MANAGING AIRPORT CONGESTION: FROM THEORY INTO POLICY PRACTICE

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ABSTRACT

A substantial amount of research work has been documented in the literature with the aim to review and critically assess alternative approaches, instruments, and strategies aiming to deal with airport congestion through the allocation of scarce airport slots. The proposed instruments and strategies introduce various combinations of market-oriented or pure pricing allocation instruments in conjunction with administrative rules, measures, and procedures. Despite the comprehensive amount of research in this field, attempts to translate such measures into policy practice were very few and fragmented due to industry inertia and voices doubting the actual necessity or effectiveness of congestion management initiatives. Another major reason behind this stagnancy seems to be the lack of guidance as to how these instruments and measures can be integrated and implemented within an overall strategic policy framework for the allocation of scarce airport capacity. The objective of this paper is twofold: i) to provide quantitative evidence and justify the real need and motivation behind the adoption of a new congestion management regime, and ii) to formulate a policy roadmap that will guide the implementation process for a new congestion management regime at different types of airports.

Keywords: airport slot allocation, congestion management, policy implementation.

INTRODUCTION & SCOPE

Over the past 30 years, exceptionally high air transport growth has been evident worldwide in terms of both passengers and aircraft movements, which have been funnelled into fewer and fewer airports. The overwhelming increases in demand in conjunction with severe political, physical, and institutional constraints in providing sufficient capacity have resulted in serious congestion phenomena and sharp delays. Congestion and delay figures have receded significantly due to the recent global economic downturn. Despite the severe industry pause and the uncertainty of actual timing for rebound, recent traffic figures provide tangible signals that the air traffic downturn is bottoming out, while there is some evidence for a sustained recovery within 2010. Irrespectively of the actual timing for rebound, the recovery of the air transport market is expected soon, hence, bringing again into the forefront severe capacity shortages and delay phenomena. It is quite certain that large airports worldwide will soon have to face substantially increased growth of demand for runway operations, which should be accommodated by a runway system of definite or even saturated practical capacity. The congestion and delay problems are expected to further deteriorate especially in Europe considering that over half of Europe's 50 largest airports have already reached or are close to reaching their saturation points in terms of declared ground capacity with only few planned major developments / expansions (DotEcon, 2001).

The increasing imbalance between airport capacity and traffic resulted in congestion and delay figures that have drawn the attention of aviation policy makers and triggered policy discussions that bring into the forefront the challenging dilemma: Demand / Congestion Management or Capacity Enhancement? The solution to the congestion and delay problem can be viewed through reducing the ratio of demand (traffic) to capacity (supply), but there is much controversy over which part of the ratio should receive higher priority. The rapidly increasing congestion and delay phenomena in conjunction with problems or complications in providing sufficient capacity to satisfy all anticipated future demand render a pure supply-side solution rather impossible. Because of the severity of the problem, demand management solutions aiming to control congestion through the allocation of scarce airport capacity (expressed in slots[1]) have lately received a great deal of consideration from policy makers, airport users, and operators on both sides of the Atlantic.

Demand management has been long recognized as a principal instrument to deal with congestion and capacity shortfalls or internalize transport externalities (e.g., delays, noise, emissions, safety / risks) imposed by various modes on the transportation system and the society at large. In the air transport context, demand management exhibits several variations. First, it covers a large variety of decisions including runway usage, stand and gate allocation, concessions, etc.. Second, it deploys a wide spectrum of measures ranging from pure administrative rules such as the diversion of general aviation traffic in “reliever” airports and air traffic perimeter rules to pure economic, market-based or hybrid instruments such as the implementation of airport congestion-based pricing schemes, as well as slot trading and auctions. Third, it aims to deal with the manifold nature of air transport externalities either through the rationing of capacity and congestion management (e.g., slot allocation), or the assessment, mitigation and pricing of noise (e.g., noise charges or surcharges, noise limits / traffic curfews) or emission-related externalities (e.g., emission charges, quantity controls, inclusion of the air transport sector in the EU Emission Trading Scheme). Fourth, it deals with both congestion and scarcity of airport infrastructure. In principle, strategies focusing on the efficient and fair allocation of capacity are meant to treat scarcity of airport infrastructure (mainly runway slots) in various ways (e.g., grandfathering, trading, auctions, congestion-

[1] According to the European Commission Regulation 95/93 (European Commission, 1993), a slot signifies the permission given to a carrier to use the full range of airport infrastructure necessary to operate an air service at a slot-controlled airport on a specific date and time for the purpose of landing or take-off.

based pricing). Once capacity is allocated, congestion may develop for several reasons. In this case, administrative procedures / rules (e.g., hourly limits, traffic diversion) or pure pricing schemes (e.g., peak hour pricing) can be applied in order to deal with congestion by handling the temporal profile of demand (e.g., traffic shifts throughout the day).

This paper focuses on airport demand management measures, instruments, and strategies aiming to deal with both scarcity and congestion by strategically allocating scarce runway capacity in the form of slot allocation[2]. Despite a comprehensive amount of policy and research proposals in this field (discussed in the next two sections), attempts to bring forward demand and congestion management initiatives were not widely adopted and have not flourished into policy practice mainly due to industry inertia forces, practical complexities, and political hesitance. Political opposition from established industry actors and voices doubting the actual necessity or effectiveness of congestion management initiatives raise substantial implementation barriers. Another major reason behind this stagnancy seems to be the gap between theory and practice, as well as the lack of guidance as to how these instruments and measures can be integrated and operationalised within an overall strategic policy framework for the allocation of scarce airport capacity. On the other hand, it is reasonable to expect that different airport environments may exhibit different congestion patterns, delay figures, or traffic characteristics that may dictate the need for different congestion management approaches (NERA, 2004; Madas and Zografos, 2008). The objective of this paper is twofold: i) to provide quantitative evidence and justify the real need and motivation behind the adoption of a new congestion management regime, and ii) to formulate a policy roadmap that will guide the implementation process for such a new regime at different types of EU airports.

The remainder of this paper consists of seven thematic sections. Section two provides an overview of the current state of affairs in terms of the historical evolution of relevant policy practices for capacity allocation in European and U.S. airports. Section three discusses the main research efforts, proposals, and alternative market-based allocation options / mechanisms examined in the literature for the allocation of scarce airport capacity. Section four justifies the need and motivation behind the adoption of a new congestion management regime, while Section five proposes a strategic policy framework guiding the adaptation and implementation process of the new regime at both local airport level and the broader airport network. Finally, Section six provides the concluding remarks and recommendations, while Sections seven and eight present the acknowledgments and the list of references.

STATE-OF-PRACTICE REVIEW

Access to airports is typically “controlled” - if any - through a landing fee that is proportional to the maximum take-off weight (MTOW) of the aircraft irrespectively of the actual infrastructure utilization and congestion levels. Currently, at most airports, aircraft are charged a small, relatively to the total operating costs of the airlines, ante fee that is uniform

[2] Demand management schemes aiming to mitigate noise and emission-related externalities are not covered by this paper and should be viewed as either stand-alone measures or add-on mechanisms to the proposed congestion management scheme.

throughout the day. The historical justification for this fee was the ability-to-pay principle (i.e., higher charge for large aircraft carrying more passengers as compared to smaller aircraft and general aviation), as well as the notion of cost-relatedness. The cost-relatedness principle implies an accounting rather than economic concept for the definition of costs, which specifies that "airport charges should be based on the cost of facilities and services provided by the airport, allowing for a reasonable return on capital, the proper depreciation of assets, as well as the efficient management of capacity" (European Commission, 1998).

Typically, charges are designed and set in order for the airport authority to break even. Given the cost-relatedness principle and the fact that large airport operators have been highly successful in boosting non-aeronautical revenues over the years, there is a paradoxical situation in which aeronautical charges (mainly landing fees) have hardly increased (in many cases have even declined in real terms) in world's largest and busiest airports since 1986 (Fan, 2003). As a result, landing fees are not at a level that automatically clears the market at least in congested airports experiencing excess demand for some part of the day (Fan, 2003). Since the typical charging mechanism cannot clear the market, as would be the case in other "normal" private goods, the industry has developed alternative means and procedures (dating back to a system created by IATA in 1947 and gradually updated over the years) to handle the conflicts of interest involved in the allocation of scarce airport capacity or - at least - to establish a clear and concrete slot allocation mechanism. Traditionally, capacity at most congested airports of the world is expressed in slots and allocated within the framework of voluntary guidelines developed and evolved over the years under the auspices of IATA with local interpretations and adaptations (IATA, 2010). Since 1993, the existing IATA-based slot allocation regime has been adapted, complemented, and further updated by regulation (European Commission, 1993; 2004; 2009) for the European Union (EU) airports. According to the IATA-based system and its complementary version of the EU regulation, these guidelines set out administrative procedures, appoint schedule / slot coordinators in the airport or national level, organize biannual scheduling conferences, and include a set of rules and criteria to be applied for the allocation of airport capacity.

