Adaptive Policies, Policy Analysis, and Civil Aviation Policymaking

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PREFACE

This report summarizes the results of one of the subtasks of a policy analysis study that was performed by the European-American Center for Policy Analysis (EAC), which is a part of RAND. The study was performed for the Netherlands Ministry of Transport, Public Works and Water Management (V&W), Ministry of Housing, Spatial Planning and Environment (VROM), and Ministry of Economic Affairs (EZ), in support of the project called 'Toekomstige Nederlandse Luchtvaart Infrastructuur' (TNLI) [Future of Dutch Civil Aviation Infrastructure].

The subtask of the RAND/EAC work reported on in this document is the specification of a framework for developing adaptive policies, and an adaptive policymaking process, which can be used to devise and implement a policy for civil aviation in the Netherlands that addresses the high levels of uncertainty confronting civil aviation policymakers.

In addition to this document, the study has produced three written products:

- A Research Brief, which is a brief description of the primary findings of the project.


- A description of the scenarios developed for the project [Scenarios for Examining Infrastructure Options in the Netherlands, EAC DRU-1513-VW/VROM/EZ, January 1997].

The information presented in this document should be of direct help to the TNLI project team in its preparation of a Perspectieven Nota, which is designed to help the Dutch Cabinet develop a view on an integral policy vision for the entire civil aviation system of the Netherlands. It should also be of use to policymakers in any organization who have to develop policies in the face of enormous uncertainties.

The EAC, an independently-chartered European unit of RAND, is located in Delft, the Netherlands. It operates as a foundation (Stichting), chartered in The Hague under Dutch law. The mission of
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GLOSSARY

Basic policy. An infrastructure option and one or more additional actions, together with a plan for their implementation. Construction of a basic policy is the second step in the adaptive policymaking process.

Contingencies. Policy actions that are taken as a result of being triggered. There are three types of contingencies: defensive actions, corrective actions, and policy reassessment.

Corrective actions. Adjustments to policy in response to specific triggers to remedy pieces of the existing policy in order to improve the chances for its success. They may involve changing the constraints, modifying the definition of success, and/or implementing additional policy actions. However, they do not involve a change in policy objectives.

Deferral. A delay in implementing certain parts of a policy until the results of earlier steps are secured or certain necessary information becomes available.

Defensive actions. Actions taken after the fact to clarify the policy, preserve its benefits, or meet an outside challenge. Defensive actions involve no change of policy objectives, definition of success, constraints, or existing policy actions.

Hedging actions. Actions taken in advance to spread or reduce the risk of possible adverse effects of a policy.

Implementation. The final phase in the adaptive policymaking process. In this phase, events unfold, signpost information is collected, policies may be altered, started or phased out, etc. The adaptive policy process (as distinct from the adaptive policy itself) is suspended until a trigger event is reached.

Mitigating actions. Actions taken in advance to cushion the certain adverse effects of a policy.

Policy action. A single policy change to the civil aviation system (e.g., build a new runway, establish a noise limit).

Policy. A combination of policy actions, together with a description of the timing and circumstances under which each action might be taken.

Reassessment. A process to be initiated or restarted when the analysis and assumptions critical to the existing policy’s success have clearly ceased to hold.

Shaping actions. Policy actions that can be taken to influence demand. Shaping actions may be mitigating actions, corrective actions, etc.

Signpost. Information to track in order to determine whether a policy reassessment is needed, or whether defensive or corrective actions should be taken.
**Stage-setting.** The first step in the adaptive policymaking process. During this step the important objectives, constraints, and available options are specified or discussed.

**Success (of a policy).** A specification of the outcomes from the policy in terms of the stated objectives and constraints that the participants in the policymaking process would find acceptable.

**Trigger.** A critical value of a signpost variable that leads to a policy reassessment or to the implementation of defensive or corrective actions.

**Vulnerabilities.** Certain or possible adverse consequences of the basic policy.
1. INTRODUCTION

THE NEED FOR AN ADAPTIVE APPROACH TO POLICYMAKING

Fundamental limits in our ability to predict the future present important challenges to policymakers. If the outside world did not change, and there were no uncertainty, then a fixed, clock-driven, non-adaptive policy would suffice. Even with uncertainty, if we were able to predict the future, optimal policies could be devised by simply examining the future that results from each possible policy and picking the option that produced the best results. For most systems of interest today, including the civil aviation system, prediction is not a possibility. When even the best model cannot predict the details of system behavior, the classical technique of devising policy by optimizing outcomes on a best estimate model is no longer credible. Such policies are optimal for a future that most certainly will not occur, and have properties relative to the future that actually happens that are typically not examined in the course of the policy analysis study.

For very complex policy systems whose behavior we cannot predict, policies optimized against a best estimate model can prove to be very fragile against unexpected events that often occur. Further, as policies must typically be realized over time, such “optimal” policies are typically very unrealistic. They specify policy from the perspective of an omniscient lawmaker, who dictates “optimal” actions far into the future. If there were no uncertainty, it would be easy to determine when each policy action should be implemented. But this perspective flies in the face of the realities of policy implementation, which typically involves iterative policy adjustment as a result of debate and contention among a variety of stakeholders and developments in the outside world. The stakeholders adjust their behavior in response to each others’ actions and as they gain information over the course of time.

Any analysis is necessarily limited by the range of options considered, the quality of its modeling, the strength and validity of its assumptions, the clarity with which its objectives are identified, and its recognition of its own shortcomings. The starting
point of this paper is that all of these factors change. Sometimes, 
the changes cannot be foreseen, but stem from random 'shocks.' Other 
changes are brought about simply by the advancement of time, without 
any additional uncertainty. Finally, change may occur in response to 
the implementation of policies.

A realistic approach to the formulation of policy should 
explicitly confront the fact that policy will be adjusted as the 
world changes and as new information becomes available. If such an 
approach is used, policy changes will become accepted as normal facts 
of life, not as traumatic shocks. Such an approach will also help 
policymakers to cope with the wealth of uncertainty that confronts 
them by creating a policy that includes a plan for learning.

This paper provides a rationale for this broader, more realistic 
approach to civil aviation policy analysis and policymaking. This 
approach is built on the recognition that time and uncertainty are 
essential elements of policymaking.

UNCERTAINTY ABOUT THE FUTURE SITUATION IN THE NETHERLANDS

The current policy regarding civil aviation in the Netherlands, 
whose major components are specified in PKB-Schiphol, was intended to 
guide the growth of civil aviation in the Netherlands until the year 
2015. Salient features of this policy include the development of 
Schiphol as a mainport (i.e., a primary continental hub for a major 
airline) and improvement in the environmental quality around 
Schiphol. Higher than expected growth rates in passenger and cargo 
demands at Schiphol since 1990 make it doubtful that the current 
policy can continue to guide civil aviation development in the 
Netherlands to the year 2015.

