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Original Article

The Development of Airport with the Concept of Smart Airport in Supporting Strategic Areas of National Tourism in South Sulawesi Province

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Abstract - *Smart airport concepts have been developed and implemented in developed countries, such as Indonesia. As technology advances, smart airports indirectly appeal to passengers. There is still work to be done to implement smart airports. This research analyzes and models smart airport development factors for supporting strategic national tourism areas in South Sulawesi Province. This research involves a quantitative approach utilizing structural equation modeling analysis with smart-PLS software. The objective is to identify and model the several elements that influence airport development within the framework of smart airports, which in turn promote tourism. The research is divided into exogenous variables consisting of (environmental sustainability, smart safety and security, airport operational optimization, financial solutions, accessibility, smart infrastructure, airport land use, human resources, economics and business, air traffic flow, and technology); Intervening variables (development of airports with the concept of smart airports); and endogenous variables (tourism attractiveness). The results identified 13 variables and 65 indicators, but only 58 were declared valid. Non-compliant indicators are removed from the model. The indicators were removed from the variables of financial solutions, accessibility, human resources, economics and business, and technology. This research concludes that there is a strong direction of relationship if the smart airport concept is applied to Sultan Hasanuddin development airport in South Sulawesi Province to support the strategic area of national tourism.*

Keywords - *Smart airport concept, Development of airport, Technology, Tourism*.

1. Introduction

The concept of a smart airport in a 5.0 society is closely interconnected with the notion of a smart city. The smart airport is a subsystem of the smart city[1]. Smart airport technology has been fully developed and implemented in developed countries, such as Indonesia.

In the future, airports will most likely implement digital technology[2]. The integration of new technology into suitable platforms is a distinct possibility for the development of the future smart airport concept [3].The integration of smart airport technology is constantly advancing.

Dusseldorf Airport in Germany has implemented an automated parking service using an automated system for transporting vehicles and calculating parking area dimensions. At Incheon International Airport in South Korea, a robot provides passenger escort services. Accessing the airport network at San Francisco International Airport, United States, involves using a personal device with a local beacon, an internet connection, and Bluetooth.

This allows passengers to determine their precise location on the airport terminal map and obtain information about the various airport facilities. Self-service through self-check-in and baggage drops has been implemented at Helsinki Vantaa airport in Finland.

The performance of the microchip embedded in new passports at Dallas International Airport in the United States involves storing personal information that is detected through a facial recognition system, which combines a photo of the passport holder with data obtained from a facial scanner.

At Haneda Airport in Tokyo, a humanoid robot was tested to see how well it could respond to seven questions concerning the airport's amenities [4]In Indonesia, a company called PT Angkasa Pura II has implemented the smart airport concept at fifteen airports by developing a digital smart airport concept.

Although a company called PT Angkasa Pura 1 has just recently started to develop and implement the smart airport concept in its services, it is anticipated that the tourist experience will surely be enhanced [5].

It cannot be denied that technology is progressing rapidly. Therefore, it is very important to implement airport development based on the smart airport concept, which can effectively support tourism areas.

From a very long time ago until now, the international tourism sector has been a key driver of economic development in the country for a considerable period of time [7]. As the entry point to eastern Indonesia, South Sulawesi Province exhibits substantial potential for economic prosperity and displays strong prospects across all sectors. Examples of areas encompassing investment development, tourism, and infrastructure can be identified. The government is consistently working to improve its skills, particularly in air transportation infrastructure, which is vital to promoting economic growth and supporting the tourism industry. Sultan Hasanuddin International Airport is a central hub for other nearby airports, facilitating and bolstering the commercial and tourism sectors associated with these interconnected airports. Annually, there has been a substantial growth in the volume of passengers, aircraft, and cargo. The occurrence of congestion at the airport necessitates the implementation of development initiatives [8].

Several researchers have reviewed and analyzed the concept of smart airports. According to previous research, several indicators are considered to have a significant impact on the development of airports with the concept of smart airports, including the fact that smart infrastructure buildings will permit airports to become environmentally friendly and that airport facilities will be equipped with air, noise, video, and light reflection sensors that can utilize renewable energy [9]. Major risk factors struggle with growth, efficiency, cybersecurity, and safety, as they are some of the most critical factors that require more attention in airport operations. The most frequent beliefs are data availability and quality, connectivity, integration of technology, collaboration with stakeholders, security and privacy, return on investment, and compliance with regulations [10].

The most common assumptions are about connection, integration of technology, accessibility of data and performance, collaboration with stakeholders, information security and privacy, investment profitability, and compliance with regulations. This factor implements security and safety systems by utilizing smart cyber security, airside and landside security surveillance, available baggage handling systems as a whole suspect object, and provided facial recognition technology. Smart CCTV services employing analytics-based smart CCTV at an airport can be helpful in monitoring, locating, and preventing movement and danger when personnel are insufficient [11], identification of lost passenger items, detection of pedestrian traffic, detection of passenger terminal lines, detection of traffic monitoring, and detection of accidents, as well as the process of inspecting foreign passengers for immigration[12].

Furthermore, improving performance in the operation of smart parking infrastructures [13]. Technological improvements have made it possible to transmit energy from vehicles to the grid, which has the potential to enhance the value in the automotive, grid, and electrical industries[14], airport operational control, online and real-time field condition monitoring for key airport components, including electrical systems, in-building transportation, fire alarm systems, X-ray and walk-through metal detectors (WTMD), and air circulation throughout the passenger terminal are all contributing factors [15]. Accessibility, which measures how convenient or simple it is to interact with a land-use location via a transportation network system, is a further supporting factor [16]. Accessibility involves domestic and international airlines, online taxi services at airports, tourism shuttle buses, flight routes serving tourist attractions, intra- and intermodal transportation integration, and the availability of specialized transportation services for domestic and international tourists [17]. Smart infrastructure is the next support. In this support, there are passenger departure and arrival terminals, a digital Airport lounge, unique rooms for passengers with disabilities, waiting areas for nursing mothers, smoking areas, and convention and exhibition facilities used for significant activities and events [18].

In addition to implementing smart airport concepts, the presence of various land use elements surrounding airports is anticipated to contribute substantially to airport development's rapid growth. Business services centers, banking facilities, industrial zones for warehousing, natural parks, tourist attractions at the airport, and various spots for local handicrafts are among the key features that will boost the overall appeal and functionality of smart airports [20]. The next factor will require modern organizations to have abundant information resources that significantly impact their human resource factors [21], work experience, responsibility, accomplished technology skills, motivation, dependability, honesty, and a work ethic. The next supporting factor is economic and business services, which help business economic drivers in the airport area and its surroundings generate income and investment by using land for shopping, malls, offices, restaurants, e-commerce, hotels, and micro-condominium facilities that provide passenger comfort, trade, and service-based economic activities.

