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Assessing the Growth of human capital development in airport-centered economy

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ABSTRACT

Considering the potential economic advantages brought about by airports, policymakers within airport communities embraced the aerotropolis model hoping that airports would emerge as pivotal drivers of economic progress. Regrettably, the implementation of aerotropolis-based economic strategies did not uniformly yield favorable outcomes across various airport communities. Local authorities display eagerness in constructing the necessary infrastructure for realizing the aerotropolis vision yet tend to overlook the crucial aspect of nurturing human capital. This investigation revolves around a central research question: Does the absence of robust manpower improvement serve as the critical missing element in the aerotropolis model's economic development approach? An exhaustive assessment of all 35 aerotropolis-oriented airports was undertaken to ascertain the degree of impact manpower improvement exerts on the overall prosperity of the aerotropolis concept. Notably, the findings reveal that passenger activities stand out as the foremost driving force behind the economic achievements witnessed within airport communities. Recent studies in the labor market underscore the fact that regional economic performance does not necessarily rely on the level of education, but on the relevance of the skills and job alignment, especially in regions that rely heavily on transportation; Autor, 2019; OECD, 2020.

Keywords: *Aerotropolis, Passenger Boarding, Cargo Activity, Airport Activity, Economic Growth, Airport Communities.*

1 Introduction

The term aerotropolis is a concept that refers to an urban area or metropolitan area that is positioned around a major airport. The term "aerotropolis" combines the word aero, which relates to aviation or aircraft, and metropolis, which denotes a large and densely populated urban area. In an aerotropolis region, the airport serves as the primary hub for economic and social activities and drives the development and growth of the surrounding region.

According to Ryerson (2016), airports play a crucial role in driving local economic growth and generating substantial revenues for airport communities. The concept of an aerotropolis, as defined by Kasarda and Appold (2014), revolves around an urban region where the airport acts as the central hub for all economic activities. The research paper by Kasarda and Appold emphasizes that the airport catalyzes economic activities in the surrounding area, forming the core of the aerotropolis model. In this aerotropolis model, the airport not only provides air-related services to the community but also offers a diverse range of non-air services, contributing to the region's overall revenue generation. Policymakers have recognized the significant economic benefits of the aerotropolis and have adopted various strategies to integrate it with overall economic growth (Freestone, 2009; Kasarda, 2000). New literature indicates that the aerotropolis model continues to have an effect, but its economic performance is very dependent on the system of governance, the alignment of the labor market, and the coordination of institutions; Appold and Kasarda, 2020; Freestone, 2021.

While the comprehensive planning of aerotropolis model strategies has led to success in certain airport communities, the implementation of such economic development strategies has not always been fruitful (Kasarda, 2001, 2011; Van Wijk, 2011). Researchers like Appold (2013) frequently draw attention to the absence of investment in physical capital, (Simmonds and Hack, 2000; Van Wijk, 2011), as one of the possible causes of these unsuccessful endeavors. The crucial part that manpower improvement plays in the aerotropolis model's pursuit of economic success, however, is frequently

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disregarded (Freestone and Baker, 2011; Storper, 2010). Manpower improvement is considered a critical element for the success of not only companies but also cities and regions. It involves careful planning to create the right environments that foster learning, innovation, and the acquisition of essential skills and competencies by employees and citizens. Key factors in manpower improvement include talent management, performance management, HR management, and knowledge planning (Douglas and Currie, 2010).

To underscore the significance of the aerotropolis model within airport communities and maximize its impact, it becomes essential for decision-makers to fully integrate and prioritize the concept of human capital quality as a central and guiding principle in their comprehensive planning strategies (Porter and Kramer, 2011). This not only adds depth and dimension to their approach but also ensures a more holistic and sustainable development of these dynamic urban centers. Respected researchers and scholars, such as Hanushek and Woessmann (2015) and Zak and Getzner (2014), bring into sharp focus the pivotal role that manpower improvement plays in the overarching success of the aerotropolis model. They emphasize that the cultivation of a skilled and proficient workforce serves as the bedrock for driving innovation, economic growth, and overall prosperity within these airport-centric communities (Hanushek and Woessmann, 2015; Zak and Getzner, 2014).

Failure to acknowledge or accurately assess the paramount importance of manpower improvement within the context of the aerotropolis model could potentially lead policymakers astray, causing them to miss out on valuable strategies and opportunities. These strategies have the inherent potential to not only bolster the local economy but also create an environment that fosters continual learning, skill enhancement, and personal growth, in turn nurturing a more resilient and adaptable workforce (Appold, 2013). In essence, by embracing and emphasizing the critical role of human capital quality, policymakers, and community leaders can harness the full potential of the aerotropolis model. They can establish a thriving ecosystem where innovative ideas flourish, businesses thrive, and individuals are empowered to reach their maximum potential. This approach not only strengthens the foundation of these airport communities but also contributes to the broader advancement of society as a whole.