However, while global air travel is forecast to continue to 
grow, this does not mean that the demand for capacity at Schiphol 
will also continue to grow. The demand for capacity at Schiphol will 
be determined in large part by what happens to and at KLM, which is 
the largest user of capacity at Schiphol. KLM is a small airline 
compared to other mega-carriers in Europe and the United States. 
Despite its best efforts, the survival of KLM as an independent mega-
carrier with a global route network is far from assured. So, since 
the future of KLM is uncertain, the future need for capacity at 
Schiphol is also uncertain. If KLM were to disappear today, Schiphol
would be left with about 16 million passengers -- the origin/destination (O/D) passengers. It is, therefore, not inconceivable that the current capacity of Schiphol, as defined by PKB-Schiphol, would be adequate for much more than the next 20 years.

Other uncertainties make it very hard to gauge the economic benefits and environmental impacts of meeting demand in the far future. For example, improvements in aircraft technology make it difficult to determine the future environmental impacts of an airport. The determination of economic benefits is similarly problematic. So, questions such as how many more aircraft can be accommodated at Schiphol without increasing the noise load, or how much additional employment will be generated by accommodating higher levels of demand cannot be answered with any certainty.

As a result, combining an assessment of the costs and benefits of a variety of infrastructure options with uncertain assumptions about the nature of future demand provides a shaky foundation for the specification of a policy for civil aviation in the Netherlands for the next 30-40 years. Rather, what is needed is a new policy framework that is able to adapt easily to the changing realities of the civil aviation business -- global competition, deregulation, and liberalization of air travel -- and to the increasing importance of price (in place of regulation) as a factor in shaping how the system operates and in determining who wins and who loses.

**THE ROLE OF TIME**

Long lead times are necessary for adding airport capacity. Given the various uncertainties and the long lead times, it is clear that the planning process should try to be adaptive and responsive to changes in the development of demand, environmental impact awareness, and other factors that influence the determination and balancing of the costs and benefits of adding airport capacity. In this respect, the timing of policy actions is very important. Two outcomes that should be avoided are adding significant capacity when it is not needed and lacking capacity when it is needed. Being 'too early' or 'too late', whether as a result of other parties' reactions, or our ability to respond to new information in time to make a difference, may have profound consequences. This leads us to suggest developing
policies that are adaptive and developing policy assessment methods that discount the future appropriately.

**THE RANGE OF POLICY OPTIONS FOR MEETING DEMAND**

There are many things that can be done to alter airport capacity in the Netherlands, the efficiency with which that capacity is utilized, the evolution (in size and composition) of demand in the future, the matching of supply and demand, and the ancillary effects (e.g. noise nuisance, aircraft emissions, etc.) of that matching. Figure 1 puts the consideration of these options squarely into the policy process, as alternatives or complements to infrastructure construction. What is needed is an approach to policymaking that starts with a specification of the policy’s objectives and criteria for success, and assembles the policy options in time and space that can lead to a successful outcome.

![Diagram of policy options](image)

**Figure 1-Types of Policy Options**

As suggested in Fig. 1, the government has a wide variety of policy options available to it, and a wide range of ways to employ them as policy actions\(^1\). Assuming that a policy decision has been made to accommodate demand, there are basically four ways in which the government can influence airport capacity and the demand for use of the capacity. It can build new airport infrastructure, use the existing infrastructure more efficiently, modify (shape) the demand, and

\(^1\) A policy option becomes a policy action when the choice is made to include it in a policy.
and use the market to improve the match between supply and demand. In each case, there are a variety of instruments available. These instruments fall into four major categories:

- **Managerial instruments**, which change the rules by which a particular infrastructure is managed (e.g., by changing the way the runways are used);

- **Technical instruments**, which are physical changes to the civil aviation infrastructure (the "new infrastructure" options all fall into this category, as do changes to the equipment used for air traffic control);

- **Regulation instruments**, which control the use of the civil aviation system with legal and administrative measures (e.g., placing environmental constraints on the use of an airport);

- **Pricing instruments**, which are charges on the use of the system (e.g., surtaxes, licenses, and user fees).

All four types of instruments can be used (as shown in Fig. 1) to shape demand, make more efficient use of the existing infrastructure, and/or help the market to function more efficiently.

In the following subsections, we briefly describe some of the different types of policy options and their uses, and provide some examples. In the remainder of the paper, we develop a framework for putting all of these policy options together in the face of time and uncertainty.

**Infrastructure Options**

One way of accommodating an increased level of demand is to build new infrastructure. Infrastructure options are changes to the infrastructure in the Dutch civil aviation system. The RAND/EAC assessment of infrastructure options for the year 2025 and beyond is given in [European-American Center for Policy Analysis, 1997].

The infrastructure options were defined in terms of the following key characteristics:

- The number of national airports in the Netherlands (1 or 2)

- In case there are two national airports, whether the traffic at the airports is allocated based on: type of traffic (intra-European versus intercontinental), hub-carrier, or purpose (pure cargo versus mainly passengers)

- The location of (the parts of) the airport (densely populated area; sparsely populated area; in the sea; in a lake; at the border)
In the context of adaptive policymaking, an important policy question is how much to build. If land is acquired in the knowledge that demand is uncertain, or with an eye to future expansion, it may be efficient to construct somewhat smaller facilities (especially terminal facilities) than the site will support, especially if adverse demand information is received in the interim period of obtaining planning and other administrative approvals. This type of downsizing or delay gives a strategic advantage as well, since an airport whose design capacity is not limited by the size and other characteristics of its site can expand its operational capacity relatively rapidly -- or at least it can credibly threaten to do so.

The construction decision must embrace the groundside and airside access infrastructures as well as the terminal and ATC facilities. It may also be appropriate to include options to ensure the creation of adequate human capital and infrastructure, especially if there are shortages of suitably-skilled personnel in the local area. A variety of interim policy options, from direct subsidies to work-sharing arrangements, can be used to 'grow' the labor supplies needed to use the new capacity.

