on tourism SMEs has arisen through the influence of small particulate matter on factors related to SMEs. The following are some previous studies based on surveys that have dealt with the factors related to SMEs. Chittithaworn [16] identified factors that affect business success in small and medium enterprises (SMEs) in Thailand and found that products/services factor because these are the key strategic dimension of success. The way of doing business and cooperation due to success in business often comes from good execution and the availability of good plans. Resources and finance are factors because stable finance ensures the SMEs' business success. Nabintu and Ntakobajira [17] studied 47 SMEs to establish the factors affecting the performance of small and micro-enterprises (SMEs) traders at City Park hawkers market in Nairobi County, Kenya. They found that the number of customers affected the performance of the business. Customers are the key elements in relation to running a successful business; if there are no customers, the business cannot operate. Happy S. Mpunga [18] reviewed the factors that affect the growth of small and medium enterprises (SMEs) in Tanzania and found that Tanzanian SME growth is mostly impacted by financial constraints and capital constraints. Difficult access to funding

is a barrier to doing business. In addition, if the business cannot generate profits or has enough income, it may affect the survival of the business. Baporikar and team [19] studied the factors hindering small and medium-sized enterprises' (SMEs) growth in the Khomas region in Nambia. By using depth interviews and deep observations, they found that the lack of skilled manpower and poor customer service hinder their business growth. Employee learning, continuity of work, and well-being of the employees will help the business to continually develop and result in business growth. Shpresim Domi and her team [20] identified three significant factors that potentially affect the performance of SMEs within the tourism industry based on a deep literature review and found that training practices are affecting SMEs' performance because the training process will broaden the knowledge and skills of employees and will increase their intrinsic motivation. Based on the findings of earlier research, the factors related to the performance of SMEs can be organized into five categories which are financial factors, customer factors, operational factors, product or service factors, and learning and development factors. In this research, these factors will be used to study the effects of small particulate matter on tourism and related SMEs.

Tourism and small particulate matter; Small Particulate Matter refers to solid or liquid particles suspended in the air that are smaller than 10 µm [21]. They originate from natural and human activities such as wildfires, the combustion of fuel in transportation systems, power generation, agriculture, etc. [22]. Studies on the impact of the particulate matter problem are plentiful, especially in countries with this problem happens frequently. China [23,24] and India [25,26] are top Asian countries confronting serious air pollution problems due to their fast industrial development and over-population in India. Previous studies show that small particulate matter has many negative effects on human health [2,3]. Li [27] investigated the impact of air pollutants on acute respiratory outcomes in outpatients. This study shows that air pollutants had acute effects on outpatient visits for acute respiratory outcomes. Jeong and Sang Jin [28] investigated the health effects of air pollution in Suwon city and found PM10 had an impact on 1,118,000 Suwon residents, causing a total of 105 of the 4254 deaths in one year. Thus, people put more energy into protection by taking such precautions as wearing a protective mask, modifying the nature of outdoor activities, customizing shelters, installing technology to measure small dust particles, and installing residential air purifiers [29]. Some studies have shown the small particulate matter effects on the environment. Hao Wu [4] studied the effect of small particles on urban heat island intensity in Nanjing. This study showed that the daily range of the surface air temperature was reduced by up to 1.1 K due to the particles' radiative effects. Xiao-Ling Zhang showed that the absorption of aerosol particles could cause a 100–400 W/m^2 increase in atmospheric radiation in a study on aerosol optical properties and radiative forcing using ground-based and satellite remote sensing at a background station during regional pollution episodes [5], Santosh Kumar Prajapati studied the ecological effect of airborne particulate matter on plants and found that dust particle size has important and predictable effects on the energy exchange properties of vegetation [30]. For the economic effect, Daxin Dong studied the impact of air pollution on domestic tourism in China and found that air pollution significantly reduces domestic tourist arrivals in the local city [6]. XuXu and Markum Reed examined the interaction between perceived pollution and inbound tourism in China and found that perceived pollution lowers inbound tourism [7]. Although many aspects of the impact of particulate matter have been studied, however, most of the research has mainly focused on the effects of small particulate matter on health.

