

Airport-driven Cityspaces: Redefine Cityscape of Malaysia by Introducing Airport into Urban Areas

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ABSTRACT

The aviation industry is becoming one of the greatest economic growth drivers in nations and arguably an indispensable form of transport. Airports are already built up around population centers and are already operating at high capacity. And aviation is now going beyond mobility between continents and cities – it is starting to impact mobility within cities. Despite that, the distance between city and airport may be in the line of slowing down the evolution of airport. Thus, introducing airport into urban areas by challenging the notion of airport development towards verticality to sustain the ever-expanding behavior and redefine cityscapes of Malaysia. In order to understand and imagine the potential changes that could be made to the city airport's development while supporting the always changing, explosive activities, and providing a seamless connection to the urban sphere, interviews and phenomenological research will be conducted. By understanding the factors and variables of city airport in formulating scenarios, which will be adjusted and applied towards its dynamic and demand. Future research can add more variables to planning towards verticality: pro-active urban designs that are developed from alternative expansions.

Keywords: Cityscape, Aerotropolis, Verticality Development, Airport

1. INTRODUCTION

1.1 Background Study

Evolution is commonly defined as gradual development of living organisms, in any case of event. The crux of Darwin's theory focuses on a process called natural selection which eliminates inferior species gradually over time. This phenomenon occurs through developing, transforming, distorting, and reconstructing till the fittest possible outcomes have been

achieved. Airports are usually referred to as the main example if one wishes to know how well-evolving one country's construction industry is in the context of an urban area. Most modern airports are transformed and developed from military zones, shopping malls, brand names and more (Fuller and Harley, 2004). Throughout history, we have witnessed aviation that is limited to soldiery service have marched its way towards a complex techno-cultural machine, which drives special attention to keep these ever-changing spaces intact. This scenario is the same as urban areas.

1.1.1 Trend of Aviation Industry | Growth in Asia Pacific Market

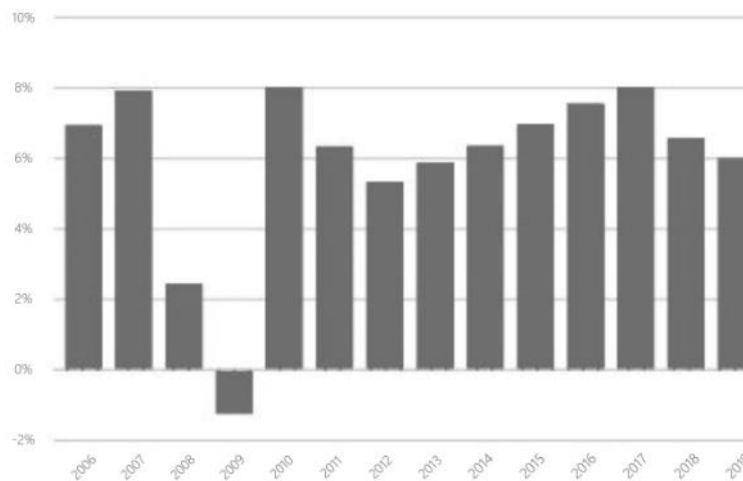


Figure 1.1.1 shows the annual growth of air traffic passenger demand.

Source: IHLG (2017)

The aviation industry is becoming one of the greatest economic growth drivers in nations and arguably an indispensable form of transport. According to Industry High-Level Group (IHLG) report, Aviation Benefits 2017, air transport has doubled in size every 15 years and has grown faster than most other industries. (IHLG, ACI Annual Report – 2017, The Voice of the World's Airport, 2018)

