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Congestion Management, a mechanism to relief demand

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Introduction

At least portion of the time, certain airports face significant congestion, where 'congestion' indicates that one aircraft delays or prevents another aircraft from using the airport in that time slot.

Almost all economists agree that when a resource is scarce, it may be distributed most effectively by using a system that values it to represent its worth to all other possible customers. However, efficient pricing can only be guaranteed in theory if all supply and demand are competitive, markets are full (allowing any number of transactions at any time), and players maximise utility by maximising profit revenues.

Among the airports that are "cooperative,"

Beyond the need to reduce congestion and increase service efficiency and coverage, the air transportation business faces other challenges. Two major issues are ensuring the safety of the air transportation system and ensuring environmental compatibility. NASA and its research partners are working on new technologies and capabilities that might improve GA's safety and environmental features. Before evaluating if the SATS model is a desired outcome, it is necessary to examine whether the proposed system has the ability to improve overall air transportation safety and environmental compatibility.

The FAA's Operations Network collects data on flight delays in or out of the country.

Significance of airport congestion management

Demand management has long been acknowledged as an important technique for resolving traffic congestion and capacity shortages, as well as internalising transportation externalities (e.g., delays, protection / dangers) placed on the transportation system by diverse modes. Demand management may take many different shapes.

To begin with, it encompasses a wide variety of considerations, such as runway usage, stand and gate distribution, concessions, and so on.

Second, it utilises a wide range of measures, including pure administrative regulations such as redirecting general aviation traffic to "reliever" airports and air traffic perimeter restrictions, as well as pure economic, market-based, or hybrid instruments such as airport congestion-based pricing.

Problem Statement

The main sources of congestion at most large airports are peak hours, which often create delays in the morning, noon, and evening. When it comes to international connecting flights, delays during morning rush hours can have a cascading effect, resulting in additional reactive delays that can extend all day or even longer. The optimization of operational operations, which is the responsibility of airport owners, airlines, and air traffic control, can help reduce peak-related delays.

Homogeneous traffic and wake turbulence

Final approach allows for less spacing between approaching aircraft due to comparable speeds, which enhances runway capabilities. As a result, it is not advisable to combine approaching jet aircraft with slower turboprops or general aviation. Most large hubs impose tight limitations on general aviation, and several airports outright ban the use of turboprops.Adverse weather management

The runway's ability will be reduced to zero due to low visibility and cloud ceilings. Landings are more vulnerable to damage than takeoffs. Instrument landing systems (ILS) can be installed on runways to provide for predetermined cloud ceilings and visibility during approaches and landings. Approaching planes can only take advantage of the reduced minimum if they are properly equipped and have a competent cockpit crew. Wind direction can suddenly alter 180 degrees as approaching planes approach. If the essential minimum airspeed is not maintained, accidents will occur. Approaches might be cancelled or postponed when wind shear is detected near airports. The worst-case scenario is a global wind shear alert surrounding an airport.

Noise Abatement management

Restrictions that result in a reduction in runway size are frequently used to reduce noise. During crucial periods, any runway activities may be limited or forbidden. Night

flight limits might be imposed across the board, effectively reducing capacity to zero. Because of noise issues, standard instrument departures (SIDs) and standard arrival routes (STARS) may be altered.

Noise quota limitations are imposed by airports that choose to use them, and these noise quotas appear to tighten over time at many airports. Only by switching to aircraft with the lowest noise levels would airline operators be able to preserve appropriate space at such airports.

Why is it important (Purposes and objectives)

This study focuses on airport demand management programmes, mechanisms, and techniques that try to solve both scarcity and congestion by distributing finite runway capacity wisely through slot allocation. Due to market inertia, functional challenges, and political reticence, despite a great number of policy and research ideas in this field, efforts to develop demand and congestion management strategies have not been extensively adopted and have not bloomed into policy practise. Congestion management solutions, whether essential or successful, have major implementation hurdles due to known industry actors' political resistance and sceptics' voices.

The objective of this paper is twofold:

- to provide quantitative evidence to support the need for and inspiration for a new congestion management system, and
- to develop a policy roadmap to direct the introduction of such a new regime at various types of airports.