In the tourism sector, tourist attractions are forced to shut down in those affected places because acid rain can destroy cultural artifacts. Small particulate matter impairs visibility which reduces the beauty of tourist attractions [31], and tourists are particularly concerned about the aesthetics of the sights [32–34]. The low visibility caused by small particulate matter causes travel delays and cancellations. Perceived health threats affect the willingness of tourists to visit certain places and cause tourists to change their travel destinations [32,33] and also change tourism market segments [34]. Small particulate

matter causes the number of tourists to decrease [6,7], and the number of tourists in each attraction decreases significantly. Some research has shown that increased particulate matter is associated with an increase in the number of tourists in the area [9,35,36]. Small particulate matter has led tourists to change their destinations and has caused a decrease in tourists in certain areas. These effects show the possibility that businesses in the tourism sector will be affected by the dust. There is evidence that there is a relationship between the environment and SMEs, and it has been clearly stated that a critical issue that needs to be focused upon is the evaluation of the current impact of the natural environment on SMEs [37]. However, there is no conclusive evidence on the impact of small particulate matter on SMEs in the tourism sector. Therefore, this study is dominant for the reason that it explains the impact of small particulate matter on tourism and related SMEs.

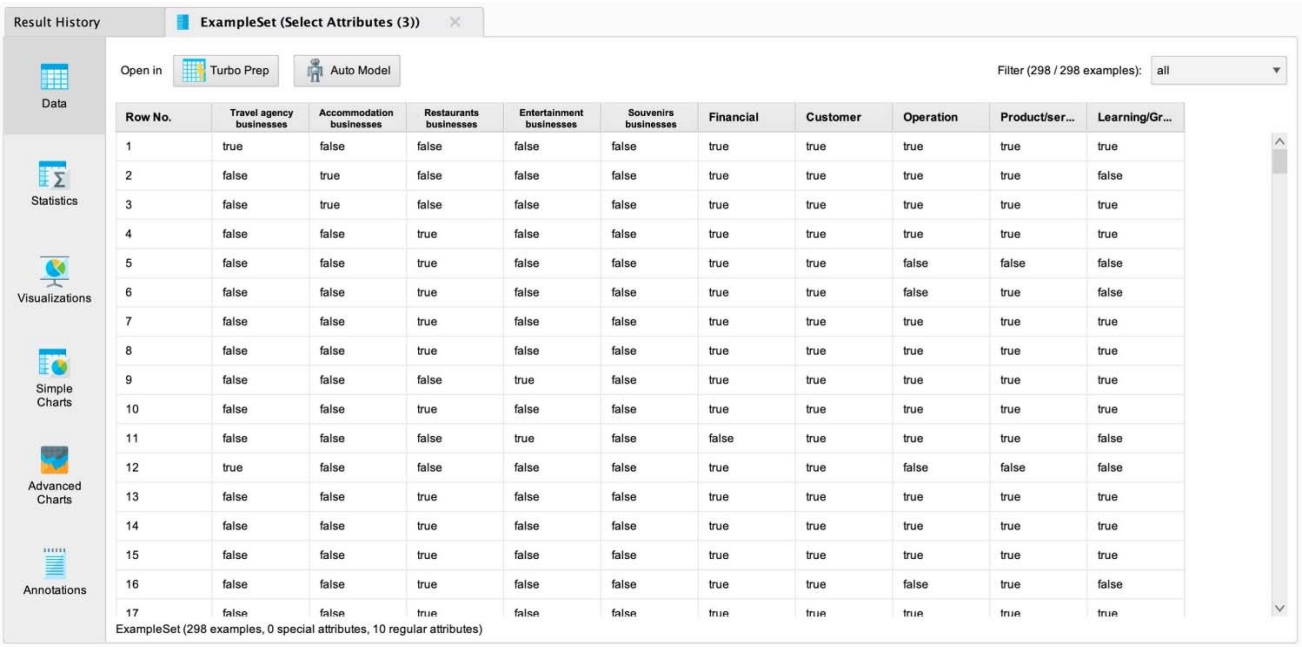
3. Materials and Methods

This study is a quantitative study to illustrate the effects of small particulate matter on tourism and related SMEs. The tourism sectors and related SMEs in this research include accommodation businesses, souvenirs businesses, travel agency businesses, restaurants businesses, and entertainment businesses. The data from the Department of Business Development, Ministry of Commerce, show the number of tourism and related SMEs still operating in Chiang Mai is 916. Therefore, the researcher set the sample size using the Taro Yamane table at a 95% confidence level, requiring the collection of at least 286 samples.

