Beyond a Transfer Hub: Leveraging International Airports for Startup Growth and Innovation

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Abstract: International airports are vital to global connectivity, serving as transportation hubs and catalysts for economic growth and innovation. Beyond passenger transfers, they function as gateways to business opportunities and integrate with diverse global networks. Developing air-front cities strengthens infrastructure, enhances quality of life and supports sustainable urban growth across social, economic, and environmental aspects. This study explores the role of international airports in fostering innovation and startup ecosystems within air-front urban environments. Through a comparative analysis of the physical and non-physical environments of airports in various countries, it identifies key factors that drive entrepreneurial growth and innovative initiatives in airport-driven urban economies. The findings offer insights into how international airports can enhance startup ecosystems to contribute to economic development and urban sustainability.

Keywords: Air-front development, International Airport, Startup ecosystem, International Connectivity, Innovative City

1. INTRODUCTION

Even though the aviation industry experienced a significant decline during the COVID-19 pandemic, it is undeniable that air transportation has regained its vitality after the prolonged three-year outbreak. Air transportation is used for both passenger and cargo transport. Passengers may travel for various purposes, including business negotiations, tourism, family visits, or medical treatment. Over 96 million aircraft movements with 67,300 routes occur in a year (ATAG, 2024). The development of airport infrastructures to accommodate passenger capacity is essential. At the same time, the development of air-front areas is equally important to assist innovative activities for city and regional development. Passengers' travel purposes can be effectively fulfilled only when seamless connectivity between the airports and their

destinations of flights and their hinterlands, as well as living environment for higher quality of life is ensured.

Currently, labor and talent shortages, particularly in science and healthcare have become a pressing issue in many countries (Mosley, Zajdel et al., 2025). As a result, policies promoting workforce diversity have been increasingly emphasized, focusing on upskilling domestic workers and attracting talent from abroad. The development of digital technology has positively impacted urban development, particularly for entrepreneurs. Although the effects may not be directly visible, such advancements contribute to enhancing infrastructure and facilities, creating a more conducive environment for business operations (Marquardt & Harima, 2024). Creating a well-connected environment between urban areas and airports is essential. It not only serves as a gateway for cultural diversity and talented individuals but also provides opportunities for domestic entrepreneurs to expand their markets globally for foreign entrepreneurs. Quality of life for their family is also an important concern besides business environment. The value generated from this expansion further enhances the economic growth of the home country, fostering a sustainable development cycle that benefits residents, enterprises, and the city as a whole.

Therefore, this study aims to examine the key factors conducive to the development of an innovative city with a well-integrated air-front infrastructures and facilities that supports the growth of entrepreneurs and startups.

2. LITERATURE REVIEW

2.1 Concept of living environment and quality of life for innovation initiation

Recently, technological resources have been recognized as a fundamental component of innovative city development. Artificial Intelligence (AI) and the Internet of Things (IoT) have been integrated into the urban landscape, making technology an essential part of daily life. It is undeniable that vast amounts of data are generated and utilized in urban environments. Digital tools and technological resources enhance the quality of life by facilitating the development of new services, maintaining infrastructure, preserving cultural heritage, managing waste, and improving healthcare systems (Jacques, Neuenfeldt Júnior et al., 2024). Citizens are key contributors to smart city development. The needs of urban residents shape the approach to urban planning and development.

The development of physical infrastructure, such as business centers and innovation incubation hubs, should be guided by the implementation of appropriate policies to ensure seamless integration into people's daily lives. Otherwise, the negative spillover effects of excessively rapid transformation may drive economic progress while leaving residents behind (Du & Wang, 2024).