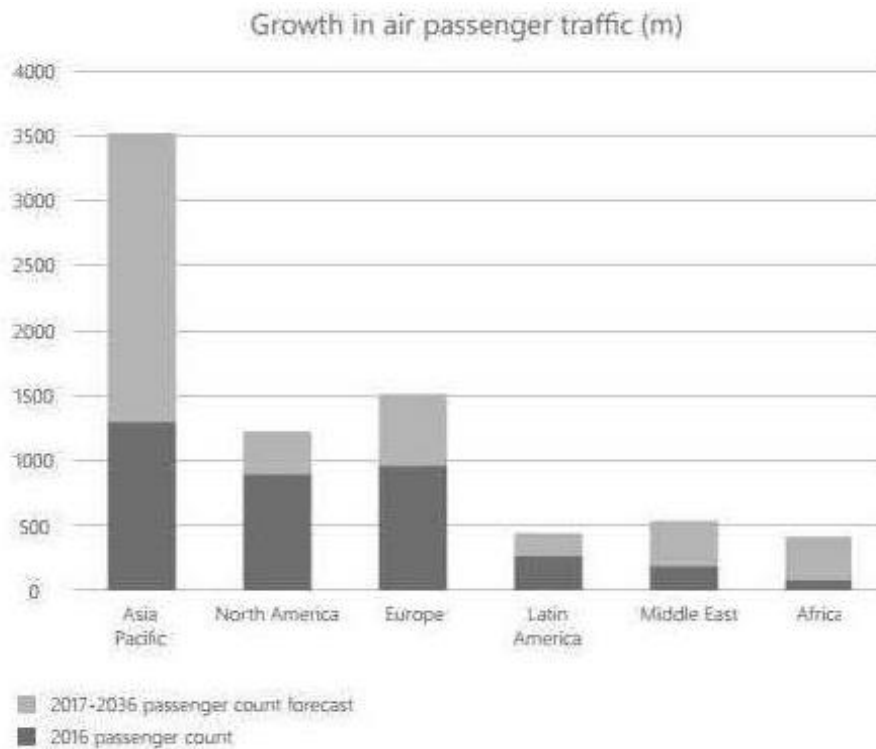


Figure 1.1.2 shows the 20-year forecast of air passenger traffic growth.

Source: IATA (2017)

Based on IATA’s 20-Year Air Passenger Forecast in 2017, passenger numbers could double to 8.2 billion in 2037. This forecast also predicts that the Asia-Pacific region will drive the biggest growth with more than half the total number of new passengers coming from these markets. (IATA, Passenger Forecast – Global Report – 2017 Edition, 2018)

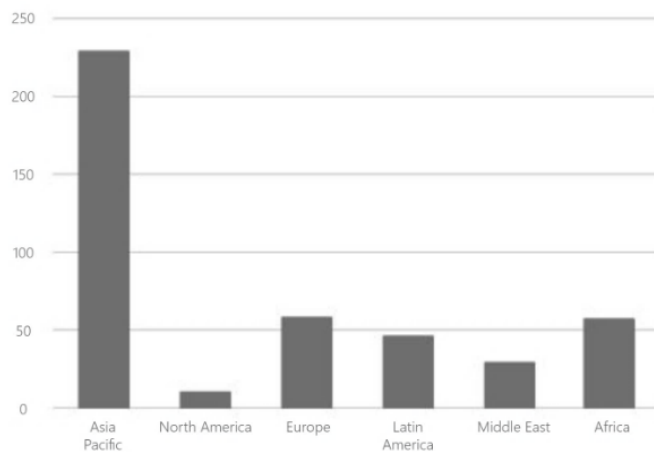


Figure 1.1.3 shows the number of new airports under construction in 2018.

Source: CAPA (2018)

Based on data from CAPA, there were 229 new airport projects being planned in Asia as of March 2018. This is more than the combined total of the rest of the world, underlining the growth trajectory and potential of the sector. (CAPA, CAPA Premium Analysis Report, 2018)