1.1. Purpose of the Study

This research study employed a systematic and rigorous quantitative methodology, specifically an explanatory quasi-experimental design, to delve deeply into the multifaceted and intricate interplay between the development of human capital and the operational performance of airports within the overarching framework of the aerotropolis model. By employing this methodological approach, the study aimed to shed light on the complex relationships, patterns, and influences that underlie the dynamic interaction between human capital and the functioning of airports within the unique context of the aerotropolis. Furthermore, the research sought to extend its investigation beyond the immediate confines of individual components. It aimed to explore the potential broader implications and connections that manpower improvement might have on the overall effectiveness and success of the aerotropolis model as a holistic urban development strategy. This perspective is particularly relevant as it acknowledges that manpower improvement can have ripple effects that extend far beyond its immediate boundaries, contributing to the overall vitality and resilience of the aerotropolis.

It is crucial to underline that the primary objective of this study was intentionally nuanced and multifaceted. Rather than solely seeking to establish a straightforward and deterministic causal relationship between manpower improvement within the airport vicinity and the achievements of the aerotropolis model, the study adopted a more comprehensive approach. The researcher aimed to intricately assess and understand the nuanced dimensions of manpower improvement within the specific context of the aerotropolis model's airport region. In doing so, the research not only aimed to measure the extent of manpower improvement but also to analyze its qualitative aspects, such as the skill diversity, knowledge dissemination, and collaborative potential it brings to the aerotropolis model. This holistic evaluation was then compared and contrasted with the overall outcomes and accomplishments of the aerotropolis model itself. This broader perspective allowed for a more comprehensive understanding of the intricate relationship between human capital and the aerotropolis model's effectiveness. In essence, this study represents an in-depth exploration that moves beyond simple cause-and-effect paradigms. It embodies a holistic and nuanced approach to unraveling the multifaceted connections between manpower improvement and the success of the aerotropolis model, contributing valuable insights to the realm of urban planning and development strategies.

1.2. *Research Objectives*

Research Objective 1 (RO 1): To determine whether there is a relationship between the aerotropolis model's prosperity, as measured by indicators like employment in the airport area, gross regional product in the airport area, and per capita income in the airport area, and the model's operational performance and talent flow.

Research Objective 2 (RO 2): To investigate any potential connections between the educational and training programs provided by community colleges and universities (which serve as the talent pipeline), the airports' performance, and the aerotropolis model's overall effectiveness. This evaluation will involve metrics such as the count of passenger placements (Passenger-Activity) and the magnitude of cargo handled in metric tons (cargo activity) at each aerotropolis model airport, relative to the population of the airport's corresponding Metropolitan Statistical Area (MSA). Recent empirical data show that passenger-focused airport operation causes greater local job multipliers alongside service-based spillovers of any cargo-centric operations; Percoco, 2019; Sheard, 2019.

1.3. *Significance of Study*

Communities that prioritize investments in human capital tend to achieve greater success (Sweetland, 1996). The findings of this research endeavor could shed light on the pivotal role played by manpower improvement initiatives in contributing to the triumph of the aerotropolis model. The outcomes may serve to highlight the presence of any disparities between the educational and training requisites of businesses within the airport vicinity and the existing human capital reservoir of the same community.

Such insights would empower policymakers to address potential gaps by formulating policies aimed at bolstering education and training programs focused on manpower improvement, tailored to the specific needs of employees in airport-related roles. As underscored by Phillips (2012), the implementation of robust assessment and reporting mechanisms can result in the creation of more effective training programs. This knowledge could also serve as a deterrent against the outsourcing of jobs by employers based at airports. The knowledge derived from this study could extend beyond the immediate locations under scrutiny, benefiting airport administrators, community leaders, and urban planners in other locales. They might leverage the insights gained to discern the influential factors for fostering success within the aerotropolis model within their communities.

1.4. *A*erotropolis Airports

The aerotropolis model has been recognized as having the potential to bring about economic success within airport communities, despite the challenges faced by community leaders during its development (Kasarda, 2006, 2011; Peneda, Reis, & Macário, 2011). According to Kasarda and Appold (2014), 35 airports are using the aerotropolis paradigm in the United States. These 35 airports were chosen because they were among the most prominent and well-known examples of airports embracing the aerotropolis pattern in the United States. These airports have been categorized into four distinct types, each representing a unique implementation and development stage. The categories include:

a) Operating Aerotropolis: Airports that have fully embraced the aerotropolis model and are currently reaping the benefits of enhanced economic activity within their communities.
b) Operating Airport City: Airports where the aerotropolis model has been effectively integrated, leading to the emergence of a thriving airport city with an array of commercial and residential activities.
c) Developing Aerotropolis: Airports in the process of implementing the aerotropolis model, with significant infrastructural and economic developments underway.
d) Developing Airport City: Airports that are in the initial stages of adopting the aerotropolis model, showing promising potential for future growth and transformation into vibrant airport cities.

These airports are excellent illustrations of how the aerotropolis model can benefit airport towns, promoting economic development, job creation, and a higher standard of living for locals. The aerotropolis model offers a forward-thinking approach to planning for the region by coordinating urban development with aviation infrastructure, providing a sustainable path to economic success in the contemporary era of globalized trade and travel. Please see Table 1:

Airports Based on the Aerotropolis Model in the United States for a complete list of these airports.