The solution to the questions of airport congestion has been divided into four options

- Option A involves the addition of new infrastructure; this option boosts the airport's overall capacity or the capacity of any of its subsystems.
- Option B defines mechanisms to reduce airport service demand.
- Option C redistributes operations, resulting in greater airport operational performance, despite the fact that it does not reduce demand.
- Finally, Option D improves the airport's productivity by operational or technical advances.

Option A: New infrastructure investment

The system's functionality is immediately enhanced by the installation of new airports or the expansion of existing ones. However, such projects are sometimes difficult to complete because to budget constraints, environmental concerns, and local community opposition to new airport building. In addition, such technologies would be unable to fulfil the need for increased capacity in the near future. A new terminal, for example, can take anything from five to 10 years to construct. Increasing the capacity of an existing

facility, on the other hand, does not always need physical expansion; in some cases, just reorganising the existing space would suffice..

Option B: Demand management

To lessen demand at an airport, a portion of demand may be transferred to alternate destinations or other modes of transportation, such as:

Processing at a distance: This approach tries to reduce airport demand by supplying a portion of it outside the airport at alternative or complementary venues. On the landside of the airport, this will largely pertain to automobile parking, passenger screening, and the assignment of aircraft gates.

If the capacity of the airport vehicle parking facilities is insufficient to meet demand and cannot be enlarged successfully within the airport's limi, additional parking facilities may be developed outside the airport and linked to the terminal via a circulation system, such as shuttle buses.