Air traffic flow is affected by aircraft, passengers, and cargo. The impact of the airport's rapid development rate is an increase in the frequency of changes in movement requirements and a high degree of mobility. The provision of biometric service facilities in developing airports through the provision of technological services is the most important component of the smart airport concept. Using self-check-in kiosks, self-drop-bags, self-boarding gates, and self-boarding passes, users can utilize intelligent self-service facilities. A new, secure method of object and service interaction is provided by the Internet of Things [22].

The Internet of Things has come to be seen as an essential enabler for a number of applications, including smart cities, smart farms, and smart airports. There are significant challenges in the areas of constructing an energy-efficient network and optimizing channel models for energy-efficient communication. [23],

The variety of Internet of Things (IoT) applications is found in most of the new smart airports. However, analysis of smart airport cybersecurity mechanisms is limited [19]; RFID, Big data for the protection of passenger digital information, e-ticketing systems, convenience for passengers and visitors in making payment processes via e-payment at commercial tenants, airport mobile applications, available smart visa and automatic immigration and tourism services [6].

This research proposes a framework for implementing the elements that influence the concept of smart airports in the key national tourism area of the South Sulawesi province. The aim is to apply these characteristics to the development of international airports, with a specific focus on promoting local culture through tourism. The smart airport model for Sultan Hasanuddin International Airport in Makassar was inspired by the butterfly, which is the symbol of Bantimurung National Park, known worldwide as The Kingdom of Butterflies.

This is a tourist attraction for the South Sulawesi Province tourism strategy area. During the development of the airport, the airport area will be decorated with unique architectural features and ornaments that refer to local cultural designs like Phinisi ships, Toraja patterns, and symbols of tourist design on all other tours. With the Angkasa Pura I, the airport development project expects more international flights to occur in the future. This will benefit and have a positive impact on the industry in the strategic area of national tourism in South Sulawesi Province. The aim of this research, based on the description, is to identify and analyze the factors that impact airport development in South Sulawesi Province, specifically in relation to the smart airport concept.

The goal is to enhance the key region of national tourism and make it more appealing to visitors and tourists. It is hoped that this concept will become a dream airport for the future based on advanced technology that can showcase South Sulawesi province’s tourist attractions and local culture through the Sultan Hasanuddin International Airport, and it will also become a special attraction for passengers and visitors.

2. Materials and Methods

2.1. Location of the Research

The location of the research was carried out at Sultan Hasanuddin Makassar International Airport as, a HUB airport for other airports that support tourism in the national tourism strategic area in South Sulawesi Province.

2.2. Data Collection

This research consists of 13 variables and 65 indicators. The variables and indicators in this research are categorized into three parts: variable X, which represents the exogenous variable; variable Z, which denotes the intervening variable; and variable Y, which signifies the endogenous variable. The data-gathering process involved the administration of direct surveys and the completion of the questionnaire. Primary data collection is accomplished by using methods of observation, the processing and distribution of questionnaires to respondents or sources, and the conduct of interviews.

The respondents in this research consisted of 476 participants, including stakeholders, experts, academics, and the public. The purpose of this research is to evaluate the impact of research variables on the growth of smart airports in South Sulawesi Province, specifically in relation to their contribution to the development of the National Tourism Strategic Area. The identification and analysis of these variables will provide valuable insights into the variable influencing. Table 1 displays the 13 factors involved in the main research. Among these variables, variable X represent an exogenous variable comprising 11 variables that influence the concept of smart airports in the development of Sultan Hasanuddin International Airport. The variable Y represents endogenous variables, namely the development of aviation infrastructure through the concept of smart airports. Z stands for intervening variables, namely the tourism industry’s attractiveness in South Sulawesi Province’s supporting attractions for visitors.From Table 2, it can be seen that 65 indicators support 13 variables where variable X affects the change or emergence of variable Y through variable Z. The X variables and their indicators in this research consist of 11 variables and 58 indicators. Furthermore, variable Z is a mediator that is used in the relationship mediate between variable X and variable Y. The intermediate variable is employed as a mediator between the variables X and Y,

Table 1. The variable of research

NO	{ }	Variables
1	X_1	Environmental Sustainability
2	X_2	Smart Safety and security
3	X_3	Airport operational optimization
4	X_4	Financial Solution
5	X_5	Accessibility
6	X_6	Smart Infrastructures
7	X_7	Airport land use
8	X_8	Human resources
9	X_9	Economic and business
10	X_{10}	Air traffic flow
11	X_{11}	Support of Technology
12	Y	Development Airport with the smart airport concept
13	Z	Tourism attractiveness

Table 2. The research indicator

Indicator					
X1.1	Green buildings	**X6.1**	Passenger departure and arrival terminals	**X9.5**	Hotel/micro hotel facilities
X1.2	sensors: Air, noise, video, light monitoring	**X6.2**	Digital lounge Airport	**X9.6**	Condominium facilities
X1.3	renewable energy	**X6.3**	Prayer Room	**X10.1**	Passenger movement
X2.1	Smart cyber security	**X6.4**	Special area for passengers with disabilities	**X10.2**	Aircraft movement
X2.2	Airside and landside security surveillance	**X6.5**	Room of nursing mother and smoking area	**X10.3**	Cargo movement
X2.3	Baggage handling system	**X6.6**	Convention Exhibition	**X11.1**	Biometric service
X2.4	Smart CCTV services	**X7.1**	Business service center	**X11.2**	Intelligent self service facilities
X2.5	Immigration check process	**X7.2**	Banking service facilities	**X11.3**	E-ticketing system and convenience
X3.1	Smart Parking services	**X7.3**	Warehousing industries areas	**X11.4**	e-payment at commercial tenants
X3.2	Airport operational control	**X7.4**	Natural theme park	**X11.5**	Airport Mobile Application
X3.3	Online and real-time monitoring	**X7.5**	Visitor attractions at the airport	**X11.6**	Smart visa and automated immigration services
X4.1	Capital investment	**X7.6**	Special spots for local handicrafts	**X11.7**	E-Kiosk mobile application
X4.2	Government and overseas grants available	**X8.1**	Employee understanding of technology	**X11.8**	Security monitoring of artificial intelligence
X4.3	Reduce expenditure	**X8.2**	Work experience and responsibility	**X11.9**	LED lighting and WI-FI/LIFI
X4.4	Generate revenue	**X8.3**	Have skills about the technology	**Z1**	Government Policy
X4.5	Centralised operation	**X8.4**	Has motivation and reliability at work	**Z2**	Standard Operating Procedures of Airport
X5.1	Domestic and International Airlines	**X8.5**	Having honesty at work	**Z3**	Level of stakeholder understanding
X5.2	Airport online taxi service	**X8.6**	Have an attitude at work	**Z4**	Level of stakeholder participation
X5.3	Shuttle bus	**X9.1**	Shopping center/mall	**Y1**	Theme Park at airports
X5.4	Flight routes that serve tourism destinations	**X9.2**	Office facilities	**Y2**	Cultural tourism objects/entertainment places
X5.5	Intra and intermodal transportation	**X9.3**	Restaurant (Shop and dine service)	**Y3**	Tourism information center