To comprehensively assess the performance of aerotropolis model airports, a multifaceted evaluation was employed. This evaluation considered critical factors such as passenger and cargo activity, which were meticulously analyzed about the population size of the respective Metropolitan Statistical Area (MSA) associated with each airport. This approach enabled a contextual understanding of airport performance, highlighting how the activity levels within these airports relate to the local population, and thereby indicating their significance within the broader regional framework. Concurrently, the research endeavored to gauge the overall effectiveness of the aerotropolis model. This assessment was based on a comprehensive analysis of several key economic indicators within the airport vicinity,

Table 1 Aerotropolis Model Airports by Airport Activity- 2014

Rank	Aerotropolis Model Airport	Z-score		
		Passenger Activity	Cargo Activity	Total Activity
1	Ted Stevens Anchorage International	0.8200	5.1696	5.9896
2	McCarran International	2.1904	-0.2979	1.8925
3	Denver International	2.0109	-0.2582	1.7527
4	Charlotte/Douglas International	1.8764	-0.3032	1.5732
5	Hartsfield-Jackson Atlanta International	1.6198	-0.2684	1.3514
6	Miami International	1.2804	0.0489	1.3293
7	Memphis International	-0.7698	2.0174	1.2477
8	Orlando International	1.3253	-0.2791	1.0462
9	Newark Liberty International	1.2029	-0.1865	1.0164
10	Dallas/Fort Worth International	1.0670	-0.2299	0.8371
11	Minneapolis-St Paul International/Wold-Chamberlain	0.4372	-0.2857	0.1515
12	Louisville International-Standiford Field	-0.7878	0.9342	0.1463
13	Phoenix Sky Harbor International	0.3260	-0.2799	0.0461
14	Baltimore/Washington International Thurgood Marshall	0.1284	-0.2999	-0.1716
15	Raleigh-Durham International	0.0610	-0.2752	-0.2142
16	Chicago O'Hare International	-0.0139	-0.2151	-0.2290
17	Detroit Metropolitan Wayne County	0.0306	-0.3024	-0.2718
18	Los Angeles International	-0.0655	-0.2654	-0.3309
19	Indianapolis International	-0.6019	0.0511	-0.5508
20	Philadelphia International	-0.3907	-0.2801	-0.6708
21	Kansas City International	-0.4040	-0.2909	-0.6949
22	Lambert-St Louis International	-0.4826	-0.3053	-0.7879
23	General Mitchell International	-0.5249	-0.2793	-0.8042
24	Northwest Florida Beaches	-0.5350	-0.3241	-0.8591
25	John F Kennedy International	-0.6010	-0.2935	-0.8945
26	Cleveland-Hopkins International	-0.6166	-0.2993	-0.9159
27	Washington Dulles International	-0.6372	-0.3131	-0.9504
28	Pittsburgh International	-0.6721	-0.3003	-0.9724
29	Huntsville International-Carl T Jones Field	-0.8226	-0.1954	-1.0180
30	Piedmont Triad International	-0.8385	-0.2250	-1.0635
31	Jackson-Medgar Wiley Evers International	-0.9102	-0.3059	-1.2161
32	Ontario International	-1.0724	-0.2507	-1.3231
33	Rickenbacker International	-1.2214	-0.2732	-1.4946
34	Phoenix -Mesa Gateway Airport	-1.1786	-0.3241	-1.5027
35	Fort Worth Alliance	-1.2299	-0.2848	-1.5147

2 Research Design and Methodology

The fundamental aim that guided this research was to delve into the intricate interplay between the development of human capital and the operational performance of aerotropolis model airports. Additionally, the study aspired to uncover the nuanced relationship between the advancement of human capital and the broader success achieved by the aerotropolis model as a comprehensive urban development paradigm. This exploration was conducted to shed light on the complex dynamics that underlie the interdependence of human capital and the functioning of airports within the unique context of the aerotropolis.

including employment levels, gross regional product, and per capita income. By examining these metrics, the study aimed to capture a holistic picture of the model's success, highlighting its impact on local economies and livelihoods.

To facilitate the accomplishment of these research objectives, a robust regression model was meticulously developed. This model was constructed using a rich repository of secondary data acquired from two distinct and reputable sources. The Federal Aviation Administration (FAA) contributed essential information regarding passenger boardings and air cargo shipments, providing valuable insights into airport activity and connectivity. Simultaneously, Economic Modeling Systems, Inc. (EMSI) played a pivotal role by curating a comprehensive and intricate database, integrating data from a staggering 90 distinct sources. This expansive database granted researchers the remarkable ability to analyze and interpret data at a remarkably granular level, allowing for insights that spanned even down to the granularity of individual zip codes.

2.1. *Dataset Name Conversion to IBM SPSS*

The utilization of hard spaces and specific symbols in dataset names is prohibited by IBM SPSS, prompting the researcher to undertake a renaming of variables (Field, 2014). The updated nomenclature aligns with the sanctioned naming conventions within IBM SPSS, as elucidated by Cohen, Cohen, West, and Aiken (2003). Detailed information about the variables, encompassing the variable name, the corresponding IBM SPSS name, a description, and the dataset I.D. for each, is provided in Table 2.

Table 2 Community College and University Programs Evaluated by CIP Code and Industry Type.