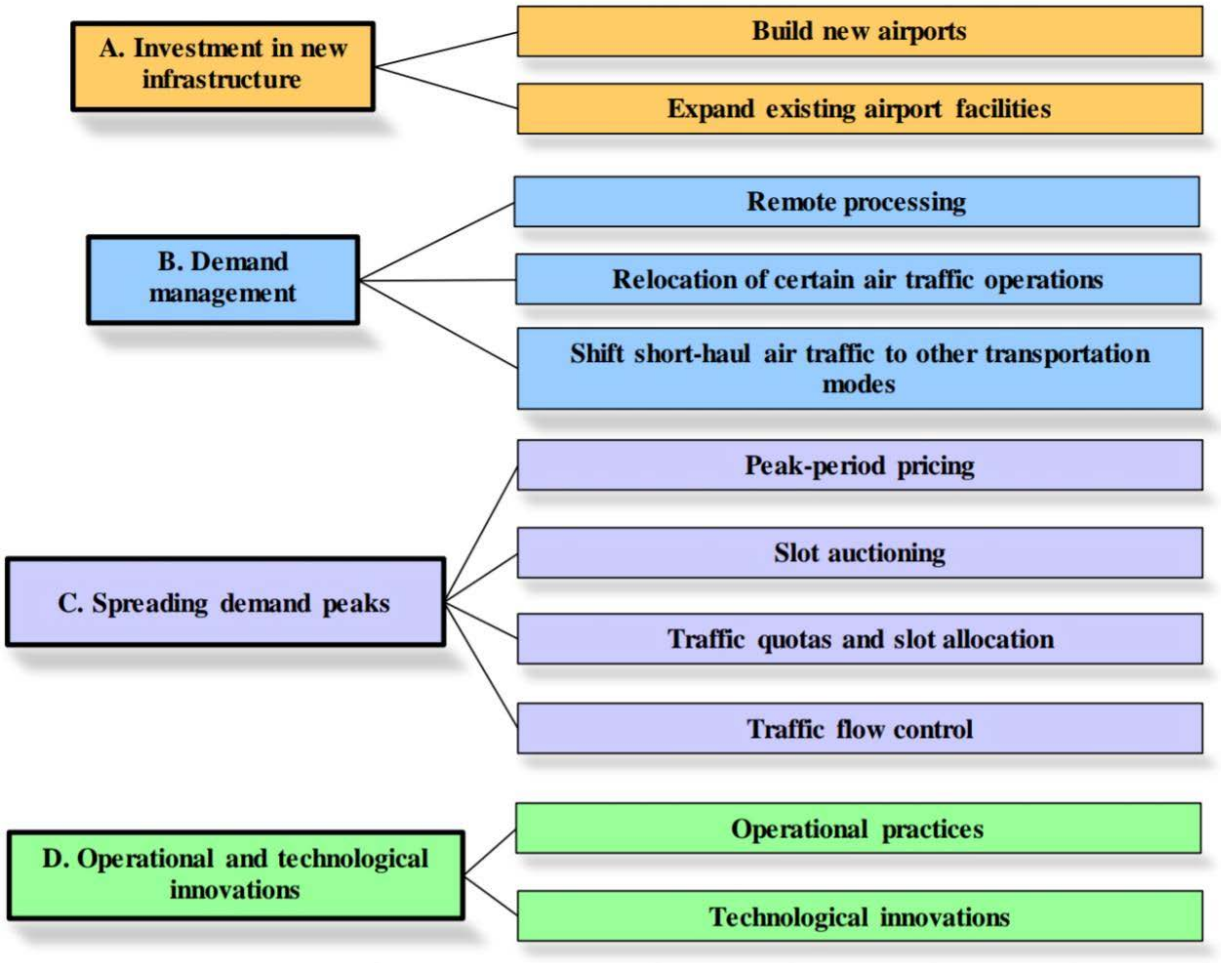
Option C: Spreading demand peaks

The adoption of economic and/or administrative procedures aimed at changing demand profiles to fit within capability limits is included in this concept. As a result, this strategy may be useful in situations when additional airport capacity growth is either impossible or too expensive.

Although airport expansion may be essential in the long run, peak-spreading solutions may be implemented in a fraction of the time it takes to build a new facility, postponing the need for expansion and minimising the expensive capital outlay.

Option D: Application of operational and technological innovations.

Apart from the measures outlined above for minimising congestion and the consequent delays, introducing and implementing new technologies and advancements to enhance the usage efficiency of existing facilities is another viable area for boosting airport capacity..



❖ **Options for balancing Airport capacity and demand**

Hypothesis

According to the hypothesis, traffic is caused by the fact that most airports allow unrestricted test flights and takeoffs, and airlines arrange flights without considering how their flights would influence the travel itineraries of other airlines. The failure to calculate the true marginal cost of adding an aircraft is the source of airport congestion and flight delays. The usage of a Tradable allows for taxes, such as a price based on the time of day or the thickness of the line, as well as congestion control and individual liberty assignment by selling rights to a limited number of final approach slots at international airports.

As a second reason of considerable air traffic delays, we suggest the network advantages associated with the hub and spoke architecture. As the number of potential connections grows inexorably with the number of markets supplied by us all, the base station carrier has an incentive to serve an ever-increasing number of markets, as long

as demand for air travel in prospective future markets does not fall faster than the increasing benefits of the larger network.

Because airports have limited flight capacity, a connection airline must weigh the benefits of serving more markets against the costs of indirect interest, such as higher alignment rates and delays caused by increased traffic. Longer delays at hub airports are the equilibrium result of a hub airline balancing strong marginal gains from hubing with the marginal cost of delays, according to this simplified model. Base station airlines attempt to increase the number of potential passenger connecting markets at a traditional airport while reducing time spent stuck in traffic or waiting for connectivity information.

A flight departing from a transportation hub might take up to 7.2 minutes longer than one departing from a semi-airport to reach its destination. Flying to a commercial airport adds 4.5 minutes to the trip duration on average. The hub carrier's number of markets covered, or the hub's size, is increasing the number of delays at hub airports. The hub carrier, on the other hand, is responsible for the additional travel time that comes with hubs. Those departing from a hub are usually considerably delayed compared to flights arriving at a hub.

On the other hand, the evidential effect of airport volume, which we use as a measure of how thoroughly carrier delay charges are institutionalised at the airport, is much smaller than that of the centre. A 20% increase in airport expansion leads in a 0.3 to 1.4 minute reduction in flight time for all air traffic trips, depending on whether or not we include airport control elements. Arriving and departing flights have the same effect. We have a bit more good data on commute times after 1995, and we can separate the reasons of delays. Just some increased traffic flow encountered as a result of departure from the hub must be conceptualised for a flight at the entrance.

If the destination airport is the airline's hub, part of the additional travel time will be spent in the air, but the bulk will be spent taxiing to the terminal. We can also rule out the possibility that the carrier hub's delay was caused by the aircraft's late arrival on the previous inbound flight.

Appropriate interpretations of hub in the given economic system tend to favour market dominance or productivity gains above the vertical integration that we experience. The main hub carrier has substantial market power on nonstop flights to and from the hub airport, according to previous empirical investigations. According to certain studies, entrance barriers for a single airline, such as frequent flyer programmes and electronic reservation systems, lead to hub market dominance. Others say that as the number of markets serviced and the size of the operation on those routes expands, airlines benefit from economies of scale, which cut marginal costs.