**Demand Shaping Options**

Demand shaping options include a variety of constraints, pricing actions, and regulations that can be imposed on the airport operators to affect the demand. It is important to recognize that these actions may 'bundle' different objectives in ways that can hinder efficient reactions by the operators. For instance, it may be tempting to control noise and emissions problems by imposing traffic flow constraints. If the effects of these constraints are measured indirectly (e.g., through aircraft movements) rather than through the direct measurement of noise or emissions, then potentially beneficial substitutions may be prevented. For instance, it may not be possible to use smaller, quieter, and cleaner aircraft if this would result in more aircraft movements. Similarly, constraints on passenger movements provide little incentive to use quieter and cleaner aircraft, or to economize on aircraft movements. Indeed, if cargo and passengers can be bundled on the same flight, a cap on passenger movements may lead to an increase in noise and emissions.
Options That Make More Efficient Use of the Infrastructure

The usable capacity of Schiphol is below the technical capacity of the airport. What this means is that if the constraints on the number of passengers and cargo were to be lifted (regulation policy options), without lifting the noise constraints, additional demand could be accommodated without building new infrastructure (beyond construction of the fifth runway). And, if improvements in aircraft technology lead to further reductions in the size of the 35Ke contour, even more aircraft, passengers, and cargo could be accommodated. Listed below are some specific examples of ways in which to make more efficient use of the existing infrastructure through technical and managerial changes to the existing system:

- Allow mixed mode use of runways (aircraft arriving and departing on all runways) rather than runway segregation
- Reduce runway occupancy for arrivals and/or departures
- Change wake vortex criteria for arrivals (or implement new technology to measure wake vortexes)
- Adopt new departure wake vortex avoidance techniques (or implement new technology to measure wake vortexes)
- Change Standard Instrument Departure (SID) routes (for departures)
- Reduce departure separations
- Reduce radar separation (for arrivals)
- Improve the efficiency of departure sequencing

Options to Help the Market Function More Efficiently

There are many pricing and regulation policy actions that can be taken to improve the match between supply and demand. Access price regulation can be used to ensure that planned changes in airport capacity send the right signals to airlines to produce an efficient use of capacity, fair division of the resulting gains, and appropriate incentives for airlines to invest (e.g., in long-term contracts with the airport; extensive third-party or wholly-owned maintenance staff; cleaner, quieter and/or more efficient aircraft).

Among the many options, certain candidates stand out, such as the possibility of mandating an auction of landing rights, with specific provisions as to the form of the auction, the durability of the rights, and the ability of the holder to transfer them to
operations or code-sharing partners, rival airlines, etc. Traffic constraints and restrictions on the allocation and reuse of airport landing rights can also provide powerful levers. Other possibilities include:

- Change airplane landing fees
- Change airplane parking fees
- Auction runway slots
- Institute differential fees for airlines based on their contribution to the noise load
- Be more selective in the accommodation of demand
- Raise passenger taxes on transfer passengers
- Move commuter and cargo flights to regional airports
- Establish a market in noise immissions

THE STRUCTURE OF THE PAPER

So far, we have expressed the importance of developing an adaptive policy that takes account of time and uncertainty and that employs a broad range of options to meet the challenges of an uncertain future. This does not, by itself, tell us how we should go about developing such a policy.

Sec. 2 endeavors to do so by describing an adaptive policymaking process in terms of a ‘thinking phase’ and an ‘implementation phase.’ The thinking phase consists of a series of concrete steps through which we iterate until a policy has been defined and rules for its implementation developed. Although the process moves forward in clock time, we think in the opposite direction, reasoning from a particular (successful or unsuccessful) set of policy outcomes back through the actions and events that can lead us there. The implementation phase consists of the actual sequence of events, inferences, and actions that represent the execution of an adaptive policy. In short, the ‘thinking phase’ subsection describes a framework for formulating the policy problem, conducting the policy analysis, and developing a policy, while the ‘implementation phase’ subsection describes a policy and shows how it functions. Overall, we end up with a policy framework and a process for policymaking that deals with uncertainty by exploiting information that may be available in the future by taking only those actions that are
necessary now, institutionalizing a process for later action, and setting the policy into motion.

In Sec. 3 we provide an illustrative example that shows how the concepts discussed in Sec. 2 can be used to construct a policy.

Section 4 provides some summary comments.
2. DESIGNING AN ADAPTIVE POLICY

THINKING PHASE

In this section we describe an explicit process for representing and dealing with uncertainty in the context of civil aviation policy. The first step in the adaptive policymaking process is a 'stage-setting' exercise designed to make policy objectives explicit, develop a clear set of options, and develop a definition of policy success that makes operational sense. Successive steps in the process assemble the structure of the policy, identify key uncertainties, separate actions to be taken now from those that can or should be deferred until more information becomes available, develop signposts for monitoring changes in the world and triggers for various contingency plans, and establish limits to the validity of the analysis leading to the policy that, once violated, should lead to a reassessment of the policy.

Figure 2 presents a diagrammatic view of the adaptive policymaking process.

![Diagram of the Adaptive Policymaking Process](image-url)
Building Blocks Of An Adaptive Policy

Before we 'walk through' Fig. 2, it is useful to define the essential elements of the adaptive policy that emerge from the process. These 'building blocks' include:

- **basic policy** - an infrastructure option and one or more additional policy actions, together with a plan for their implementation;

- **signposts** - information to track in order to determine whether a policy reassessment is needed, or whether defensive or corrective actions should be taken;

- **triggers** - certain critical values of the signpost variables that lead to a policy reassessment or to the implementation of defensive or corrective actions; and

- additional actions to be taken in anticipation of or in response to specific contingencies or expected effects of the basic policy; these actions can be further divided into:
  - **mitigating actions** - actions taken in advance to cushion the certain adverse effects of a policy;
  - **hedging actions** - actions taken in advance to spread or reduce the risk of possible adverse effects of a policy;
  - **defensive actions** - actions taken after the fact to clarify the policy, preserve its benefits, or meet an outside challenge;
  - **corrective actions** - adjustments to policy in response to specific triggers;
  - **reassessment** - a process to be initiated or restarted when the analysis and assumptions critical to the policy's success have clearly ceased to hold.

Although the timing of actions will be considered in more detail in the next section, there is a definite relationship between the thinking phase and the implementation phase. In the following subsections, we describe the major steps in the adaptive policymaking process.

**Step 1: Setting the Stage**

The activities in the rounded box in the upper-left corner of Fig. 2 constitute the stage-setting step in the policymaking process. In this step, the important objectives, constraints, and available policy options are specified or discussed. Out of this discussion
comes a definition of success, which is a specification of the outcomes in terms of the stated objectives and constraints that the participants in the policymaking process would find acceptable.

For illustrative purposes, we may take a simplified picture of the current situation in the Netherlands for our stage setting: the constraints could be those imposed by noise, emissions, economic, and other considerations; the objective could be a continuing major role for the Netherlands in civil aviation; and the policy options could include various ways of increasing airport capacity and a host of measures for shaping demand, increasing efficiency, and mitigating adverse side-effects.