CIP Code	Program Title	Industry Type
47.0607	Airframe Mechanics and Aircraft Maintenance Technology/ Technician	Dependent
47.0608	Aircraft Power Plant Technology/ Technician	Dependent
49.0101	Aeronautics/Aviation/Aerospace Science and Technology, General	Dependent
49.0102	Airline/ Commercial/ Professional Pilot and Flight Crew	Core
49.0104	Aviation/Airway Management and Operations	Core
49.0105	Air Traffic Controller	Core
49.0106	Airline Flight Attendant	Core
52.0203	Logistics, Materials, and Supply Chain Management	Dependent
52.0209	Transportation/Mobility Management	Dependent

Note: Classification of programs by industry type is based on "Competitive advantage analysis and strategy formulation of airport city development: The case of Taiwan", Wang and Hong, (2011)

2.2. *Reliability and Validity*

Ensuring the integrity and dependability of a study holds paramount significance within the realm of research. Validity pertains to the degree to which a study accurately captures its intended measurements, while reliability concerns the steadfastness and consistency of measurements across varying populations and timeframes. The significance of upholding study validity is underscored by Shadish, Cook, and Campbell (2002). Reliability, as expounded by Shadish et al. (2002), pertains to the steadfastness of measurements produced by an assessment tool over different periods and demographics, whereas validity gauges the alignment of study outcomes with the requisites of scientific research methodology.

The aspiration is for the findings yielded by the evaluation tool to remain consistent and reliable (Shadish et al., 2002). Furthermore, the dependability and authenticity of the data obtained from EMSI are validated by other reputable institutions, spanning the spectrum from esteemed research universities to accomplished scholars (Cummings and Epley, 2015).

2.3. *Variables and Latent Constructs*

This study's underlying framework includes four latent components and nine variables altogether. Latent constructs denote things that can't be seen or measured out in the open (Bollen, 2014). The success of the aerotropolis model, local economy, manpower growth, and airport activities are all carefully defined latent structures. The variables in the model include passenger boarding flight, Talent-Pipeline in the vicinity, cargo activity in the vicinity, metropolitan statistical area (MSA) employment, air cargo activity, MSA gross-regional-product, MSA per-capita-income, and employment near airports. The significance of these constructs and variables within the study lies in their foundational role, emphasizing the concept that the prosperity of the aerotropolis model is intrinsically tied to the airport's capacity as a catalyst for a thriving and robust economy. Modern research indicates that physical locations are not sufficient to ensure successful workforce pipelines unless the educational programs are proactively co-developed with stakeholders in the industry; Holzer, 2021; Tomlinson, 2020.

In terms of measurement, the variables utilized in this study are categorized using a ratio scale. The recognition of the scale of measurement holds paramount importance as it aids in the appropriate selection of statistical analyses and facilitates a comprehensive understanding of the data (Trochim, 2006). Ordinal variables share certain characteristics with nominal variables, but they possess a distinctive order within each category. Conversely, interval variables maintain equidistant intervals between values, though they lack a true zero point (Trochim, 2006). The assignment of a zero value in interval variables is arbitrary (Davis, 2011). Ratio variables share similarities with interval variables; however, they feature an absolute zero point where zero signifies a complete absence of the measured attribute (Davis, 2011; Trochim, 2006).

3 Explanation of the Research Objectives

3.1 Research Objective 1

This study's main goal was to clarify the complex relationship between the aerotropolis model's success and its two contributing variables: performance and the talent pipeline. This objective was achieved through a robust statistical analysis employing multiple regression. Multiple regression expands upon the concept of simple linear regression by enabling the examination of how various independent variables collectively influence a dependent variable. In the context of this research, the dependent variables (denoted as "y") were AC_GRP, AC_INC, and AC_EMP, while the independent variables (denoted as "x") encompassed Passenger Boardings, Air Cargo, and employee Talent. Additionally, control variables (also denoted as "x") consisted of MSA_GRP, MSA_EMP, and MSA_INC. Since multiple linear regression entails analyzing each dependent variable separately, three distinct regression analyses were conducted corresponding to the three dependent variables. The following is a presentation of the general equation for multiple linear regression.: $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_nX_n + e$, where "y" represents the dependent variable, and "x" denotes the independent variable.

The multiple regression equation used for this research objective is represented visually in Figure 1. The three rectangles show the three observed input variables designated V1 to V3: (i) Passenger-Boardings, (ii) Cargo-Activity, and (iii) Talent-Pipeline. The three control variables, MSA Gross-Regional-Product (a), MSA-Employment (b), and MSA Per-Capita-Income (c), are represented by the rectangles V4 to V6. While the variable terms convey similar concepts within the multiple linear regression framework, researchers often prefer the term "control variables" when referring to independent variables. This choice of terminology is commonly adopted in research employing multiple linear regression. Another term occasionally used interchangeably with "input variables" and "control variables" is "independent variables." According to O'Neil et al. (2015), the phrase "control variables" is preferred because of its consistency, which improves the understanding of interactions among other factors under examination. The three observed outcome variables—Airport-vicinity-Gross-Regional-Income, Airport-vicinity-Employment, and Airport-vicinity Per-Capita-Income—are shown as rectangles V7 to V9.