2.2 Concept of air-front development for startups and innovation

Air-front development has been discussed under various names such as aerotropolis, airport city, aviapolis, and airport-driven development (Corrêa Pereira, Milne et al., 2023). This type of development does not focus solely on airports themselves but also considers the urban context and regional environment. The growth of air-front development reflects economic growth, particularly through an increasing number of businesses and investments (Yangmin, Shaohong et al., 2021). The diverse land use development near airports enhances commercial

and industrial opportunities in both business and tourism. The areas surrounding airports have been transformed into convention centers, office spaces, accommodations, retail facilities, and public areas (Stevens, Baker et al., 2010). The presence of an airport has a spillover effect on entrepreneurship, whereas cities without airports experience lower levels of business activity (Zuo & Chen, 2024). The number of flights and passengers at international airports has significantly impacted economic development (Chen, Xuan et al., 2021). Although airports contribute to business growth, airports alone are not sufficient to drive the development of an innovative city (Song, Tan et al., 2025).

The concept of a smart city has been widely adopted worldwide. It is not only a place for residents to live but also a hub for attracting talent and innovative companies. Smart cities provide essential facilities for talent and entrepreneurs to grow their businesses, while in return, they contribute to the city's development. This creates a mutually dependent relationship (Marchesani, Masciarelli et al., 2023). Nevertheless, an important question to consider is how to make this cycle happen. Firstly, a well-connected network of international airports is essential for linking different nodes. A greater number of destinations increases the chances of international companies establishing a presence. This is why airports play a crucial role in fostering an entrepreneurial city. Secondly, regarding to incoming talent seeks an environment conducive to business growth. The implementation of policy and urban planning will support the appropriate environment for them. These reasons contribute to the interconnected relationship between airports, air-front cities, and people, all of which should be developed simultaneously.

2.3 Challenges of startup growth without international expansion

Startups cannot grow their businesses without market expansion. Market growth allows them to reach more customers and generate higher profits. Nonetheless, there are several challenges to achieve their goals. The obstacle of startups has been found in many reasons such as lack of investment, insufficient knowledge and lack of accelerator network. Most of discontinued startups faced with these issues (Noelia & Rosalia, 2020). The expansion of networks connects startups with potential customers. One of the essential factors for enhancing their business is investment. The amount of investment reflects the potential growth of startups, enabling them to explore new opportunities to sell their products or services. Business incubators also play a key role in providing startups with knowledge on accessing international markets (Gao, Cui et al., 2021). These mechanisms help expand their business conceptual boundaries even further.

International airports play a vital role in reducing risks for startups, especially in finding new investment sources, exchanging know-how, and expanding into potential markets. Preparation before internationalization is also necessary, including understanding the consumption habits and lifestyles of target countries (Pinto & Rua, 2023). Thus, incubators alone cannot provide all the essential factors for startups. However, network expansion allows them to acquire more knowledge and better address challenges.

3. MAIN FACTORS TO FOSTER INNOVATION IN AIR-FRONT CITY

3.1 The roles of physical facilities in enhancing innovation environment

This study focuses on three different cities at three different phases of innovative city development: Singapore, City of Munich in Germany, and Aichi Prefecture in Japan

3.1.1 Singapore’s innovation environment

In Singapore, according to the Smart Nation development framework, the country initially focuses on practical steps fundamental to setting up physical and digital infrastructure, along with policy implementation to support research and innovation (SNDG, 2018). Owing to limited human resources, attracting talent is a key driver for Singapore's development as an innovative city. Furthermore, given the limited space, high-rise buildings are established for businesses such as financial institutions and headquarters-based companies. Moreover, the modern creation spaces have been established e.g., Marina Bay, Gardens by the Bay, Universal Studio etc. For the reasons state, both residents and entrepreneurs are able to live limited space without concerning of insufficient infrastructures.

Changi Airport is operated by Changi Airport Group (CAG) and is located in the eastern part of the country. Singapore's spatial constraints can be both an advantage and a disadvantage. However, one key benefit is that various locations are more closely connected to the airport. Passengers can reach the city center, which is within 20 kilometers, by train or car. An innovation district called 'One-north' is located 30 kilometers from the airport. Several research hubs are situated in this area, including JTC LaunchPad and BLOCK71, near the One-north MRT station and only 1.3 kilometers from the National University of Singapore (NUS). This proximity facilitates seamless knowledge exchange between research hubs and academic institutions.