Despite the fact that market dominance and cost efficiencies are important considerations in hub and voice systems, and may explain some hub airport disruptions, it does not explain why, in the absence of increased network connection returns, a hub

carrier would tolerate high delays on its own hub flights in comparison to individual carrier flights into and out of the same airport. The fact that a hub airline will aggregate departures rather than only migrants, despite the fact that it is not immediately clear, is also significant. Assume that the hub airline has scheduled all of its flights to arrive and leave simultaneously.

Because certain connections will be unnecessary from the earliest entrants to the current departing, the airline just wouldn't normally like to smooth all arrivals and departures.

Why, then, are smooth arrivals preferred over smooth departures?

The unpredictability of aircraft operations provides the explanation. Airlines are aware that certain flights may have delays at the airport, but they have no way of predicting which flights would be affected on any given day. Airlines offer themselves the option of departing on whatever aircraft arrives first by clustering departures. The research shows that departure delays are only going to become worse. Finally, delays will be longer at smaller airports. A low market share airline, whether hub or non-hub, will book more flights in our scenario since the increase in average delay caused by an additional trip has a reduced influence on the company's own aircraft.

We predicted that airport capacity will stay constant over time based on our study. Other airports, on the other hand, may be able to improve the efficiency of their runways by including taxiways. Hub airports with more producing capacity may be less motivated to invest in current taxi capacity than semi airports with more treatment and control. The proportion of flights arriving within 15 minutes of their scheduled arrival time is the most often reported statistic of congestion. Late arrivals are flights that have been cancelled or diverted.

Another issue with the use of on-time productivity as a measure of true delay is that airlines can modify it by altering the scheduled flight times to account for awaited flight cancellations.

Hypothesis conclusion

Air traffic delays have increased dramatically during the last 13 years. It's crucial to distinguish between two sorts of possible delays from a policy standpoint: network benefits from hubs, which allow hub carriers to endure greater equilibrium levels of delays, and congestion externalities, which lead all carriers at an airport to face longer waits. Despite evidence that traffic externalities cause slight delays, our findings demonstrate that the hub is the most major economic source of air traffic congestion. Aircraft leaving from hub airports take 4–7 minutes longer, while flights arriving at hub airports take 1.5–2 minutes longer. The gateway carrier's expenditures, on the other hand, are responsible for almost all delays. With the exception of the busiest hubs,

semi-airline companies encounter little delays at hub airports. Within hubs, delays increase in lockstep with hub size, with departures from the hub experiencing longer waits than arrivals.

Each of these data supports the theory that the hub carrier enjoys significant system advantages that increase in proportion to the number of markets it serves.

The hub airline may combine its planes during hub times because of these connective benefits, even if it means longer delays for its own flights. Our findings also imply that imposing a subsidy or unjustified limit on airport take-offs and landings that ignores hub spatial resolution might result in community failure. In the vicinity of a hub, the best way is to look at the benefits of connection while minimising delays. Delays aren't usually a sign of a socially inefficient conclusion. They might be the consequence of hub airlines maximising limited runway capacity to provide passengers with a varied range of potential destinations and short connecting times. With a large market share during peak hub hours, when the majority of delays occur, major hub airlines tend to internalise some of the congestion costs through their own airport terminals. Although hub airlines can exert pressure on semi airlines by prohibiting them from participating in particular flight schedules, a decision maker who knows the platform's efficiency theory can also restrict semi airlines by eliminating them from predefined flight plans.

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Significance of research on Airport congestion

The intensity of airside, landside, and terminal congestion is increasing, threatening to shut down the aviation network, but the number of feasible solutions is restricted owing to political, environmental, operational, and economic restrictions. The system will gain much-needed flexibility by building new airports and expanding existing ones. Various operational improvements will improve system flexibility in the short term, but not enough to provide long-term relief in the face of growing demandCreate slot quotas as a short-term solution to a long-term problem to alleviate congestion and delays. Administrative procedures are difficult, if not impossible, to use in a fair and efficient manner to award operating rights, and administrative techniques would not solve the fundamental problem of excess demand and insufficient supply.

Some airports may be able to alleviate congestion and delays by combining peak/off-peak landing fees with passenger surcharges.