The traditional IATA-based system of slot allocation, complemented by EU regulation, is built upon a principal and overriding rule, which essentially acknowledges an incumbent airline's "grandfather's right" (i.e., historic slot holding) to a particular slot time at an airport where the slot was used in the previous equivalent season. These rights continue to be active until an air carrier ceases to utilize it or surrenders it back to the airport slot pool. The pool of slots that are not "grandfathered", in addition to newly available slots, are allocated according to priorities and rules dictated by IATA (e.g., 50% of the slot pool goes to new entrants, slot usage patterns, flight regularity, carrier characteristics). The allocated slots, in turn, become "grandfathered" for the next season, that is, the specific users obtain the first "right" on them provided that they have used them over 80% of the time during the previous year (i.e., "use-it-or-lose-it" rule). Slots that are allocated to an airline – whether "grandfathered" or newly available – may be exchanged for slots held by another airline, on a strict one-for-one, non-monetary basis.

Demand management in the sense of IATA rules-driven slot allocation has been the dominant access control mechanism practiced by the majority of busiest (or schedule coordinated) airports outside the United States. Most of these airports have put into use more or less sophisticated instantiations of the IATA rules and allocation criteria to handle traffic and control its growth in one way or another. During the last decade or so, the European Commission pursues a radical revision of the existing IATA-based slot allocation regime. The European Commission should, by 2003, and after consultation with the interested parties and relevant airport stakeholders, have proposed a reform of the slot regime that will mostly fit the definition of market and/or hybrid demand management approaches (e.g., slot trading, congestion pricing, auctions) towards easier new entrants' access to the market, better use of airport capacities, and the establishment of "market values" for airport capacity. To that end, an industry-wide dialogue and consultation with stakeholders has been launched in Europe, while simultaneously several studies and research efforts (discussed in the next section) have come to describe, assess, and ultimately bring market-based approaches into the forefront.

The United States' experience on slot allocation exhibits some operational and principal differences stemming from the fact that it is a largely non-interventionist approach as compared to the IATA rules-driven procedures and their variations around the world. With the exception of the U.S. airports (New York region airports, Washington/Reagan, and Chicago/O'Hare) governed by the High Density Rule (HDR), demand is not administered in U.S. airports through slot allocation mechanisms. For anti-trust reasons, the IATA system does not apply at all, while airlines schedule their flights by considering only the expected delays and secondarily the negligible, weight-based landing fees. The HDR airports were designated in the pre-deregulation era (1968), and hourly capacity limits were determined as a means of supporting or guiding the slot allocation and scheduling process. The industry deregulation in the end of '80s, however, signified a radical demand growth that could not be accommodated any more. The slot scheduling procedure was proved to be rather inefficient and inflexible, while also generating significant market distortions and discriminations against new entrants. In response to these problems, the U.S. Department of Transportation abolished that rule in 1985 and introduced a "buy-and-sell" environment for slots, which essentially signified a "policy shift" towards market-based allocation of capacity.

Since 1985, the HDR airports operated under a "buy-and-sell" environment to allocate the particularly available number of slots only for domestic services according to the airport's declared capacity (i.e., limit on the number of movements). In these airports, capacity was segmented and the market approach was restricted to slots used for domestic services (air carrier and commuter slots), while slots used for subsidized "essential air services" (EAS) were excluded from trading. The market is overseen by the Federal Aviation Administration (FAA) which lays down certain conditions and scheduling rules. Slots were subject to some form of a "use-it-or-lose-it" rule on the grounds that they should be returned to FAA for reallocation unless they were used for a stipulated minimum of time (i.e., 80%) in a two-month period. Confiscated, surrendered or newly created slots were accumulated in a slot pool and were reallocated by means of a lottery (or "slottery") with 25% retained for new entrants. The post-HDR regulation (i.e., "buy-and-sell") also stipulated that any person or body was entitled to purchase, sell, and even mortgage a slot or to lease it on a temporary basis. This has been for years the capacity allocation practice at HDR airports, albeit with the mandate to remove every slot restrictions and controls at La Guardia (LGA) by 2007, thus spurring new rounds of policy making analyses.

In August 2006, FAA proposed a rule to address the risk of increased congestions and delays at LGA airport upon the expiration of slot controls by 2007 (FAA, 2006). The proposed rulemaking established an operational limit on the number of aircraft landings and take-off's, while it simultaneously introduced an airport-wide, average aircraft size requirement designed to increase utilization and passenger numbers. In other words, it assumed a hybrid approach combining the establishment of operational limits and grandfathered operating authorizations[3] accompanied by some form of a "use-it-or-lose" it rule (i.e., "average aircraft size requirement") with provisions for secondary trading. FAA announced its intention to incorporate this rule into a legislative proposal that will seek authority to utilize market-based mechanisms such as the one proposed in this rulemaking (FAA, 2006) or others investigated by NEXTOR (NEXTOR, 2004; 2005). Later (October 2008), FAA and the U.S. Department of Transportation announced a new congestion management rule (FAA, 2008) involving the auctioning of a portion of the landing slots at New York airports (i.e., La Guardia, Kennedy, Newark) amidst a chorus of objections and strong opposition expressed by the operating authority, airline associations, and other interest groups. The actual implementation of this proposal has been eventually rescinded (FAA, 2009), while it is uncertain how and when market-driven mechanisms will be brought into force for the allocation of scarce capacity at U.S. airports.

STATE-OF-THE-ART REVIEW

The role of the traditional IATA system along with the enhanced version introduced by EU Regulation 95/93 is crucial and effective in airports operating under capacity or experiencing only temporary capacity shortages. However, this is not the case for airports already operating at maximum capacity and experiencing severe congestion problems throughout the day. The rapidly increasing congestion and delay figures in both sides of the Atlantic in conjunction with the inefficiencies of the current slot allocation regime have stimulated substantial research interest and various proposals towards market-based capacity allocation.

On the European side, the European Commission has initially commissioned a number of studies with the aim to assess the implementation of the Regulation 95/93 on the allocation of slots at European Community airports. The Coopers and Lybrand study (Coopers&Lybrand, 1995) assessed the extent to which the EU Regulation has been implemented across the Community. Furthermore, it investigated the effectiveness of the Regulation and identified problems and possible modifications required for the improvement of its efficiency. In 2000, another study was commissioned by the European Commission

[3] "Operating Authorizations" constitute the US-equivalent of "slots" and are defined as "the operational authority assigned to an air carrier by the FAA to conduct one scheduled IFR arrival or departure operation each week on a specific day of the week during a specific 15-minute period.

(PricewaterhouseCoopers, 2000) in order to assess the state of implementation of the various aspects envisaged in the Regulation 95/93. Both studies have been used in order to identify problems, necessary modifications, and areas of improvements of the first version of the Regulation (1993) with the ultimate objective to prepare and release an improved version of the Regulation amending Regulation 95/93 (eventually appearing in early 2004).

In a landmark study, the Berlin University of Technology (TUB, 2001) analyzed the current practice of slot allocation and originally introduced market-based instruments and strategies in the policy landscape of Europe. In particular, the study explored the following strategies: i) the “Big Bang” involving the withdrawal of grandfather rights at a certain reference date and the auctioning of all slots at once, ii) the “Gradual Approach” standing for a gradual withdrawal of grandfather rights accompanied by improved slot recycling mechanisms and a centralized auction for the reallocation of slots returned to the pool, iii) a “More Complete Pricing Policy” envisaging the adaptation of the airport take-off and landing fees to the respective scarcity situation in accordance with the economic principle of cost-relatedness, and iv) the “Slot Trading” introducing a “buy-and-sell” environment for exchanging slots under monetary terms.

