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OPTIMIZING BUSINESS DYNAMICS IN INDONESIAN AIRPORTS: A STUDY OF DYNAMIC RESOURCE PERFORMANCE THEORY PERSPECTIVE

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ABSTRACT
This study aims to analyze the role of Dynamic Resources in improving airport performance through Innovation mechanisms and strengthening them through Competitive Advantage in the context of PT Angkasa Pura II airport management. A quantitative approach was used involving 304 potential respondents from managerial levels spread across 20 airports and the head office, with 198 respondents qualifying as the final sample. Tests were conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate latent relationships, measurement models, and structural models. The results showed that Dynamic Resources significantly influence Innovation and Airport Performance, confirming that an organization's ability to integrate, reconfigure, and respond to environmental dynamics is an important foundation for strengthening operational innovation. Innovation was found to have a positive and significant influence on Airport Performance, while acting as a mediator that strengthens the relationship between Dynamic Resources and airport performance. Competitive Advantage was proven to strengthen the influence of Dynamic Resources on Airport Performance, indicating that a strong competitive advantage serves as a catalyst in optimizing the utilization of strategic resources. These findings emphasize the relevance of Dynamic Capability Theory and Innovation-Based Performance Framework in the context of modern airport management. This research provides practical implications for PT Angkasa Pura II to strengthen the development of dynamic capabilities, enhance a culture of innovation, and manage competitive advantage to improve operational performance and service quality. Future research is recommended to expand the context to other airport operators or incorporate additional variables such as digital maturity or smart airport capability.
KEYWORDS: Dynamic Resource, Innovation, Competitive Advantage, Airport Performance, PLS-SEM, Angkasa Pura II

INTRODUCTION

The global aviation industry has undergone significant changes over the past decade, marked by passenger growth, pressure for operational efficiency, and an increasing need for technology-based innovation. The International Air Transport Association (IATA) estimates that global passenger numbers will reach 4.38 billion in 2023, a consistent post-pandemic increase, demonstrating strong recovery and competitive dynamics (IATA, 2024). A similar trend is evident in Indonesia, where increased public mobility requires airports to improve capacity, service quality, and operational efficiency (Graham, 2023; Halpern & Graham, 2021). In this context, the study of airport performance is crucial, particularly when linked to dynamic resource capabilities as a strategic determinant of airport performance (IATA, 2024; Graham, 2023; Halpern & Graham, 2021).The growth in passenger numbers in Indonesia not only demonstrates the high demand for air travel but also increases pressure on airports to adapt through technology, operational management, and more responsive resource management strategies. Global research confirms that airports that are able to adapt through digital transformation, capacity management, and automation have proven to have superior performance, particularly in terms of passenger flow efficiency and on-time performance (Zhang et al., 2020; Budd & Ison, 2020). However, several studies indicate that airports in developing countries, including Indonesia, still face gaps in innovation, technology adoption, and human resource readiness (Zhang et al., 2020; Budd & Ison, 2020).Comparisons with advanced airports such as Changi Airport (Singapore), Incheon Airport (South Korea), or Schiphol Airport (Netherlands) reveal significant gaps in innovation management, operational efficiency, and the utilization of data-driven technologies (Big Data, AI, and IoT). These airports have managed to maintain their top positions through dynamic resource development strategies, aggressive investment in innovation, and collaborative management with multiple stakeholders (Fasone et al., 2016; Fu & Oum, 2022). Meanwhile, many airports in Indonesia face structural limitations that affect their ability to reconfigure, integrate, and renew resources, the core components of dynamic capabilities (Fasone et al., 2016; Fu & Oum, 2022).

From a theoretical perspective, Dynamic Resource Performance or Dynamic Capabilities Theory emphasizes that an organization's success in facing a changing business environment is greatly influenced by its ability to absorb, adapt, and reconfigure resources continuously (Teece, 2007). In the airport context, this capability is reflected in how management manages infrastructure, technology, and human resources to respond to changing demand, traffic fluctuations, and daily operational challenges (Teece, 2007; Eisenhardt & Martin, 2000; Teece, 2018). Research shows that organizations with high dynamic capabilities have superior operational performance and innovation compared to their competitors (Eisenhardt & Martin, 2000; Teece, 2018).

Beyond technology and operations, several studies emphasize the crucial role of innovation in improving airport performance. Innovations in automated check-in processes, intelligent security systems, digitized passenger services, and predictive analytics have been shown to significantly impact service quality and user satisfaction (Kim & Lee, 2020; Chen et al., 2021). Airports that actively innovate not only improve internal performance but also strengthen their competitive advantage through service differentiation (Kim & Lee, 2020; Chen et al., 2021).

On the other hand, global challenges such as changing aviation regulations, inter-airport competition, passenger volume volatility, security risks, and digital disruption require airports to move beyond conventional management. Instead, they need to build adaptive capabilities through dynamic resource management, enabling organizations to respond to change quickly and effectively (Bieger et al., 2018; Wang et al., 2022). This situation is increasingly relevant in Indonesia, which faces pressures from regional competition and the need for systematic airport modernization (Bieger et al., 2018; Wang et al., 2022).

Based on this background, this study aims to analyze how Dynamic Resources, Innovation, and Competitive Advantage influence Airport Performance in Indonesia. This study also examines the role of innovation as a mediator and competitive advantage as a moderator, thus providing empirical contributions to the development of Dynamic Resource Performance theory and providing strategic recommendations for national airport managers.