Administrative procedures are difficult, if not impossible, to utilise to award operating rights in a fair and efficient manner, and administrative approaches would not solve the basic problem of excess demand and insufficient supply. Demand management solutions try to balance demand with available resources, and a combination of peak/off-peak landing fees and passenger surcharges may be able to help some airports reduce congestion and delays.

Landing fees must be set at the same level as marginal costs under an equitable airport pricing scheme. Those who sought access at that time would be able to do so if they were willing to pay a higher price during peak hours. Customers who do not place a high value on peak-period access may choose to go elsewhere or wait for off-peak rates. Any plan for decreasing congestion and delays should include a strategy for controlling passenger demand. Any plan for decreasing congestion and delays should include a strategy for controlling passenger demand. Passenger surcharges might be used to encourage short-haul passengers to consider other modes of transportation, connecting passengers to travel out of less congested hub airports, and all passengers to fly during less congested hours.

Airlines will be encouraged to offer nonstop service or flights that connect at less congested places as a result of the connecting cost. Passenger fees, although useful on their own, are particularly effective in reducing traffic and delays.

The difference between peak and off-peak landing costs is complimentary. As a result, a mix of passenger fees and peak/off-peak landing expenses appears to be required to fully use all airport services. Many critics say that the only way to prevent the inevitable need for expansion is to postpone it. They are entirely accurate. To extend the national transportation system, new and better infrastructure are necessary. Meanwhile, a combination of peak/off-peak landing fees and passenger surcharges might result in a more equitable and efficient use of limited airport space than is now the case.

Literature review

Contingency Management theory:

The contingency management theory's primary concept is that no single management method is suited for every company. Many external and internal elements will have an influence on the management strategy chosen in the end. A contingency theory is an organisational theory that asserts that there is no one-size-fits-all solution to group planning, leadership, and decision-making. Internal and external circumstances, rather, determine the best course of action.

The contingency hypothesis highlights three elements that are likely to have an influence on an organization's structure: its size, its use of technology, and its leadership style.

The concept of contingency management was created by Fred Fiedler. Fiedler believed that a leader's personality attributes were inextricably linked to his ability to lead. According to Fiedler's theory, there are a set of leadership characteristics that may be applied in every scenario. It suggests that a leader must be flexible in order to respond

to changing conditions. The principle of contingency management is summarised as follows:

- There is no one basic approach for handling an organization.
- The specific management style appropriate for a specific situation should be easily established by a chief.
- LPC, the least favored co-worker scale, is the primary part of Fiedler's contingency theory. LPC is used to test how a manager is well-oriented.

The contingency approach is a management theory that claims that the best management style depends on the environment and that sticking to a single, static style is inefficient in the long run. Contingency managers frequently pay great attention to the situation as well as their own personalities and try to work together efficiently.

Organizations gain from contingency theory because it allows them to learn from specific events and apply what they've learned to future management of similar or identical situations. It's also beneficial to be able to adjust to external influences and changes.

It's a synthesis of several schools of thought, including classical, behavioural, and systems thinking. It incorporates and applies ideas from several schools of thinking, depending on the needs of the scenario. It is reasonable in nature since each problem is solved after a thorough examination of the situation. It makes use of a multivariate analytic method. It considers and optimises all possible features or variables that influence the issue.

It is adaptive at its heart. Rather than accepting the organization's pre-designed structure, it adopts a structure that allows it to adapt to the environment. It assists in the planning of information decision procedures as well as the creation of the organization's layout. The nature of a small organisation can be centralised, whereas the nature of a big organisation might be decentralised.

It assists in the development of motivating and leadership techniques for employees. An authoritarian method may be utilised while dealing with unskilled personnel, whereas a participatory approach may be employed when working with skilled people. Contingency management strategy is now considered a major branch of management theory.

