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WHAT AIRPORT FOR THE FUTURE? VALUE ADDED, DURABILITY AND COOPERATION

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Abstract

The stage for discussing both the future of air transport and airports is usually set by a simplistic model of extrapolated growth of volumes of passengers and freight, subsequently translated into economic benefits and social costs. In this paper an attempt is made to go beyond this simplicity. To do so the role of logistics is taken into account including the double shift produced by it: from physical accessibility to logistic services and from tonnage to value added. Going beyond simplicity also means to reckon with the social costs of air transport, a variety of problems that can only be coped with by a variety of measures. As a result, a strategy of selected growth and shrinkage is advocated. Finally, complementary cooperation of airports can provide an antidote to unbridled competition in the EU.

A SIMPLISTIC GROWTH MODEL OF AIR TRANSPORT

The stage for discussing both the futures of air transport and airports is usually set by a simplistic model of extrapolated growth of volumes (number of passengers as well as tons of freight). According to IATA passenger transport, for example, is expected to grow till 2015 world-wide at an average annual growth rate of approximately 5%. Individual airports may grow faster or slower.

Extrapolated growth of volumes is just one side of simplicity, the other side being the assumption of simple relationships between on the one hand, growth and the benefits and costs of air transport, on the other.

Economic benefits

Economic benefits are usually measured in term of employment. This is, however, not the only possible economic indicator and may not even be the most important one, compared to value added.

Evaluators usually distinguish the economic effects into:

- direct effects: employment created by airport- or platform- bound activities (which, in turn, are related to volumes of passengers and freight),
- backward linkages: employment created by the suppliers of goods and services related to platform-bound activities,
- forward linkages: the persons employed by companies the functioning of which relates to the airport and for which the airport has been an important location factor.

Direct effects are straightforward. So are backward linkages, although indirect in nature. This is not true for forward linkages, however. They are difficult to quantify and it is also difficult to assess the importance of an airport as a location factor. A survey of factors influencing recent location decisions has shown that mobile investment in Europe, as a matter of course, depends on a variety of factors: business factors, national and local characteristics, labor factors, cost factors, infrastructure, quality of life and personal factors (Commission of the European Communities, 1993). The proximity to a major airport is one among many influences, being only one of the infrastructure factors. "No simple model can be constructed of location determinants".

As far as future developments are concerned, proximity to airport is expected to of be of critical, increasing importance for the location of European headquarters, European distribution and services as well as increasingly important with regard to high-tech manufacturing and R&D.

The question, however, is what is to be considered as a "major" airport. Certainly, international connections are an important feature, but at what level? Do only Intercontinental gateways (ICAs) in large domestic markets such as Heathrow or Frankfurt qualify as major airports? Or does it suffice to be an airport in a medium-sized market without hub dominance such as Manchester? It should be noted that these are just the top and bottom positions of a present typology of airports (see the third section).

It becomes clear that the relationship between growth of volumes and economic benefits is far from simple. What about the social or external costs of air transport?

Social costs

The costs caused by air transport, but usually not included in the price of air transport, are manifold. These external costs include:

- noise and atmospheric pollution caused by aircraft operations,
- atmospheric pollution caused by airport vehicles or other airport-related sources such as power stations,
- land-use, soil erosion and water pollution caused by the development of airport and airport-related infrastructure (including barrier effects, loss of landscape value and disturbance of ecological system),
- water and soil pollution caused by inadequate treatment of airport-related effluents (fuel, de-icing products and lubricants),
- operational and waste discharges,
- risks inherent in the transport of dangerous goods, aircraft accidents or emergency landing procedures,
- congestion (land-side access; delays/time costs imposed on others),
- energy consumption contributing to the exhaustion of fossil fuel (in the long run).

The picture of the relation between growth of volumes and social costs, too, is a complex one.

Simplification can take various forms. Evaluators can leave out important categories of social costs. Measurements can be restricted to local effects. And one can ignore backward and forward linkages. On the other hand, it seems questionable to base the measurement of social costs simply on volumes of passengers and freight or even the number of flights. In doing so one neglects intervening variables such as types of airplanes (e.g. ordinary versus "silent" engines), load factor, use of runway, take off and landing procedures, fly-in and fly-out routes.