These outcome factors are labeled as dependent variables, indicating that changes in airport efficiency or human capital growth may, in turn, affect how well the aerotropolis model performs. Four latent variables: (a) Aerotropolis-Model-Airport-Performance, (b) Human-Capital-Development, (c) Regional-Economy, and (d) Aerotropolis-Model-Success (Huber-Carol et al., 2002).

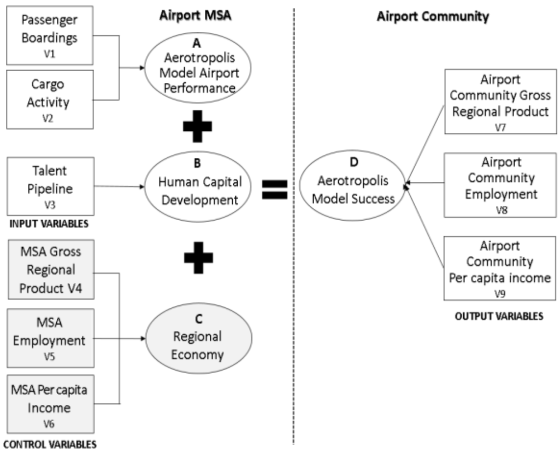
The following equation is produced by replacing the latent variables in the equation: Success is defined as a plus b1: Performance, b2: HCD, and b3: Economy. The latent variable Economy serves as the control variable in this equation, while the latent variables HCD and Performance act as independent variables. Success, a latent variable, simultaneously takes on the function of the dependent variable. Three equations are produced when the latent variables are substituted with the corresponding observable variables in the equation are:

$$\begin{aligned} AC_{GRP} = a + b_1 \times Boarding + b_2 \times Cargo \\ + b_3 \times Talent + b_4 \times MSA\_GRP \\ + b_5 \times MSA\_EMP \\ + b_6 \times MSA\_INC \end{aligned}$$

$$AC_{\text{EMP}} = a + b_1 \times Boarding + b_2 \times Cargo + +b_3 \times Talent + b_4 \times MSA\_GRP + b_5 \times MSA\_EMP + b_6 \times MSA\_INC$$

$$AC_{INC} = a + b_1 \times Boarding + b_2 \times Cargo + b_3 \times Talent + +b_4 \times MSA\_GRP + b_5 \times MSA\_EMP + b_6 \times MSA\_INC$$

Figure 1 Illustration of Multiple Regression Equation Model with Control Variables.



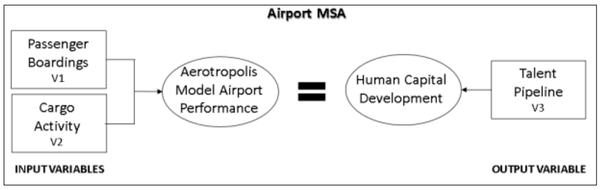
3.2 Research Objective 2

The second research goal was to compare the efficiency of aerotropolis model airports with the expansion of human capital. To achieve this purpose, a detailed multiple regression analysis was conducted, comparing Passenger-Activity and Cargo Activity against the Talent-Pipeline.

The regression equation related to this goal is shown graphically in Figure 2. The latent variables (a) Aerotropolis-Model-Airport-Performance, and (b) Human-Capital-Development (HCD) are represented by the paired ovals. The variables that were noticed during the investigation are shown as rectangles. The two observed input variables, (a) Passenger Boardings and (b) Cargo Activity, are represented by the rectangles V1 and V2, respectively. Rectangle V3 relates to the latent variable of Human-Capital-Development, which is aligned with the observable outcome variable, Talent-Pipeline. By replacing the latent variables, the resulting equation is as follows: $Talent\ Pipeline = a + b_1 \times Passenger_{Boarding} + b_2 Cargo\backslash\_Activity$

In this equation, the variable Talent-Pipeline serves as the dependent variable, while *Passenger-Activity* and Cargo-Activity function as independent variables (Field, 2014).

Figure 2 Illustration of the Multiple Regression Equation Model for RO2.



4. Results of Data Analysis

It is anticipated that investing in human capital will increase economic success within society (Becker, 1993). This quantitative inquiry explored the relationship between manpower improvement and the successes of the aerotropolis model as well as the performance of the model's airports. This section presents the findings from the two research objectives of the study. The rankings are as follows: (a) Aerotropolis-Model-Airport-Performance, (b) Talent-Pipeline-Assessment, (c) Aerotropolis-Model-Airport-Performance and Airport Neighbor Success, and (d) Aerotropolis-Model-Airport-Performance and Manpower Improvement.

Multiple regression, Z-scores, and ratio analysis were all employed as research techniques for these objectives. To assess the performance of the 35 aerotropolis model airports, the first study goal used Z-scores for passenger and cargo activities. This parameter is crucial to the study since airport performance and the economic health of the airport's neighborhood are positively associated.

Determining the size of the Talent-Pipeline within the MSA was the second study goal. The ratio of people (aged 15 to 64) completing training and educational programs connected to aerotropolis relative to the working-age population within the airport MSA was used to evaluate the Talent-Pipeline. For local firms in the airport vicinity, a lack of people in the pipeline can worsen skills gaps, weaken competitive advantage, and impair productivity. Despite methodological differences, each research goal offers new perspectives on how the aerotropolis model's effectiveness is influenced by theories of transportation and manpower improvement.