Framework for Airport congestion Management

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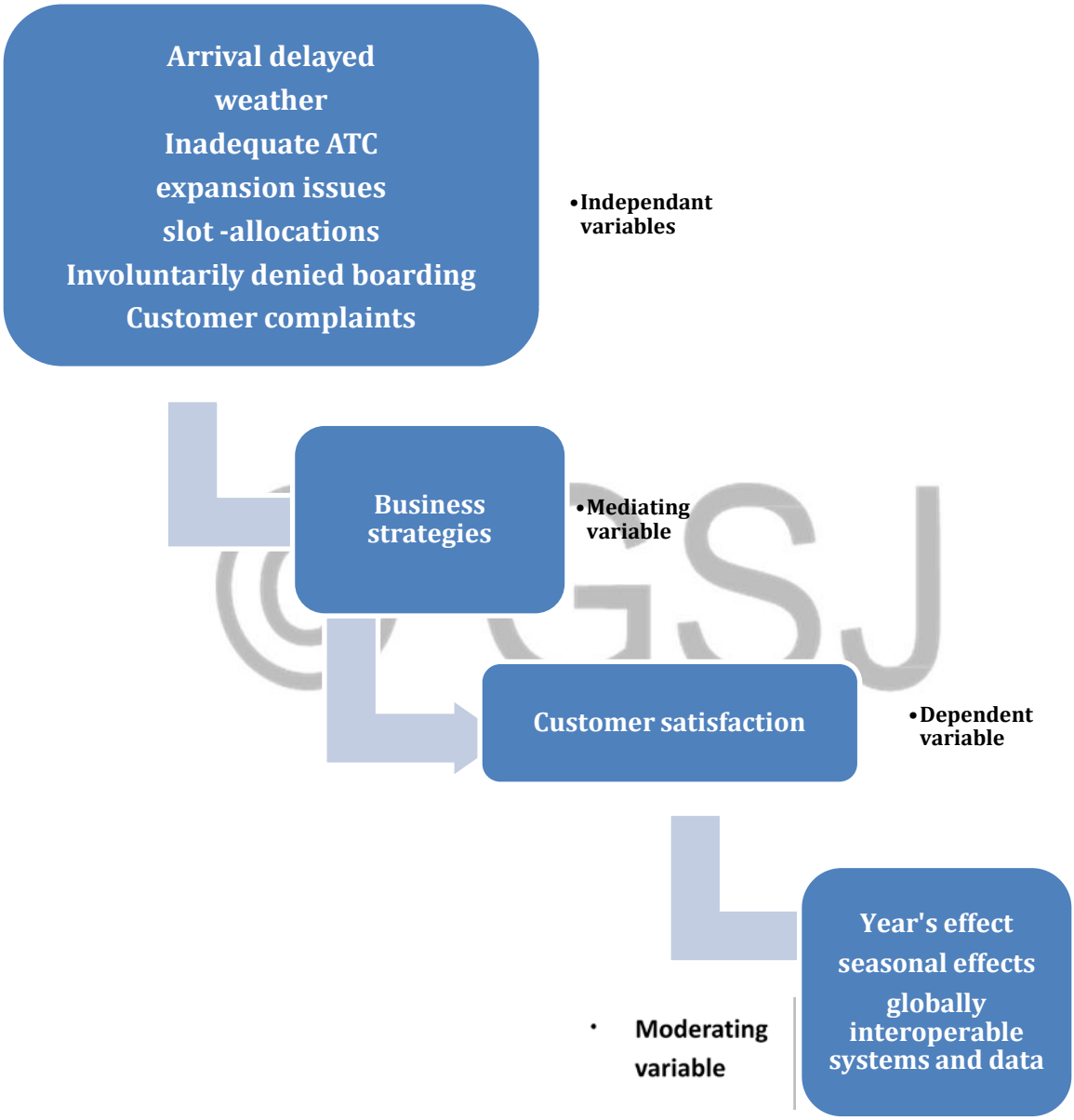


Air traffic delays arise when demand for airports or airspace exceeds available capacity. As a result, delays can be reduced by boosting capabilities or changing air traffic demand. Increasing capacity is a fantastic concept, but it's a long-term answer that will require major modifications such as facility construction, basic process changes, and improved navigational ease. Alternative flight plans may be recommended by a tactical-optimization model to reduce delays in short-term decision-making. A tactical-optimization model is particularly difficult because of the fluctuation in airport-capacity projections, which are mostly reliant on weather.

Relationship between Independent and dependent variables

The Airport Service Quality (ASQ) customer experience section of Airports Council International (ACI) World provides a 360-degree perspective of airport customer experience management with a unique range of solutions. ASQ is the world's most used airport benchmarking and passenger service software. The American Society for Quality (ASQ) offers the airport community information, insights, and best practises.