Almost immediately after the amended EU Regulation (793/2004) has been put into force, the European Commission launched an industry-wide consultation on the potential implementation of market mechanisms, while simultaneously commissioning a study to assess the effects of market-based slot allocation schemes (NERA, 2004). This consultation document proposed a drastic revision of the current status and practice by introducing market-driven slot allocation instruments in various contexts: i) secondary trading accompanying either the existing administrative procedures of primary allocation or even a market-based primary allocation mechanism, ii) higher posted prices accompanied by secondary trading, iii) auctioning of pool slots complemented by secondary trading, and iv) auction of 10% of slots complemented by secondary trading.

In parallel to research proposals, some European Union Member States (e.g., UK, Italy, France, The Netherlands, Germany) have considered technical amendments and proposals. The United Kingdom Government has instituted a consultation study (U.K. Department of the Environment, Transport and the Regions, 2000; DotEcon, 2001) stating its intention to support and lead a proposal for a fundamental change on the current system of slot allocation. The proposed mechanism was based on a concession system with a time limitation of slot rights subject to regular auctions combined with secondary trading. In a similar direction, the U.K. Civil Aviation Authority has prepared a technical consultation paper setting out guidelines and proposals for the implementation of a formalised system of secondary trading in slots (CAA, 2001). This widely discussed alternative (DotEcon, 2001; TUB, 2001; NERA, 2004) practically involves the establishment of a “buy-and-sell” environment, where slots will be traded in monetary terms under specific legal provisions, thus enabling carriers to better adapt their slots’ portfolio in the global airport network.

A more recent study (Mott MacDonald, 2006) investigated the potential acceptability and evaluated the implications from the introduction of secondary trading mechanisms for runway slots at congested European Community airports. This study presented the relevant experience of secondary trading in U.S. and the "grey" London airports' market as well as other industries (e.g., capacity rights for natural gas and electricity, emissions trading), developed comprehensive forecasts of slot demand to 2025 (both with and without secondary trading), and performed a series of economic impact assessments based on slot forecasts. Furthermore, it gave consideration to a range of possible amendments to the current regulation with emphasis on the impact assessment of an increased (from 80% to 90%) "use-it-or-lose-it" rule, the auctioning of newly created slots, and a recycling programme for increasing the mobility of historic slot usage rights.

From the U.S. perspective, FAA and the Department of Transportation have requested the NEXTOR Universities (NEXTOR, 2004; 2005; Ball et al., 2007) to design and conduct a series of strategic simulations (referred to as "strategic games") aiming to evaluate alternative policy options for allocating airport capacity after the expiration of slot controls in 2007 (basically for LGA, but with view to potential applicability to other congested airports as well). The following alternative options were initially examined (NEXTOR, 2004): i) a compensatory Passenger Bill of Rights law forcing airlines to reimburse passengers with about one-third of the estimated lost productivity costs resulting from delays, ii) government administrative actions aiming to satisfy a wide range of policy objectives with emphasis on delay reduction, and iii) congestion pricing. In a second phase, another strategic simulation / game has been designed and conducted with the aim to investigate the impacts from the potential application of an auction for allocating arrival and departure "operating authorizations" (NEXTOR, 2005).

Auctions have recently gained increasing acceptance in the research community as a hybrid demand management measure for congested airports. Many researchers believe that auctions can be applied in the airport context similarly to their application in other industries (e.g., radio spectrum, emissions, railway track capacity) (Nilsson, 2003) and went even further by designing and assessing auction-based allocation models at specific congested airports (Le et al., 2004; Ball et al., 2007). In most cases, however, the operation of an aftermarket (e.g., secondary slot trading) has been considered as a necessary supplement of the auction process in order to mitigate possible slot complementarity problems. In a pure pricing form, congestion-based pricing schemes have been extensively examined as an access control mechanism. In one way or another, congestion-based pricing schemes envisage the complete removal of slots and grandfather rights. Each carrier will be able to operate at any time by paying the corresponding scarcity surcharges that will vary throughout the day based on congestion and will be set at a level being able to internalize marginal social costs or at least this portion of delay costs imposed on others (TRB, 2001; Brueckner, 2002; Fan, 2003; Morrison and Winston, 2007). Other research efforts (Madas and Zografos, 2006) have capitalized on the individual mechanisms / instruments discussed above in order to define a series of integrated slot allocation strategies introducing a varying application of market-driven allocation mechanisms (e.g., decentralized auctions, centralized trading, full secondary trading) or pure pricing schemes (e.g., congestion pricing).

Recognizing the crucial importance of airport congestion management towards sustainable air transport in the future, transportation economists and other researchers have very recently analyzed possible causes and alternative remedies to congestion in conjunction with the associated performance outcomes of such congestion management options. As a direct consequence of congestion, delays and their major determinants, causes, and patterns were examined in European hub airports vis-à-vis relevant empirical evidence from the United States (Santos and Robin, 2010). A major bulk of recent research work concentrates, though, on alternative views, remedies, and mechanisms available to efficiently deal with congestion. These basically address congestion pricing and slot trading in various formats and assess their potential effectiveness and applicability under different market power, demand, and cost conditions at both single and airport network level (Basso and Zhang, 2010; Czerny, 2010; Verhoef, 2010). Finally, side impacts and possible implications of such congestion management options on both airlines and airports (e.g., anticompetitive behaviour, aircraft size, flight frequency, capacity investments) were further elaborated in recent literature (Flores-Fillol, 2010; Fukui, 2010; Zhang and Zhang, 2010).

The approaches discussed in the literature range from minor adjustments or enhancements of the status quo to more radical or aggressive revisions of the current slot allocation regime contemplating primary and/or secondary slot trading, auctions of (part of or the entire) slot pool, and congestion pricing. On the other hand, during the last two decades, there is an industry consensus that the existing system cannot (and will not definitely in the future) cope with the current and mainly forecasted traffic volumes. Based on the congestion and delay evidence, it comes that the current slot allocation regime needs to be drastically improved, while small, periodical adjustments or local adaptations of the status quo may not suffice. A number of policy attempts or initiatives motivated by relevant research work have been emerged with the purpose of introducing market-driven schemes but they have not materialised until now due to the long standing debate in the aviation industry concerning the real need and potential impacts of such a “policy shift”.

IS A NEW REGIME NECESSARY?

This section aims to provide some quantitative evidence on the real need and motivation behind the adoption of a new congestion management regime. This has been pursued through the analysis of the following: i) what are the potential (quantified) impacts (e.g., costs) and estimated operational implications (e.g., delays) of congestion management at different types of European airports, and ii) to what extent is the current system under-priced and hence ineffective for controlling access to busy airports?

The impact assessment exercise was implemented with the use of DELAYS model (Malone and Odoni, 2001). DELAYS is a macroscopic analytical queuing model that is well suited to the modelling of runway complexes with an extremely fast, efficient, and reliable approximation of airfield delays (Malone and Odoni, 2001; Fan and Odoni, 2002; Fan, 2003). It models the runway system of an airport and its ancillary airspace as a single server where aircraft queue up to depart from or arrive at. The departing and arriving aircraft queues are modelled as one queue with the same distribution of service times on the runway system.

Both departing and arriving queues are served on a “first-come, first-served” basis. There are two basic categories of input for DELAYS: i) the sustainable capacity of the runway system in terms of maximum hourly movements, and ii) the number of flight operations demanded per hour. Based on this input, DELAYS estimates the probability distribution and the evolution over time of the aircraft queue and computes the expected waiting times (i.e., delays) for the aircraft in order to take-off or land. It is important to note here the following: i) the impact assessment exercise does not account for externalities other than congestion and delays, and ii) the computed delays are exclusively due to the lack of runway capacity without accounting for other non-runway-related causes of delay (e.g., ground or airspace congestion, congestion at other airports).