As a result, the exogenous variable has no direct influence on the change or development of the endogenous variable. This research examines the relationship between variable Z, which represents the expansion of airports, including the concept of smart airports, and variable Y, which is affected by the result of variable X. Variable Z is considered an intervening variable and is supported by four indicators. This research examines variable Y and endogenous variables associated with tourism attractiveness, which are measured using three indicators.

2.3. Analysis Approach

Smart-PLS software is used to conduct structural equation modeling research that aims to model the concept of smart airports and considers the impact of airport development on tourism attractiveness. This analysis is carried out after identifying and analyzing the factors and indicators involved.

The results of this research are used to demonstrate the concept of the structural equation model by conducting validity and reliability tests, analyzing the inner and outer models, and conducting hypothesis testing. The analysis method used a quantitative approach based on structural equation modeling analysis to identify and model a set of variables that influence the development of airports in support of tourism through the concept of smart airports.

In this research, analysis was used to test the predicted relationship between constructs by looking for links or influences between these parts. The validity test analysis results were used to create a theoretical model, which was made easier by converting the path diagram into equations. The validity assessment included an examination of the internal structural models as well as discriminant and convergent validity.

In the present work, a structural equation model was used with the Smart PLS software to generate the structural equation that follows:

$$Y = aX_1 + bX_2 + cX_3 + dX_4 + eX_5 + fX_6 + gX_7 + hX_8 + iX_9 + jX_{10} + kX_{11} + lZ \quad (1)$$

By using the Smart-PLS software, a model description is obtained from Tables 1 and 2, as well as Figure 1, shown in Figure 2.