4.1. Results for Research Objective 1

The multiple regression model applied to the dependent variable (DV) AC_GRP yields statistically significant results. Table 3 provides the Model Summary and ANOVA for AC_GRP, presenting the statistical measures utilized to evaluate the significance of differences between two or more means. The F-test, serving as an indicator of the model's suitability for the data (Field, 2014), has been employed.

The p-value associated with the DV, AC_GRP, is 0.019, indicating a significant divergence within the model. Furthermore, the coefficient of determination (R2) stands at 0.399, signifying that 39.9% of the variability in the dependent variable can be attributed to the combined influence of the three independent variables (IVs) and three control variables (CVs). Consequently, a discernible relationship exists between AC_GRP and the success of the aerotropolis model.

Table 3 Descriptive Statistics for Talent Pipeline, n=34

Observation	Minimum	Maximum	Mean	Standard Deviation
Talent Pipeline (per million)	0.00	573.10	142.73	137.44

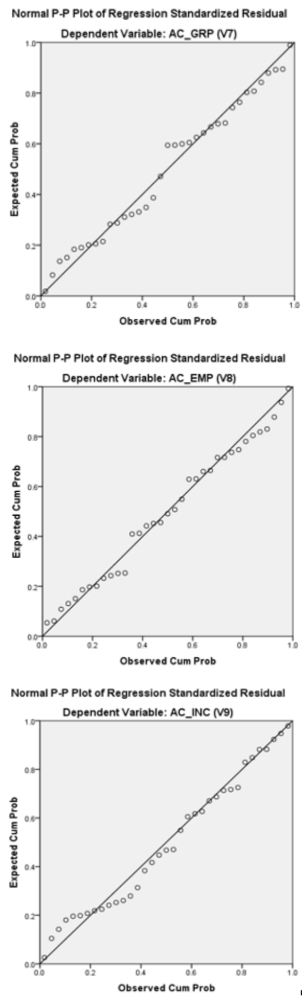
The statistical significance of the multiple regression model applied to the dependent variable (DV) AC_EMP is evident. The application of the F-test determines the model's appropriateness for the data (Field, 2014).

The p-value corresponding to the DV, AC_EMP, is 0.049, indicating a noteworthy divergence within the model. Moreover, the coefficient of determination (R2) stands at 0.345, implying that 34.5% of the variability in the dependent variable is attributable to the combined influences of the three independent variables (IVs) and three control variables (CVs). Consequently, a discernible relationship is discerned between AC_EMP and the triumph of the aerotropolis model.

4.2. *Assumption Testing*
4.2.1. Linearity: The existence of a linear relationship between the independent factors and the dependent variable is one of the key premises of multiple regression (Field, 2014). According to Field, a relationship between two variables is said to be linear when the dependent variable behaves in that way. The regression coefficients may be underestimated if this premise is broken. Scatterplots were used to analyze the correlation between the independent variables Boardings, Cargo, and Talent-Pipeline and the dependent variables AC_GRP, AC_EMP, and AC_INC in order to visually evaluate the linearity assumption. The scatter plots produced by IBM SPSS were carefully examined, and no major deviations were found. As a result, it can be said that third research objective's linearity assumption was satisfied (Field, 2014).

4.2.2. Normality: Assumption of Normality: Normality testing was performed using a probability plot (p-plot) to evaluate the distribution fit of the data (Field, 2014). P-plots offer a graphical approach to assess distribution fit by plotting each observation against its estimated cumulative probability, resulting in an estimated cumulative distribution function. Normality is indicated when data points closely align with the diagonal line on the graph. Figure 3 illustrates p-plots that consistently track closely to the diagonal line, confirming the presence of normality.

Figure 3 P-Plots of Dependent Variables AC_GRP, AC_EMP, and AC_INC



4.2.3. Multicollinearity Assessment: The variance inflation factor (VIF) and tolerance statistics, which measure the degree of connection among predictor variables, are provided in the regression output from IBM SPSS (Field, 2014). VIF values under 10 and tolerance statistics over 0.2 are examples of acceptable criteria (Field, 2014). The lowest tolerance statistic was 0.204 (MSA_INC) while the highest observed VIF in the instance of RO3 was 4.901 (MSA_INC), both well within acceptable bounds for dealing with multicollinearity. To assess multicollinearity, a Pearson's Correlation study was carried out using IBM SPSS (Field, 2014). As shown in Table 5, the findings of Pearson's correlation show that the control variables have only weak correlations, with absolute r values ranging from 0.002 to 0.528. These results guarantee that multicollinearity-related worries are unfounded.

4.2.4. Consideration of Control Variables: The multiple regression models incorporated control variables (MSA_GRP, MSA_EMP, and MSA_INC) to address variances within the airport Metropolitan Statistical Area (MSA) and dependent variables (AC_GRP, AC_EMP, and AC_INC) within the airport vicinity. Inspection of the Pearson's Correlation Matrix in Table 4 revealed no notable influence or effects of multicollinearity stemming from the control variables (Bernerth and Aguinis, 2016). Consequently, the results concerning the control variables were not documented.