10 largest passenger growth airports in 2018

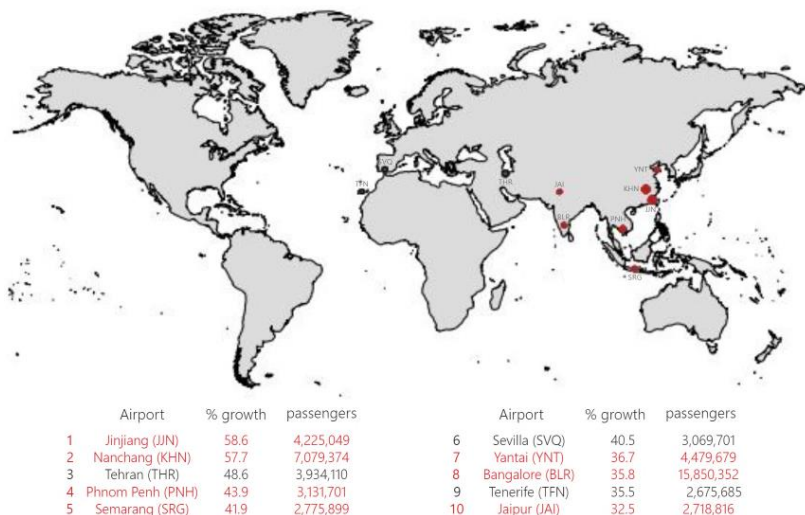


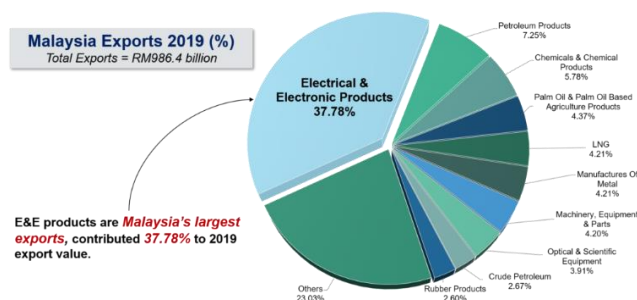
Figure 1.1.4 shows the largest passenger growth.

Source: CAPA (2018)

The future of air traffic is getting out of hands. However, the airport cannot escape its fate to be prepared for any rise in demands with the cities they served. Equilibrium of both travelers and cargo capacity need to be maintained so that airport could function satisfactorily. In fact, these variables are getting more dependable on aviation. (CAPA, CAPA Premium Analysis Report, 2018)

Global Top 10 Busiest International Airline Routes

Route	Route Name	Seats
1	KUL-SIN Kuala Lumpur - Singapore Changi	355,540
2	DXB-RUH Dubai - Riyadh	305,002
3	JFK-LHR New York JFK - London Heathrow	281,291



Source: Matrade 2019

Figure 1.1.5 shows the International Airline Routes and Malaysia Exports.

Source: OAG (2018) left; Matrade (2019) right

In October 2022, Kuala Lumpur (KUL) – Singapore Changi (SIN) continues to be the busiest international route with 355,540 seats and a 9% increase in capacity compared to last month. (OAG, Official Airline Guide 2018) Penang, “Silicon Valley of the East,” with 350 multinational, high-tech companies establishing factories, 4,000 small and mid-sized enterprises. Despite a population under two million, Penang had 5% of the world semiconductor exports in 2019. (Matrade, 2019)

1.2 Problem Statement and Research Gap

1.2.1 Motivational Problem

Worldwide – 51% of the population lives within 100 km of an International Airport – and 74% live within 100 km of any kind of airport. So, airspace is quickly becoming congested and air traffic is slated to double over the next two decades. In addition to air space – we must consider airports themselves. Airports are already built up around population centers and are already operating at high capacity. And aviation is now going beyond mobility between continents and cities – it is starting to impact mobility within cities. (Future of Aviation, International Civil Aviation Organization ICAO, 2019) Since 2006, John Kasarda, the most prominent proponent of aerotropolis developments, has published a plethora of articles extolling the supposed benefits of these megaprojects. The series begins with: Airport Cities and the Aerotropolis. In subsequent publications the same examples of aerotropolis-type projects crop up repeatedly, such as Schiphol, Frankfurt, Munich, Stockholm Arlanda in Europe, Hong Kong, Kuala Lumpur, Changi and Incheon in Asia, McCarran and Dallas/Fort Worth in the USA. Over the years some of the ambitious aerotropolis plans have been realized. Others are repeatedly stalled, in spite of heavy-handed intervention of governments designating large land areas and bestowing sweeping planning powers on airport-developer partnerships. (Aerotropolis 2020: Visions vs Realities, Global Anti-Aerotropolis Movement GAAM, 2020) Cargo capacity out of Penang International Airport is insufficient to handle current demand. As a result, Penang-based factories need to use Kuala Lumpur and Singapore as gateways to connect with the US, Europe, and other countries. That has spurred interest in freight forwarders with cross-border road, rail, and ship freight capabilities. (Matrade, 2019)

However, there is no guideline and framework provided on how existing city could link with the existing or new airport like other transportation modes such as car, bus and train terminal which eventually effect how cityscapes work from individual checkpoints into station hubs and land use.