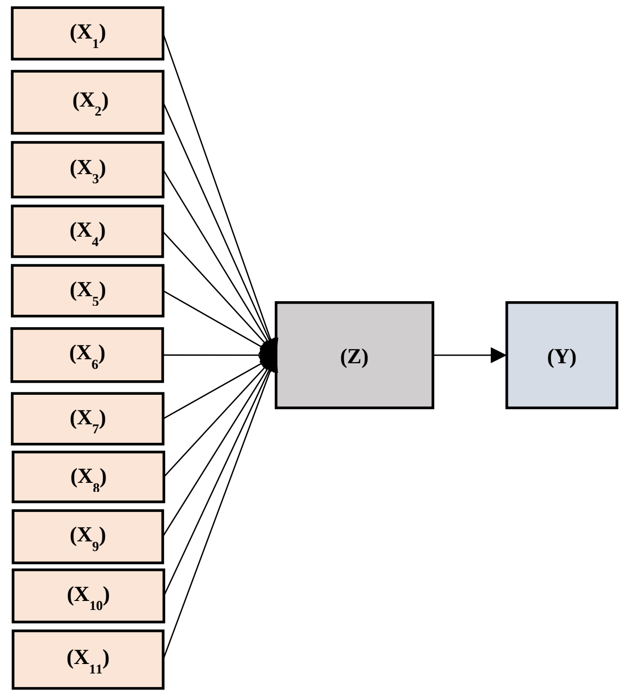

Fig. 1 The conceptual model

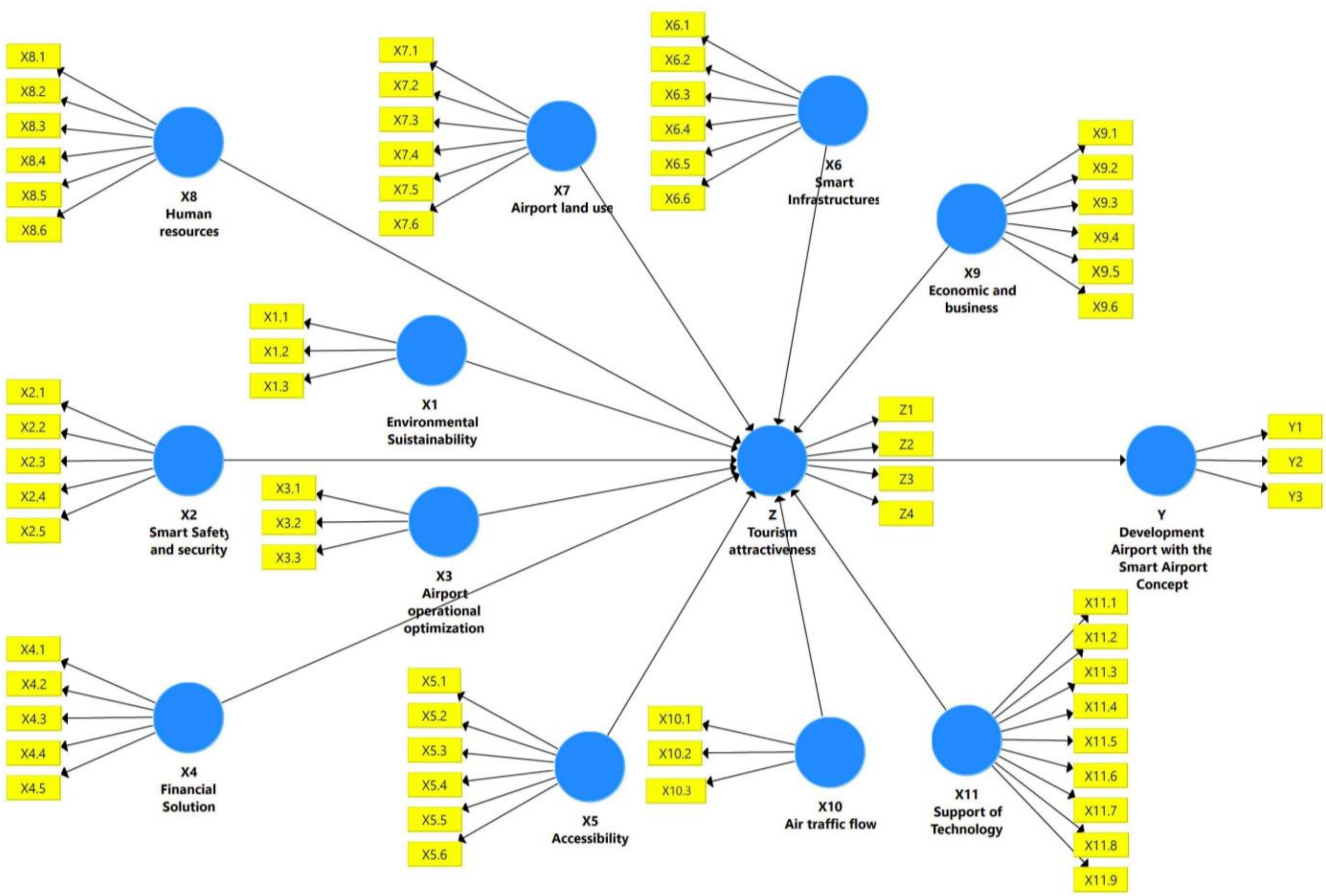

Fig. 2 The conceptual framework model with the SMART-PLS software

Table 3. Discriminant validity

Variable	Indicator	Outer loading	Description	Variable	Indicator	Outer loading	Description
X_1	$X_{1.1}$	0,864	Valid	**X_8**	$X_{8.1}$	0,84	Valid
	$X_{1.2}$	0,886	Valid		$X_{8.2}$	0,834	Valid
	$X_{1.3}$	0,816	Valid		$X_{8.3}$	0,85	Valid
X_2	$X_{2.1}$	0,751	Valid		$X_{8.4}$	0,818	Valid
	$X_{2.2}$	0,846	Valid		$X_{8.5}$	0,653	Invalid
	$X_{2.3}$	0,847	Valid		$X_{8.6}$	0,684	Invalid
	$X_{2.4}$	0,832	Valid	**X_9**	$X_{9.1}$	0,757	Valid
	$X_{2.5}$	0,817	Valid		$X_{9.2}$	0,819	Valid
X_3	$X_{3.1}$	0,901	Valid		$X_{9.3}$	0,822	Valid
	$X_{3.2}$	0,906	Valid		$X_{9.4}$	0,631	Invalid
	$X_{3.3}$	0,887	Valid		$X_{9.5}$	0,792	Valid
X_4	$X_{4.1}$	0,81	Valid		$X_{9.6}$	0,804	Valid
	$X_{4.2}$	0,621	Invalid	**X_{10}**	$X_{10.1}$	0,847	Valid
	$X_{4.3}$	0,662	Invalid		$X_{10.2}$	0,837	Valid
	$X_{4.4}$	0,72	Valid		$X_{10.3}$	0,885	Valid
	$X_{4.5}$	0,706	Valid	**X_{11}**	$X_{11.1}$	0,791	Valid
X_5	$X_{5.1}$	0,67	Invalid		$X_{11.2}$	0,831	Valid
	$X_{5.2}$	0,709	Valid		$X_{11.3}$	0,778	Valid
	$X_{5.3}$	0,812	Valid		$X_{11.4}$	0,812	Valid
	$X_{5.4}$	0,79	Valid		$X_{11.5}$	0,846	Valid
	$X_{5.5}$	0,761	Valid		$X_{11.6}$	0,813	Valid
	$X_{5.6}$	0,723	Valid		$X_{11.7}$	0,804	Valid
X_6	$X_{6.1}$	0,868	Valid		$X_{11.8}$	0,69	Invalid
	$X_{6.2}$	0,844	Valid		$X_{11.9}$	0,733	Valid
	$X_{6.3}$	0,863	Valid	**Z**	Z_1	0,867	Valid
	$X_{6.4}$	0,832	Valid		Z_2	0,89	Valid
	$X_{6.5}$	0,862	Valid		Z_3	0,928	Valid
	$X_{6.6}$	0,775	Valid		Z_4	0,868	Valid
X_7	$X_{7.1}$	0,808	Valid	**Y**	Y_1	0,89	Valid
	$X_{7.2}$	0,804	Valid				
	$X_{7.3}$	0,811	Valid		Y_2	0,908	Valid
	$X_{7.4}$	0,878	Valid				
	$X_{7.5}$	0,821	Valid		Y_3	0,879	Valid
	$X_{7.6}$	0,713	Valid				

3. Results and Discussion

The first step involved using the outer model or measurement model to test the structural model. Then, starting from the variable validity test stages, including convergent and discriminant validity, to the second step, which is the reliability test.

3.1. Validity Test

In the validity test of structural equation modeling, there are two types of validity, namely discriminant and convergent validity. The validity of convergent indicators has the meaning that each indicator represents a single latent variable and those that refer to latent variables. The assessment of discriminant validity involves the application of the criterion of Fornell-Larcker and the examination of cross-loading values. To achieve a high discriminant validity score, the √AVE of a variable must exceed its correlation with other variables. Additionally, the cross-loading test indicates that the values of the indicators are higher than those of the indicators in other constructs. The loading factor, also known as the external loading value, shows the relationship between the score on a question item and the score on the indicator variable that measures the variable. Different viewpoints suggest different parameters for quantifying the loading factor or coefficient of correlation. If the loading factor or load value is greater than 0.70, it is considered valid. The calculation for the discriminant validity test based on closest loadings is shown in Table 3.

Table 4. Correlation between variables (AVE) with the calculated value of the fornell-larcker criterion

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	Y	Z
X_1	0,863												
X_2	0,415	0,806											
X_3	0,606	0,566	0,856										
X_4	0,656	0,568	0,716	0,840									
X_5	0,468	0,688	0,604	0,596	0,907								
X_6	0,723	0,413	0,592	0,637	0,557	0,820							
X_7	0,668	0,543	0,687	0,745	0,556	0,684	0,763						
X_8	0,642	0,575	0,887	0,783	0,609	0,640	0,743	0,843					
X_9	0,573	0,472	0,571	0,624	0,501	0,631	0,603	0,620	0,808				
X_{10}	0,580	0,409	0,575	0,682	0,530	0,803	0,659	0,625	0,581	0,852			
X_{11}	0,654	0,575	0,757	0,775	0,573	0,668	0,734	0,822	0,743	0,680	0,808		
Y	0,651	0,512	0,659	0,712	0,610	0,871	0,711	0,729	0,703	0,811	0,789	0,892	
Z	0,666	0,556	0,661	0,826	0,521	0,637	0,774	0,770	0,675	0,696	0,804	0,752	0,888