According to ACI World's research report "Does passenger happiness enhance airport non-aeronautical revenues (NAR)?" released in 2016, customer service is the single best approach to improve non-aeronautical revenues. The following is based on the ASQ data:

- Non-aeronautical revenue increases by 0.7 percent to 1% with every 1% rise in passenger numbers.
- A 1% rise in the size of the commercial area results in a 0.2 percent increase in NAR.
- On average, a 1% increase in global passenger satisfaction (as described by the ASQ Survey) results in a 1.5 percent increase in NAR.

Since airports are intertwined with a number of organizations and businesses with differing business objectives and priorities, it is vital for all stakeholders involved to have a mutual understanding of the general norm and customer service positioning.

To fix this issue, ACI created the Airport Customer Experience Model, which is comprised of eight core domains:

Managing the customer experience at an airport is a difficult undertaking that requires many individuals from multiple airport teams, as well as other stakeholders such as airlines, suppliers, governments, and others. The ASQ program's capacity to bring all stakeholders together to focus more on the customer experience is one of the things that makes it so effective..

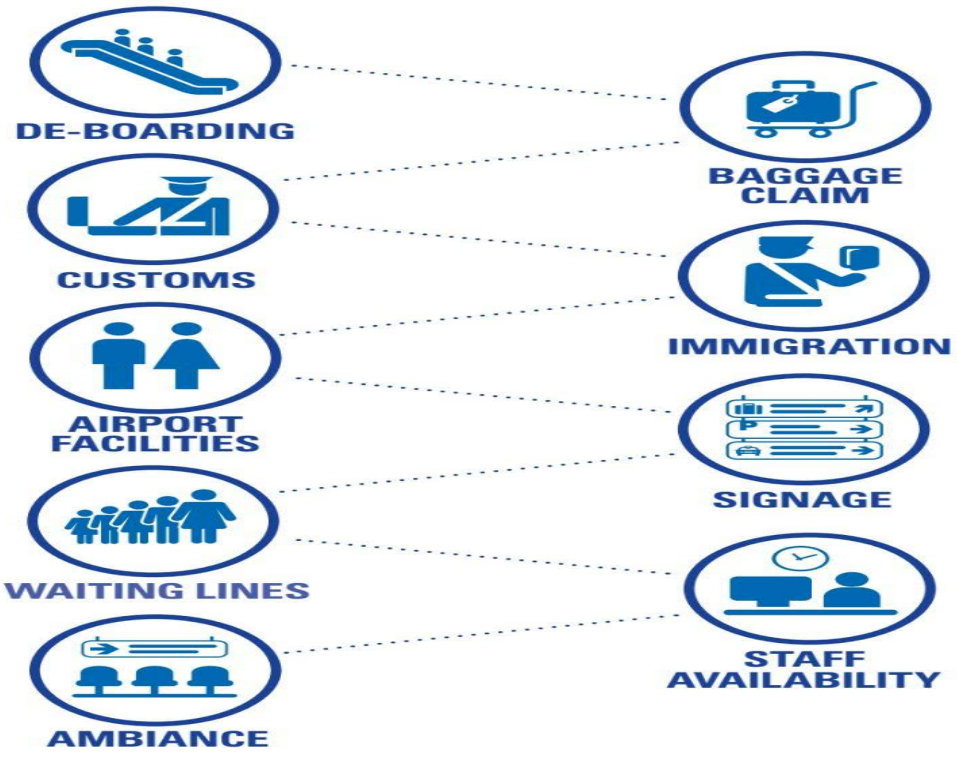
Relationship between Mediating and independent variables

A mediating variable connects the dependent and independent variables. All of the variables that contribute to an airport's congestion are dependent on clients, who can only be pleased by implementing certain business tactics. Business strategy aids a company in dealing with the elements that obstruct its operations. Similarly, when an airport becomes crowded, which can lead to unsatisfied consumers, an effective plan can assist to alleviate the situation. Relationship between Moderating and Mediating variables

Some moderating variables such as year's effect, seasonal effects like occasions, or globally interoperable systems and data can highly affect to increase congestions at an airport. So business strategy also helps to cater in these uncertain situations. It also affect the revenue of an airport.