Step 2: Assembling the Basic Policy

The next step is the assembly of the basic policy. This involves two related activities: (1) specification of a promising policy, and (2) identification of the conditions that must be met in order for it to succeed. These conditions complement the definition of success by providing an advance warning of failure.

Continuing the example, a basic policy could be developed around the expansion of Schiphol. It might include the building of the fifth runway, plus additional measures from the PKB for reducing noise around Schiphol, such as phasing out Chapter 2 aircraft sooner and changing procedures for takeoffs. One necessary condition for success of this policy might be that Schiphol maintains its market share compared to competing airports.

It should be noted that success and failure will be defined in terms of sets of possible outcomes, any one of which can be classified as acceptable or unacceptable. Since the results of a policy choice cannot be known with certainty when the choice is made, the definitions of success and failure, like estimates of policy effects, are necessarily somewhat indeterminate; the result of a policy will be a lottery over assessments. An analysis of alternative adaptive policies would need to be designed to shed as much light on the character of this lottery as possible, to give sufficient scope for risk aversion\(^2\), strategic choice, risk-spreading

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\(^2\) Interpreted broadly here to include fear of ruin, preference for flexibility, minimum regret and other methods for making choices under conditions of uncertainty and risk.
activity, etc. The important activities of defining success and failure must take account of this variation by determining when the possible outcomes of a policy overlap sufficiently with the 'acceptable outcomes' zone (see diagram below).

![Diagram](image)

**Step 3: Specifying the Rest of the Policy**

In the third step of the adaptive policymaking process, the necessary conditions for success and the details of the basic policy are combined in two sorts of forward-looking analyses, which result in a specification of the remaining pieces of the policy. One analysis is the identification of vulnerabilities -- certain or possible adverse consequences of the basic policy. These vulnerabilities can reduce the acceptance of the policy to the point where they imperil its success. Associated with a certain vulnerability, such as an increase in the noise around Schiphol, are mitigating actions to be put in place immediately. Examples include buying out homes in the noise zone, subsidizing sound insulation or real estate markets, paying compensation, or creating 'noise markets.' In anticipation of uncertain vulnerabilities, such as an increased risk of accidents, various hedging actions are available to diversify or reduce exposure or cushion the consequences. In our example, these might include widening the vrijwaringszone, or subsidizing business or residential insurance.

The second analysis is the translation of the necessary conditions for success into signposts that should be monitored in order to be certain that the underlying analysis remains valid, that implementation is proceeding on schedule and according to expectations, and that any necessary policy corrections or additional
actions are taken in a timely and effective manner. The identification of signposts does not call for any direct policy actions to be immediately implemented. But once they are identified, an effort must be initiated to collect and monitor the necessary information.

Also in this step, the critical levels and appropriate contingency plans that make up the triggers should be specified.

**IMPLEMENTATION PHASE**

From this point on, we are in the *implementation phase*. In this phase, events unfold, signpost information is collected, policy actions may be altered, started, or phased out, etc. The adaptive policymaking process (as distinct from the adaptive policy itself) is suspended until a trigger event is reached.

The response to a trigger event depends on the nature of the alarm. Many contingencies will have been foreseen in the original plan, or can be handled within the discretion of those charged with implementing the policy. They will decide whether to defend a policy that is in jeopardy or to pursue the objectives of the policy by another means. As long as the basic policy, objectives, and constraints remain in place, these responses can be characterized as *defensive actions* or *corrective actions*. In our example, a major air disaster may overwhelm the hedging and mitigating provisions, and lead to widespread dissatisfaction. Depending on the nature of the public debate, these concerns could be addressed by:

- Defending the policy in public forums, conducting inquiries into the accident, highlighting the economic effects of the expansion, sharing information about impending safety improvements, etc.;

- Defending the basic policy by instituting additional safeguards;

- Defending the policy objectives (a major Dutch role in civil aviation) by expanding the feeder-reliever role of regional airports to reduce dangerous congestion at peak times; or

- Correcting the policy by, for example, scaling back expansion plans, adding supplementary demand-shaping policies, undertaking additional investment in air traffic control, intervening in flight scheduling, etc.

If the trigger is slower than expected demand growth, some combination of reduction in the planned expansion or direct demand
subsidies may be employed.

Under some circumstances neither defensive nor corrective actions will suffice. For instance, there may be a major change in the objectives of stakeholders, an extremely large shock to the signpost information (e.g., a collapse of demand, runaway growth in demand, rapid growth in regional air traffic), or a significant unforeseen action by other players (e.g., a large cooperative expansion of Charles de Gaulle and Berlin airports, an EU directive imposing an open market in landing slots or 'equal access,'). In such cases, the policy should be reexamined in its entirety. This means restarting the policy process.

But the process would not have to be started 'from scratch.' In the first place, when the policy is reassessed, much more will be known about the world and the identities, motivations, and capabilities of other key players. In the second place, many aspects of the policy will already be in place and, to some extent, irreversible. Moreover, more will be known about the effects of the initial policies. Finally, the participants in the process will have a significant collective commitment to the process as a whole.

The conditions triggering a reassessment should be stated explicitly as part of the original policy (just as the conditions under which corrective and defensive actions will be taken are part of the policy).

The main difference between the concept of time in the thinking phase and the implementation phase is that the thinking phase divides time into two periods: now and later. It defines a set of policy actions, and distinguishes the actions to be taken now from actions to be taken after certain information becomes known. Whether that means one year or ten years is not specified; the time-scale for resolution of uncertainty or implementation of the policy (other than the simple ordering of contingency plans) is not specified. Moreover, time in the thinking phase runs backwards: from desired end results to a combination of circumstances and actions that may lead to them, and the means used to secure good outcomes and avoid or mitigate bad ones.
3. AN ILLUSTRATIVE EXAMPLE

The example provided in this section is intended to illustrate the adaptive policy framework described in Sec. 2. It uses a concrete example to illustrate what we mean by an adaptive policy, and what such a policy could look like if one were developed for civil aviation in the Netherlands. The example is not intended to provide a recommendation about what is a good or a bad policy. It is strictly designed to illustrate the concepts. Thus, the example should not be used to argue for or against any specific policy choices.

The example closely follows the representation of the adaptive policymaking process (APP) outlined in Fig. 2. The various components of the adaptive policy framework -- constraints, objectives, definitions of success, vulnerabilities, etc. -- are illustrated using specific examples. Then, the examples for the various components are combined in a sequence of policymaking and policy implementation steps that illustrate the advantages of being adaptive when faced with large uncertainties. The following subsections illustrate the various steps in the APP: stage setting, assembling a basic policy, identifying and dealing with vulnerabilities of the basic policy, setting up signposts, specifying triggers, and identifying actions to be taken in response to triggers. Table 2, which appears at the end of the section, summarizes the elements of the policy that are used in the example.