When it comes to decisions on building new airports or expanding existing ones, more often than not, a simplistic growth model of air transport is used to appraise the pros (economic benefits) and cons (social costs), confronted with the investment required. An overestimation or underestimation of either benefits or costs can tip the balance. Take, for example, the inclusion of the "backward linkages of forward linkages": among others, employment created by the suppliers of goods and services related to activities connected to the airport and for which the airport has been an important location factor. Or the neglect of intervening variables in measurements of external costs. In the end, however, the choice may be presented to decision-makers as a simple dichotomy between "economy" and "environment".

Beyond simplicity

From a scientific point of view, however at least, three issues are essential. The simplistic growth model of air transport tends to ignore the existence of both major uncertainties and limits to growth. It also assumes that the future will bring more of the same, which is another way of saying that it ignores or underestimates major innovations ahead.

First, there is no such thing as "perfect knowledge". The evaluations of airport projects or airport expansion plans are based on the assumption that the positive impact on regional (national) economic development of air-transport infrastructure and services is unequivocal (Pols, 1997). This assumption, however, is not or at best scarcely corroborated by empirical evidence.

One can hardly ignore the existence of a major uncertainty.

Next we come to limits of growth. Assuming, as IATA does, that passenger transport is growing exponentially at a rate of 5% till 2015, implies that passenger transport is going to double worldwide within some 14 years. Airfreight transport could even grow faster if there were no restrictions on night flights. As the growth of passenger transport, too, meets with constraints one has to face airport congestion.

Finally, there is the question whether there are not major innovations ahead challenging the implication of the growth model of air transport that the future will simply bring more of the same. While major technological breakthroughs, beyond nature and medium-term technologies, are not to be expected for the time being, the whole "environment" of air transport certainly will undergo important changes. Take only the new trends in freight transport (Ruijgrok et al., 1991). In this paper the focus is on the role of logistics. This includes the use of IT or ICT for far-reaching management and control of production and transport flows.

THE POSITIONING OF AIRPORTS

The positioning of airports is always hierarchical. And hierarchy breeds competition for market shares.

Table 1 - Present typology of airports plus some examples per type

	USA	Europe
Intercontinental gateway (ICA) in large domestic market	JFK Chicago	Heathrow Frankfurt
Second airport in large domestic market	La Guardia Newark	Gatwick Orly
Intercontinental gateway (ICA) in medium-sized domestic market	- -	Schiphol Zurich
Continental hub with moderate ICA-function	Dallas/Fort Worth Atlanta	Brussels Copenhagen
Continental hub with limited ICA-function	Charlotte Pittsburgh	Munich Düsseldorf
Airports in medium-sized markets without hub dominance	Boston Orlando	Manchester

Table 1 (Source: Bleumink et al, 1995, 80) gives an example of the positioning of airports, referred to earlier. It results from a study of 40 US- and European airports. The typology is based on passenger transport (with freight transport being considered as an important by-product). There are three criteria:

- (continental) hub dominance on airport by one or two airlines,
- intercontinental function of airports (ICA function),
- size of domestic market.

The present typology is expected to change in future, in particular in Europe thanks to the liberalization of the air transport market.

The criteria for positioning airports, both at present and in the future are rather simple. They are either volume-oriented (size of domestic market) or supply-oriented in terms of types of origins and destinations (continental and intercontinental) offered by the airport or the airlines operating from it.

Hub dominance refers to the hierarchy of airports, i.e. their degree of centrality in an international network of airports. The positioning approach can be summarized by the following equation, similar to the conventional positioning of seaports (with the exception of T replacing C, the centrality index of seaports. C measures the infrastructural access of ports to their hinterland by rail, road and inland waterway, i.e. its multimodal physical accessibility):

$$M.T = Co.Q$$

where:

M = mass of freight and passengers to be transported per airport
T^* = type of airport (as in table 1)
Co = transhipment/transit costs in airport in relation to competing airports
Q = quantity of freight and passengers transhipped in airport

THE ROLE OF LOGISTICS: A DOUBLE IMPACT

In the foregoing section, the positioning of airports has been summarized by a simple equation. The impact of (product channel) logistics on this kind of approach is twofold. On the left-hand side, the emphasis is shifting from physical accessibility to controlled and dedicated logistic accessibility (facilities and services). And, as far as the right-hand side is concerned, "tonnage thinking" is replaced by "chain and value-added thinking". The focus is on the transport of goods. However, the new reasoning can also be applied to passenger transport. But in order to set the scene, recent trends in European logistics need to be described first.