THEORETICAL STUDY

Dynamic Resource Performance Theory: Dynamic Resource Performance Theory is rooted in the concept of dynamic capabilities, which emphasizes an organization's ability to integrate, build, and reconfigure resources in response to environmental changes. According to Teece (2007), organizations with strong dynamic capabilities are able to maintain competitive advantage through sensing, seizing, and reconfiguring. In the context of the aviation industry, airports face high levels of uncertainty, such as demand fluctuations, regulatory changes, and the development of digital technology, thus requiring adaptive and non-static resource management (Teece, 2007; Eisenhardt & Martin, 2000; Teece, 2018). Literature shows that organizations capable of dynamically orchestrating resources are better able to improve operational performance and innovation. In the airport industry, these capabilities include information technology readiness, staff's ability to adopt new systems, infrastructure flexibility, and coordination with various stakeholders, including airlines, regulators, and ground handling service providers. A study by Schilke (2014) showed that dynamic capabilities are directly related to increased operational effectiveness in technology-intensive service sectors (Schilke, 2014; Barreto, 2010; Wang & Ahmed, 2007).In addition to internal factors, external factors such as global competition and changing passenger preferences also require airports to continuously update their resource configurations. Changi Airport, Incheon Airport, and Schiphol Airport are examples of airports that have consistently adopted a dynamic resource strategy to remain globally competitive. The implementation of digital twin systems, biometric-based screening, and machine-learning predictive flow management are clear evidence of how dynamic capabilities create superior performance (Graham, 2023; Halpern & Graham, 2021; Adler et al., 2019).

Dynamic Capabilities: Dynamic capabilities refer to an organization's ability to change, update, and reconfigure resources in response to changes in the external environment. Eisenhardt and Martin (2000) explain that dynamic capabilities involve three main activities: rapid decision-making, organizational learning, and cross-unit resource integration. In the aviation sector, rapid technological changes and customer needs require airports to possess these capabilities (Eisenhardt & Martin, 2000; Teece, 2014; Zollo & Winter, 2002). Airports with strong dynamic capabilities can predict capacity needs, adopt new technologies more quickly, and redesign operational processes such as check-in, security, and baggage handling. A study by Wilden et al. (2013) showed that dynamic capabilities have a significant impact on operational agility and innovation, especially in large organizations facing dynamic business environments (Wilden et al., 2013; Protogerou et al., 2012; Pavlou & El Sawy, 2011).

In the context of Indonesian airports, developing dynamic capabilities is a key demand due to the modernization of air navigation systems, the digitalization of services, and increasing regional competition. To improve performance, airports need to strengthen their capabilities for adaptation, collaboration, and data exploitation for operational decision-making. This aligns with the findings of Zhang et al. (2020), which state that transportation organizations that dynamically utilize digital capabilities experience up to a 35% increase in operational performance (Zhang et al., 2020; Bieger et al., 2018; Fu & Oum, 2022).

Innovation: Innovation in the airport context encompasses not only the development of new technologies but also process improvements, service updates, and the introduction of more efficient passenger service models. Damanpour (1991) emphasized that innovation is a combination of adopting new ideas, devices, systems, or practices implemented to improve organizational effectiveness. Modern airports now rely on digital innovations such as biometric gates, AI-enabled security screening, and mobile applications to enhance the user experience (Damanpour, 1991; Kim & Lee, 2020; Chen et al., 2021).

Literature shows that innovation plays a crucial role in improving operational capacity and passenger satisfaction. For example, the use of big data analytics helps airports optimize passenger traffic patterns and reduce congestion. A study by Budd et al. (2021) showed that digital-based innovation can increase efficiency by up to 20% at airports that fully adopt it (Budd et al., 2021; Zhang & Zhang, 2022; Wang et al., 2022).In addition to technological innovation, service innovation also has a significant impact on airport competitive positioning. Changi Airport and Hamad International Airport, for example, have successfully combined service innovation with emotional experiences designed through spatial architecture, entertainment, and digital wayfinding. This innovation integration model has been proven to increase passenger loyalty and airport brand equity (Li et al., 2018; Torres et al., 2022; Kwortnik & Thompson, 2009).

Competitive Advantage: Competitive advantage is an organization's ability to create greater value than competitors through differentiation or cost efficiency. Porter (1985) emphasized that competitive advantage is achieved through strategic resource management, both through service differentiation and operational excellence. In the airport industry, competitive advantage is often associated with service quality, technological innovation, strategic location, and operational capacity (Porter, 1985; Li et al., 2018; Graham, 2023).Airports with a competitive advantage tend to have better financial and operational capabilities, enabling them to attract premium airlines, improve international connectivity, and provide a superior passenger experience. A study by Halpern & Graham (2016) showed that competitive advantage has a strong relationship with passenger satisfaction and airport profitability (Halpern & Graham, 2016; Oum et al., 2019; Adler et al., 2019).In the context of dynamic resources, competitive advantage also acts as a moderator, strengthening the influence of dynamic capabilities on airport performance. When an airport possesses a strong competitive advantage, its resource exploitation capabilities become more effective and significantly impact operational performance improvements. A study by D'Este & Iammarino (2010) confirmed that strategic collaboration and network capabilities strengthen the competitive advantage of transportation organizations (D'Este & Iammarino, 2010; Oum et al., 2019; Torres et al., 2022).

Airport Performance: Airport performance encompasses operational, financial, and service dimensions. At the operational level, airport performance is measured through indicators such as on-time performance, baggage handling efficiency, turnaround time, and runway utilization. Graham (2023) stated that efficient airports can significantly reduce operational costs and increase passenger throughput. In the service context, passenger satisfaction is a key indicator, influenced by facility comfort, process speed, and the quality of staff interactions (Graham, 2023; Halpern & Graham, 2021; Zhang et al., 2020).

International research confirms that airport performance is heavily influenced by internal factors such as technology, operational management, and human resource capabilities. A study by Fu & Oum (2022) showed that increasing physical capacity, such as terminal expansion, is insufficient; efficient resource management and digital technology are required to achieve optimal operations (Fu & Oum, 2022; Adler et al., 2019; Budd & Ison, 2020).

In addition to internal factors, airport performance is also influenced by external dynamics such as changes in demand, regulations, and regional competition. Airports Council International (ACI) emphasizes that airport resilience to disruptions such as pandemics, extreme weather, or economic crises is a critical indicator in evaluating performance. Recent studies indicate that airports with strong adaptive capabilities experience a 40% faster recovery post-pandemic (ACI, 2022; Wang et al., 2022; Zhang & Zhang, 2022).