STAGE SETTING

In this, the first step in the adaptive policymaking process, the objectives of the policy are specified, constraints on the policy are identified, and the set of policy options to be considered is developed. The step results in a definition of what success of the policy would mean, and the set of policy options from which the policy will be created.

In order to make the presentation understandable and somewhat realistic, we use some of the information from the current policy regarding Schiphol Airport, known as the PKB-Schiphol [Planologische
Kernbeslissing Schiphol en Omgeving]. Note that the actual PKB-Schiphol is considerably different from the simplified basic policy we present in the example.

PKB-Schiphol is intended to guide the growth of civil aviation in the Netherlands to the year 2015. The goal of PKB-Schiphol can be stated generally as promoting the sustainable development of aviation so as to derive as much economic benefit for the Netherlands as possible given the other objectives and constraints in the policy. The policy document states two specific objectives: development of Schiphol as a mainport and improvement in the environmental quality around Schiphol. A mainport is defined as an airport that serves as a home base for at least one dominant European airline and promotes the investment climate in the region. The environmental quality definition includes people disturbed by aircraft noise, stench, air pollution, and external safety.

Success with regard to the first objective, development of Schiphol as a mainport, can be measured by the market share (in both passenger and cargo markets) of Schiphol’s home carrier compared to the home carriers of other airports such as London Heathrow, Paris Charles de Gaulle, and Frankfurt. Success in meeting the mainport development objective also requires that KLM continue operating from Schiphol as one of the major European airlines.

With regard to the second objective, improvement of environmental quality around Schiphol, a number of constraints and targets were specified for aircraft noise, stench, air quality, and external safety. With regard to aircraft noise, PKB-Schiphol specifies a geographic zone defined by the 35Ke noise contour. This zone cannot be violated. In addition, a significant reduction is required in the number of highly annoyed people living within the 20Ke contour compared to 1990 levels. A significant reduction is also required in the number of people disturbed in their sleep within the L\text{Aeq} night contour of 20 dB(A) compared to 1990 levels. Finally, PKB-Schiphol mandates a standstill in the level of stench, air pollution, and external safety at the 1990 levels. So, success of the PKB-Schiphol policy means not violating the noise zone and meeting the targets for "significant reductions" in the number of annoyed or disturbed people.
PKB-Schiphol specifies three constraints that have to be satisfied in meeting the objectives: 1) the geographic zone defined by the 35Ke noise contour cannot be violated; 2) Schiphol is allowed to accommodate no more than 44 million passengers in any given year; and 3) Schiphol is allowed to accommodate no more than 3.3 million tons of freight in any given year.

There are over one hundred different policy actions included in PKB-Schiphol. One of the most important actions that is explicitly stated in PKB-Schiphol for achieving the policy objectives is the construction of a fifth runway at Schiphol, so we will include that in our basic policy, although the basic policy can include other infrastructure options. (The construction of the fifth runway was agreed to as a way to accommodate more aircraft movements at Schiphol without violating the noise constraint.) There are many non-infrastructure actions that the Dutch government might also take to help it achieve its objectives while satisfying the constraints. Table 1 lists some examples of the non-infrastructure policy options available to the Dutch government that might have come out of the stage-setting step of the APP.

Table 1

Examples of Non-Infrastructure Policy Options

<table>
<thead>
<tr>
<th>Non-Infrastructure Options</th>
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<tbody>
<tr>
<td><strong>Pricing and Regulation (demand shaping):</strong></td>
</tr>
<tr>
<td>• Auction slots at Schiphol to airlines</td>
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<tr>
<td>• Declare Schiphol to be a slot constrained airport</td>
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<tr>
<td>• Institute a regime that penalizes approaching and departing flights for deviations from established approach and departure routes, and for not following established noise abatement procedures</td>
</tr>
<tr>
<td>• Revise the system of charges for an airline’s use of Schiphol based on its:</td>
</tr>
<tr>
<td>- contribution to Schiphol’s noise budget</td>
</tr>
<tr>
<td>- average size of the aircraft</td>
</tr>
<tr>
<td>- load factors</td>
</tr>
<tr>
<td>- time of day</td>
</tr>
<tr>
<td><strong>Technical and Managerial (increasing Schiphol’s operational capacity):</strong></td>
</tr>
<tr>
<td>• Implement new landing systems (Microwave Landing System, Global Positioning Systems)</td>
</tr>
<tr>
<td>• Reconfigure approach and departure routes (SIDS and STARS)</td>
</tr>
<tr>
<td>• Change use of the runway system</td>
</tr>
<tr>
<td>• Use the Continuous Descent Approach (CDA) for landings at Schiphol</td>
</tr>
</tbody>
</table>

Note: This list of options is not exhaustive; it is merely illustrative.
ASSEMBLING A BASIC POLICY

Briefly, the situation at Schiphol in 1995-96 was as follows: Schiphol accommodated 25 million passengers, slightly over 1 million tons of cargo, and almost 330,000 aircraft movements. The growth in passengers, cargo, and aircraft movements has been faster than expected during the period 1990-1995. Despite this growth, the passenger movements and amount of cargo handled remain well below the specified limits.

The basic policy outlined in PKB-Schiphol consists of several policy actions addressing the issues of capacity, aircraft noise, external safety, substitution of passengers to the high speed train, and land use. Several policy actions are outlined for each of these issues. However, for the purposes of this discussion, our primary focus will be on the issues of airport capacity and aircraft noise. We focus on these two issues, not because the other issues are any less important. Rather, the issues of airport capacity and noise provide a convenient and clear way to illustrate the concept of the adaptive policy framework.

Conditions Necessary for Success

Consider the necessary conditions for the success of the policy. First, Schiphol has to be able to stay within the 35Ke noise contour boundaries defined by PKB-Schiphol.

A second necessary condition for success, is the continued viability of KLM as one of the dominant European airlines operating from Schiphol.

Finally, for this policy to function to the year 2015, it is obvious that the constraints on passengers and cargo should not be reached before then. This implies that the rate of growth in both passengers and cargo should not exceed the forecast growth rates used by PKB-Schiphol in specifying the constraints of 44 million passengers and 3.3 million tons of cargo.

VULNERABILITIES OF THE BASIC POLICY

The vulnerabilities of PKB-Schiphol are closely linked to the necessary conditions for success of the policy. Since the specification of PKB-Schiphol, the growth in traffic at Schiphol has been much faster than expected. As a result, the reductions in noise that have been achieved so far have been offset by the higher traffic
levels. If traffic continues to grow, it is only going to become more difficult for Schiphol to remain within the boundaries of the noise zone defined by PKB-Schiphol.