Logistics: recent trends

The 1980's and 1990's have been periods of extensive change in European logistics. Many companies have, in response to a changed business environment, restructured their physical distribution networks. The removal of barriers means that is increasingly possible to internationalize rationally and economically and to achieve geographical integration in logistics, with operations spanning country borders. The single European production plant is no longer a rare phenomenon. There is a strong tendency in industry towards specialized production sites, serving the European and even global markets within a company's broad range of products. The number of factories and warehouses dedicated to within-country production and movement has been reduced. Cross-border sourcing and deliveries have increased. The number of regional warehouses serving more than one country has grown extensively.

From physical accessibility to logistic services

Product channel logistics has become one of the leading logistics strategies. It is expected be developed further in the future (Cranfield et al, 1992; European Logistic Consultants, 1996). Product channel logistics will strongly influence the behavior of logistic service providers and therefore will have a strong influence on the type of services they require from airports. To carriers, the emerging customer service requirements are directly translated into more time pressure and higher reliability and quality requirements. The emphasis has shifted from product profitability and transactions to building long-term relationships with customers, from profit focused around margins to customer profitability. Modularization of load units is necessary to combine quality requirements and to achieve the necessary cost reductions. Multimodality and intermodality have become important concepts. Load and vehicle identification techniques, telematics, smart cards and communication and information technology make it possible to manage logistic systems in real-time, or approaching real-time.

Logistic service providers are forced to develop differential strategic responses with regard to specialization and integration (NEA, 1997). More types of logistic services are offered while, at the same time, the geographical coverage of services is broadened. Air cargo transports and more in particular express cargo are integrated into the logistic concepts of shippers. The high costs of express cargo services are more than compensated for by the reduction in other logistics costs such as inventory costs. Express cargo shipments today are for more than 90% planned shipments and not restricted to documents, highly perishable goods or spare parts.

There seem to be no longer any restrictions with regard to weight or volume. "Integrators" such as UPS, Federal Express and TNT-KPN are investing heavily into their networks and IC-technology and are becoming strong players in the field of value-added logistic services, as there are dedicated and public warehousing, order-picking, and after-sales services. "Conventional carriers", on the other hand, are offering today services with logistic characteristics formerly restricted to express services (high frequency, high reliability). Apart from the air freight carried directly by the integrators, i.e. with the use of their own equipment, almost 95% of this traffic is in the hands of other logistic services providers, especially the forwarders who play a crucial commercial role in the logistic networks of their customers, the consignors. It can, however, be argued that in the very near future, integrators will take over a considerable part of this air freight market by providing door-to-door services. Figure 1 and 2 (adapted from Van Riet and Ruijgrok, 1996) show the differences in market situations of the express market in 1985 and 1997.

Market situation in 1985

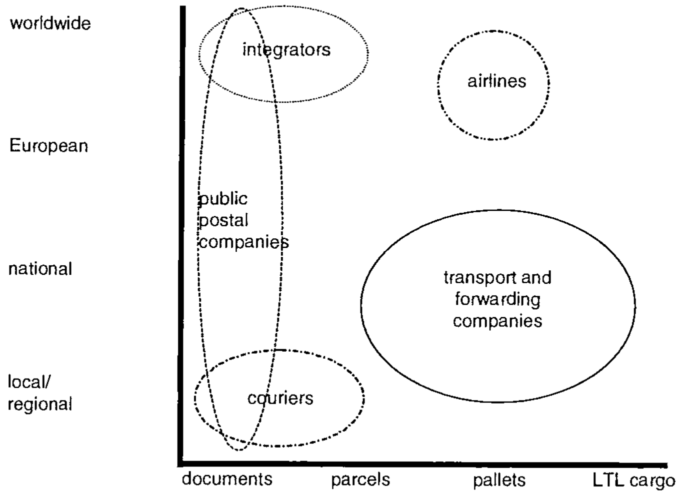

Figure 1 - Activity packages of suppliers of express services on the European market, 1985.