This research presumes that the impact of small particulate matter has arisen through the influence of small particulate matter on factors related to SMEs. From the literature review about factors related to SMEs, the factors to be studied for each business include: (1.) Financial factors, study the impact on income, cost, working capital, and business profit. (2.) Customer factors, study the impact on the number of customers, customer segment, customer satisfaction, and claims (3.) Operational factors, study the impact on operational plan, operation action, and operation result. (4.) Product/service factors, study the impact on product/services, price, distribution channel, and promotion. (5.) Learning and development factors study the impact on learning time, the number of absences, and employee satisfaction. This research applied association rule techniques because it can show correlations and co-occurrences between data sets. The results are shown in the form of a rule indicating the possibility of an effect on the studied factor. For measurements, evaluate association rules based on confidence values and correlation values (Lift). The operating procedures are according to the Cross-Industry Standard Process for Data Mining (CRISP-DM).

The data used in this research were collected from 286 tourism and related SMEs in Chiang Mai by using an online questionnaire. The questionnaire was verified for content validity, language suitability, and reliability (0.925 Cronbach's Alpha Coefficient). The questionnaire used to collect the data was divided into two main parts: 1. A general information section, and 2., the impact of small particulate matter section. For this section, an entrepreneur identified the business factors that were affected by small particulate matter on an online questionnaire. The questionnaire was a 6-level score, using a Likert Scale to determine the degree of the impact of particulate matter on each factor. The data were collected from April 2019 to June 2019, at which time the COVID-19 pandemic had not yet occurred.

To prepare the data for analysis, the data from the questionnaire was transformed to identify the factors affecting each business. After that, a table of factors that affect each business due to small particulate matter was created. An example is shown in Figure 1. Item Row No. 1 Business type is Travel Agency Business(true), Factors effect are Financial factor(true), Customer factor(true), Operational factor(true), Product/services factor(true), and Learning and development factors(true).



Row No.	Travel agency businesses	Accommodation businesses	Restaurants businesses	Entertainment businesses	Souvenirs businesses	Financial	Customer	Operation	Product/ser...	Learning/Gr...
1	true	false	false	false	false	true	true	true	true	true
2	false	true	false	false	false	true	true	true	true	false
3	false	true	false	false	false	true	true	true	true	true
4	false	false	true	false	false	true	true	true	true	true
5	false	false	true	false	false	true	true	false	false	false
6	false	false	true	false	false	true	true	false	true	false
7	false	false	true	false	false	true	true	true	true	true
8	false	false	true	false	false	true	true	true	true	true
9	false	false	false	true	false	true	true	true	true	true
10	false	false	true	false	false	true	true	true	true	true
11	false	false	false	true	false	false	true	true	true	false
12	true	false	false	false	false	true	true	false	false	false
13	false	false	true	false	false	true	true	true	true	true
14	false	false	true	false	false	true	true	true	true	true
15	false	false	true	false	false	true	true	true	true	true
16	false	false	true	false	false	true	true	false	true	false
17	false	false	true	false	false	true	true	true	true	true

Figure 1. Example table of affected factors for each business.

In this study, the FP-Growth algorithm was used to determine the frequent itemset with a minimum support value of 0.30. In association rule analysis, a minimum confidence value of 0.60 was set. The performance of the association rule was examined by confidence value and lift values. The operation was conducted by RapidMiner program version 9.7 by RapidMiner, Inc. in Massachusetts, USA.

4. Results

The results are shown in Table 1; there are association rules that were obtained from the analysis and the interpretation.

Table 1. Association rules obtained from the analysis.