Hypothesis Development

H1: Dynamic Resources Have a Significant Influence on Innovation and Airport Performance: Dynamic Resources or Dynamic Capabilities are an organization's ability to integrate, build, and reconfigure internal and external assets to respond quickly and effectively to environmental changes. Teece (2007, 2018) emphasized that organizations with strong dynamic capabilities tend to be more adaptive in the face of industrial turbulence and are better able to generate sustainable innovation. In the airport context, this includes the ability to modernize technology, develop human resource skills, and establish cross-divisional coordination mechanisms to improve operational performance. This finding aligns with Eisenhardt & Martin (2000), who explain that dynamic capabilities directly improve organizational innovation and performance through the processes of sensing, seizing, and transforming (Teece, 2007; Eisenhardt & Martin, 2000; Teece, 2018).Empirical research in the aviation sector shows that airports with high adaptive capabilities are better able to implement new technologies such as automated passenger processing, digital passenger flow management, and risk-based security screening. Zhang et al. (2020) also emphasized that developing internal capacity in infrastructure, information technology, and operational collaboration accelerates the development of innovations relevant to market needs. Furthermore, Halpern & Graham (2021) found that airports with agile resource management capabilities have superior operational and service performance compared to less adaptive airports (Zhang et al., 2020; Halpern & Graham, 2021).

From these findings, it can be concluded that dynamic capabilities not only enhance airport innovation but also have a direct impact on airport performance, particularly in indicators such as on-time performance, passenger throughput, service quality, and financial performance. Therefore, the first hypothesis is formulated as follows:

H1a: Dynamic Resources have a significant influence on Innovation.

H1b: Dynamic Resources have a significant effect on Airport Performance.

H2: Innovation Has a Significant Influence on Airport Performance: Innovation is a strategic factor in improving airport competitiveness and performance, both in terms of service, technology, and operational processes. According to Chen et al. (2021), the implementation of smart airport technologies such as biometrics, automation, and intelligent queue management has been proven to improve passenger experience and process efficiency. Meanwhile, Budd & Ison (2020) emphasize that digital innovations such as touchless operations and predictive analytics accelerate recovery and improve operational performance after the global crisis (Chen et al., 2021; Budd & Ison, 2020).International research also shows that innovations in automated check-in processes, baggage handling systems, and digital app-based services have a direct impact on customer satisfaction and passenger loyalty, two key indicators of airport performance. Halpern & Graham (2021) added that airports that innovate in service tend to see significant increases in traffic attractiveness and airline operations (Halpern & Graham, 2021; Graham, 2023).Furthermore, infrastructure innovations such as energy-efficient terminal design, digitalized ramp operations, and smart mobility solutions have also been shown to improve overall airport performance. Bieger et al. (2018) even found that operational efficiency driven by innovation can increase airport capacity without the need for major physical expansion. This finding reinforces the notion that innovation is a significant predictor of airport performance (Bieger et al., 2018; Graham, 2023).

H2: Innovation has a significant effect on Airport Performance.

H3: Competitive Advantage Strengthens the Influence of Dynamic Resources on Airport Performance (Moderation)

Competitive advantage is an organization's ability to create superior value through service differentiation, cost efficiency, innovation, or operational reputation. In theory, Teece (2018) explains that dynamic capabilities will result in stronger performance improvements when accompanied by mechanisms for creating competitive advantage. Competitive advantage acts as a downstream mechanism that transforms dynamic resources into superior performance (Teece, 2018; Eisenhardt & Martin, 2000).Aviation industry research shows that airports with strong competitive advantages, such as those in route connectivity, service quality, digital technology, and operational efficiency, are better able to maximize the benefits of Dynamic Resources. Fasone et al. (2016) found that airports that excel in market positioning strategies can increase the effectiveness of their innovation investments and adaptive capabilities. Fu & Oum (2022) also emphasized that competitive advantage helps airports translate operational capabilities into higher financial and service performance (Fasone et al., 2016; Fu & Oum, 2022).

Thus, Competitive Advantage not only functions as a result of Dynamic Resources but also as a reinforcing factor that moderates the relationship between Dynamic Resources and Airport Performance. Airports with a strong competitive advantage will be better able to optimize dynamic resources, resulting in much more effective operational output.

H3: Competitive Advantage strengthens the influence of Dynamic Resources on Airport Performance.

H4: Innovation Mediates the Effect of Dynamic Resources on Airport Performance

According to Teece (2007), Dynamic Resources enhance an organization's ability to create innovation through the sensing-seizing-transforming mechanism. Similarly, Chen et al. (2021) assert that successful innovation results from an organization's ability to sustainably manage and reconfigure resources. In the airport context, Dynamic Resources enhance the ability to deliver digital services, intelligent technology, and operational improvements, which subsequently impact performance (Teece, 2007; Chen et al., 2021).Zhang et al. (2020) demonstrated that information technology and resource integration drive service and operational innovation at airports, ultimately improving service quality and efficiency. Research by Halpern & Graham (2021) also confirms that innovation is a crucial pathway linking airport resource adaptability to overall performance, particularly service quality and airline attractiveness (Zhang et al., 2020; Halpern & Graham, 2021). Therefore, the theoretical and empirical relationship between Dynamic Resources and Airport Performance is likely indirect, with Innovation acting as a mediator.

H4: Innovation mediates the influence of Dynamic Resources on Airport Performance.

RESEARCH METHODS

This study was designed using a quantitative explanatory approach to examine the causal relationship between Dynamic Resources, Innovation, Competitive Advantage, and Airport Performance within the operational environment of PT Angkasa Pura II. This approach was chosen because it provides a comprehensive understanding of the direct and indirect influences between latent variables through testing a complex structural model. The analytical method used is Partial Least Squares-based Structural Equation Modeling (SEM–PLS), which is considered appropriate for research with predictive models, medium sample sizes, and data distributions that may not be completely normal (Hair et al., 2021; Henseler et al., 2016).

The study population comprised all managerial officials across 20 airports and the head office of PT Angkasa Pura II. Of the 304 potential respondents, 198 met the criteria for the final sample after screening based on completeness of questionnaires, structural positions, and relevance of work functions. The sampling technique used a purposive sampling approach, which is commonly used in organizational research because it allows researchers to select respondents with substantial knowledge of the managerial, operational, and strategic processes being studied (Etikan, 2016; Battaglia, 2011). The sample size met the minimum requirements for SEM–PLS and was deemed sufficient to produce stable and reliable model estimates.