Market situation in 1997

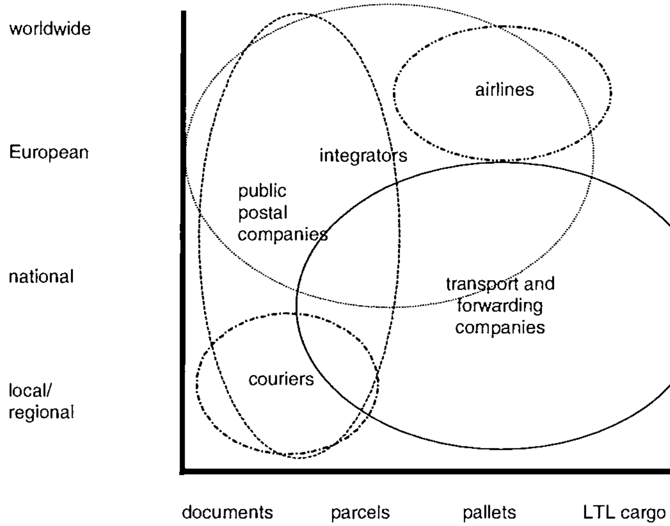

Figure 2 - Activity packages of suppliers of express services on the European market, 1997

About two thirds of airfreight is carried on passenger aircraft. Airlines still are important players in express and intercontinental airfreight. They, however, do not have the necessary ICT-systems or networks to offer door-to-door services and to cover every region (European Conference of Ministers, 1997, 104-105). Airports as nodes in logistic networks are necessary in order to achieve the required scope in connecting multiple origins and multiple destinations with high frequencies.

As to the air transport of passengers, the emerging approach of "seamless multimodal mobility" could be of interest. Even if it is still a research program (Bovy, 1996). The general idea is to design unprecedented multimodal personal travel services in a ubiquitous information environment.

Air passenger transport or airports for that matter, could be dealt with as an integral part of a seamless, multimodal trip chain.

From tonnage to value-added

The shift from "tonnage thinking" to "chain and value-added thinking" can be illustrated by experience from seaports. As a first step, freight volumes are to be divided into segments and the (gross) value added per segment per ton is to be calculated. Take Rotterdam as an example:

1 ton of conventional cargo = 2.5 tons of oil products = 3 tons of containers = 4 tons of cereals = 7.5 tons of other bulk = 8 tons of ro/ro = 10 tons of coal = 12.5 tons of ores = 15 tons of crude oil (this is the so-called Rotterdam rule).

The basic reasoning then is that it is possible to create the same amount of value added or even more value added by shipping lesser volumes of goods. To wit, a shift from crude oil to conventional cargo reduces the volume from 15 tons to 1 ton, producing the same amount of value added. Similarly, only two tons of conventional cargo suffice to double the value added produced by the shipping of 15 tons of crude oil.

In order to apply this kind of reasoning to airfreight, one needs to identify the relevant segments of goods transported by air. The concept of the "air-freight cube" appears to be a useful tool. Whether a product should preferably be transported by air, is determined by three factors, its

- value density (value of product per unit of volume, say, 1 m^3),
- urgency of transport (emergencies, perishable goods etc.),
- volume density (the volume/weight ratio - i.e. cubic meters divided by kilograms - in relation to the suitability of products for stacking).

Each factor can be divided into three positions: high (large), medium and low (small). Together, they form a cube composed of 27 subcubes. See figure 3.

It should be noted that the value density of a product is related to its position in the logistic chain. Urgency can also be seen as an expression of lead time, the time interval between the placing of an order and delivery, which is a basic concept of logistics.

Unlike sea transport, heavy, non-perishable goods with a relatively low value density are usually not transported by air. The optimal situation is reached when value and urgency are high, but volume density is low (figure 3, Source: Junne et al., 1996, 19). A situation which corresponds to the shift from tonnage to chains and value added.

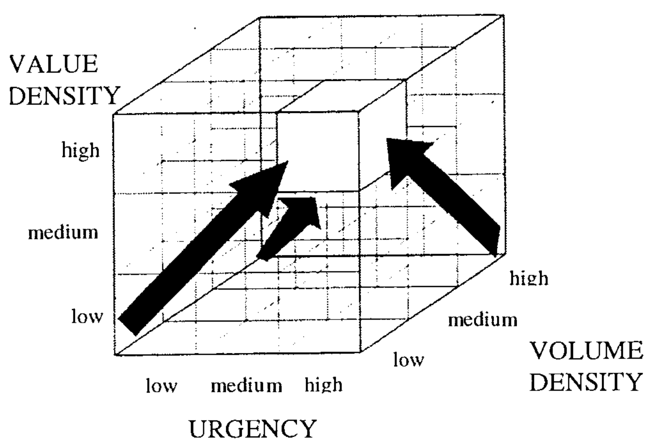

Figure 3 - The optimal subcube

Whether a product is actually transported by air, eventually, is decided by an interplay of demand (business firms) and supply (airlines). This does not prevent suppliers of air transport services, however, to focus more on chains and value added.