No.	Association Rules Obtained	Interpretation
1	Accommodation ==> Operation Con:0.70, Lift:2.92	The small particulate matter situation has quite an impact on the operational factors of the accommodation business.
2	Accommodation ==> Product/service Con:0.85, Lift:3.38	The small particulate matter situation has quite an impact on the product/service factors of the accommodation business.
3	Accommodation ==> Customer Con:0.94, Lift:3.15	The small particulate matter situation has quite an impact on the customer factors of the accommodation business.
4	Accommodation ==> Financial Con:1, Lift:2.61	The small particulate matter situation has quite an impact on the financial factors of the accommodation business.
5	Accommodation, Customer ==> Financial, Product/service, Operation Con:0.62, Lift:4.04	For the accommodation business, the impact of the small particulate matter situation on the customer factor affects the financial factor, product/service factor, and operational factor.
6	Travel Agency ==> Product/service Con:0.63, Lift:2.51	The small particulate matter situation has an impact on the product/service factors of the travel agency business.
7	Travel Agency ==> Operation Con:0.63, Lift:2.62	The small particulate matter situation has an impact on the operational factors of the travel agency business.
8	Travel Agency ==> Customer Con:0.90, Lift:3.02	The small particulate matter situation has an impact on the customer factors of the travel agency business.
9	Travel Agency ==> Financial Con:0.92, Lift:2.42	The small particulate matter situation has an impact on the financial factors of the travel agency business.

Table 1. *Cont.*

No.	Association Rules Obtained	Interpretation
10	Travel Agency, Financial, Customer ==> Product/service Con:0.68, Lift:2.72	For the travel agency business, the impact of the small particulate matter situation on the financial factor and customer factor affect the product/service factor.
11	Travel Agency, Customer ==> Financial Con:0.94, Lift:2.47	For the travel agency business, the impact of the small particulate matter situation on the customer factor affects the financial factor.
12	Travel Agency, Product/service ==> Operation Con:0.69, Lift:2.86	For the travel agency business, the impact of the small particulate matter situation on the product/service factor and customer factor affects the operational factor.
13	Souvenirs ==> Financial Con:0.73, Lift:1.91	The small particulate matter situation has quite an impact on the financial factors of the souvenirs business.
14	Souvenirs ==> Customer Con:0.89, Lift:2.90	The small particulate matter situation has quite an impact on the customer factors of the souvenirs business.
15	Souvenirs, Customer ==> Financial Con:0.90, Lift:3.02	For the souvenirs business, the impact of the small particulate matter situation on the customer factor affects the financial factor.

According to the analysis results shown in Table 1, this study found that three of the five businesses studied were affected by the small-particulate matter problem, comprising the accommodation business, travel agency business, and souvenir business. It was found that the customer factor was greatly affected. For example, rule No. 3, "Accommodation => Customer Con:0.94, Lift:3.15", means that the accommodation business is affected by the customer factor with a confidence value as high as 0.94, and the correlation (lift) of 3.15 is quite high. In terms of the factors that are affected, it was found that the impact occurred on four out of the five factors studied, including the customer factor, financial factor, operational factor, and product/service factor.

5. Discussion

Several pieces of previous research have focused on the effects of small particulate matter on health [2,3], while there is little research on the impact of small particulate matter on the economy. Recent studies have shown that air pollution affects the tourism industry [37]. In Thailand, the small particulate matter is more frequent and more severe. Although this pollution problem is a serious concern for the government and civil society sectors, until now, little study has been done on evaluating the effects of air pollution on various components of the tourism industry. To fill the gap in the literature, this study has investigated the effect of small particulate matter on tourism and related SMEs sector with a sample of 289 businesses in Chiang Mai, Thailand.

By applying the association rule technique, small particulate matter is found to significantly affect SMEs in the tourism sector on customer factors. When small particulate matter exceeds the general atmospheric air quality standard, tourists' concerns about health effects [2,38], the decreased beauty of the place [39], and travel difficulties arise. These resulted in a decrease in the number of tourists and led to decreased customers. The customers of the tourism and related business are tourists, and the decrease in tourists has a huge impact on the customer factor.