A second vulnerability of the PKB-Schiphol policy is that the constraints of 44 million passengers and 3.3 million tons of cargo are based on the assumption of 5 percent annual growth of demand. The actual annual growth rates have been almost double this rate for the past five years, and show no signs of slowing down. If passenger traffic at Schiphol continues growing at its current rate, the 44 million passenger constraint will be reached well before 2015 -- in fact, it could be reached as early as 2003-2004.

A third vulnerability of PKB-Schiphol has to do with the people living around Schiphol who are disturbed or annoyed by aircraft noise, emissions, or the stench that results from Schiphol’s operations. One of the objectives specified in PKB-Schiphol is the reduction in the number of annoyed and disturbed people living around Schiphol. As traffic at Schiphol increases, it is reasonable to expect that the number of annoyed or disturbed people will also increase. The vulnerability of PKB-Schiphol arises from not knowing exactly what disturbs or annoys people, and the fact that what constitutes a disturbance or annoyance differs from one person to the next. It is possible that in the future, even if Schiphol is able to stay within the 35 Ke noise contour, there may be more annoyed people than before because of a lower tolerance for aircraft noise, stench, and emissions. Thus, the changing perceptions of people about the problems of aircraft noise, stench, emissions, and safety are an important vulnerability of PKB-Schiphol.

Finally, a fourth vulnerability of PKB-Schiphol is the uncertain future of KLM. The growth of KLM has been the primary driver of the rapid growth experienced at Schiphol. KLM wants to replace its three-bank system at Schiphol by a five-bank system. It views this as being necessary to compete with the larger European carriers. For Schiphol, this would mean even faster growth, and an even larger proportion of transfer passengers than what it has at present. If KLM were able to introduce a five-bank system, it is likely that traffic levels at Schiphol would continue to grow, at least for the next few years, at the same rapid rate as they have grown in the past five years. If actions were taken to limit the
growth of KLM, it is possible that KLM would not be able to compete with the other European airlines, such as British Airways, Lufthansa, and Air France. If KLM were unable to compete with these, and possibly other, European carriers, its future survival could be jeopardized. This then is the fourth vulnerability inherent in PKB-Schiphol -- if KLM were to go out of business or be taken over by another carrier, PKB-Schiphol would not be successful in achieving its objective of developing Schiphol as a mainport.

**Mitigating Actions Against Certain Vulnerabilities**

One of the certain vulnerabilities is that, as traffic at Schiphol increases, the number of disturbed and annoyed people will also increase. This is something that could be addressed ahead of time by taking mitigating actions. For example, the implementation of the noise insulation program for households can be accelerated, Schiphol can try to reduce the number of households within the 35Ke contour by "buying out" households, land use within the vrijwaringszone can be restricted to commercial or business uses, and incentives can be given to increase the proportion of passengers traveling to Schiphol using public transport.

**Hedging Actions Against Uncertain Vulnerabilities**

One of the uncertainties that makes current policy vulnerable is the future of KLM. Although KLM is currently a financially sound airline, its future remains uncertain for two reasons. First, compared to British Airways, Lufthansa, and Air France, KLM is a relatively small airline. And second, the North American partner of KLM, Northwest Airlines, is relatively small and weak compared to the North American partners of British Airways, Lufthansa, and Air France. In the long-term, the capacity constraints at Schiphol, KLM’s base of operations, are bound to interfere with KLM’s hubbing strategy. Thus, for all these reasons, KLM’s future as one of the dominant European airlines is not yet secure.

What can the Dutch government do to hedge against this uncertainty? There are two types of policy actions that it might take. First, the government could try to level the playing field on which KLM has to compete. And second, the Dutch government could try to develop contingency plans for two cases: (1) KLM is acquired by
another airline and (2) KLM is unable to compete and goes out of business.

Given the ECs liberalization of air transport in the EU, there is little the Dutch government can do to help KLM's competitive position other than to try and ensure that there is a level playing field. Despite the ECs commitment to create a competitive aviation sector in the EU, several European flag carriers continue to get financial assistance from their national governments in one form or another. While the Dutch government cannot provide KLM with financial assistance, it can play an active role in discouraging the EC from agreeing to allow airlines such as Alitalia, Air France, TAP, and Iberia to continue to get state subsidies. Another possible way of leveling the playing field would be to try and instigate European action on the issue of environmental policy for airports. Schiphol is the only European airport that is regulated by policies that codify and institutionalize numerical environmental standards and capacity constraints. Based on the experience with its existing policy for Schiphol, the Dutch government might promote the idea of a single environmental policy for airports within the EU. However, this approach takes a long term perspective, and little can said about its chances of success.

The second thing the Dutch government might do to hedge against the uncertainty about KLM's future is to develop contingency plans. It is unlikely, though not impossible, that KLM will cease to exist. It is more likely that KLM will cease to exist in its current form, as an independent airline with a global route network. There are two ways in which its form might change. First, KLM might decide to change its strategy and become a regional or niche carrier, such as Southwest Airline or Alaska Airline in the United States. Such a strategy could be profitable for KLM. However, it would reduce the chances of meeting PKB-Schiphol's objective for Schiphol to become a mainport. This, then is the first contingency that needs to be planned for. Second, KLM could be taken over by another European airline such as British Airways. If British Airways, or another European airline, were to take over KLM, it is likely that KLM flights would be used to feed intercontinental flights of the airline that acquires it. If this were to happen, Schiphol would probably be used as a secondary hub by the acquiring airline. The acquisition
of KLM by another, larger airline is the second contingency that
needs to be planned for.

If KLM were to decide to change its strategy and become a
smaller airline, the government might try to attract another hub
carrier to Schiphol. It would probably be difficult to get a major
European airline to establish its hub at Schiphol, since moving an
airline's entire base of operations means giving up a large
investments in infrastructure and people elsewhere. However, a large
European carrier may be willing to locate a secondary hub at
Schiphol. Airlines seem to be more willing to relocate secondary
hubs than they are willing to relocate their primary hubs. In the
United States, for example, Delta Airlines has a secondary connecting
hub in Salt Lake City, and Northwest Airlines opened a secondary hub
in Detroit when its hub in Minneapolis-St. Paul became congested.

If KLM were acquired by another airline, the acquiring airline
might establish a secondary hub at Schiphol. Whether this would be
sufficient to enable the mainport objective of PKB-Schiphol to be
achieved is an open question. However, little more can be said about
this, since the definition of a mainport is not entirely clear (other
than the airport being used as a base of operations by a major
airline). If it was felt that being a secondary hub was inadequate
for reaching this objective, the Dutch government, in its capacity as
majority shareholder in KLM, could withhold its approval of the
merger of KLM with the other airline.