1.2.2 Research Problem

As a result of the liberalization of the air transport market in the EU, the demand for regional airports, which are often far from metropolitan areas, has expanded significantly. Initially the aim of the liberalization of the air transport market was to increase competition. This caused an increasing demand for take-off and landing slots at airports. As established major airports were not able to respond to this increased demand, several regional airports (some of them formerly military airports) expanded. (New EU regulatory framework for batteries - European Parliament, 2021) One of the most effective ways to increase national airspace capacity is to construct additional runways and associated taxiways and gates in those heavily used airports in which limited infrastructure capacity is a recurrent problem. Runway investments have the greatest potential to reduce congestion and delay in high-demand airports prone to adverse weather patterns that can severely restrict use of existing runways because of their configuration, geometry, length, and other characteristics. (Alabi, B. N. T., et al. "Evaluation criteria to support cleaner construction and repair of airport runways: A review of the state of practice and recommendations for future practice." 2021) However, new runways are expensive to build and difficult to modify once built. The construction of new runways at major airports has proved to be a costly and time-consuming process, largely because of noise and environmental concerns, as well as the lack of sufficient land at some older, urban airports. These difficulties have prevented all but seven major airports from adding new

runways during the past 10 years. (National Academies of Sciences, Engineering, and Medicine, 2022)

Previous studies only focused on horizontal expansion, without eliminating the complexity, design for airport in city center should be analyzed in the condition of trying to understand how the urban design works can be executed as being stacked vertically.

Therefore, this research will formulate a design strategy on challenging the notion of airport development towards verticality. In addition, to sustain the ever-expanding behavior of airport and redefine cityscapes of Malaysia.

2. LITERATURE REVIEW

2.1 Airport implied into Urban Areas

Terminal operational facilities are also discussed by Dakshayini R Patil (2019) in The Architecture of Airport Terminals: Gateway to A City to understand the difference of basic flow of passenger and baggage in domestic and international airports. (Dakshayini R Patil, and Mamatha P Raj, 2019) In conjunction, the ‘servicescape’ introduce by Kankaew (2020) in the servicescape of air transport terminal affecting passenger satisfaction includes these 6 characteristics: feeling safe and secure when using the airport; the airport design easy to find facilities; cleanliness of toilette; terminal cleanliness and natural light shine into the terminal; the exhibition of arts and culture in terminal and the decoration of local arts and culture. (Kankaew, Kannapat, 2020)

This has expanded into determining the value connection which supported in Sokolowicz (2020), the value of ambiguous architecture in cities. The concept of a valuation method of 20th century post -socialist train stations. In his study, use and non-value of heritage is compared to logic of action in this matter: when use value is more than its non-use value, the heritage generates resources for its protection and economic pressure on heritage and risk of deterioration; in the other way round when non-use value is more than the use value, heritage will be as a public/common good, option/existence/bequest value easily identified by society and social awareness is then created of the need for heritage protection; however if both value matched the same, both protection and exploitation will faced dilemmas, the question of whether society perceives the value of heritage at all and the temptation to “measure the unmeasurable” to support decision-makers. (Sokołowicz, Mariusz E., and Zbigniew Przygodzki, 2020)

Document	Problem Statement	P.O.D	Method	Recommendation / Future Studies	Remarks
Dakshayini R Patil (2019) - The Architecture of Airport Terminals: Gateway To A City	The architecture of Terminal building involves diverse perspectives of analysis and understanding.	Hence, form and function of Terminal buildings are both equally prime aspects of planning & design.	While passenger comfort and safety are of utmost importance, on air-side the operational activities of the aircrafts require critical planning and management.		Introducing greens not only to airport but also cities.
Kankaew (2020) - The servicescape of air transport terminal affecting passenger satisfaction	The aim of this research is to assess the airport environment specific on services cope or the architecture design, and function which affecting the passenger's satisfaction.	The structural equation modelling (SEM) was utilized to confirm the factors affecting the user's comfort and satisfaction.	The questionnaires were distributed to 400 Thai passenger using DMK airport.	As since, the new normal life has started and every passenger needs to keep social distancing to avoid unwanted infectious disease. The limitation of this study is focusing only Thai travelers. Further study should study and collected data from various nationalities who use DMK airport.	The convenience, comfort and satisfaction outreach the passengers from city to airport.
Sokolowicz (2020) - The value of ambiguous architecture in cities. The concept of a valuation method of 20th century post-socialist train stations	Many members of society still do not treat them as a valuable part of the cultural and social heritage, particularly when modernist architecture is underinvested or derelict.	Hence, we suggest discussing an appropriate approach to estimate the ambiguous value of modernist heritage.	Based on a review of existing classifications of heritage value, as well as valuation methods, we propose a three-stage valuation procedure to capture the value of the 20th Century Post-Socialist Train Stations in Warsaw.	Perhaps extending the scope of the research sample would reveal a stronger impact of the socio-economic features on the value of Warsaw Cross-City Railway stations, which in our study turned out to be statistically insignificant.	This paper only talk about modernist heritage.
Kaszewski (2004) - Enhancing the sustainability of airport developments	New airport developments are invariably controversial for both local and global sustainability reasons.	The study examines the feasibility of four scenarios encouraging more sustainable airport development, focusing on airport terminal building design and surface access transport.	The scenarios were a 'business as usual' (BAU) plan for an airport's surface access transport and terminal building design, a green transport plan (GTP), a green architecture plan (GAP).		Green planning might not be only stucked on ground.