3.1.2 Munich’s innovation environment

The City of Munich is the second-largest startup hub after Berlin, with a strong focus on business-to-business (B2B) enterprises. Most facilities are located in the city center, which is approximately 40 kilometers from Munich Airport. Several innovation and entrepreneurship centers are situated in this area, such as the Munich Innovation Ecosystem. Some of these centers collaborate with universities, including UnternehmerTUM from the Technical University of Munich and the Innovation and Entrepreneurship Center (IEC) from Ludwig Maximilian University of Munich. Besides balancing commercial areas with natural spaces, the city is also enriched with extensive public spaces for relaxation, such as Hirschgarten, the largest beer garden in Munich. Additionally, the city features a combination of well-preserved historical heritage areas and commercial districts near Marienplatz.

Munich Airport is planning to establish an innovation and industrial area near the airport called 'LabCampus.' Over 29 buildings will be constructed in this area, with two already completed: LAB48 and LAB52. LAB48 serves as a space for office rentals and research centers, while LAB52 is a training facility for the airport academy. This area is open to both Munich-based and international companies, especially those seeking to scale up their businesses. Munich Airport intends to fully utilize the advantages of air transport accessibility as one of the major European aviation hubs. It has a major advantage over the city center by avoiding travels between airport and the city for international business travelers coming from abroad.

3.1.3 Aichi’s innovation environment

Aichi Prefecture is a hub for manufacturing and cutting-edge industries. It is home to various types of industries, including traditional companies such as Noritake, a pottery brand company, and modern technology firms like Toyota. In 2024, Aichi Prefecture established its center of innovation, 'STATION Ai'. This hub hosts numerous startup companies, accelerators,

and mentors from both regional and international organizations. STATION Ai is located in downtown Nagoya, approximately 40 kilometers from Chubu Centrair International Airport.

Moreover, Aichi is also home to globally renowned attractions, such as 'Ghibli Park,' operated by the famous animation studio located in Expo 2005 Aichi Commemorative Park, which is accessible from the city center within 30 kilometers. Furthermore, Aichi maintains various international business connections with countries such as France, Singapore, China, and Israel. These connections create greater opportunities for scaling up regional businesses beyond national boundaries.

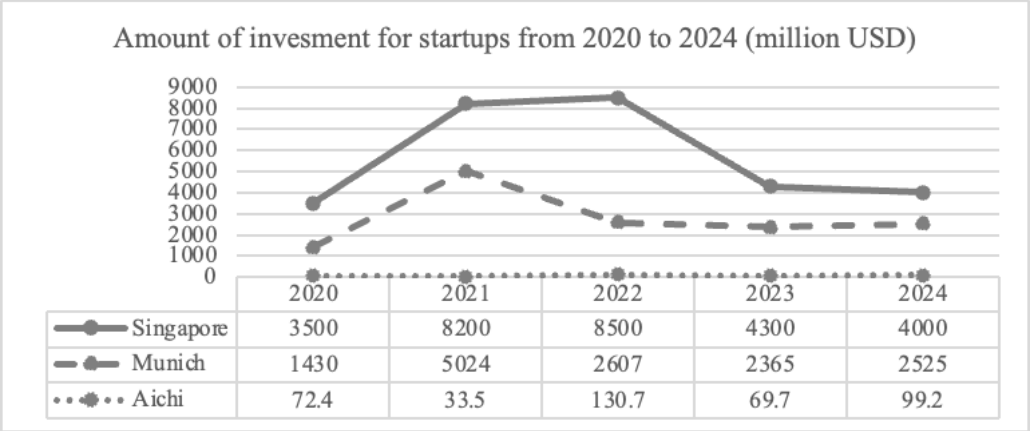
Chubu Centrair International Airport was established in 2005 as the central international airport for Japan's Chūbu region. The surrounding area features hotels and conference facilities with scenic views of Ise Bay. Centrair Airport is located in Tokoname City, which is well known for its ceramic industry, including manufacturers such as INAX.