The DELAYS model was used to estimate the potential impact of demand management (or the lack of it) by quantifying the delays caused by additional runway movements or saved due to reduced runway movements. A systematic calculation process was applied in order to estimate delays according to the notion of marginal delay (Carlin and Park, 1970). The marginal delay is defined as the incremental delay that one additional aircraft accumulated in the beginning or middle of an aircraft queue will impose on all other aircraft waiting to be served in the queue. The idea behind the use of marginal delays was that the delay one aircraft imposes on another can be substantial, and therefore landing fees should be charged to account for that delay (Morrison and Winston, 1989; 2007)[4]. The model computed the increase or decrease in delays caused by one additional or one less flight at each specific hour of the day, respectively. This approach provides a good approximation of marginal delays, while simultaneously demonstrating and quantifying the propagation effects of delays within the day (Fan and Odoni, 2002; Fan, 2003). The marginal delay figures can then be reasonably converted to monetary terms (i.e., marginal delay costs) by multiplying delay figures with an estimated average cost consisted of: i) direct operating costs, and ii) passenger costs (through the time spent waiting) (Oxford Economic Forecasting, 2006).

The aforementioned exercise was implemented for a number of European airports with the ultimate objective to assess the potential operational and economic impacts of congestion management at airports exhibiting significantly different traffic volumes, congestion patterns, and/or delay symptoms: i) Amsterdam-Schiphol (AMS) and London-Heathrow (LHR), ii) Brussels (BRU), Düsseldorf (DUS), and Copenhagen (CPH), iii) Athens (ATH), and iv) Venice (VCE). The selected airports cover a wide range of traffic conditions and congestion severity / patterns of the European airport network. In particular, AMS and LHR can be seen as representative of the largest, busiest, and most congested European airport hubs with a worldwide presence and a strategic role in the European airport network. Furthermore, BRU, DUS, and CPH are indicative examples of metropolitan airports acting mostly as large international hubs (at least for certain national carriers) with focus on intra-European routes. Finally, ATH can be considered a representative case of medium-sized airports acting mainly as a national hub channelling traffic from the national spokes to other national spokes or

[4] Some researchers (Brueckner, 2002) pointed out that because an air carrier bears already the cost of delay imposed on its other flights, it should be charged only for the delay it imposes on other carriers’ flights. However, more recent work (Morrison and Winston, 2007) has shown that the bulk of delays is not internalized and the efficiency or equity loss from pricing already internalized congestion (practically all subsequent flights including flights of the same carrier) is small.

international hubs, while VCE resembles the small, satellite or regional airports acting as the spokes of their national airport network. For the purposes of this analysis, the following data were collected for the selected airports: i) hourly traffic data for a typical day of operations, ii) hourly nominal runway capacity (maximum throughput) under both Visual Meteorological Conditions (VMC) and Instrument Meteorological Conditions (IMC), iii) declared airport capacity (in terms of runway movements) specified by the national slot coordinator, and iv) current pricing scheme of aeronautical charges with emphasis on aircraft landing fees.

According to the results of the impact assessment exercise, some of the representative European airports experience severe delays whose a snapshot is reflected on the marginal delay figures presented in Figure 1. For example, it is interesting to see that one additional movement at Amsterdam-Schiphol Airport (AMS) during the 17 busiest hours of its typical day of operations would cause an additional delay to practically each of the subsequent movements during the rest of the day that would result on average in roughly 1 aircraft-hour of additional total delay. The same figure corresponding to London-Heathrow Airport (LHR) would be roughly 3,9 aircraft-hours of additional total delay with lower values being evident at large and medium-sized airports (e.g., BRU, DUS) or even negligible values appearing at smaller airports (e.g., CPH, ATH, VCE).

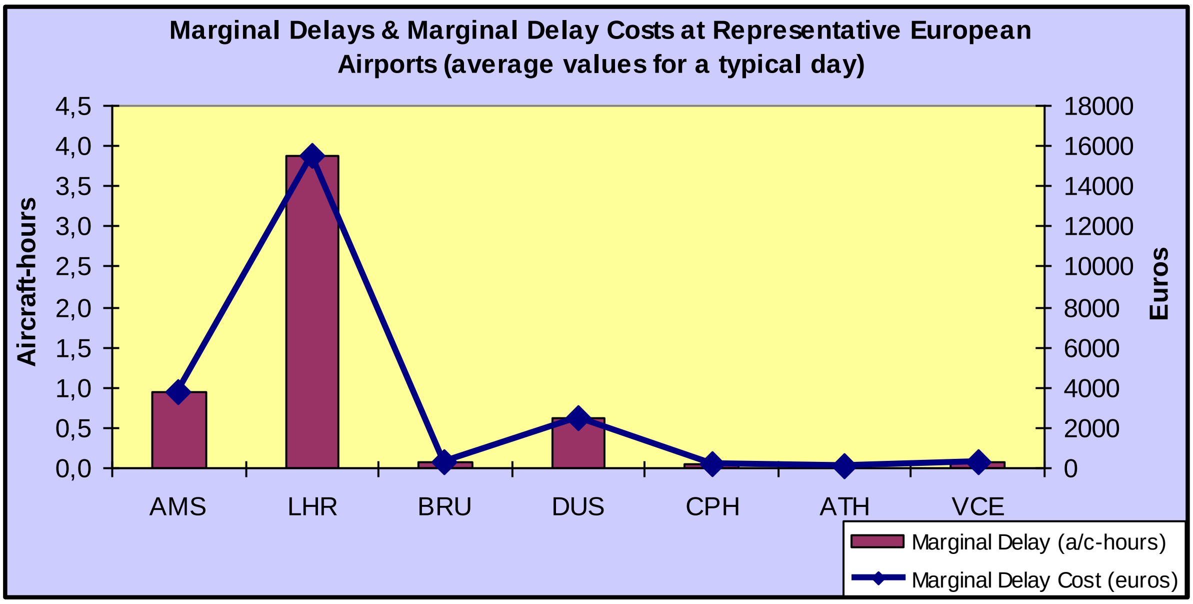

Figure 1 – Marginal Delays & Marginal Delay Costs at Representative European Airports

Delays can be indirectly translated into costs assuming that each minute of delay would entail direct operating costs for airlines and waiting costs for passengers (Oxford Economic Forecasting, 2006). The cost quantification of marginal delays demonstrates that the aggregate impact of such an incremental movement is remarkable and significant – at a varying extent though – in economic terms as well[5]. In other words, an additional movement during the 17 busiest hours would impose on airlines and passengers a total cost ranging between 100-300 € (at non-congested European airports) and 3.000-15.000 € (at heavily

[5] It is important to underline here that the estimated costs do not account for externalities other than congestion and delays (e.g., noise, emissions).

congested European airports) (Figure 2). Most importantly, it can be seen that the extent and severity of marginal delays and their derived costs vary substantially with the airport, while simultaneously being in direct and close association with the congestion levels experienced by the airport as these are expressed in terms of demand-to-capacity ratios (Figure 2). As a matter of fact, airports experiencing high demand-to-capacity ratios (above 80%) like LHR, AMS, and DUS, are those suffering from the most severe delays and their associated costs (above 2.500 € of total marginal delay costs). In general, a demand-to-capacity ratio of approximately 60% seems to constitute the maximum threshold above which total marginal delays and their costs start to boom (from 100-300 € to 3.000-15.000 €).

Extrapolating the estimated marginal costs (currently computed on the basis of a typical day) to a yearly basis would give some outstanding figures on the order of one to a few million Euros in most of the busiest European airports. Certainly, marginal delays and their associated costs can be also seen from the opposite viewpoint in terms of less delays and cost savings as a result of one less flight, respectively. Consequently, marginal delays and their cost quantification can be reasonably interpreted as the potential impact of an attempt to control demand through any kind of congestion management scheme.