Figure 2.1.1 shows the literature review gathered for deductive 1 in the study.

Proposed solution for sustainability approaches Kaszewski (2004), enhancing the sustainability of airport developments by inventing transport policies with respect to passenger behavior and vehicle technology in relation with surface access road traffic congestion and emission. Privately owned vehicles (cars and taxis) are not discouraged. Car park spaces and pricing have relatively large number and no high charging price. Public transport such as bus and train services are limited that just connect to airport and town-centers which mostly are poorly timed mode interchangeability. Employee car and minibus sharing schemes only have minimum target and are only proposed to large company firms. Employee cycling and walking are only limited to cycling around poorly connected cycle routes across town and region. Airport ground-fleet vehicles are not all fitted with electric converters, nor all use unleaded fuel. Travel information, advertising and awareness of different modes published in different forms are few and poorly displayed or advertised. In addition, Kaszewski also mentioned the government has defines Green Transport Plans, GTP as a management approach that analyses the key transport challenges and opportunities facing an employer and provides the structure to develop an integrated, strategic response. A GTP can include measures that encourage travel to work by public transport, cycling to work, a flexible benefits package to provide alternatives to a company car that are attractive to employees and do not cost employers any more in hand with increasing the fuel efficiency of the aircraft fleet. All are aimed at reducing road traffic congestion and emission pollution, as well as developing effective partnerships between business, local authorities, and transport operators. (Kaszewski, Andrea L., and William R. Sheate, 2004)

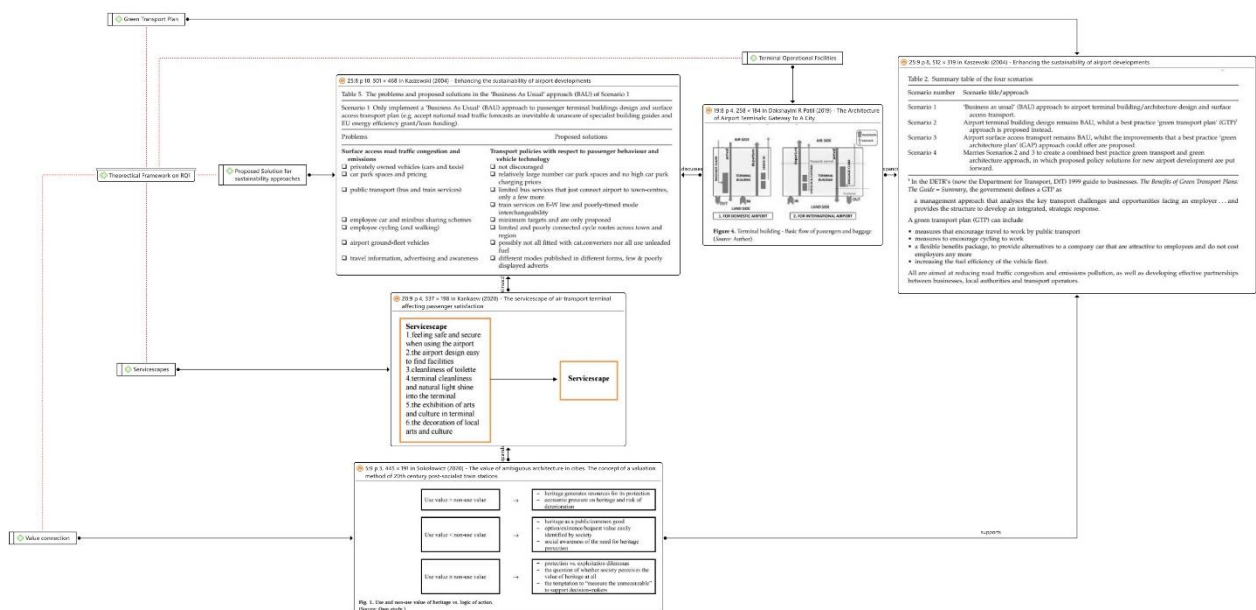


Figure 2.1.2 shows the theoretical framework of deductive 1 in the study.