3.1.4 The comparison of startups and innovative environment between Singapore, Munich and Aichi.

Table 1. Distances from the airport to destinations

Location	Singapore		Munich		Aichi	
	Location	Distance (km)	Location	Distance (km)	Location	Distance (km)
City center	Raffles Place	20.7	Marienplatz	35.7	Nagoya	42.1
Innovation hub	One-north	29.2	MIE	33.9	STATION Ai	43.5
University	NUS	28.7	TUM	33.9	Nagoya Univ.	46.8
Medical hub	CGH	7.6	LMU Hospital	37.6	NU Hospital	44.1
Recreation space	Marina Bay	19.9	Hirschgarten	37.8	Expo 2005	57.4

According to Table 1, a common factor among Singapore, Munich, and Aichi is the accessibility of public transportation between international airports and key locations, such as city centers, innovation hubs, medical hubs, universities, and recreational spaces. However, when examining the amount of investment from 2020 to 2024, it was revealed that Singapore received the highest investment among the three locations, followed by Munich and Aichi, as shown in Figure 1. Due to the relationship between investment levels and the number of flights, it is important to note that Singapore has only one airport where all flights are international. In contrast, both Munich and Aichi have a mix of domestic and international flights.



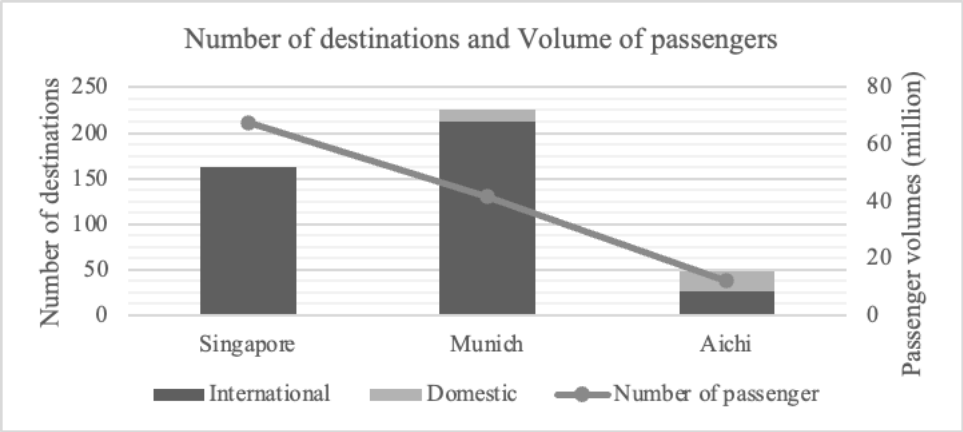
Source: StartupSG, Minich-Startup, METI and Speeda, 2024.

Figure 1. Amount of investment for startups from 2020 to 2024

Despite this, Munich has a higher number of total flights than both Singapore and Aichi, even though Singapore receives the highest amount of investment. This indicates that the number of flights is not the sole factor influencing investment levels. Additionally, Singapore is unique in that it is the only city in the country, which may contribute to its investment dynamics.

When comparing the economic significance of Munich and Nagoya, capital City of Aichi, Munich is the second-largest economic hub in Germany after Berlin, while Nagoya ranks as the third-largest economic center in Japan, following Tokyo and Osaka. However, the amount of investment received by Nagoya is significantly lower than that of Munich. From another perspective, Munich stands out in the automotive industry, particularly with the presence of BMW, similar to the role of Toyota in Aichi. Nevertheless, over 70 % of investment for startup in Japan is concentrated solely in Tokyo, highlighting Nagoya's initial-stage readiness as an innovation-driven city. This is evident from the official launch of STATION Ai last year (Speeda, 2024).