To shed more light on the air-freight cube, let us take a look at four selected product groups representing the bulk of (intercontinental) freight transport in the Netherlands: cut flowers; electronics and machines; textiles and clothes; agricultural and horticultural products. The results are shown in table 2. Electronics and machines are broken down by position in the production (logistic) chain which has an impact on the three determinants.

Table 2 - The air-freight subcubes of selected product groups in the Netherlands

Product group	Value density	Urgency of transport	Volume density
CUT FLOWERS	medium	high	medium
ELECTRONIC & MACHINES:			
raw materials	low	low	high
standard components	low	low/medium/high	low
customized components	high	high	low
assembly products	medium/high	high	low/medium
end products	high	high	high
after-sales and repair	medium	high	low/medium/high
TEXTILE & CLOTHES:			
in general	medium	low	medium
fast delivery	medium	high	medium
AGRICULTURAL & HORTICULTURAL PRODUCTS:			
French beans	high	high	low
paprika	high	medium	medium

Table 2 describes the present situation. But the air-freight cube can also be used for analyzing potential future developments, trying to identify products that are moving toward the optimal situation: products marked by an increasing value density and urgency combined with a decreasing volume density, generally speaking. Of course, other factors come into play, too (e.g. new forms of substitution, especially between air and sea transport). Moreover, company strategies can create new flows of airfreight, strategies such as specialization and scaling-up (on the supply side) as well as world-wide "sourcing" and selling (on the demand side). Altogether future developments, however, will be subject to uncertainties.

Instead of using the airfreight cube as a tool of analysis, one could also apply, for example, the so-called logistic-family concept:
"A logistic family is a group of products sharing similar product and market characteristics, underlying similar logistics decision making. It is a method aimed at logistic segmentation" (Kuipers et al, 1995, 55).

The characteristics are: value density, package density, keeping quality, market range, market scope, client density and demand frequency.

What about passengers? What we are looking for is a segmentation of the air passenger's market that takes into account differences in value added. Relevant types of passengers to be considered are, for example: non-stop versus stop, business versus economy class, scheduled versus charter flights, continental or intercontinental destinations versus transit. One could think of constructing some kind of "air-passenger cube" or, at least, set up the "Schiphol equivalent" of the Rotterdam rule (of thumb). These tools may help to answer the basic question: is it possible to produce the same amount of value added or more value added by transporting lesser numbers of passengers? Airline strategies could be focused accordingly, catering to the needs of specific passenger segments. Market research can teach us what a target group values most. As far as business travelers (in the Netherlands) are concerned it is: speed, advantageous fares, suppliers helping to think of solutions, speedy dispatch, flexibility, up-to-date information, round-the-clock accessibility (in descending order of importance).

And finally, there is also the possibility of combining freight and passenger strategies as in the case of belly-and combi-freight.

THE SOCIAL COSTS OF AIR TRANSPORT: 'ONLY VARIETY CAN DESTROY VARIETY'

The different social costs of air transport have already been dealt with in the first section. Given the complexity of the problem, there are no simple solutions. One has to consider various ways of reducing the damage caused by air transport, various interventions and measures as in the case of freight transport in general.

Reduction of total number of ton-kilometers

A strategy focusing on value added rather than on tonnage, may lead to a (selective) shrinking of the total number of both passenger- and ton-kilometers. But from the vantage point of social costs, one can also think of spatial planning interventions and, in particular, the internalization of external costs.

Spatial planning, implying a locational policy and locational norms, applies primarily to the physical expansion of existing airports or the construction of new airports: reducing further growth of passenger- and ton-kilometers. If for example contour lines of noise are enacted and carried out, this too can limit further growth. Internalizing the social costs of air transport requires at policy at the Community level. In fact, the Directorate-General for Transport has already announced its policy intentions in this area (European Commission, 1996). The policy options aiming at fair and efficient pricing in (air)transport relate to internalizing:

- costs paid by others (with regard to transport expenditure: such as tax exemption of fuel and tickets),
- uncovered infrastructure costs (such as the provision of extra land-side access to airports),
- uncovered accident costs (e.g. pain and suffering imposed on others),
- uncovered environmental costs (such as air pollution, noise; also environmental tax exemption of transit passengers),
- delays/time costs imposed on others (due to land-side access congestion).