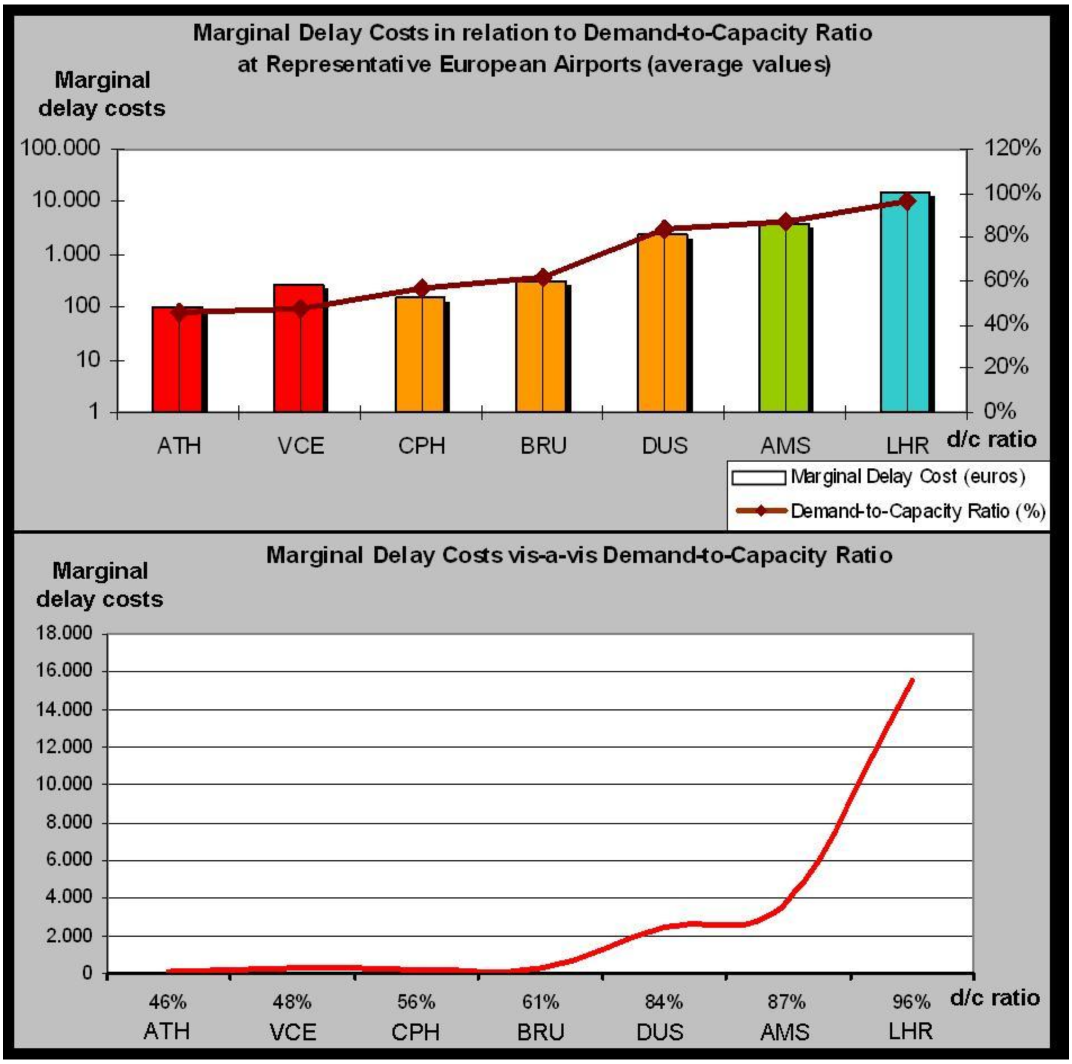

Figure 2 – Marginal Delay Costs in Relation to Demand-to-Capacity Ratio at Representative European Airports

In theory, the above discussed congestion and delay externalities could be eliminated through an appropriate pricing system that would price the utilization of a scarce airport infrastructure - in the form of one landing or take-off operation - by one user at a level equal to the total marginal cost imposed on all subsequent operations (Morrison and Winston, 1989; 2007; Fan and Odoni, 2002). More specifically, negative externalities like congestion and delays or other distortions arise when, in the absence of an appropriate pricing system, the cost internalized by one user lags behind the total marginal cost imposed on the system as a whole (i.e., users, passengers). The associated negative externalities (excess demand, congestion, delays) and their costs are the subsequent result of inappropriate or insufficient internalized cost by each user (in the form of landing fees for airports). The comparison between marginal delay costs and landing fees reveals that the actual pricing system of scarce airport infrastructure is quite far from perfect (Figure 3). Ideally, a perfect balance (i.e., 50%-50%) between marginal delay costs and landing fees would constitute the definition of the perfect pricing system since it would imply full internalization of marginal delay costs through the landing fee. As it can be inferred from Figure 3, substantial imbalances exist between marginal delay costs and landing fees, thus rendering some (mainly the largest and busiest) airports extremely under-priced. The latter provides full justification of the need for a "policy shift" to a new congestion management strategy with a specific pricing scheme capable of dealing with congestion and delay costs (discussed in the next section).

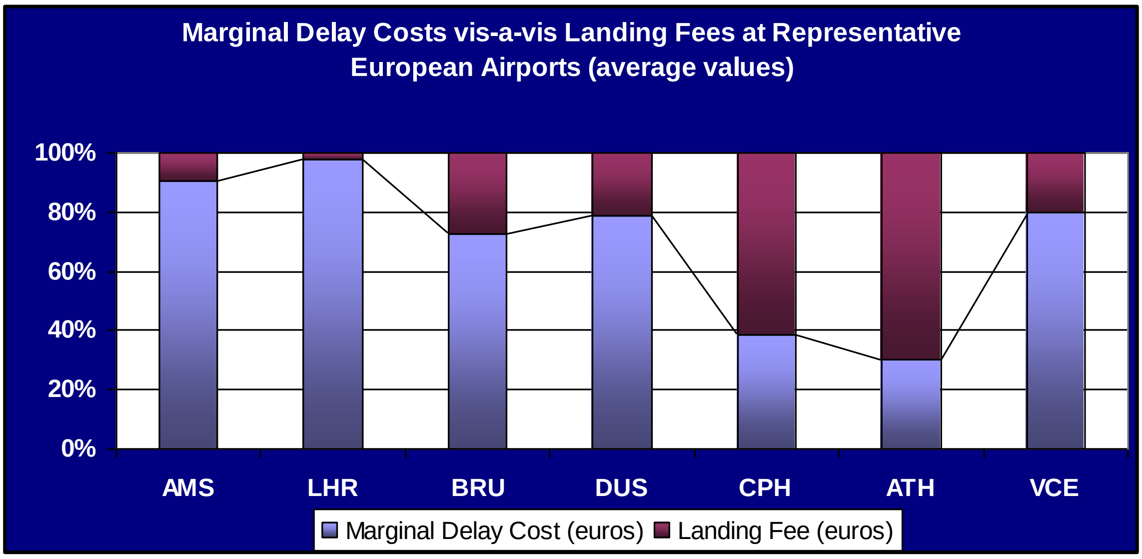

Figure 3 – Marginal Delay Costs vis-à-vis Landing Fees at Representative European Airports

FROM THEORY INTO POLICY PRACTICE

Research proposals aiming to bring forward new congestion management measures, instruments, or schemes were not widely adopted and have not flourished into policy practice. One major reason behind the observed gap between theory and policy practice seems to be the lack of guidance as to how these various instruments and measures can be integrated and operationalised within an overall strategic policy framework for the allocation of scarce airport capacity. This section aims to formulate a policy roadmap that will guide the implementation and adaptation process for a new congestion management strategy / regime at different types of EU airports. The proposed strategic policy framework borrows some theoretical principles of congestion pricing and introduces a simple, open, and adaptive framework for allocating capacity through congestion-based surcharges complemented by reservation fees and the traditional weight-based landing fees. Furthermore, it exhibits some clear advantages over the existing rule-based procedures or even market-driven mechanisms in certain cases since:

- it confronts directly with the severe congestion problem of airports by means of varying congestion fees aiming to internalize congestion costs,
- it assigns some quasi-market valuations upon scarce airport capacity,
- it is simple, inexpensive, and immediately implementable since it does not require substantial organizational and institutional arrangements,
- it does not involve drastic regulatory amendments and it is fully compatible with the existing IATA worldwide scheduling procedures, and
- it removes the need of administering slots and substantially enhances carriers' scheduling flexibility.

Furthermore, the proposed policy framework efficiently accommodates some fundamental policy requirements:

- it is flexible on the grounds that it can be easily adapted to the local airport needs and characteristics through the appropriate congestion fee schemes and levels varying not only in time, but also among different airports,
- it is expandable since it can be clearly seen as a "middle-of-the-road" pricing / economic solution that can easily migrate to a more radical market-driven congestion management regime (e.g., auctions, trading) in the future,
- it fulfils the principle of cost-relatedness since it can potentially establish congestion fees reflecting (or at least approximating) the scarcity of infrastructure and the actual costs of congestion,
- it is fair and transparent in that it is not inherently discriminatory against any user group (e.g., new entrants), while there is no possibility of manipulating the allocation outcome, and
- it efficiently deals with the trade-off between efficiency and complexity of the pricing scheme since it applies a simple adjustment procedure in order to determine a reasonable approximation of the optimum level of congestion fees.