SIGNPOSTS

Signposts provide information about the progress of a policy
towards its objectives as well as the likelihood of violation of one
or more of its constraints. This information is obtained by
monitoring the conditions necessary for the success of the policy and
its vulnerabilities. The conditions necessary for the success of
PKB-Schiphol require that Schiphol remain within the boundaries of
the 35 k per noise contour, no more than a certain growth rate in
passenger and cargo traffic, and the survival of KLM. The size of
the actual 35k e noise contour and the number of dwellings within this
contour, the growth rates for passenger and cargo traffic, and the
market position of KLM are three obvious signposts. The first two of
these three signposts are clear enough. However, effectively
monitoring the market position of KLM requires understanding the factors that influence it. This is elaborated upon below.

Some of the more obvious indicators for the health of KLM are the market share of KLM in various market segments -- business, leisure, intra-European and intercontinental, transfer and O/D, bulk and express cargo. These market shares compared to those of other airlines such as British Airways, Lufthansa, and Air France, provide an indication of the relative standing of KLM in the European market. A cost indicator would also be important. As the European airline industry becomes more competitive, airlines that control their costs are likely to do better than airlines that do not. The more important costs are for labor, equipment, fuel and services.

In addition to monitoring the above indicators, it is important to keep abreast of developments in the airline industry, developments in capacity at other European airports, developments in the aeropolitical regimes regulating air travel in various parts of the world, and the emergence of competition from other forms of transport. In the airline industry, the creation of alliances and agreements between European and other airlines, route networks, pricing strategies, and competition from low cost carriers on key routes are some of the developments that have to be monitored. An alliance between one or more airlines can help an airline gain a competitive advantage. The importance of alliances can be gauged by the recent agreement between British Airways and American Airlines, and the strong opposition of other airlines to this alliance being approved by the regulators in the United States, the United Kingdom, and the EC.

The development of hub-and-spoke networks to serve the intra-European market is another important signpost. Currently, it is thought that most intra-European flights will continue to be direct origin/destination flights. However, this ignores the relationship between price and demand. Currently, fares are quite high relative to US levels. Given the high fares for intra-European air travel, it is not surprising that most passengers want to fly directly from their origin to their final destination. As hub-and-spoke networks mature, it is feasible that fares will decline, and routes that were once served mostly by direct flights will be served through a connecting hub.
Capacity developments at other European airports should also be monitored. Currently, most European airports are congested and lack the capacity for accommodating the predicted increase in air travel in Europe. However, several European airports are currently in the process of increasing capacity by building new terminals and runways. As long as the supply of airport capacity lags the demand for airport capacity throughout the European airport network, Schiphol will not be at a competitive disadvantage if it does not meet the demand for additional capacity. However, if the situation changes and other European airports are able to offer capacity to airlines, they could attract traffic away from Schiphol and hurt the competitive position of KLM.

The emergence of low cost competitors can also hurt KLM. For example, the recent emergence of the low cost carrier "Easy Jet," offering flights between London and Amsterdam for NLG 99 could erode the market share of KLM on this highly profitable route. In the future, more such competitors can be expected.

Finally, aeronautical developments also need to be monitored. Currently, intra-EU air travel has been almost completely liberalized. However, one of the major limitations facing EU carriers is that they cannot offer beyond services from locations outside their home country. For example, KLM cannot offer intercontinental services from a hub in Paris, unless it becomes a French airline. However, this situation can change. Recently, the EC was given the authority to begin negotiations with the United States to conclude a multi-lateral open skies agreements between the EU and the US. Once this agreement is finalized, it is bound to have consequences for the way airlines operate.

**TRIGGERS**

Values of signposts above or below certain levels, or significant developments of the type suggested above, constitute the triggers in the adaptive policy framework. The specific values, or developments in the signposts, individually or in combination with other signposts, become part of the policy and signal the need for action. There are three types of actions that can be taken: 1) defensive actions; 2) corrective actions; or 3) a complete reassessment of existing policy. The triggers for each type of
action differ. The strength of the signal being sent by the information contained in these triggers calibrates the nature of the policy response. The stronger the signal, the stronger the policy response.

One of the signposts mentioned earlier was the rate at which passenger and cargo traffic is growing at Schiphol compared to other European airports. Suppose that the growth rates of the past five years continue for the next two years. This is a strong signal that some action needs to be taken to influence the growth of traffic at Schiphol. Furthermore, assume that nothing else changes with regard to the capacity of competing airports. This information indicates that some actions need to be taken with regard to shaping the level and nature of demand at Schiphol. However, it does not indicate the need for any drastic response in the form of a reevaluation of the basic policy objectives outlined in PKB-Schiphol.

With regard to the market position of KLM, a clear trigger could be the creation of one or more new alliances between European and US airlines. For example, the recent alliances between British Airways and American Airlines, and Air France and Delta airlines, underlines the importance of KLM’s alliance with Northwest. Based on this information, KLM should take some defensive action to make sure that it’s alliance with Northwest is not jeopardized.

**ACTIONS TAKEN IN RESPONSE TO TRIGGERS**

**Defensive actions**

Defensive actions are actions taken to preserve existing policy. No change in policy objectives, definition of success, constraints, or existing policy actions is involved. Defensive actions involve actions in addition to the actions specified in the basic policy. In the case of PKB-Schiphol, actions that would delay the reaching or violations of the capacity constraints would be considered to be defensive actions.

Assume that in a year or two the traffic at Schiphol exceeds some threshold level. This would be a trigger calling for defensive actions that might slow the growth of traffic. There are several ways of slowing the growth of demand. All use one of two mechanisms: regulations or prices. Regulatory mechanisms determine who can use
Schiphol and who cannot. Price mechanisms work by varying the prices charged to different users for using Schiphol. It is left for the users to decide whether the benefit of their using Schiphol is worth the price they have to pay.

Defensive actions that can be used to slow the growth of traffic at Schiphol include moving commuter, cargo, and charter flights to regional airports, increasing the landing fees charged for flights, taxing transfer passengers more than O/D passengers, and making the conditions for getting access to Schiphol more stringent. For example, certain types of aircraft that are relatively unsafe can be banned from using Schiphol, or flights originating from airports in countries without adequate security measures can be denied access to Schiphol. It should, however, be pointed out that all such regulatory actions have adverse consequences. In the case of denying certain carriers access to Schiphol, Dutch carriers could face similar bans in the countries whose airlines are denied access to Schiphol. Whether or not the benefits from preserving existing policy outweigh the adverse consequences of implementing these defensive actions is, ultimately, a political decision.