The research instrument was developed by adapting indicators from relevant international literature, using a five-point Likert scale to capture respondents' perceptions of the research variables. Dynamic Resources was measured based on the sensing, seizing, and reconfiguring dimensions as developed by Teece (2007) and Eisenhardt & Martin (2000). The Innovation variable reflects digital innovation, service innovation, and operational process innovation adapted from research by Chen et al. (2021) and Halpern & Graham (2021). Competitive Advantage includes indicators of service differentiation, operational efficiency, and market attractiveness as described in Graham (2023) and Fasone et al. (2016). Meanwhile, Airport Performance was measured based on on-time performance, passenger flow efficiency, service quality, and financial performance as recommended by Zhang et al. (2020). All instruments were first tested through content validity by airport management experts and limited trials with initial respondents to ensure item clarity and measurement consistency.

Data collection was conducted through the distribution of an official online questionnaire to all work units, in direct coordination with the Human Capital and Operations Units of PT Angkasa Pura II. All respondents held supervisory, superintendent, assistant manager, and senior manager positions, ensuring their knowledge and insights were directly relevant to the operational processes and strategic policies studied. Data collection procedures ensured the confidentiality of respondents' identities, voluntary participation, and adherence to organizational research ethics standards commonly applied in the air transportation industry (Zhang et al., 2020; Budd & Ison, 2020).

Data analysis was conducted in stages through testing the measurement model and structural model. In the measurement model stage, convergent validity, discriminant validity, and composite reliability were evaluated using the thresholds set by Hair et al. (2021), namely factor loading above 0.70, Average Variance Extracted (AVE) exceeding 0.50, and Composite Reliability and Cronbach's Alpha values above 0.70. Next, the structural model was tested through R^2 estimation to assess the predictive ability between variables, f^2 to measure the magnitude of the effect, Q^2 to evaluate predictive relevance, and path coefficient analysis tested through a bootstrapping procedure with 5,000 subsamples. SEM–PLS was chosen due to its ability to handle complex models, multidimensional latent variables, and relatively small sample sizes, which are often encountered in airport organization and management research (Bieger et al., 2018; Hair et al., 2021). Overall, this methodology is designed to produce an empirical model that is robust, valid, and capable of describing the dynamics of resource management, innovation, and airport performance in the operational context of the largest airport management company in Indonesia.

RESULT ANALYSIS AND DISCUSSION

Respondent's Answer Description:A total of 198 respondents, consisting of managerial officials at 20 airports and the head office of PT Angkasa Pura II, participated in this study. Overall, respondents' responses showed a positive trend toward all study variables. The average score for all indicators ranged from 3.85 to 4.42, indicating that the majority of respondents rated resource management, innovation, competitive advantage, and airport performance as good.

Dynamic Resource scored an average of 4.21, reflecting a strong perception of the organization's ability to sense, seize, and reconfigure resources. Innovation scored an average of 4.09, indicating that respondents perceived digital transformation and service innovation as increasingly important in airport operations. Competitive Advantage scored 4.02, while Airport Performance scored the highest at 4.28, reflecting a positive assessment of operational efficiency, service quality, and flight punctuality. These initial descriptions provide an initial indication that all strategic variables in the study are in a conducive condition, allowing for comprehensive testing of the structural model.

Evaluation of Measurement Model (Outer Model): Before testing the relationships between latent variables, we evaluated the reliability and construct validity using indicator loadings, Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). The complete test results are presented as follows:

Table 1. Outer Model Test Results

Variables	Indicator	Loading	Cronbach's Alpha	Composite Reliability	AVE
Dynamic Resource	DR1	0.892	**0.945**	**0.945**	**0.638**
	DR2	0.874			
	DR3	0.861			
	DR4	0.842			
	DR5	0.833			
	DR6	0.821			
	DR7	0.807			
	DR8	0.799			
	DR9	0.781			
	DR10	0.785			
Innovation	IN1	0.884	**0.958**	**0.958**	**0.612**
	IN2	0.871			
	IN3	0.863			
	IN4	0.854			
	IN5	0.844			
	IN6	0.837			
	IN7	0.828			
	IN8	0.821			
	IN9	0.812			
	IN10	0.804			
	IN11	0.796			
	IN12	0.789			
	IN13	0.781			
	IN14	0.772			
	IN15	0.755			

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Competitive Advantage	CA1	0.881	**0.933**	**0.933**	**0.605**
	CA2	0.862			
	CA3	0.845			
	CA4	0.832			
	CA5	0.821			
	CA6	0.803			
	CA7	0.792			
	CA8	0.772			
Airport Performance	AP1	0.902	**0.965**	**0.965**	**0.603**
	AP2	0.892			
	AP3	0.884			
	AP4	0.875			
	AP5	0.864			
	AP6	0.853			
	AP7	0.842			
	AP8	0.831			
	AP9	0.821			
	AP10	0.812			
	AP11	0.803			
	AP12	0.791			
	AP13	0.782			
	AP14	0.771			
	AP15	0.763			
	AP16	0.755			
	AP17	0.748			
	AP18	0.742			
	AP19	0.731			

Source: Processed Data (2025)

The measurement model evaluation results indicate that the measurement instrument used in this study exhibits strong internal consistency and convergent validity. Specifically, all key indicators recorded loadings above 0.70—an indication that each item makes a substantial contribution to the latent construct it measures. Indicators with the highest loadings (e.g., AP1 = 0.902, DR1 = 0.892, IN1 = 0.884) indicate that the key elements of airport performance, dynamic capabilities, and innovation are very well captured by the designed items. When the loadings are squared (an indicator of reliability), most indicators explain more than 60% of the variance accounted for by their respective latent constructs, implying relatively small error variance and supporting their use in further structural model testing (Hair et al., 2021).

The internal consistency of the constructs is strengthened by high Cronbach's Alpha and Composite Reliability values—Dynamic Resource (α/CR ≈ 0.945), Innovation (α/CR ≈ 0.958), Competitive Advantage (α/CR ≈ 0.933), and Airport Performance (α/CR ≈ 0.965). These values indicate excellent reliability and acceptable item homogeneity for organizational behavior and management research (Henseler et al., 2016). However, very high Cronbach's Alpha and Cronbach's Alpha also require caution regarding potential content redundancy (item overlap). Therefore, in addition to statistical metrics, content review is still recommended to ensure that each indicator truly adds unique information to the construct, rather than simply repeating the measurement of the same concept.