In what follows, a step-by-step approach for the adaptation and operationalisation of the strategy is presented and briefly discussed (Figure 4):

<u>Step 1: Develop and Apply a Systematic Airport Designation Process</u>

As with EU Regulation 95/93 and its several amendments (European Commission, 1993; 2004), EU Member States shall continue to play an active – mainly supervisory – role with emphasis on the airport designation process and the appointment / supervision of the slot coordinator. At a first stage, EU Member States should develop and apply an airport designation process that will be less subjective to interpretations and more systematized to implementation. The traditional designation process (e.g., schedule coordinated vs. schedule facilitated) could be a starting basis, but it should be supplemented by specific, commonly defined, and measurable performance criteria (e.g., average delay threshold per movement, demand-to-capacity ratio, acceptable number of cancellations[6]). These criteria will represent threshold points above (or below) which further policy action should be triggered. Alternatively, other classification methodologies (e.g., cluster analysis) (Madas and Zografos, 2008) could be used to develop some airport typologies for designation purposes. Each EU Member State will have the authority to voluntarily trigger policy action by changing the designation of a given airport in response to extreme / irregular congestion or sudden (but not temporary) traffic changes. The competent authorities responsible for the airport designation and its periodic assessment will be the corresponding civil aviation authorities or transport ministries in each EU Member State. The airport designation will be periodically (every 2-3 years) re-assessed in order to timely identify trends or potential changes required in the status / designation of specific airports.

Step 2: Appoint a Schedule Coordinator and Schedule Coordination Committee
EU Member States shall appoint and supervise a schedule coordinator for all airports comprising the national airport network. The schedule coordinator should be competent with substantial experience from the former IATA scheduling coordination process, and most importantly should act in a transparent, independent, and non-discriminating manner. The schedule coordinator will be supported by an advisory body, the Schedule Coordination Committee that will be composed by representatives of user groups (e.g., air carriers regularly using the airports concerned) and other stakeholders (e.g., airport operators, ATC service provider, Civil Aviation Authority). The Schedule Coordination Committee (chaired by the Schedule Coordinator) will still have a consultative role to the Schedule Coordinator. Most importantly, the Committee will act as an independent pricing board (Ball et al., 2007) that will establish the target rate of operations and coordinate the adjustment process of congestion fees (discussed below).

Step 3: Conduct a Comprehensive Capacity Assessment and Enhancement Study
Before changing the designation of a given airport or launching further policy actions, the Schedule Coordination Committee will conduct, in consultation with the Member State (through the competent Ministry of Transport or Civil Aviation Authority), the specific airport operator, and regular airport users, a comprehensive capacity assessment and enhancement study. Where a capacity analysis indicates that there is no short-term solution to a capacity shortage, then the Schedule Coordination Committee will provide a recommendation / proposal to the Member State for the change of the airport designation and the triggering of further policy action. The capacity study will be conducted at least once with the introduction of the new regime, while it will be re-assessed whenever there is a recommended change in airport designation (Step 1) or considerable changes in the airport's infrastructure with possible implications on capacity.

Step 4: Specify Maximum Allowable Number of Operations
Based on the aforementioned capacity assessment study and previous operating experience of the airport, the Civil Aviation Authority will have the ultimate control to specify the

[6] The specific time horizon (e.g., daily, hourly, annual) and reference base (e.g., typical, peak day) needs to be defined as well.

maximum allowable number of runway operations for safety purposes at each airport within its (basically national) jurisdiction (FAA, 2001).

Step 5: Determine and Communicate the Objectives (a priori) of the Strategy

The objectives of the strategy subject to implementation should be explicitly specified and communicated in advance to all airport stakeholders and affected parties. Furthermore, performance targets or impacts should be early identified as input for the post-fact assessment of the strategy. Among them, one could see average delay figures, number of cancellations, passenger costs, airline costs, passenger enplanements, aircraft movements, average load factor, service to small communities or thin routes, short vs. long-haul services, unscheduled operations, new airline entrants, low-cost airlines, degree of competition etc.

Step 6: Specify the Effective Date of the Strategy

The date that the new strategy will take effect should be early specified and communicated to all affected parties and stakeholders. This will be specified at a centralized level (e.g., European Union) and be part of the necessary regulatory amendment for the introduction of the new strategy. For the specification of the effective date of the strategy, the following issues should be also taken into consideration: i) transition from and synchronization with the existing IATA scheduling procedures, the current HDR regime, or other demand management schemes applied in airports worldwide, ii) synchronization with the strategies implemented in other EU airports governed by the same overall framework, but probably different instantiations of the same strategy. The expiration date of the strategy will be signified by either a possible change in the airport designation or the expiration date that might be explicitly specified for this particular airport (or groups of airports) for the transition to a new regime.

Step 7: Specify the Scheduling Season of the Strategy

The scheduling season of the strategy will be also specified at a centralized level (e.g., European Union) and will be similar to the existing regulatory framework, that is, 6 months split into winter and summer scheduling season. All parameters and decisions about capacities, fees, surcharges, and schedules will be in effect within the framework of the scheduling season.

Step 8: Remove Slots & Historic Slot Usage (Grandfather) Rights

Slots and grandfather rights will be totally and immediately removed at the effective date of the strategy. Each carrier will be able to operate at any time by paying the corresponding access fees (weight-based landing fee) and congestion surcharge. Under this strategy, access will be open to all users and price (in the form of variable or non-variable congestion surcharges) will be solely used as the airport access control mechanism. The removal of all slots will be centrally enacted through EU legislation, while slots will be generally replaced by their US-equivalent operating authorizations (FAA, 2001).

Step 9: Implement Strategy

This step will signify the implementation and adaptation of the new congestion management regime at the local airport context. From this step forward, the overall framework will break down to a series of sub-steps pertaining to the specific strategy operationalised at each designated airport group or other airport typology adopted.

Based on the existing designation of EU airports (schedule coordinated vs. schedule facilitated), the following sub-steps are proposed for schedule coordinated airports (Figure 4):

Step 9.1.1: Define the Congested Period

The Congested Period will consist of all hours of the day during which the demand for access at the particular airport is close to or even above the maximum allowable number of operations. The Congested Period will be purposely “inflated” with at least 1 hour immediately preceding or following that period. This inflation aims to avoid an insufficient rescheduling of flights in the close proximity of the Congested Period that would simply shift delays during the day. The Congested Period will be defined by the Schedule Coordination Committee in cooperation with the local airport operator.

Step 9.1.2: Specify the Target Rate of Operations & Maximum Delay Thresholds

The identification of the target rate of operations is of paramount importance for the successful application of this strategy since it is the most influential control in determining the level of delays experienced at the airport. A target rate of operations in terms of runway movements per unit of time will be established by the Schedule Coordination Committee during the Congested Period of each airport. The target rate of operations will be invariable (or slightly variable) within the day. A slight variability of the target rates might be introduced to account for local airport peculiarities or policy objectives. Most importantly, some variability of target rates is strongly recommended to airports congested during only some parts of the day. This would purposely specify some lower target rates immediately before and after the currently experienced traffic peaks as a time buffer to allow for a system recovery or preparation before or among various daily peaks. Moreover, lower target rates before and after peaks would keep airlines from squeezing flights just before or after the Congested Period in order to circumvent the congestion pricing process. The target rates will be specified in direct association with the maximum allowable number of operations, as well as the resulted delay figures. Finally, this step will also specify a maximum delay threshold above which further policy action will be triggered towards revising the strategy either in its entirety or its integral elements (e.g., level of congestion surcharges, target rate of operations, congested period).

Step 9.1.3: Retain Weight-based Landing Fees

Existing weight-based landing fees will continue to exist at each airport as the time-tested way to recover operating and capital costs in accordance with the cost-relatedness principle foreseen in the existing regulatory framework.

Step 9.1.4: Specify Operations Subject to Fees & Exemptions

All landings at the particular airport during any time of the day will be subject to the existing weight-based landing fees specified by the airport operator. In addition, all aircraft movements operated during the Congested Period would be charged (on top of landing fees) the corresponding congestion surcharge. The operations exempted from the congestion surcharge will be specified by the competent supervisory state authority (basically Civil Aviation Authority or Ministry of Transport). Such exemptions will pertain to flights operated outside the Congested Period, flights subject to international bilateral agreements, or other policy-driven exemptions. Unscheduled operations will be also subject to congestion surcharges, while a multiplier factor (e.g., 1,2 - 1,5) can be considered as a disincentive on top of congestion surcharges due to the additional scheduling uncertainty and stochastic delay that unscheduled operations introduce in the price-capacity adjustment process.