Methodologies

The Departures Survey closely follows the passenger trip, examining 34 service attributes across 18 segmentation fields to provide the most comprehensive image of the departing passenger experience at your airport, including:



Every passenger trip starts with a departure and finishes with an arrival, which adds yet another important element to the customer care storey. The American Society for Quality (ASQ) is a non The programme employs the same 'live' questioning technique as the previous one, capturing the customer's ideas in the middle of their flight. From customer loyalty to retail purchasing, higher service standards produce better commercial success and encourage revenue stream diversification. Recognizing the critical importance of commercial income sources in the retail, food, and beverage industries. The commercial Survey was designed by ACI to help managers in boosting non-aeronautical earnings.

Passengers are becoming increasingly used to a fully immersive airport experience. The ASQ Commercial Survey is intended to assess not just the ride's service characteristics, but also the customer's overall experience of the trip. Customer happiness isn't the sole driver driving non-aeronautical revenue growth, as we've

observed before. Growth in passenger numbers and the size of the commercial area accompany increases in non-aeronautical sales.Additional Optional Services

ASQ offers a range of survey and support solutions, allowing you to configure the software to your airport's unique requirements.

Passenger comments analysis	This interactive report (Departures only) gathers free text feedback from completed ASQ Departures Survey questionnaires at participating airports on a quarterly basis. Each statement is coded and classified, allowing for more thorough analysis and comparison over time.
Dissatisfied passenger probe	The Dissatisfied Passenger Probe was created to figure out what's causing a passenger's frustration (Departures only). Dissatisfied Passenger Probe forms are issued to the ASQ Departures Survey fieldwork agent. The form is used by the fieldwork agent to ask the passenger additional questions and to document the reasons for the low score. These forms are analyzed, and along with the quarterly deliverables, a report is issued.
Terminal analysis report	This graph depicts the efficiency of airport terminals, indicating which terminals perform better/worse than others and which facilities need to be improved. A summary table of average scores per item by terminal and traffic form is given, along with the option to filter data by a variety of criteria and a graph of the trend over time comparing the scores of your terminals, gates, and airlines for advanced users.
Comprehensive Insight Report	During the annual review over the four quarters of surveying, the Quantitative Insight Report (CIR) offers a comprehensive overview of the participating airport's strengths and weaknesses. It digs deeper into the factors that influence passenger satisfaction and presents the findings as actionable management data, allowing the executive team to devise a strategy for change. • Passenger satisfaction data by airline and citizenship nation are among the additional studies included in the CIR. • Gap assessments (e.g., passenger satisfaction with shopping facilities at your airport vs. other airports in your region) • Improvements in customer satisfaction inside your personalized panel of airports (comparison with previous year)
Airport executive presentation	The presentation is intended to include an executive summary of the findings, interpretation, benchmarking, and insights from the ASQ Survey to the airport's top management team. Content is produced on an individual basis and can be adapted to the target audience.

	ACI's own or contracted market research experts may provide the presentation in person or online, as well as encourage dialogue on areas for change and the value of customer service.

ASQ uses the same methodology to provide personalized analysis that quantifies the proportion of each persona at the airport as well as their satisfaction level. In terms of demographics, motivations, travel patterns, and aspirations, the study summarizes the various profiles.

BUSINESS RESEARCH METHOD

QUESTIONAIRE

BACKGROUND INFORMATION

Name: ……

Gender: ◯Male ◯Female ◯Transgender

Age: ……

Education: ◯Master's ◯Bachelor's ◯**……(if any other)**

Occupation:

- o Student
- o Public employed
- o Private employed
- o Self-employed
- o Retired

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1. **Purpose of flight**
   - o Business

- Leisure
- Both
- Other

2. **Class you usually fly when travelling**
   - First class
   - Business class
   - Economy class

	Highly disagree	disagree	neutral	satisfied	Highly satisfied
Departure time was favorable					
Arrival time was favorable					
Airfare was better					
Like the OTP of airline					
Service offered by airline was good					

Airport survey

Please rate it how long did you wait in line:

	Highly disagree	disagree	neutral	satisfied	Highly satisfied
At ticket counter					
To check-in					
Baggage drop					
Seat assignment					
Getting from security hold to boarding gate					
boarding					
Deplaning					
Waiting for luggage at destination airport					

State your satisfaction with below:

	Highly disagree	disagree	neutral	satisfied	Highly dissatisfied
Congestion mitigation					
Time and consistency mitigation of service					
Check-in staff was helpful					
Baggage handling					
Self-check in counters					
Courtesy of airport employees					
Appearance of crew					
Cleanliness					

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