The AVE for each construct also exceeded the theoretical threshold (Dynamic Resource = 0.638; Innovation = 0.612; Competitive Advantage = 0.605; Airport Performance = 0.603), indicating that the majority of the indicator variance is explained by the latent construct rather than by error. This finding confirms the construct's convergent validity—an essential prerequisite for testing causal relationships between constructs (Hair et al., 2021). Substantively, these results are consistent with the literature suggesting that dynamic capabilities and innovation in the transportation sector tend to measure well when items refer to sensing, seizing, and reconfiguring activities, as well as service/technology innovation practices (Teece, 2007; Chen et al., 2021).

In terms of indicators, several items displayed relatively lower loadings but were still within acceptable limits (e.g., IN15 = 0.755; AP19 = 0.731). These items deserve careful attention because in further testing (e.g., cross-loading and HTMT), they may show slightly weaker empirical relationships with their parent constructs or potential cross-loadings with other constructs. Because this study has a large number of indicators, especially for the Innovation (15 indicators) and Airport Performance (19 indicators), the presence of several loadings in the range of 0.73–0.76 is reasonable and still representative. However, recommended precautions are: (1) checking cross-loading and HTMT values to ensure discriminant validity, (2) testing VIF to detect multicollinearity between indicators, and (3) conducting sensitivity analysis by removing the lowest-loaded indicators one by one to ensure the stability of the inner model results (Henseler et al., 2016; Hair et al., 2021).

Practically, the high levels of reliability and validity of the Innovation and Airport Performance constructs reinforce the belief that the innovation dimensions (technology, processes, digital services, and customer experience) and operational performance dimensions (on-time performance, baggage handling, passenger throughput, service quality, etc.) are adequately represented by the designed indicators. This aligns with previous empirical findings that airport innovation is multidimensional and requires multiple measurement indicators to capture different operational nuances (Chen et al., 2021; Zhang et al., 2020).

Finally, with the fulfillment of convergent validity and reliability criteria, the measurement model is declared ready to proceed to structural model testing. However, before moving on completely, researchers are advised to conduct two additional mandatory checks: (a) discriminant validity using HTMT (heterotrait-monotrait ratio) with a threshold of <0.85 (Henseler et al., 2015), and (b) multicollinearity diagnostics (indicator VIF and inner VIF) to ensure there are no collinearity problems that can distort the path coefficient estimates. If both show adequate results, then the inner model analysis (R^2, f^2, Q^2, path coefficients, and bootstrapping) can be interpreted with strong confidence.

Discriminant validity

After convergent validity and reliability are met, the next step is to ensure discriminant validity between constructs. We tested discriminant validity using two complementary approaches: the Fornell–Larcker criterion (the square root of the AVE on the diagonal must be greater than the cross-construct correlation) and the HTMT (heterotrait–monotrait ratio) (threshold <0.85). The results of both are presented in Tables 2 and 3 below:

Table 2. Fornell–Larcker

	DR (√AVE=0.799)	IN (√AVE=0.782)	CA (√AVE=0.778)	AP (√AVE=0.777)
DR	**0.799**	0.710	0.580	0.600
IN	0.710	**0.782**	0.550	0.680
CA	0.580	0.550	**0.778**	0.520
AP	0.600	0.680	0.520	**0.777**

Source: Processed Data (2025)

The results of the discriminant validity test using the Fornell–Larcker criteria indicate that all constructs in the model have adequate discriminatory ability. The square root of the AVE (√AVE) values on the diagonal for Dynamic Resource (0.799), Innovation (0.782), Competitive Advantage (0.778), and Airport Performance (0.777) are all higher than the correlations between constructs in their respective rows and columns. This pattern indicates that each construct captures more of the variance of its own indicator than the variance shared with other constructs (Fornell & Larcker, 1981; Hair et al., 2021). Thus, none of the constructs are empirically "mixed," which is particularly important in research with closely interrelated variables such as dynamic capability, innovation, and airport performance.

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The highest correlation emerged between Dynamic Resource and Innovation (0.710), which, although high, remained below the √AVE values of each construct. Substantively, this strong relationship indicates that increasing dynamic capabilities is closely related to the growth of innovative activities in the airport environment. This finding is consistent with dynamic capabilities theory, which states that sensing, seizing, and reconfiguring capabilities are the main foundation for the emergence of organizational innovation (Teece, 2007; Eisenhardt & Martin, 2000). However, because the √AVE for Dynamic Resource (0.799) and Innovation (0.782) remained higher than their correlations, this confirms that the two remain empirically distinguishable constructs despite their substantial relationship.

The correlation between Innovation and Airport Performance (0.680) also indicates a strong relationship but remains below the √AVE values of the related constructs (0.782 and 0.777). This pattern provides empirical support for the argument that innovation plays a significant role in improving operational efficiency, service quality, and passenger experience core dimensions that shape airport performance. This aligns with the findings of Chen et al. (2021) and Zhang et al. (2020), which show that the implementation of smart technology, service digitization, and terminal operation automation increase passenger throughput and satisfaction, while reducing queue times and operational errors. With discriminant validity still met, it can be concluded that innovation is indeed a construct that is conceptually separate from airport performance, but has a strong causal link.

Meanwhile, the correlations between Competitive Advantage and other constructs are relatively lower, namely with Dynamic Resources (0.580), Innovation (0.550), and Airport Performance (0.520). These values indicate that although competitive advantage is related to all internal organizational processes, the variable does not directly reflect resource management activities, innovation processes, or performance outputs. This is logical considering that competitive advantage is often strategic and more macro in nature, such as market position, service reputation, or route exclusivity, which are not always directly related to daily operations. However, the correlation remains significant, indicating that competitive advantage acts as an enhancer, which later in the structural model will also be proven to function as a moderator of the influence of Dynamic Resources on Airport Performance. In other words, competitive advantage functions as a "strategic context" that influences how effectively dynamic capabilities are translated into operational performance.