Although there have been no studies mentioned previously on the decline of customers in tourism and related business due to air pollution, the results of this study are consistent with research findings by Namcome [40] that show that the number of tourists in Chiang Mai fell during the small-particulate matter situation. The decrease in the number of tourists also happened in China [36], Cyprus, and Great Britain [35]. In addition, a negative correlation has been found between air pollution and the company's performance [14], and air pollution has been shown to harm human health [41]. In a similar manner, this study found the effect of small particulate matter on products/services and operations. For example, travel routes and places to visit are changed, air purifiers are installed, air filters are installed in the air conditioner, and masks are provided to protect their employees

and service their customers as to maintain the positive image of the business. Travel agency businesses need to use closed buses to travel. Regarding the operational planning aspect, budget planning in accordance with the changing activities is required. Moreover, the impact on customers, products/services, and operations leads to the financial impact in terms of additional expenses such as an increased electricity bill, increase marketing promotions, and a corresponding price reduction in order to motivate customers to use the service, the cost of air filters, a drop in revenue due to decline in customers, etc.

This research highlights the effect of small particulate matter on tourism SMEs to fill the information gap concerning air pollution effects on the tourism industry and point out the impact of small particulate matter on tourism SMEs in Chiang Mai. Therefore, these pollution problems should be solved urgently in order to eliminate the many negative effects due to small particulate matter in order to promote tourism and promote the well-being of the people in the area. The government should expressly respond to the problem. Many things should be done, such as planning sustainable forest fire management and educating people on agricultural waste management in order to raise awareness and reduce the occurrence of small particulate matter. These particles do not have boundaries, so the government should integrate domestic and international sectors to vigorously revise and create cooperation to solve this problem in order to solve this problem at the root cause. Furthermore, develop an environmentally friendly public transport system that will facilitate and support the travel of domestic citizens and foreign tourists. This will result in attracting tourists to the area and increase the number of customers for tourism businesses. The government should set up support measures during times when air pollution occurs, such as sufficiently supplying N95 masks to people in the area and reducing electricity bills for businesses registered as dust-free areas in order to reduce the financial impact by reducing the operational cost of the business. For entrepreneurs, this information will be helpful in planning your business. Knowing the nature of the impact of small particulates on various factors of a business can be prepared in advance. Due to the small dust particles affecting the business operation, entrepreneurs should consider these conditions in the operational plans in order to prepare protective equipment and work procedures during this period. For example, during times of small-particulate matter situations, the need to use air conditioner dust filters and dust masks. In the business plan, capital reserves must be considered for spending on these items for the impact of small particulate matter on the product/service factors, although during those times, there will be fewer tourists entering the area. However, the health concerns of the local people still persist. For this customer segment, accommodation businesses should modify rooms into dust-free rooms and offer these to customers. For travel agency businesses, travel routes should be arranged to avoid areas with dense small dust, etc.

In the future, further studies must be conducted in order to identify the specific area of operations that are impacted by small particulate matter. Moreover, further studies should be conducted in-depth using in-depth interviews or business-specific questionnaires because different business operations may be affected by different small-dust problems. Moreover, this research studies the effects of small particulate matter on the tourism industry and related sectors, so the effects of other pollution on these sectors can be studied further. In addition, these results can be applied to the study of impacts in other business sectors. In view of the adverse situation, there are other interesting events and issues whose impact on many businesses has yet to be sufficiently studied, such as the COVID-19 Pandemic, etc.

6. Conclusions

This study aims to investigate the effect of small particulate matter on tourism and related SMEs in Chiang Mai, Thailand. The data were collected from 286 toruism businesses and related SMEs and analyzed using association rule approaches. Finally, this research found that the accommodation, travel agency business, and souvenir businesses, which are the businesses whose main customers are tourists, were greatly affected by the customer

factor. In addition, operational factors and product/service factors are also affected. Operations used during normal conditions cannot be performed during dust problems. Most importantly, the financial factors were severely affected due to lower revenues and higher business costs during the period. Therefore, it is extremely important that this issue be resolved urgently.

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