2.2 Future Spatial in Vertical Airport

Vertical Landscape is encouraged by Seo (2020) in Articulate Design Thinking for Sustainable Airport Environment: A Case Study of Singapore Changi Airport T3 showing intervention of how vertical tapestry with water feature and baggage carousel works together. (The landscape works from the groundside is continued to the interior of terminal such as a green lobby or a wedding space with abundance types and quantities that come to an end before

reaching airside of the terminal. These spaces are welcomed towards both ticketed and non-ticketed passengers. (Seo, Ducksu, 2020)

Martinez-Munoz (2021) mentioned in SKYWAYS: A STRATEGY to HUMANIZE the MOBILITY of the VERTICAL CITIES on how the Hong Kong Skywalks could implement in the Second New York Regional Plan in 1969. He then supported in 2020, Humanizing the vertical city: Three strategies to bring the ground level closer to the clouds. Stated in his third strategy, perhaps the most radical, that tries to exemplify as multiplication and manipulation of the ground level is the one that, in an almost unnatural way, proposes to separate and elevate an imprecise fragment of earth with everything on it. The Mesa City project (1959) of the Italian architect Paolo Soleri and the project The Lifted Village (2011) of the Dutch team MVRDV could be paired within this strategy and establish a dialogue. The study concludes that those ‘urban meshes’, made of skyways, can become an alternative to pedestrian mobility in vertical cities if they are conceived as a total urban design, instead of as an isolated intervention in a group of skyscrapers. (Muñoz, Adrián Martínez, 2021)

Document	Problem Statement	P.O.D	Method	Recommendation / Future Studies	Remarks
Seo (2020) - Articulate Design Thinking for Sustainable Airport Environment: A Case Study of Singapore Changi Airport T3	Particularly, airport construction has a negative influence on it with pressure regarding the aviation industry's environmental impact.	This study aims to find significant implications for sustainable airport design from the critical review of Changi Airport T3.	This envisions an articulated design approach by creating the inner spaces to integrate with the groundside landscape, building performance, and green technologies.		To not overlook on the sustainability issues that been highlighted on current traditional airport.
Martínez-Muñoz (2021) - SKYWAYS: A STRATEGY to HUMANIZE the MOBILITY of the VERTICAL CITIES	Therefore, the urban space suffers a strong dehumanization, disconnecting the inhabitants from the urban context.	This paper proposes a rereading of those experiences and projects that, from the beginning of the 20th century to the present, built or unrealized, contributed to elaborating a new ideology about elevated pedestrian mobility.	A survey of the history of architecture was done, worked with the idea of radically introducing a fragment of urban space at a certain height: skyways, skywalks, pedways and footbridges.	The solution must find a dynamic balance between the public realm and capitalist logic: a fair proportion in the programs that accompany these skywalks, threading the network with residential lowers and feeding the network of public spaces for socialization, far from a purely commercial circuit.	This aids in studying the relation of cityscapes and aviation mobility.
Muñoz (2020) - Humanizing the vertical city: Three strategies to bring the ground level closer to the clouds	Urban developments, mainly located in the Asian-Pacific cities, are driven by a rising real estate market that builds to speculate and not to inhabit.	This paper will go over some projects, which are closer to vertical urban planning than to the building itself, which sought the radical multiplication of ground level, elevating the social and the relational away from ground level to find more human growth strategies.	The actions analyzed in this text will be strategies such as the shelving of villas as an architectural structure, the location of semi-open spaces such as squares or parks distributed in height, or fragments of cities uprooted from the Earth's crust and elevated hundreds of meters.		This discussion helps reflect on the function of airport if being elevated.
Kotzen (2021) - Future cities: Speculation on the case for vertical biophilic cities	The current model of a central city core area and expansive suburbs does not provide a solution for future growth.	This is an 'ideas paper' which speculates on the forms of future vertical cities and the necessity of integrating biophilia into the vertical city.			The nature may arise issues of obstruction in air mobility.

Figure 2.2.1 shows the literature review gathered for deductive 2 in the study.