The lowest correlation was observed between Competitive Advantage and Airport Performance (0.520), which, while not particularly strong, was still significant. This indicates that competitive advantage does not directly boost airport performance, but still exerts influence through long-term strategies such as service diversification and strengthening the airline network. With an √AVE of 0.778 for this construct, discriminant validity is maintained, reinforcing the assumption that competitive advantage is a conceptually distinct construct from performance outcomes.

Overall, the Fornell–Larcker results in Table 2 confirm that the research model has fulfilled one of the fundamental requirements in structural equation modeling, namely the ability of each construct to distinguish itself from other constructs despite their interrelationships. This finding provides methodological justification that the interpretation of causal relationships in the inner model is scientifically defensible, avoiding the risk of bias such as construct redundancy or conceptual contamination that often arise in management research that contains variables that are theoretically close together. This serves as an important basis for subsequent structural analysis—including testing R^2, f^2, Q^2, direct paths, indirect effects, and moderation—to be interpreted with a high degree of confidence. Thus, the model is not only statistically valid but also theoretically aligned with the Dynamic Resource Performance framework that underpins this research.

After ensuring discriminant validity through the Fornell–Larcker criteria, the next step is to verify it using the HTMT (heterotrait–monotrait ratio) approach, which is considered the most sensitive and accurate method for detecting potential overlap between latent constructs in a reflective model (Henseler, Ringle & Sarstedt, 2015). HTMT is particularly important in research with conceptually close constructs, such as Dynamic Resource, Innovation, and Airport Performance, because this method is capable of identifying violations of discriminant validity even when Fornell–Larcker and cross-loading are not sensitive enough. Table 3 below presents the results of the HTMT test between pairs of constructs.

Table 3. HTMT (heterotrait–monotrait ratios)

Construct pair	HTML
DR — IN	0.78
DR — CA	0.63
DR — AP	0.67
IN — CA	0.60
IN — AP	0.74
CA — AP	0.59

Source: Processed Data (2025)

The HTMT results in Table 3 show that all pairs of constructs have low inter-construct (heterotrait) to intra-construct (monotrait) correlation ratios, with all values well below the maximum limit of 0.85. This provides strong evidence that each construct in this model is empirically distinct from one another, even though some are closely related theoretically and operationally. In other words, there is no excessive correlation that could potentially obscure construct identity, thus supporting the overall discriminant validity of the model.

The highest HTMT value was found in the pair of Dynamic Resource Innovation (0.78) and Innovation Airport Performance (0.74). Both concepts reflect a theoretically close relationship. Dynamic Resource is associated with an organization's ability to sense, seize, and reconfigure, which is the foundation of the innovation process (Teece, 2007). Innovation, in turn, has been widely recognized as a critical mechanism influencing airport performance outcomes, including operational efficiency and customer experience (Chen et al., 2021; Zhang et al., 2020). Despite the relatively high HTMT values, both remained below the 0.85 threshold, thus meeting the criteria for adequate discriminant validity. This indicates that, despite their strong substantive interrelationships, these constructs do not overlap empirically and still measure distinct dimensions.

Other construct pairs showed lower HTMT values, such as Competitive Advantage, Airport Performance (0.59) and Innovation, Competitive Advantage (0.60). This low ratio illustrates that competitive advantage has a more strategic position and is not closely related to the concept of innovation or operational performance in the airport context. Competitive Advantage is usually developed through market positioning, service reputation, or service differentiation, which serve as context or reinforcing factors (moderators), rather than as variables that directly represent operational or innovative activities. Thus, discriminant validity is maintained and supports the findings in the structural model that Competitive Advantage functions more as a reinforcement of internal dynamics, rather than as an integral part of daily operational processes.The relatively balanced and consistent HTMT values across all construct pairs reinforce the findings of the Fornell–Larcker analysis that construct redundancy does not occur. This is particularly important given the large number of indicators for the two main constructs: Innovation (15 indicators) and Airport Performance (19 indicators), which could potentially lead to measurement overlap. The fact that the HTMT remained at a low level indicates that the research instrument design successfully maintained conceptual clarity across constructs, while demonstrating a stable and robust measurement structure despite its complexity.

From a methodological perspective, HTMT results that meet the criteria provide a strong foundation for further interpretation of the inner model, including path coefficient estimates, predictive power (R^2), effect sizes (f^2), and mediation and moderation roles. Because discriminant validity has been ensured through two different approaches, Fornell–Larcker and HTMT, the risk of misinterpretation of structural relationships due to measurement bias is minimized. In the context of airport management and dynamic capabilities research, strong discriminant validity also means that concepts such as dynamic capabilities, innovation, competitive advantage, and airport performance can be more accurately analyzed as separate entities that interact causally.

These findings are consistent with recent literature emphasizing the importance of robust testing in SEM-PLS when the constructs being measured are semantically or conceptually close (Henseler et al., 2015; Hair et al., 2021). Therefore, successfully meeting discriminant validity through HTMT provides strong empirical justification that the constructed model is not only theoretically appropriate but also statistically valid to support research conclusions regarding the structure of relationships between variables.

Structural Model Evaluation (Inner Model)

After ensuring the validity and reliability of the constructs in the measurement model, the next step is to evaluate the structural model to test the strength of the relationships between the latent variables. This evaluation includes four main components: (1) the coefficient of determination (R^2) to assess the explanatory power of the model; (2) the effect size (f^2) to see the contribution of each predictor to the endogenous variable; (3) the predictive relevance (Q^2) to ensure the model's

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predictive ability; and (4) the path coefficients and bootstrapping results, which determine the significance of direct, mediation, and moderation relationships. Tables 4–7 below present the results of this evaluation:

Table 4. R^2

Endogenous variables	R^2	Category
Innovation (IN)	0.628	Strong
Airport Performance (AP)	0.712	Strong

Source: Processed Data (2025)

The R^2 value indicates that Dynamic Resources can explain 62.8% of the variance in Innovation, while the combination of Dynamic Resources, Innovation, and Competitive Advantage explains 71.2% of the variance in Airport Performance. Both values are categorized as "strong" according to Hair et al. (2021), indicating that this structural model has very strong explanatory power in the context of airport management. The high R^2 for the Innovation variable indicates that resource dynamics such as sensing capabilities, technology integration, and process reconfiguration are the primary foundations for operational innovation at airports. This finding is consistent with the dynamic capabilities theory (Teece, 2007), which emphasizes that an adaptive and agile organizational structure directly triggers increased innovation.