Step 9.1.5: Allocate Capacity not Subject to Congestion Surcharges

The state authority (Civil Aviation Authority or Ministry of Transport) responsible for the determination of fee exemptions will also determine the number of operating authorizations that should become available per hour of the Congested Period. Interested carriers will be asked to submit their interest and scheduling details for operating authorizations falling into this category 120 days before the start date of the next scheduling season. The Schedule Coordination Committee will collect all requests for fee-exempted operating authorizations and assess them in terms of eligibility, operational feasibility, and possible violation of the fixed number of available operating authorizations. In case that the requested number of operating authorizations does not exceed availability, all applicant carriers will be notified about the approval of the requested operating authorizations. Otherwise, the Schedule Coordination Committee will allocate the available number of operating authorizations based on a lottery among users that are eligible for this category.

Step 9.1.6: Announce (Initial) Congestion Surcharges

Traditional landing fees will be supplemented by a scheme of congestion surcharges aiming to discourage the actual operation of flights beyond the targeted level of operations. Congestion surcharges will apply only during the Congested Period and will be announced by the Schedule Coordination Committee 120 days before the start date of the next scheduling season. The surcharges will vary throughout the day based on congestion and will be set at (or close to) a level being able to internalize congestion costs. At a simplified version, a flat surcharge (or even multiplier to weight-based landing fees) can be alternatively applied. Although this would appear to be a “second-best” fee (coarse tolling) (Fan, 2003), it is not expected to have a serious impact in the end of the process due to the fact that this is only aimed to be a first round of fees subject to many subsequent rounds of adjustments (FAA, 2001). An interesting observation is that even in the absence of detailed knowledge about the demand curve, coarse tolling results in congestion fees that are quite near to optimal levels (Fan, 2003). Furthermore, it is strongly recommended that congestion surcharges will be initially set at a relatively high level (with downward prospects) in order to trigger more drastic or, at least, sufficient price responses from carriers since the beginning of the process. The authority responsible for the establishment of congestion surcharges will be the Schedule Coordination Committee in the form of an Independent Pricing Board (Ball et al., 2007) with the ultimate mission to set congestion surcharges that will clear the market for airport access by adjusting fees up or down in order to meet the mandated level of operations.

Step 9.1.7: Request and Receive Tentative Planning Schedules

All airport users will be requested by the Schedule Coordination Committee to express their interest for operating authorizations during the Congested Period based on the initial congestion surcharges. Practically, interested carriers will submit a tentative planning schedule with all scheduling details by considering the congestion surcharges applied during the particular hour of the Congested Period. The planning schedule will be submitted to the Schedule Coordination Committee 105 days before the start date of the next scheduling season.

Step 9.1.8: Assess the Achieved Target Rate of Operations

The Schedule Coordination Committee will collect all tentative planning schedules submitted by applicant carriers and will consolidate them in an overall planning schedule. This will summarize the requests for operating authorizations for each hour (or smaller time window) of the Congested Period and will be announced to all interested parties 90 days before the start date of the next scheduling season. The ultimate objective of this exercise will be to assess whether (and in what extent) the targeted rates of operations have been achieved. Given that an absolute matching will be difficult to achieve in practice, some reasonable deviations of the consolidated planning schedule from the targeted rates of operations will be deemed acceptable as long as safety standards are not compromised and deviations are not persisting for more than few (2-3) hours in a row. In this case, the Schedule Coordination Committee will notify all carriers about the approval of the requested operating authorizations, otherwise, a next round of adjustments will be triggered.

Step 9.1.9: Revise Congestion Surcharges

In case that the requested number of operating authorizations is substantially above or below targeted rates of operations, the Schedule Coordination Committee will propose a revised scheme or levels of congestion surcharges aiming to bridge the gap between targeted operations and actually requested operating authorizations. The new pricing adjustments / revisions will practically signify the starting of a feedback loop that will be exited only after some balance has been achieved even with a reasonable deviation from the targeted rates of operations. The length of these pricing adjustment sessions will be of about 2 weeks with an ultimate deadline of the process to be not later than 45 days before the start date of the next scheduling season.

Step 9.1.10: Announce Final Planning Schedule and Request Reservation Fee Payments

After an acceptable planning schedule has been achieved, the final requests for operating authorizations (from the latest pricing adjustment session) will be “frozen” and announced to their prospective users at least 45 days before the start date of the next scheduling season. Before the final approval of operating authorizations, each carrier will be asked to deposit a reservation fee for each awarded operating authorization during the Congested Period. The reservation fee will be equivalent to some percentage (10 - 30%) of the finally posted congestion surcharge. In addition, it will not be recovered in case of non-use (“no-show”).

Step 9.1.11: Monitor the Dynamic Evolution of the Strategy

The actual implementation of the strategy during the scheduling season will be closely monitored by the airport operator in cooperation with the Schedule Coordination Committee. Their basic responsibility will be to monitor the actual utilization of operating authorizations and the regular assessment of experienced congestion levels. The Schedule Coordination Committee will retain the right to revise the congestion surcharges at any level and any time during the Congested Period in case that congestion and delays start to build up beyond certain acceptable operational thresholds. In case of additional requests for authorizations, additional flights (beyond the ones included in the awarded planning schedule) will be treated as unscheduled operations that will be subject to congestion surcharges in conjunction with a multiplier factor (e.g., 1,2 - 1,5) applied on top of congestion surcharges.

Step 9.1.12: Assess (A Posteriori) the Strategy

The close monitoring of the actual implementation of the strategy will be complemented by a post-fact assessment of the strategy that will basically aim to evaluate the degree of accomplishment of certain agreed performance targets. The post-fact assessment of the strategy will provide useful experience, evidences, and lessons learnt for the implementation and potential adjustments of the strategy for the next scheduling season. Finally, it will provide input or even trigger the process for a possible revision of an airport's designation.

As far as the schedule facilitated or non-designated airports are concerned, the following sub-steps are proposed (Figure 4):

Step 9.2.1: Retain Weight-based Landing Fees

Airport access will be open to all users and each carrier will be able to operate at any time by only paying the corresponding landing fees. Traditional weight-based landing fees will continue to be in effect at small regional airports with negligible or no congestion at all. In such airports, weight-based landing fees will be maintained at their existing form, i.e., based on the Maximum Take-Off Weight of the aircraft.

Step 9.2.2: Monitor the Dynamic Evolution of the Strategy

The actual implementation of the strategy will be closely monitored by the airport operator in cooperation with the Schedule Coordination Committee. The Schedule Coordination Committee will retain the right to intervene into the determination of landing fees in case that these are proven to be insufficient or inefficient. Finally, the Schedule Coordination Committee will be empowered to put forward the escalation of congestion management measures in case that congestion and delays start to build up beyond certain acceptable thresholds.

Step 9.2.3: Amplify Landing Fees

In case that a particular airport violates the established delay or other performance thresholds, the Schedule Coordination Committee will be entitled to replace weight-based landing fees by flat, non weight-dependent fees. In this case, all operations will be charged with an identical landing fee irrespectively of the aircraft weight. The justification of such a fee is that traditional weight-based fees may lead to a paradoxical situation where carriers will be encouraged to fly lighter aircraft, a fact that has undoubtedly played a decisive role on deteriorating airside congestion and delays. Consequently, the application of flat landing fees will practically provide the appropriate incentive to carriers to use heavy aircraft and upgauge their average load factors. These amplified landing fees will be specified by the Schedule Coordination Committee in consultation with the airport operator and will be applicable either throughout the entire day or some part thereof. Finally, in case delays still persist, the Schedule Coordination Committee will be authorized to further strengthen the pricing impact.