In Kotzen (2021), Future cities: Speculation on the case for vertical biophilic cities stated three hypothetical options to accommodate future urban populations: carry on current trends with ever increasing horizontal expansion; after Montgomery (2015) increasing density overall; the biophilic vertical city option, creating the vertical city around the existing city (in order to reduce payments for land and releasing land to be put back to ecosystem services provision. Eventually the existing city will be replaced and become integrated into the Biophilic Vertical City. Both arguments are well derived future spatial and program that should be proposed for future development of airport that constructed vertically. (Kotzen, Benz, 2021)

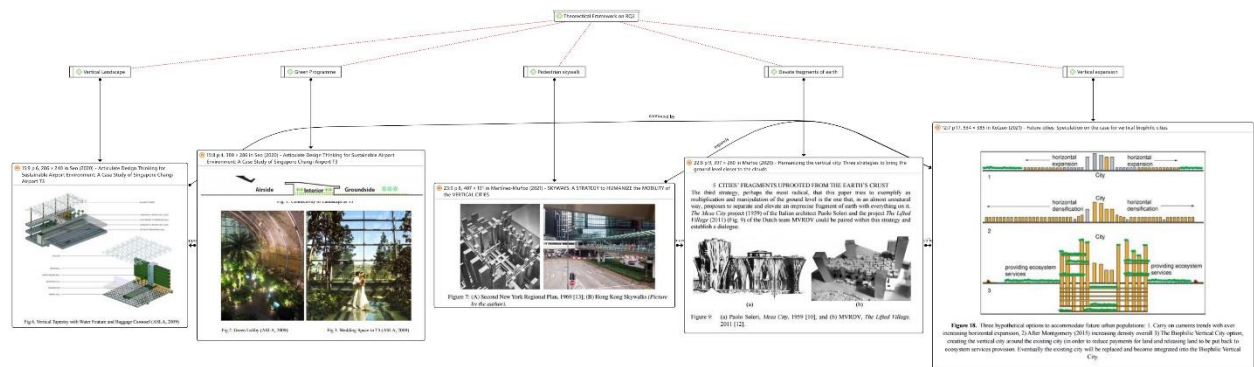


Figure 2.2.2 shows the theoretical framework of deductive 2 in the study.

3. CONCEPTUAL FRAMEWORK

To implied airport into urban areas is important to understand on how the airport works and compare it side by side to urban transportation currently like trains and buses. Airport expansion is caused by airport driven facilities, which airport in the middle are supported by the outside, tech labs and expressway. This is a hierarchy of needs on city’s mobility hub, which decided by land use firstly, and linking them from hubs to hubs and it gets smaller to a local checkpoint like a bus stop which ends up in someone’s home. The understanding of this two come to these three factors of development: physically driven, limits from the structure, highways, and runways; programmatically driven by services around the area like carparks; socially driven for passenger mobility that function as transportation nodes. With the 3 factors come to a theory for each of them: physical evolution which cause internal factor is verticality expansion; program which derive an external factor is complexity and last is the urban realm which is the social evolution to go against the norm of airport as a non-place.