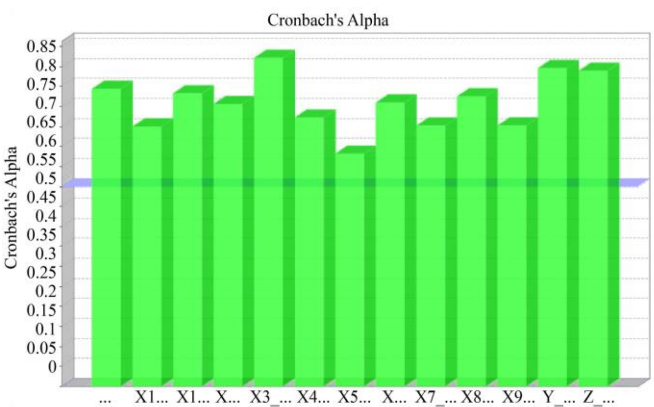

Fig. 3 Calculation of AVE value

According to the results of the discriminant validity test, as shown by the loading factor and outer loading values in Table 3, it was found that out of the 65 indicators corresponding to 13 variables, only 58 indicators were considered valid.

Therefore, it can be concluded that seven indicators are invalid because their peripheral loading values do not meet the requirement of higher than 0.70, necessitating their exclusion from the model. These invalid variables include variable X_4 with two indicators, namely indicators $X_{4.2}$ and $X_{4.3}$ with values of 0.621 and 0.662 smaller than 0.70, variable X_5 with indicator $X_{5.1}$ with a value of 0.670 smaller than 0.70, variable X_8 with two indicators $X_{8.5}$ and $X_{8.6}$ with values of 0.653 and 0.684 smaller than 0.70, variable X_9 with indicator $X_{9.4}$ with a value of 0.631 smaller than 0.70, The results obtained show that indicators with an outer loading value of 0.70 or higher are considered valid and demonstrate a Significant level of accuracy. However, indicators with an outer loading value of higher than 0.70 are deemed invalid and present a low level of validity. According to Table 4 shows that the calculated value of the Fornell-Larcker criterion (√AVE) for all variables is higher than the correlations between the variables (AVE). This indicates acceptable discriminant validity for all variables examined in this research.

Table 5 and Figure 3 show that each variable's AVE value exceeds 0.50, as specified. Variable X5 has the smallest AVE value at 0.582 (58.2%), while variable X3 has the highest AVE value at 0.822 (82.2%). The 13 variables have an average AVE value of 71.04. According to conducted research, the AVE and √AVE can be concluded variables meet the specified criterion of being higher than 0.50, thus validating their validity.

Table 5. AVE (Average Variance Extracted) value and √AVE value

Variable	AVE	$\sqrt{AVE}$	Description
X_1	0,733	0,856	Valid
X_2	0,706	0,840	Valid
X_3	**0,822**	**0,907**	**Valid**
X_4	0,672	0,820	Valid
X_5	**0,582**	**0,763**	**Valid**
X_6	0,710	0,843	Valid
X_7	0,652	0,807	Valid
X_8	0,725	0,851	Valid
X_9	0,653	0,808	Valid
X_{10}	0,744	0,863	Valid
X_{11}	0,650	0,806	Valid
Y	0,789	0,888	Valid
Z	0,796	0,892	Valid

Table 6. Cronbach's alpha and composite reliability value

Indicator	Cronbach'sAlpha	Composite Reliability	Description
X_1	0,828	0,897	Reliable
X_2	0,923	0,937	Reliable
X_3	0,817	0,892	Reliable
X_4	0,896	0,923	Reliable
X_5	0,891	0,932	Reliable
X_6	0,757	0,860	Reliable
X_7	0,837	0,874	Reliable
X_8	0,918	0,936	Reliable
X_9	0,894	0,918	Reliable
X_{10}	0,876	0,913	Reliable
X_{11}	0,867	0,904	Reliable
Y	0,873	0,921	Reliable
Z	0,911	0,937	Reliable

3.2. Reliability Test

The assessment of reliability in the SEM-PLS methodology involves examining the composite reliability value. There are two methods for measuring test reliability, namely Cronbach's alpha and composite reliability. The parameter of calculation evaluation of the reliability test stage involves considering several aspects, including collective and composite reliability and also Cronbach's alpha. Establishing a validating criterion for the Cronbach's alpha test in order to provide an evaluation of the measurement model's reliability. This criterion indicates that a minimum value of 0.70 must be achieved. The composite dependability index is considered more significant than Cronbach's alpha. However, there is currently no composite dependability index available for this assumption. Additionally, the notion of collective reliability relates to the degree of generalizability demonstrated by the inquiries included in the survey instrument.

In this research, the variables used showed composite reliability and Cronbach's alpha values higher than 0.70, according to the calculation results shown in Table 6. Therefore, it can be observed that the variables in this research have significant reliability values and fulfill the required parameter limits for reliability test parameters. According to the calculation findings shown in Table 6. Thus, it can be concluded that the variables in this study have acceptable reliability values and are in accordance with the required parameter limits for reliability test parameters.

3.3. Model Evaluation Result

Structural model testing (Inner Model) is utilized to identify variables and indicators after validity tests and reliability tests.