However, when examining the growth rate of investment over the past decade since 2009, Aichi has experienced a remarkable 35.9 % increase in startup investment, surpassing Tokyo's growth rate of only 21 % (JETRO, 2021). This underscores Aichi's potential for startup expansion and innovation-driven growth.



Source: CAG, Minich-Airport, Centrair Group, 2024.
Figure 2. Number of passengers from 2020 to 2024

The number of international flight destinations in Munich is greater than in Singapore and Aichi, while the number of passengers in Singapore is the highest. It can be approximately estimated that there are 0.42 million, 0.18 million, and 0.24 million passengers per destination in Singapore, Munich, and Aichi, respectively, as shown in Figure 2. This suggests that flights to the same destinations operate more frequently at Changi Airport. This also reflects that Munich has over 150 short-distance international flights operated by small aircrafts.

In terms of airport capacity, Changi Airport consists of four terminals with a total floor of 1,308,000 square meters, while Munich Airport has two terminals covering a total floor of 448,800 square meters. Similarly, Centrair Airport also has two terminals with a total floor of 265,000 square meters. When calculating passenger density per floor square meter, Munich Airport has the highest density at 93 passengers per square meter, followed by Changi Airport at 52 passengers per square meter and Centrair Airport at 45 passengers per square meter as shown in Table 2.

Table 2. Passenger density per square meter in terminals

Factor	Singapore	Munich	Aichi
Number of Terminals	4	2	2
Terminal Size (sqm)	1,308,000	448,800	265,000
Number of passengers	67.7	41.6	12.0
No. of Passenger per area (man/sqm)	52	93	45

3.2 The roles of non-physical facilities in supporting innovation activities

In addition to the development of physical facilities, it is equally important to create opportunities for entrepreneurs and startups through policies and mechanisms that support settlement, such as the implementation stakeholder collaboration. This approach will further open pathways for entrepreneurs and startups, both for external entrepreneurs seeking to understand the context of a new market and for local entrepreneurs looking to explore opportunities for market expansion beyond national borders. As exemplified by the presence of well-defined networks and organizations in all three countries, such as Startup SG in Singapore, the Startup Ecosystem in Munich, and STATION Ai in Aichi, which are specifically responsible for supporting these initiatives. These organizations play a crucial role in supporting entrepreneurs, from nurturing ideas to providing advisory services for business growth. Additionally, they serve as intermediaries, connecting entrepreneurs with investors to facilitate business expansion.

Universities serve as knowledge hubs for research, with many businesses emerging from the spin-off of research into commercial ventures (Bodolica, Shirokova et al., 2024). Therefore, designing learning processes centered around universities or educational institutions is essential. Establishing a strong foundation for sustainable urban development is partly achieved through the cultivation of a highly skilled workforce. Equipping students with entrepreneurial skills plays a crucial role in driving long-term urban and economic growth. This is evident in various programs such as GRIP from the National University of Singapore, UnternehmerTUM from the Technical University of Munich, and STAPS, which utilizes multiple university spaces to conduct workshops in Aichi. These initiatives not only foster innovation and entrepreneurship among students but also create an ecosystem where academic research translates into real-world business opportunities.

Furthermore, in addition to supporting local entrepreneurs and startups, welcoming external entrepreneurs contributes to the development of new services and products driven by diverse cultural perspectives (Abd Hamid, Pidduck et al., 2023). It can therefore be stated that the increasing number of flight destinations reflects the growing diversity of visitors to the country. This is essential for enhancing the role of international airports and their integration with startup development.

4. ENHANCING STARTUP GROWTH THROUGH AIR-FRONT DEVELOPMENT

A comparison of key factors in Singapore, Munich, and Aichi reveals as shown in Figure 3. One of the reasons Singapore attracts significant investment is its structured policy approach, which begins with establishing a robust infrastructure foundation. This is exemplified by the presence of multiple terminals designed to accommodate passenger traffic, despite having fewer flight routes compared to Munich. Following this, Singapore has strategically advanced its development by fostering educational institutions to design learning programs that enhance domestic human resources while also attracting international talents.