Conceptual Framework / Kerangka Konsep

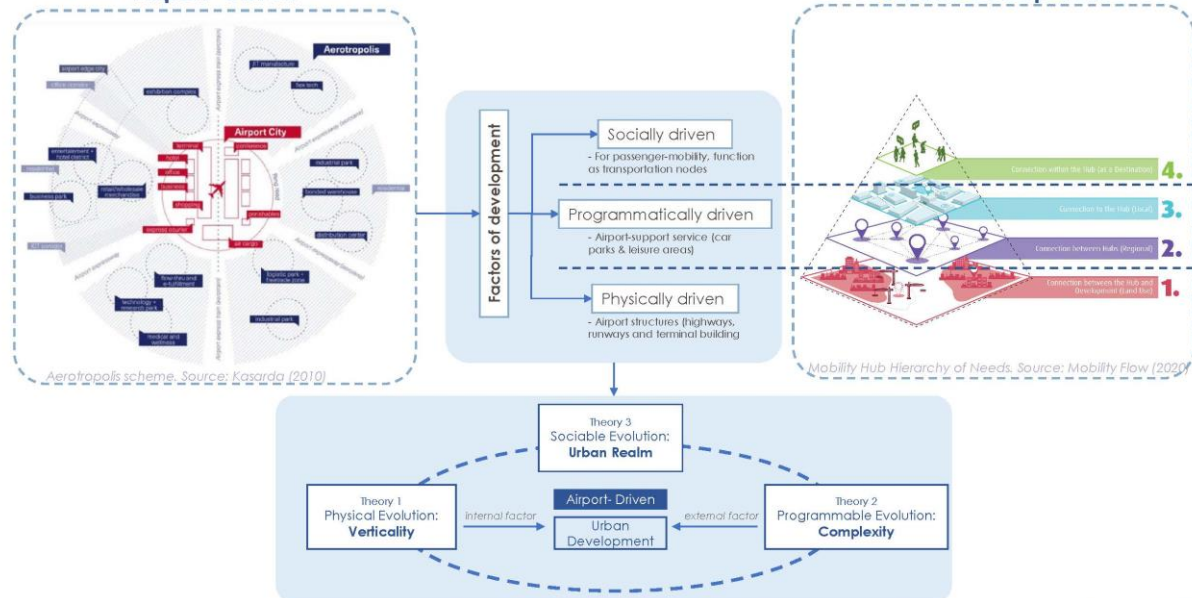


Figure 3.0 shows the conceptual framework of the research.

4. CONCLUSION

This study shows that history cannot speak of itself as a masterplan would not be achievable as the future has become uncertain to what have been predicted. The design strategy of the

airport in the city center maybe leads to multiple directions of growing developments: planning design response to increasing traffic and rearrangement of terminal operation at the same time. The project should not focus on searching for a pattern but proceed on having possible outcomes over prediction that will happen. Despite there might be difference in knowledge of future, verticality is a must to be the catalyst of designing airport vicinity. Without eliminating the complexity, design for airport in city center should be analysis on condition on trying to understand how the urban design works can be execute as being stacked vertically. The aim of verticality results in smaller footprints incorporated with urban activities that would redefine the relation between terminal, urban context, and cityscapes. This study will be using qualitative methods through In-depth Interview from airport management and aircraft engineering departments to have a better understanding of the connectivity network of city to airport. In addition, to get the framework on how secure and sterile system works in an airport by adding gate control, health facilities and spatial configuration aspects. Safety and sustainable challenges will be researched through desk review, such as aircraft landing, runway criteria, surrounding skyscrapers and so on. Observation on current development of airports and urban transportation modes, focusing on communal network, traffic tracking and public accessibility to encounter challenges of vertical spatial expansions in aviation infrastructure. Phenomenological research is well analyzing the preferred facilities, infrastructure, and sense of place that travelers wish to experience. Besides, structural components for designing vertically are gathered through desk review to draw a list of schedules as required guideline for the same typology.

5. CONTRIBUTION AND BENEFITS OF RESEARCH

The study offers alternative solutions which support the cities not only economic viability, but also spatial continuous adaptability and hence results in sustainable city-airport developments. This goes against the conception of airport city which too concentrate on development has direct relation to airport, leaving surrounding municipalities. This condition includes a business-driven district, creating an extreme contrast to the existing cities, which usually have low density.

Derived new design transformational approaches on future aviation capabilities, skills, and services towards Malaysian Aviation Commission (MAVCOM) scopes. This research also helps to promote a more commercially viable, consumer-oriented, and resilient aviation industry which having the same vision as Civil Aviation Authority of Malaysia (CAAM). Additionally, moving people and goods more safely, efficiently, and sustainably across Malaysia to improve quality of life and support a competitive economy hand in hand with Ministry of Transport Malaysia Aviation.

6. LIMITATION OF RESEACH / FUTURE RECOMMENDATIONS

This study shows that most of the aviation industry are still practicing the current concept, 'airport corridor' in developing its infrastructure despite the introduction of other concepts like 'airea.' Besides, further research needs to consider the built structure of constructing a runway in verticality. A list of materials with bearable durability and construction methods should be set as scheduled specifications.

Furthermore, limitations on the control of safety guidelines for the runway to be in public area may need to be adjusted in the future. Discussion, experiment, and integration may be acted by Malaysian Aviation Commission (MAVCOM), Civil Aviation Authority of Malaysia (CAAM)and Ministry of Transport Malaysia Aviation.

Most of the current airports may face huge loss if one airport is built in the city center. Thus, it's best recommend to a specific population of users and aircraft models. For example by using electric aircraft that suffices of having 9 passengers on board of flying 440 nautical miles. With different types of target customers, it helps aviation industry to grow bigger in various fields instead of shrinking the economy into a single input.

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