Step 9.2.4: Enforce Peak Period Pricing

In the event that landing fees, in their traditional or amplified version, did not succeed to reduce delays to acceptable levels, the Schedule Coordination Committee will be authorized to migrate to a peak period pricing scheme that is closer to or an intermediate step before shifting to a congestion-based pricing strategy described for schedule coordinated airports. Peak period pricing will be applied at airports experiencing delay problems due to some time-limited traffic peaking during the day with sufficient capacity during most of the day. In this case, peak period pricing will involve higher landing fees during the specified peak hours in the form of a multiplier factor (1,5-3) applied on top of existing landing fees. Existing landing fees will remain unchanged during off-peak hours.

Step 9.2.5: Assess (A Posteriori) the Strategy

By the end of the scheduling season, a post-fact assessment of the strategy will be performed. This assessment will be performed by the airport operator in cooperation with the Schedule Coordination Committee and will basically aim to evaluate the degree of accomplishment of established performance targets. The post-fact assessment of the strategy will provide useful input for the implementation and potential adjustments of the strategy for the next scheduling season. Finally, it will provide input or even trigger the process for a possible revision of an airport’s designation when delays reach levels that may justify a more drastic strategy.

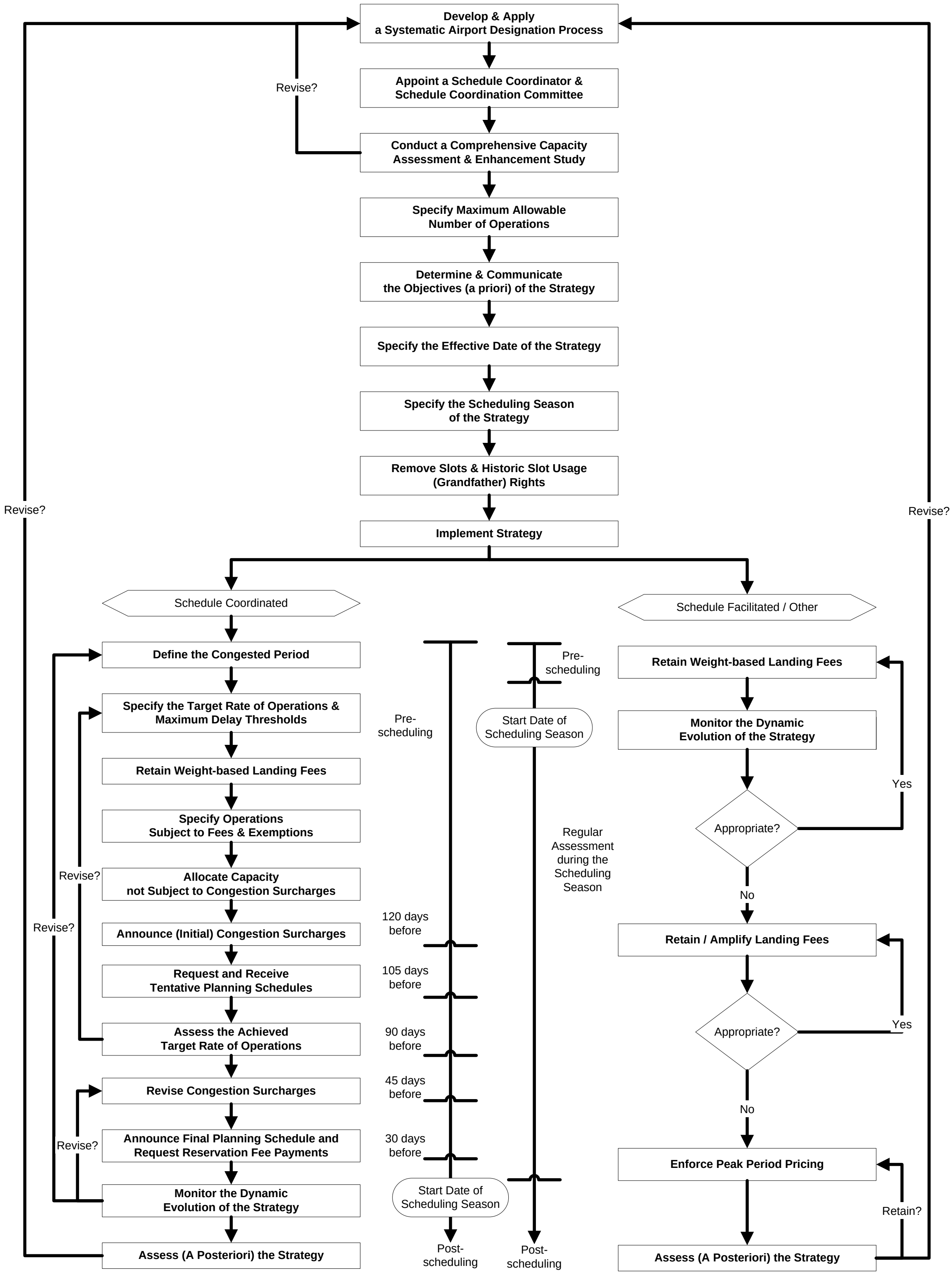

Figure 4 – Strategic Policy Implementation Roadmap

CONCLUDING REMARKS

A substantial amount of research work has been documented in the literature with the aim to review and critically assess alternative capacity allocation options in the form of administrative measures and rules accompanied or adjusted by market-based or pure pricing instruments. The identified approaches range from minor adjustments or enhancements of the status quo to more radical or aggressive revisions of the current slot allocation regime. On the other hand, there is an industry consensus that the existing IATA-based system for allocating scarce airport capacity cannot cope with existing or forecasted traffic, hence urging for a radical departure from the status quo. A number of policy initiatives motivated by relevant research work have been emerged with the purpose of introducing market-driven schemes but they have not materialised until now mainly due to industry inertia forces, practical complexities, and political hesitance. Political opposition from established industry actors and voices doubting the necessity or effectiveness of congestion management initiatives raise substantial implementation barriers. Another major reason behind the gap between theory and policy practice seems to be the lack of guidance as to how these instruments and measures can be integrated and operationalised within an overall strategic policy framework for the allocation of scarce airport capacity.

In response to the identified gap, this paper aims to provide quantitative evidence and justify the real need and motivation behind the adoption of a new congestion management regime. Furthermore, it formulates a policy roadmap aiming to guide the implementation process and propose specific instantiations / adaptations of the strategy applicable to different types of EU airports. The policy roadmap sets the rationale along with the fundamental steps, rules, and procedures for a new congestion management regime based on congestion pricing. In particular, it envisages the removal of slots and grandfather rights and practically the absence of any initial capacity allocation (through slots). Each carrier will be able to operate at any time by paying the corresponding access fees (i.e., weight-based landing fee), reservation fees, and scarcity rents (i.e., congestion surcharges) in order to obtain operating authorizations. Under this strategy, access will be open to all users, and price (in the form of congestion surcharges) will be solely used as the airport access control mechanism.

The implementation of a congestion pricing strategy undoubtedly introduces an important first step towards the efficient pricing and the rationalization of use of scarce airport resources. Congestion pricing exhibits some clear advantages over previous administrative procedures or other proposed market-based strategies in that: i) it assigns some market valuations on scarce airport capacity, ii) it is simple and inexpensive to implement, iii) it does not involve drastic regulatory amendments, and iv) it substantially enhances carriers' scheduling flexibility. Most importantly, a congestion pricing regime confronts directly with the severe congestion problems of airports by means of varying congestion fees and enjoys high acceptability albeit without compromising implementability. Furthermore, it introduces a very open and adaptive framework, which can be easily customized with the local airport needs and characteristics through the appropriate congestion fee schemes and levels.

On the other hand, there are practical difficulties (e.g., determination of fees, scope of implementation, use of revenues), political concerns (e.g., social exclusion of small communities, competition, acceptability and effectiveness of congestion fees), and legal / institutional barriers (e.g., regulatory amendments, possible discrimination, equity issues, revenue neutrality) that have to be overcome at the policy level. At the same time, other important practicalities need to be also addressed at both policy and technical fronts such as the structure, components, and levels of fees, the definition of congested periods and the targeted rate of operations, as well as the role of slot coordinators and supervising authorities. Despite the fact that a number of open issues or practicalities still need to be resolved, the congestion pricing framework described in this paper can be clearly seen as a "middle-of-the-road" solution that can potentially act as a transition roadmap to a pure market-driven capacity allocation scheme in the future. Needless to say that strong political will and active industry dialogue constitute inviolable conditions for promoting the major policy reforms needed in order to successfully migrate from theory into policy practice.

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