4.3. Findings Regarding Research Objective 1

The results revealed no clear correlation between any of the nine distinct CIP aerotropolis model education and training categories provided by education institutions (representing the Talent-Pipeline) and the success of the aerotropolis model, including jobs near airports, gross-regional-product near airports, and per-capita-income near airports. The findings did, however, point to a positive relationship between activity of passengers and the gross-regional-product and occupation type in the vicinity of the airport.

4.4. Outcomes for Research Objective 2

The statistical significance of the multiple regression model applied to the dependent variable (DV) HCD was not established. Table 5, presenting the Model Summary and ANOVA, furnishes insight into the multiple regression analysis for RO4. The F-test's utilization gauges the model's fit with the data (Field, 2014). The p-value associated with the DV, HCD, is 0.123, signifying a lack of significant disparity Additionally, the coefficient of determination (R2) stands at 0.123, indicating that 12.3% of the variability in the dependent variable can be attributed to the inclusion of the Passenger-Activity independent variable (IV) and the cargo activity IV. The Beta coefficients for each IV are

Table 4 Regression Output: AC_GRP (DV)

Variables	Coefficients	Std. Error	t	Sig.	95% Confidence Interval		Collinearity Statistics	
					Lower	Upper	Tol.	VIF
Intercept	45.340	35.107	1.291	.270	-26.573	117.254		
Boardings	2.223	1.045	2.128	.042	.083	4.364	.795	1.258
Cargo	-.347	1.035	-.335	.740	-2.468	1.774	.637	1.570
Talent	-.005	.023	.226	.823	-.053	.042	.731	1.367
MSA_GRP	.024	.023	1.005	.323	-.024	.071	.293	3.411
MSA_EMP	-78.9647	71.863	-1.009	.281	-226.168	68.241	.326	3.063
MSA_INC	.000	.001	.760	.454	-.002	.002	.204eeee	4.901

Table 5 Regression Output: AC_EMP (DV), n=35

Variables	Coefficients	Std. Error	t	Sig.	95% Confidence Interval		Collinearity Statistics	
					Lower	Upper	Tol.	VIF
Intercept	.267	.544	.491	.627	-.846	117.254		
Boardings	.050	.016	3.121	.004	.017	4.364	.795	1.258
Cargo	.015	.016	.919	.366	-.018	1.774	.637	1.570
Talent	.000	.000	.386	.702	-.001	.042	.731	1.367
MSA_GRP	-.000	.000	-.273	.787	-.001	.071	.293	3.411
MSA_EMP	.949	1.113	.853	.401	-1.330	68.241	.326	3.063
MSA_INC	-.000	.000	-.674	.506	.000	.002	.204	4.901

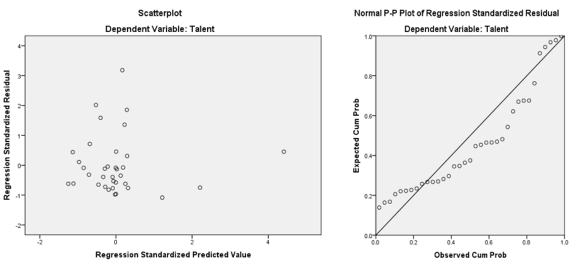
displayed in the Regression Output Table (Table 6). Leveraging these coefficients, the regression line's equation can be expressed as follows: y = HCD = -7.385(Boardings) + 13.550(Cargo).

Table 6 displays the Model Summary and ANOVA for AC_INC, providing essential statistics for testing the significance of means (Field, 2014). Employing the F-test, the model's fit

Table 6 Regression Output: AC_INC (DV)

Variables	Coefficients	Std. Error	t	Sig.	95% Confidence Interval		Collinearity Statistics	
					Lower	Upper	Tol.	VIF
Intercept	30,879.44	53,445	0.578	.568	-78,599	140,358		
Boardings	4,120.54	1,590	2.591	.015	862.43	7,378	.795	1.258
Cargo	560.76	1,576	0.356	.731	-2,667	3,789	.637	1.570
Talent	-0.518	35.150	-0.015	.989	-71.48	71.48	.731	1.367
MSA_GRP	-26.086	35.621	-0.732	.467	-99.05	46.88	.293	3.411
MSA_EMP	-42,739	109,401	-0.391	.696	-266,837	181,360	.326	3.063
MSA_INC	0.891	0.887	1.005	.320	-.925	2.708	.204	4.901

Figure 4 Scatter Plot and P-Plot for Dependent variable HCD (DV)



5 Summary of Findings

The study's outcomes underscored the lack of an evident connection between the Talent-Pipeline in the airport Metropolitan Statistical Area (MSA) and the prosperity of the airport vicinity. Nevertheless, the results did reveal a positive correlation between Passenger-Activity and both the airport vicinity's gross-regional product and employment levels. Additionally, the study indicated no substantial association between the performance of aerotropolis model airports and the development of human capital. Lastly, in terms of ranking aerotropolis model airports and assessing the talent pipeline of the airport vicinity, it became apparent that Passenger-Activity played a more influential role in determining Aerotropolis-Model-Success compared to cargo activity. Furthermore, the impact of the Talent-Pipeline on the ranking of aerotropolis model airport

5.1. Aerotropolis Model Performance and Airport Vicinity Success (RO1)

The statistical significance of the multiple regression model applied to the dependent variable (DV) AC_INC was not established. to the data is assessed (Field, 2014). The p-value associated with the DV, AC_INC, is 0.053, indicating a lack of significant variation within the multiple regression model. Additionally, the coefficient of determination (R2) holds a value of 0.340, suggesting that 34.0% of the variability in the dependent variable can be attributed to the combined influence of the three independent variables (IVs) and three control variables (CVs). Nonetheless, a discernible relationship between AC_GRP and the success of the aerotropolis model is not established.