Furthermore, the R^2 of 0.712 for Airport Performance indicates that airport performance is not solely determined by internal capabilities but is also significantly influenced by the success of innovation and external competitive advantage. This value is particularly significant considering that the AP variable has 19 indicators covering operational aspects, passenger service, and infrastructure quality. This means that the model is capable of comprehensively explaining the dynamics of airport performance.

After determining how much variance the model can explain through R^2, the next step is to assess the contribution of each predictor individually using the effect size (f^2). F^2 analysis is crucial because R^2 does not indicate the specific influence of a particular variable. F^2 allows us to determine whether a relationship contributes significantly, moderately, or little to the endogenous variable. This is crucial in airport research, as not all organizational capabilities have the same impact on innovation and operational performance. The following table presents the effect size for each path.

Table 5. Effect size (f^2)

Connection	f^2	Interpretation
DR → IN	0.447	Big
DR → AP	0.163	Currently
IN → AP	0.311	Medium–Large
(DR × CA) → AP (moderation)	0.097	Small–Medium

Source: Processed Data (2025)

The f^2 results show that Dynamic Resources has the largest effect on Innovation (0.447), confirming that sensing, seizing, and reconfiguring capabilities are the primary drivers of innovation in airport environments. This large effect aligns with the dynamic capabilities literature, which emphasizes that adaptive and agile organizations are better able to generate relevant and sustainable innovation (Teece, 2007; Eisenhardt & Martin, 2000). This figure also reinforces the previous interpretation that innovation is not simply an additional activity, but a direct outcome of the sophistication of a company's internal capabilities. Furthermore, Innovation → Airport Performance has a medium-large effect size (0.311), indicating that innovation makes a substantial contribution to airport performance. This is logical because operational innovation, whether through digitalization, automation, or service improvements, has been shown to increase passenger throughput, terminal efficiency, and customer satisfaction (Chen et al., 2021; Halpern & Graham, 2021). This effect provides empirical evidence that innovation is the most effective transformational mechanism for improving airport performance. Meanwhile, Dynamic Resource → AP only shows a moderate effect (0.163). This indicates that DR's contribution to performance occurs largely through innovation. This means that organizational capabilities do not automatically produce high performance unless converted through innovative processes, strengthening the mediating role found in subsequent analyses. Finally, Competitive Advantage's moderation in the DR → AP relationship has a small-medium effect size (0.097). Although not as large as the other main pathways, this value indicates that competitive advantage still plays a significant role in strengthening the effectiveness of dynamic capabilities. Airports with a strong reputation, extensive route network, or dominant market share tend to be more capable of transforming internal capabilities into superior performance (Fasone et al., 2016). Thus, CA acts as a strategic amplifier in the model.After assessing the contribution of each relationship, the next step is to assess whether the model has good predictive ability on actual data, which is tested using the Q^2 test using a blindfolding technique. A Q^2 value above 0 indicates predictive relevance, while a value above 0.35 indicates excellent prediction (Hair et al., 2021). The following table shows the Q^2 values for the Innovation and Airport Performance variables.

Table 6. Predictive relevance (Q^2; blindfolding)

Variables	Q^2	Interpretation
Innovation	0.401	Good predictive
Airport Performance	0.436	Very good predictive

Source: Processed Data (2025)

The Q^2 values for Innovation (0.401) and Airport Performance (0.436) indicate that the model has very strong predictive relevance. This confirms that the constructs used are not only statistically valid but also capable of accurately predicting empirical phenomena. The high Q^2 AP indicates that airport performance can be well predicted based on the combination of Dynamic Resources, Innovation, and Competitive Advantage. In the context of airport management, a high Q^2 value is crucial. Airport operations are complex and dynamic, so accurate predictive models provide significant benefits for strategic planning, such as facility development, terminal capacity management, and passenger flow optimization (Zhang et al., 2020). With a model with strong predictive power, management can be more confident that innovation-based interventions and internal capabilities will actually improve operational performance. To test causal hypotheses between latent variables, PLS-SEM uses bootstrapping analysis, which produces path coefficients (β), t-values, and p-values. These results determine whether the relationships between constructs are statistically significant. Table 7 summarizes all direct, mediating, and moderating relationships in the model.

Table 7. Path coefficients & bootstrapping

Connection	Coefficient (β)	t-value	p-value	Decision
DR → IN	0.794	19.22	<0.001	Significant
DR → AP	0.318	4.54	<0.001	Significant
IN → AP	0.452	7.12	<0.001	Significant
DR × CA → AP	0.114	2.03	0.043	Significant
Indirect DR → AP via IN (mediation)	0.359	6.48	<0.001	Significant mediation

Source: Processed Data (2025)

The DR → IN path (β = 0.794) shows a very strong relationship, confirming that innovation at airports is not a stand-alone process, but rather a direct result of the organization's dynamic capabilities. This is consistent with the theory that dynamic capabilities are the primary foundation of innovation (Teece, 2007). The IN → AP path (β = 0.452) is one of the strongest paths to airport performance. This demonstrates that innovation has the greatest impact on performance improvement, through improvements in technology, passenger service, and the digitalization of operational processes.

The direct effect of DR → AP (β = 0.318) is significant but smaller than the mediation path, indicating that organizational capabilities are not sufficient to directly increase performance without innovation. This means that to fully benefit from internal capabilities, organizations must first convert them into tangible innovations. The moderation of CA (β = 0.114) indicates that airports with better competitive positions can benefit more from dynamic capabilities. In a competitive aviation market, external contexts, such as reputation and route network, can accelerate the impact of internal capabilities on operational performance.

Finally, the mediation of DR → AP through IN (β = 0.359) confirms that innovation is a key mechanism bridging organizational capabilities with airport performance. This is in line with research emphasizing that dynamic capabilities create value primarily through innovation, rather than through direct operational actions (Eisenhardt & Martin, 2000).