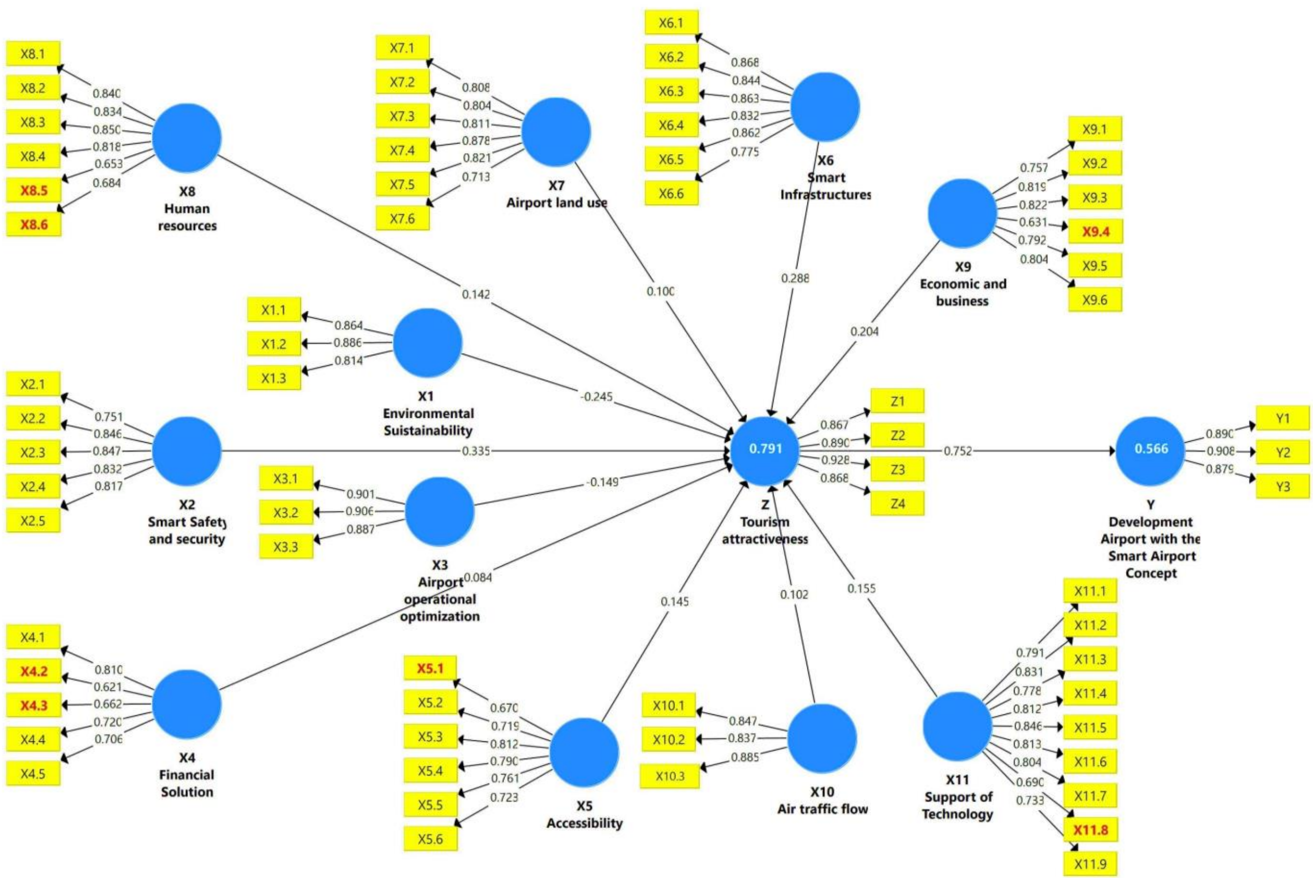

Fig. 4 Full model path diagram with 65 indicators (Running 1)

3.3.1. Structural Modeling Test (Inner Model)

Assuming the results of the inner model hypothesis testing of direct effects, it is found that variables X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, and X_{11} have a significant effect on variable Z.

- H1 : Variables X_1 to variable X_{11} have a significant effect on variable Z .
- H0 : Variables X_1 to variable X_{11} have no significant effect on variable Z.

Hypothesis test results from the inner model of indirect effects:

- H1 : Variables X_1 to variable X_{11} through variable Z have a significant effect on variable Y.
- H0 : Variables X_1 to variable X_{11} through variable Z have a significant effect on variable Y.

According to the assumption that the decision-making process depends on the analysis of T-statistics and P-values, a statistically significant effect is indicated by a T-statistic value > 1.965 and a P-value < 0.05.

The following in Figure 4 presents an image of the results of the calculation of the loading factor and outer loading on the full model path diagram.

In Figure 4, there are indicators that do not meet the requirements and are declared invalid.

So that the indicator is removed from the model and the full model path diagram is re-estimated again until it obtains valid results.

The following Figure 5 presents a picture of the model path diagram after running 8 times with the assumption of removing indicators on variables that do not meet the requirements and are declared invalid.

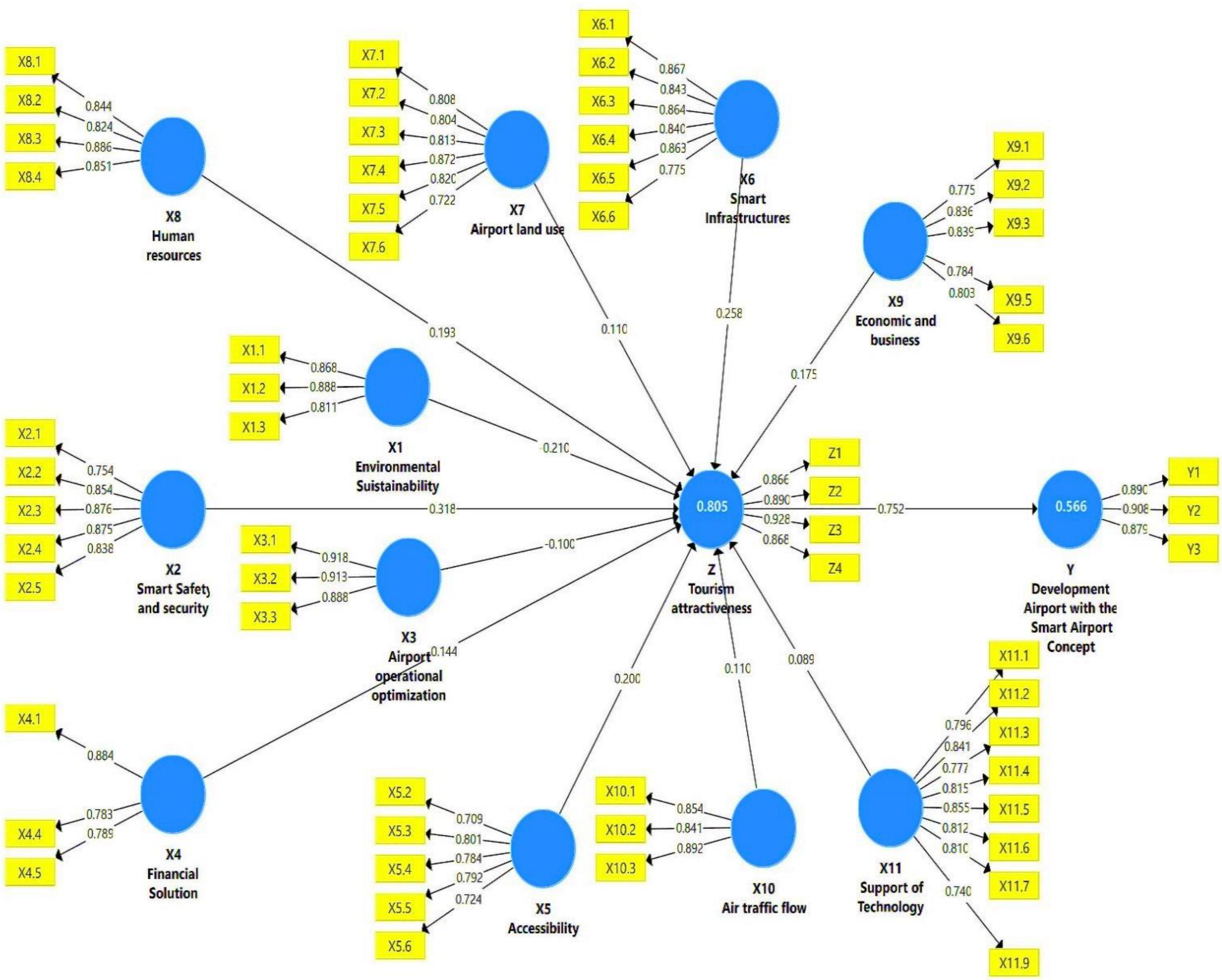

Fig. 5 Full Model Path Diagram with 58 Indicators after invalid indicators are removed from the model (Running 8)