Beta coefficients for each model are presented within these tables. Importantly, upon reviewing the Regression Output in Table 5, Table 6, and Table 7, a statistically significant p-value for Boardings is evident for the DV, AC_GRP (p=0.042), and this significance is sustained for the DV, AC_EMP (p=0.004). However, the p-value for AC_INC is disregarded due to its lack of statistical significance (p=0.053).

The research identified a disparity between advancements in workforce capabilities and the success of airport proximity. This gap may be attributed to shifting trends in the air transportation industry, demanding skill sets beyond the scope of the existing nine categories within the CIP aerotropolis model education and training programs offered by community colleges and universities. For example, Cronin et al. proposed that the aviation sector requires professionals in engineering and IT. As a result, it is imperative for policymakers and local leaders in the airport Metropolitan Statistical Area (MSA) to collaborate closely with local businesses, community colleges, and universities to devise and implement relevant programs aligned with the aerotropolis model.

In contrast, a positive correlation was established between Passenger-Activity (a pivotal element of aerotropolis model performance) and both the gross regional product and employment levels of the airport vicinity. This finding resonates with Cooley's (1894) research on transportation theory, which asserted that transportation significantly influences a city's development and prosperity. Cooley argued that disruptions or breakdowns in the transportation chain within the aerotropolis model airport and its vicinity coincide with population and prosperity surges. This phenomenon may elucidate the positive relationship between Passenger-Activity and economic indicators. The transportation theory also suggests that whenever transportation is disrupted or goods change hands, additional personnel are required to facilitate the exchange. Green's studies (2007) support Cooley's theory by revealing a positive correlation between Passenger-Activity and employment. Importantly, the research by these scholars indicates that the creation of white-collar jobs is primarily driven by Passenger-Activity rather than cargo operations.

In contrast to Passenger-Activity, there is no apparent association between cargo activity and the gross regional product or employment levels of the airport vicinity. The study conducted by Button and Yuan (2013) on the impact of air cargo activity on economic growth may shed light on the limited influence of this activity on economic expansion. Although Button and Yuan's research lacked a definitive conclusion, it did suggest a fragile positive causal connection between air freight activity and regional economic growth. Similar findings were confirmed by Mayer (2016), who noted that the cost of handling 100 kg of cargo at the airport is equivalent to boarding one passenger. These conclusions imply that the aerotropolis model airport requires a higher level of cargo activity.

6 Future Research Directions

This study acknowledges its limitations and offers directions for future research based on both its findings and the constraints encountered. As Roberts (2010) defines, limitations encompass factors beyond the researcher's control and addressing them is essential for identifying potential gaps in design, instrumentation, and study population, as highlighted by Creswell (2014). Moreover, it is crucial to recognize potential researcher bias.

The limitations of this study encompass the relatively small size of the population, the chosen methodology, and the accuracy of archival data. Examining 35 airports aligned with the aerotropolis model is comprehensive; however, it is acknowledged that there might be other airports worldwide meeting the aerotropolis criteria, yet they were excluded from this research due to insufficient available data.

To pave the way for future research endeavors, this study proposes two distinct avenues: first, broadening the number of airports in the study, and second, conducting more extensive assessments of the impact of manpower improvement in the airport vicinity. Here are six suggestions for prospective research:

i. Extend the scope of the study to include all commercial cargo airports. The population would increase to 115 airports if cargo-capable airports were included, as Kasarda (2011) noted in the context of the success of the aerotropolis plan.
ii. Widen the scope of the investigation to include all commercial airports in the population. A larger sample size of all commercial airports would result in a population of 565 airports, which is a larger number. Furthermore, a more robust use of multiple linear regression analysis would be made possible by this increased dataset.
iii. Use the methodology of structural equation modeling (SEM). By evaluating the overall model rather than specific coefficients, SEM offers a more flexible modeling method and a more thorough analysis.
iv. Look into more studies to learn more about the unique skills needed in the airport vicinity outside of the nine CIP programs this study analyzed. Community leaders and educators might benefit from investigating whether the aerotropolis model promotes employment in the airport vicinity.
v. Examine how the aerotropolis model affects the mobility of workers. Focusing on hiring from aerotropolis model employers in the airport neighborhood may reveal whether there is a link between new employees and regional training initiatives.
vi. Examine any conceivable skill gaps within the airport industry. To ascertain whether the current training programs provided by the airport MSA are in alignment with the skill

requirements of enterprises located in the airport vicinity, more investigation of the Talent-Pipeline is required.

The insights and knowledge gained from this study could serve as a foundation for pursuing these suggested research avenues. Exploring these areas would provide decision-makers with valuable data to develop effective strategies for fostering economic prosperity within the airport vicinity.

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