Technical improvement of vehicles

Vehicles in our case are basically airplanes. But it can also be trucks as in the case of air-freight trucking. Technical improvements are mainly twofold. They can aim at airplanes ("silent" engines, fuel efficiency or reduced emissions) as well as their "driving" and sailing habits". The latter includes changes in use of runway, takeoff and landing procedures, fly-in and fly-out routes, among others. Moreover, there may be potential uses of information and communication technologies to be explored.

Optimization of transport logistics

Interventions under this heading target a more efficient use of vehicle-kilometers through:

- using the potentials of ICT (e.g. for improving the performance of air control),
- trip planning techniques ("fuller", "less empty", "bigger"),
- introduction of sophisticated logistic transport concepts (as referred to in the third section),
- improved intermodal transport (which also figures under the next heading).

Shift to environmentally less damaging modes of transport

There are two ways of achieving such a shift. One is improving intermodal transport, the other changing the modal split. They can be interrelated when air-rail connections are made "seamless" thus producing a shift from air-road to air-rail transport of both freight and passengers.

If actions are taken to cope with the social costs of air transport, this would mean the end of the simplistic growth model which is basically a laissez-faire approach. The future growth of air transport would be constrained both directly (in particular through taxes and higher prices because of higher "total visiting costs") an indirectly (through local environmental and capacity limits). On the other hand, the interventions listed above open up new options. This holds for technical improvements of airplanes (including the improvement of their "driving and sailing habits"), the optimization of transport logistics and a shift to environmentally less damaging modes of transport comprising improved intermodal transport. It is essential to stimulate research and development in these areas.

If actions directed at the social costs of air transport are combined with logistics strategies in general and those focusing on value added in particular, then a policy of selective growth and shrinkage becomes possible (Pols, 1997). This is a far cry from a simple dichotomy between "economy" and "environment". Of course, to move from a simplistic model of extrapolated growth of volumes to "organized complexity" (Jane Jacobs), requires a major effort.

AIRPORTS: FROM COMPETITION TO COOPERATION?

The European market for air transport will undergo substantial changes with the forthcoming liberalization and privatization. For decades, air transport has been subjected to state regulation with regard to market entry, routes, capacity and fares. National airports and national airlines have been subsidized by their governments. But national airports and national airlines will have to go as airlines within the EU will become free to choose their own network of routes to be served. The Trans-European Airport Network of 1993 comprises 237 airports out of a total of 313, all of which have been presented by the member states as airports of "national interest".

Will deregulation bring more unchecked or even cut-throat competition with only the most efficient, commercially operating companies being among the survivors and the losses being counted as another social cost? And if the construction of new airports or the expansion of existing ones is meant to produce a competitive advantage in one case, will this advantage not be nullified by similar projects elsewhere? Isn't the economic and social cohesion in the Community at stake here? And what about strengthening the competitive position of EU airports vis-à-vis non-EU airports when open-sky treaties and strategic alliances turn the market for air transport into a global one tending to further boost competition within the European Union? And who is going to orchestrate a policy of selective growth and shrinkage under these circumstances?

With so many queries, one can hardly expect to find a simple recipe. One could try cooperation and coordination instead of competition as advocated in the case of seaports (Drewe and Janssen, 1998). Complementarity is a key factor in cooperation. Complementarities can be translated into opportunities for selective growth and shrinkage of airports in the European Union, taking into account both the development of logistic potentials and the management of social costs (as outlined in the third and fourth sections respectively).

Complementary cooperation and a suiting new hierarchy of airports in Europe require a concerted action of the numerous shareholders: airports, airlines, national and regional authorities, business firms, etc. They also require new guidelines for the Trans-European Airport Network (plus a more efficient Eurocontrol). By the way, back in 1993, the European Commission has doubted whether a hub-and-spokes approach will contribute to the overall efficiency of the Community network in the long run: "Special attention should thus be given to measures aimed at easing the pressure on the large airports and favouring a geographical distribution of air transport services for both current and future demand" (European Commission, 1993, 8).

The airport of the future is part of an uncertain world. Are we heading for the global village, global recession or greening of business? Whatever looms ahead, a strategy of complimentary cooperation provides a way to reduce uncertainty. So does R&D. They may go a long way towards reducing uncertainty, but unlikely the whole way. So one also needs to accept uncertainty to some extent resorting to an intelligent phasing of the implementation of plans. Why not try a strategy of selective growth and shrinkage? It is preferable to a risky laissez-faire and to the "simple, easy to convey, wrong solution".

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