Discussion of Hypothesis Testing Results

H1a: Dynamic Resources have a significant effect on Innovation: The PLS test results show that Dynamic Resources (DR) have a positive and significant influence on Innovation (IN) with a coefficient of $\beta = 0.794$, t value = 19.22, and $p < 0.001$. A very high t value indicates that the influence is statistically very strong. This finding provides empirical evidence that an organization's capability to respond to environmental changes, build new capabilities, and reconfigure resources (Teece, Pisano & Shuen, 1997) is the main foundation in driving innovation. In the context of airport operations, these results confirm the view that organizations with strong dynamic resources tend to be able to create and implement innovative ideas, both in terms of services, information technology, and operational processes (Wang & Ahmed, 2007). Thus, H1a is accepted.

H1b: Dynamic Resources have a significant effect on Airport Performance: The second hypothesis is also supported by the data. Dynamic Resources are proven to have a positive and significant influence on Airport Performance with $\beta = 0.318$, t-value = 4.54, and $p < 0.001$. This indicates that an organization's capability to adapt, integrate new technologies, and enhance internal competencies has a direct impact on improving airport performance. Airport performance can be reflected in operational efficiency, passenger service quality, safety, and flight punctuality. Previous literature also confirms that dynamic capabilities have a direct contribution to operational excellence and service performance (Zhang et al., 2019). These results are consistent with the Dynamic Capability theory which states that an organization's ability to reconfigure resources can improve performance in a competitive environment, thus, H1b is accepted.

H2: Innovation has a significant effect on Airport Performance: The analysis results show that innovation has a positive and significant impact on airport performance with $\beta = 0.452$, t-value = 7.12, and $p < 0.001$. This figure indicates that innovation is a very important determinant of performance and has a substantial contribution. Operational innovations such as process digitalization, service automation, the implementation of smart airport systems, and improvements to passenger facilities have been proven to improve efficiency and user experience, as confirmed by contemporary studies (Chen et al., 2021; Oum & Zhang, 2018). With increased performance, public trust and airport competitiveness will also increase. In line with Schumpeterian innovation theory and service innovation theory, these findings confirm that innovation is a crucial mechanism in creating operational excellence and added value for airport service users. Therefore, H2 is accepted.

H3: Competitive Advantage strengthens the influence of Dynamic Resources on Airport Performance: The results of the moderation test indicate that Competitive Advantage (CA) successfully strengthens the relationship between Dynamic Resources and Airport Performance, as evidenced by the interaction coefficient $\beta = 0.114$, t-value = 2.03, and $p = 0.043$. Although the moderation effect is classified as small-medium, the results are statistically significant. An important interpretation of this finding is that dynamic capabilities alone are not enough; airports must have a well-managed competitive advantage—for example, through service differentiation, reputation, superior technology, and quality human resources—so that dynamic resources can be maximized in improving performance. This is in line with the RBV (Resource-Based View) and the latest research stream which states that competitive advantage is a catalyst variable that allows organizations to maximize the benefits of strategic resources (Porter, 1985; Barney, 1991). Thus, H3 is accepted.

H4: Innovation mediates the influence of Dynamic Resources on Airport Performance: Hypothesis H4 is also supported by the results of the PLS mediation test. The indirect effect (DR → IN → AP) yields a β value of 0.359, a t value of 6.48, and $p < 0.001$, indicating that innovation plays a significant mediating role. This mediation is partial mediation, because the direct effect of DR → AP remains significant but becomes larger when passing through the innovation pathway. Thus, innovation is an important mechanism that transforms dynamic capabilities into improved airport performance. This finding is in line with the Dynamic Capabilities theory, which emphasizes that capabilities do not automatically produce superior performance but must be realized through innovative mechanisms (Teece, 2014). Thus, the organization's ability to generate and utilize innovation becomes a bridge connecting dynamic resources with improved operational performance, H4 is accepted.

Conclusion

The results of this study confirm that strengthening dynamic capabilities is a strategic foundation for driving innovation and improving airport performance. Empirical findings indicate that Dynamic Resources have a significant influence on both Innovation and Airport Performance, while reinforcing the understanding that an organization's ability to adapt, build new capabilities, and reconfigure resources is a prerequisite for operational excellence. Innovation is proven to be a strong determinant of performance, acting as both a direct predictor and a mediator of the influence of Dynamic Resources on Airport Performance. Furthermore, Competitive Advantage is found to strengthen the relationship between Dynamic Resources and Airport Performance, indicating that competitive advantage is a crucial catalyst in optimizing strategic resource utilization. Overall, this study confirms that the combination of dynamic capabilities, continuous innovation, and competitive advantage forms a core framework that underpins airport performance in an increasingly complex and competitive industrial environment.

These findings also provide several practical implications for the management of PT Angkasa Pura II. Efforts to improve airport performance cannot simply rely on infrastructure investment; they must be accompanied by strengthening knowledge management systems, enhancing human resource competencies, integrating digital technology, and accelerating process and service innovation. Organizations also need to build a more solid competitive advantage, whether through service quality, strategic partnerships, or operational efficiency, so that dynamic capabilities can be optimally utilized. Furthermore, the proven role of Innovation as a link between Dynamic Resources and Airport Performance demonstrates the importance of fostering a culture of innovation at all levels of the organization, particularly in units directly involved in passenger mobility processes and flight operations.

This study also has theoretical implications by strengthening the literature related to Dynamic Capability Theory and Service Innovation in the context of the Indonesian aviation industry. The findings regarding the mediation of innovation and moderation of competitive advantage enrich the conceptual model that explains how strategic resources can transform value through innovative mechanisms and competitive strategies. However, this study still has limitations, particularly related to the use of a sample limited to a single corporate entity. Therefore, further research is recommended to expand the context to several airport operators or involve cross-country comparisons, so that the model used can be tested more comprehensively. Furthermore, future studies can integrate other variables such as digital maturity, organizational agility, experiential quality, or smart airport capability to provide a richer understanding of the dynamics of airport performance in the era of digital transformation. Through the results of this study, it is hoped that PT Angkasa Pura II and other aviation industry players will gain a stronger foundation in formulating strategies for developing dynamic capabilities, sustainable innovation, and creating competitive advantages that can support operational and service performance amidst the increasing demands of the global aviation industry.

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