Table 7. The result of direct effect analysis

Causal Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistics (|O/STDEV)	P-Values	Direction
X_1 -> Z	-0,210	-0,209	0,062	3,402	0,001	Significant
X_2 -> Z	0,318	0,322	0,063	5,030	0,000	Significant
X_3 -> Z	-0,100	-0,095	0,049	2,044	0,041	Significant
X_4 -> Z	-0,144	-0,138	0,054	2,692	0,007	Significant
X_5 -> Z	0,200	0,203	0,044	4,569	0,000	Significant
X_6 -> Z	0,258	0,252	0,075	3,424	0,001	Significant
X_7 -> Z	0,110	0,106	0,036	3,056	0,002	Significant
X_8 -> Z	0,193	0,193	0,059	3,290	0,001	Significant
X_9 -> Z	0,175	0,171	0,064	2,754	0,006	Significant
X_{10} -> Z	0,110	0,107	0,049	2,246	0,025	Significant
X_{11} -> Z	0,089	0,086	0,042	2,100	0,036	Significant
Z -> Y	0,752	0,755	0,023	3,282	0,000	Significant

Table 8. The Result of indirect effect analysis

Causal Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Direction
X_1 -> Z -> Y	-0,158	-0,157	0,046	3,412	0,001	Significant
X_2 -> Z -> Y	0,239	0,243	0,048	4,946	0,000	Significant
X_3 -> Z -> Y	-0,075	-0,072	0,037	2,046	0,041	Significant
X_4 -> Z -> Y	-0,108	-0,104	0,040	2,717	0,007	Significant
X_5 -> Z -> Y	0,151	0,153	0,031	4,832	0,000	Significant
X_6 -> Z -> Y	0,194	0,190	0,056	3,481	0,001	Significant
X_7 -> Z -> Y	0,082	0,080	0,027	3,025	0,003	Significant
X_8 -> Z -> Y	0,145	0,146	0,045	3,239	0,001	Significant
X_9 -> Z -> Y	0,132	0,130	0,050	2,666	0,008	Significant
X_{10} -> Z -> Y	0,082	0,081	0,037	2,224	0,027	Significant
X_{11} -> Z -> Y	0,067	0,065	0,032	2,098	0,036	Significant

According to Table 7 and Table 8, it can be concluded that the calculated P-values for the two types of indirect and direct effects satisfy the criterion of being greater than 0.05. Consequently, these P-values are deemed to demonstrate a concurrent and statistically significant impact on the variable Y (tourism attractiveness) and Z (development airport with the smart airport concept).

3.3.2. Calculation Results of the Coefficient of Determination (R-$_{Square}$)

According to Table 9, it is possible to see that the Coefficient of R-square for variable Y is 0.566, indicating that it has a moderate degree of explanatory power. This is comparable to 56.6% in terms of proportion. In terms of strength, the variable Z, which was measured at a value of 0.805, is classified as strong, with a proportion of 80.5% on the strength indicator. On the basis of the results that were obtained from the modeling of the R-square coefficient and the P-values, it is possible to draw the conclusion that the implementation of smart airport principles ought to be taken into consideration during the process of developing an airport.

3.3.3. Calculation Results of the F-Square

According to Table 10, it can be observed that the condition of F-Square > 0.35 fails to show a significant or substantial effect. The moderate effect, indicated by an F-Square value between 0.15 and 0.35, pertains to the influence of X_1 on Z.

The impact of X_1 on Y, X_2 on Y, X_2 on Z, and Y on Z appears to be minimal, as indicated by the F square value falling within the range of 0.02–0.15. Despite being ignored, the influence can be considered non-existent because no one has an F-square value of 0.00.

Table 9. R-$_{square}$ value

	R-Square	R Square Adjusted
Y -> Tourism Attractiveness	0,566	0,565
Z -> Development Airport with the Smart Airport concept	0,805	0,800

Table 10. F-$_{Square}$ Value

Indicator	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	Y	Z
X_1													0,046
X_2													0,138
X_3													0,021
X_4													0,025
X_5													0,065
X_6													0,049
X_7													0,025
X_8													0,055
X_9													0,032
X_{10}													0,023
X_{11}													0,022
Y													
Z												**1,305**	

Table 11. Predictive relevance (Q-square)

	SSO	SSE	Q^2 (=1-SSE/SSO)
X_1	1428,000	958,527	0,329
X_2	3808,000	2064,590	0,458
X_3	1428,000	877,034	0,386
X_4	2380,000	1417,274	0,405
X_5	1428,000	775,300	0,457
X_6	1428,000	1124,293	0,213
X_7	2380,000	1674,746	0,296
X_8	2856,000	1456,096	0,490
X_9	2856,000	1757,379	0,385
X_{10}	1904,000	990,935	0,480
X_{11}	2380,000	1438,318	0,396
Y	1428,000	772,668	0,459
Z	1904,000	896,226	0,529

3.3.4. Predictive Relevance (Q-Square) Results

The predictive relevance test evaluated the reliability of the blindfolding method in generating observation values by examining the Q-square value.

If the Q-square value is greater than zero, the observation value is classified as satisfactory. However, if the Q-square value is negative, predictive relevance outcomes (Q-square) are provided.

According to the findings presented in Table 11 of the Q-Square calculation results, the variable Y, representing tourism attraction, exhibits a value of 0.459, equivalent to 45.9%. Additionally, the variable Z, indicating the development of the airport with the smart airport concept, demonstrates a value of 0.529, corresponding to 52.9%.

This research shows the model implemented offers strong predictive performance. It suggests that the research model has a good predictive value.