Munich Airport is well-designed for accessibility, ensuring convenient connections with the city center and key areas such as innovation hubs, educational institutions, medical facilities, and recreational spaces. However, the airport faces spatial constraints, operating with only two terminals while handling over 40 million passengers annually. As a result, passenger density within the terminals is significantly higher compared to Singapore and Aichi.

While Centrair Airport in Aichi benefits from lower terminal density, this advantage is counterbalanced by the limited number of flight routes, leading to less passenger diversity. Although Centrair Airport has the same number of terminals as Munich Airport, space constraints particularly within Terminal 2 limit its capacity to accommodate flights. At present, Terminal 2 exclusively serves low-cost carriers. Nonetheless, the balance between domestic and international flight routes stands at approximately 50%, indicating that the airport places equal importance on international connectivity as it does on domestic travel

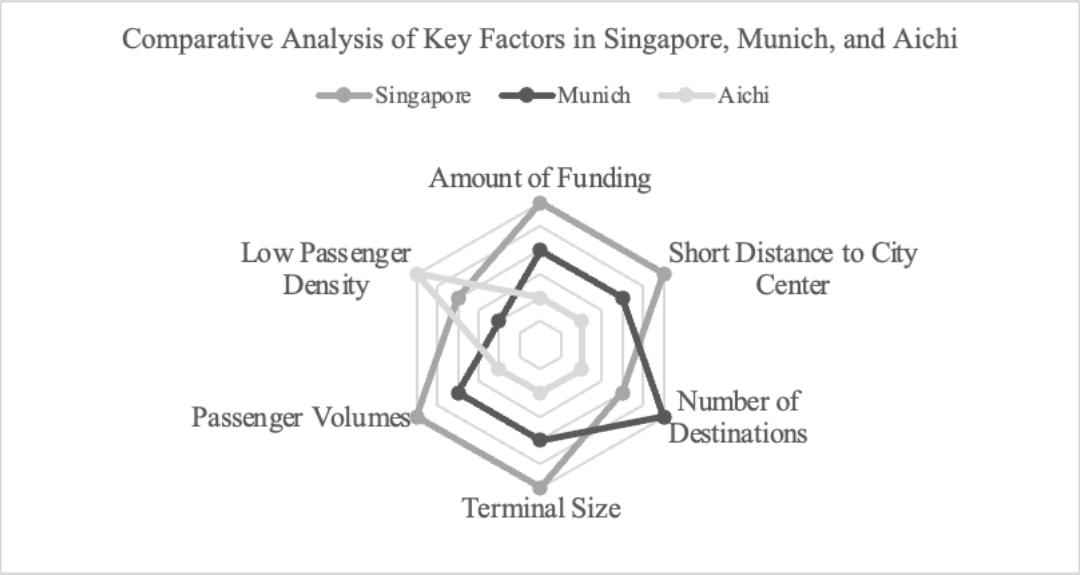


Figure 3. Comparative Analysis of Key Factors in Singapore, Munich and Aichi

5. DISCUSSION

This paper highlights that the development of accessibility infrastructure and facilities directly influences the opportunities for nurturing local entrepreneurs and attracting external ones. The establishment of an innovative city should therefore take into account the foundational policies and their potential for expansion to ensure balanced development across social, economic, and environmental dimensions. Focusing solely on infrastructure development may not be sufficient without collaboration from key stakeholders, such as the private sector and academic institutions, to build a resilient network for startups and entrepreneurs, enabling them to thrive in a diverse and dynamic environment.

Building on the cases of these three cities, one experiencing rapid development (Singapore), another an established hub with distinct strengths (Munich), and the third in the early stages of building its innovation network (Aichi), it is evident that each has cultivated its own unique approach. From the perspective of startups and entrepreneurs, beyond a city's individual identity, an environment conducive to both living and business growth is equally crucial. In this regard, international airports play a vital role in expanding access to new markets and fostering the exchange of ideas, ultimately driving the evolution of novel services and products that have not previously existed.

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