Table 12. Path coefficients value

Causal Relationship	Total Effects
X_1 -> Z -> Y	-0,367
X_2 -> Z -> Y	0,557
X_3 -> Z -> Y	-0,176
X_4 -> Z -> Y	-0,252
X_5 -> Z -> Y	0,351
X_6 -> Z -> Y	0,452
X_7 -> Z -> Y	0,192
X_8 -> Z -> Y	0,338
X_9 -> Z -> Y	0,308
X_{10} -> Z -> Y	0,192
X_{11} -> Z -> Y	0,156
Z_-> Y	0,752

3.3.5. Path Coefficients Results

In this research, The path coefficient is an instrument for measuring the linear causal relationship between a variable and its related indicator, providing information about the strength and direction of this relationship. A path coefficient value of 0 indicates the absence of a linear relationship between the exogenous variable X, the intervening variable Z, and the endogenous variable Y. The range used for determining the path coefficient value is from +1 to -1. Table 12 provides an overview of the association direction for each variable. The research shows a causal relationship between variables X and Y, mediated by the significant and substantial variable Z.

According to the conclusions shown in Table 12, the findings of this research indicate the direction of the variable's influence as follows:

- Variable X_1 (Environmental Sustainability) through variable Z (Development Airport with the smart airport concept) negatively affects variable Y (Tourism Attractiveness).

  The limited adoption of environmentally friendly buildings, alterations in land use and spatial organization near the airport, and the escalating noise from growing air traffic density have hindered the widespread use of renewable energy. This is primarily due to the substantial financial investment required. Consequently, the implementation of the smart airport concept is anticipated to be a crucial factor in airport development.
- Variable X_2 (Smart Safety and Security) through variable Z (Development Airport with the smart airport concept) positively influenced variable Y (Tourism Attractiveness).
- Variable X_3 (Operational optimization) through variable Z (Development Airport with the smart airport concept) negatively affects variable Y (Tourism Attractiveness).
- Variable X_4 (Financial Solution) through variable Z (Development Airport with the smart airport concept) negatively affects variable Y (Tourism Attractiveness).
- Variable X_5, (accessibility) through variable Z (Development Airport with the smart airport concept) has a positive impact on variable Y (Tourism Attractiveness).
- Variable X_6, (Smart Infrastructures) through variable Z (Development Airport with the smart airport concept) positively influenced variable Y (Tourism Attractiveness).
- Variable X_7, (land use) through variable Z (Development Airport with the smart airport concept) has a positive impact on variable Y (Tourism Attractiveness).
- Variable X_8, (human resource) support through variable Z (Development Airport with the smart airport concept) has a positive impact on variable Y (Tourism Attractiveness).
- Variable X_9, support for economic and business services through variable Z (Development Airport with the smart airport concept), has a positive impact on variable Y (Tourism Attractiveness).
- Variable X_{10}, (air traffic flow) through variable Z (Development Airport with the smart airport concept) has a positive influence on variable Y (Tourism Attractiveness).
- Variable X_{11}, (technology) through variable Z (Development Airport with the smart airport concept) positively influenced variable Y (tourism Attractiveness).
- Variable Z (Development Airport with the smart airport concept) has a positive influence on variable Y (Tourism Attractiveness)

3.3.6. Model Fit

In model fit assessment criteria, The result of this research has produced a model that was built to test whether it is good or not.

According to the results presented in Table 13, it is possible to conclude that the correlation between variables satisfies the requirements of the measurement parameters of the path coefficient model (Model Fit), with RMS theta values of 0.007 > 0.102 and NFI values of 0.524 < 0.90. This indicates that the NFI value has validated the model's quality.

The percentage of the model built is determined by NFI multiplied by 100%; therefore, the percentage of the model built is NFI = 0.524 x 100% = 52.40% model fit. This implies that the smart airport concept has been built 52.4% of the way and was declared fit during the application for the development of Sultan Hasanuddin International Airport in South Sulawesi Province.

Table 13. Criteria of model fit assessment

	Saturated Model	Estimated Model
SRMR	0,077	0,087
d ULS	10,069	12,904
d_G	12,530	13,236
Chi-Square	17474,838	17953,458
NFI	0,524	0,511

Table 14. Hypothesis testing of direct effect, indirect effects and total effects

	Causal Relationship	Direct Effect	Indirect Effect	Total Effect
H_1	X_1 -> Z -> Y	-0,210	-0,158	-0,367
H_2	X_2 -> Z -> Y	0,318	0,239	0,557
H_3	X_3 -> Z -> Y	-0,100	-0,075	-0,176
H_4	X_4 -> Z -> Y	-0,144	-0,108	-0,252
H_5	X_5 -> Z -> Y	0,200	0,151	0,351
H_6	X_6 -> Z -> Y	0,258	0,194	0,452
H_7	X_7 -> Z -> Y	0,110	0,082	0,192
H_8	X_8 -> Z -> Y	0,193	0,145	0,338
H_9	X_9 -> Z -> Y	0,175	0,132	0,308
H_{10}	X_{10} -> Z -> Y	0,110	0,082	0,192
H_{11}	X_{11} -> Z -> Y	0,089	0,067	0,156
H_{12}	Z_-> Y	0,752	-	0,752

According to Table 14, the estimated structural equation model employed in this research may be described as follows:

$$Y = -0{,}367X_1 + 0{,}557X_2 - 0{,}176X_3 - 0{,}252X_4 + 0{,}351X_5 + 0{,}452X_6 + 0{,}192X_7 + 0{,}338X_8 + 0{,}308X_9 + 0{,}192X_{10} + 0{,}156X_{11} + 0{,}752Z$$

In this equation, X_I (environmental sustainability), X_3 (operational optimization), and X_4 (financial solution) all point in the wrong direction. However, this is used as a guide to see what problems need to be fixed now for the future if the concept of a smart airport in airport development is to promote tourism in the southern province of Sulawesi.

4. Conclusion

The calculated structural equation model in this research shows the following coefficients based on the Smart-PLS software results: $Y = -0.367X_1 + 0.557X_2 - 0.176X_3 + 0252X_4 + 0.351X_5 + 0.452X_6 + 0.192X_7 + 0.338X_8 + 0.308X_9 + 0.192X_{10} + 0.156X_{11} + 0.752_Z$. These coefficients were calculated from direct, indirect, and total effects. The structural equation in this research model shows how each element influences airport growth if the smart airport idea is implemented to make South Sulawesi Province a tourism attraction.

All variables X (environmental sustainability, smart safety and security, airport operational optimization, financial solutions, accessibility, smart infrastructure, airport land use, human resources, economics and business, air traffic flow, and technology) through Z (Development Airport with the smart airport concept) significantly affect Y (tourism attractiveness). This suggests that using the smart airport concepts at Sultan Hasanuddin International Airport will boost tourism, especially in the National Tourism Strategic Area in South Sulawesi Province.

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