There are also several actions available to the Dutch government for regulating noise. For example, old noisy Chapter II aircraft can be phased out sooner than the date set by the International Civil Aviation Organization (ICAO). Also, a noise charge could be included in the airport use fees. A noise charge that varies with the level of noise produced by an aircraft would give operators an incentive to use the best available technology for their flights to Schiphol. Another possibility would be to charge night flights ten times what daytime flights are charged (since the nighttime noise penalty in the Ke calculation is ten times the daytime penalty). Thus, there are a large number of actions that could be taken by the government to both delay reaching the capacity constraints and avoid violation of the noise regulations.

It should be pointed out that no policy can continue unchanged for very long. The underlying premise of an adaptive policy (and the reality of any "fixed" policy) is that changes that accompany the passage of time will ultimately require modifications to even the best of policies. Defensive actions are not intended to substitute for changes, or replacements to existing policy. Rather, defensive
actions are intended to preserve existing policies as long as is possible and sensible. Of course, if Schiphol continues growing rapidly, even after the Dutch government takes actions to slow the growth of demand, defensive actions will not be provide an adequate solution.

**Corrective Actions**

Corrective actions are actions taken to remedy pieces of the existing policy in order to improve the chances for its success. They may involve changing the constraints, modifying the definition of success, and/or implementing additional policy actions. However, they do not involve a change in policy objectives.

In the case of PKB-Schiphol, there are several components of the policy whose modification or replacement could improve the chances for the policy to succeed. To start, the constraints on passengers and cargo could be lifted. These constraints were based on assumptions about average aircraft size, the fleet mix at Schiphol, aircraft engine technology, landing systems, and approach and departure routes. Over time, as these aspects of the system change, the assumptions made in the course of developing the policy become less valid. For example, if average load factors were to increase significantly above what they were assumed to be when the 44 million passenger constraint was set, more passengers could be accommodated on the same number of flights. A similar situation exists in the case of cargo. In 1995, more than 50 percent of the cargo arriving at Schiphol was carried by full freighters. However, only 3 percent of all the aircraft movements that brought cargo to Schiphol were full freighters. In the future, if most cargo is carried on full freighters, it may be possible to accommodate significantly higher volumes of cargo than the 3.3 million tons specified in PKB-Schiphol without violating any of the noise regulations.

Consider another situation. Suppose that Schiphol determines that handling cargo is more profitable than handling passengers. As

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3 We are aware that, in the current policymaking environment, an extensive process is required in order to implement corrective actions. However, if an adaptive policymaking process is adopted, changes might be able to be made in these procedures.
a result of this, Schiphol may want to put in place a strategy to become the cargo hub of Europe -- i.e., it may want to become the base of operations for Federal Express, DHL, TNT, KLM-Cargo, and other dedicated cargo carriers -- and reduce its role as a passenger hub. This could result in fewer aircraft movements per year, but more movements would be by full freighters. Under current constraints this would be impossible, because it would mean more than 3.3 million tons of cargo every year.

Another corrective action might be to modify the geographic boundaries of the 35Ke noise contour defined in PKB-Schiphol. Under current policy, after the construction of the fifth runway there can be no more than 10,000 dwellings within this contour, and no new construction will be allowed within the contour. But the actual 35Ke contour is determined by the way in which the runway system is used, the landing systems, approach and departure routes, aircraft engine technology, and fleet mix. In the future, if it turns out that the actual 35Ke contour were smaller than the one defined in PKB-Schiphol, corrective actions might be to allow Schiphol to increase its capacity to more than 44 million passengers (while staying within the 35Ke noise limit) or to allow the additional land lying outside the actual 35Ke contour to be put to productive use. However, under PKB-Schiphol neither is possible without violating one or more of the constraints specified by it. PKB-Schiphol does not provide an incentive to reduce noise below the level required by the 35Ke zone defined in PKB-Schiphol, even if it is possible, since there is no benefit from doing so.

Reassessment of Existing Policy

Abandoning existing policy is a big step. It should only be undertaken if it becomes clear that the existing policy is not functioning, if the existing policy cannot be corrected, or if new information becomes available that requires that the current policy objectives be revised. The triggers for signaling a reassessment of existing policy would have to describe a situation that is very different, in important ways, from the situation in which the existing policy is supposed to function. For example, if KLM’s market share were to decline in both transfer and O/D markets, intra-European air traffic continued to grow at 10-15% per year, the French
decided to build a new Paris airport, the alliance of British Airways and American Airlines went through. KLM's partnership with Northwest broke down, several low cost carriers were to emerge, British Airways and Lufthansa were to respond by consolidating their operations at larger connecting hubs and engaging in price warfare, then existing policy may have to be reassessed and, possibly, replaced.

Another possible trigger for a reassessment might be that new information linking aircraft emissions to global environmental changes and harmful health effects becomes available. This information might produce an urgent need for governments to act to reduce the level of air transport.

We will continue the example by assuming that growth in air transport demand had triggered a reassessment of policy. But, before considering whether a change in policy might be needed, it is worthwhile clarifying what could result from a reassessment. A reassessment of PKB-Schiphol could result in changes to the policy objectives, the definition of success, the constraints, and/or the policy actions. Consider the current situation in light of the objectives and constraints stated in PKB-Schiphol. First, consider the mainport objective and the capacity constraints. In 1995, Schiphol accommodated 25 million passengers and slightly over 1 million tons of cargo. These numbers are well below the constraints specified in PKB-Schiphol. However, if the double digit growth were to continue, Schiphol would reach the capacity constraints quite soon. Is there a good chance that this growth in demand will continue? The growth has largely been due to KLM's success in implementing a bank system for its flights. KLM was one of the first European airlines to introduce the bank system. As a result of this, KLM has been more successful than other European airlines in gaining market share in the transfer market. However, other European airlines are now starting to introduce the bank system at their connecting hubs as well. This will almost certainly mean more competition for passengers in the transfer market. Stiffer competition in the transfer market means KLM will find it increasingly difficult to increase its market share in this market. For Schiphol, this could mean that growth in demand will not be as rapid as it has been in the past five years.
What would happen if the growth of demand at Schiphol did continue at its current pace? From a technical point of view, Schiphol has the capacity to accommodate far more aircraft movements, and therefore more passengers and cargo, than it presently accommodates. In fact, the technical capacity of Schiphol with the fifth runway has been estimated at 685,000 aircraft movements. This is a very large number. Thus, unlike most other European airports, the situation at Schiphol is not one where current operations are close to physical capacity.

In determining whether or not PKB-Schiphol needs to be replaced, the capacity available at other European airports is another important consideration. If capacity were available at other European airports, it would be more likely that KLM would contemplate moving its operations away from Schiphol to another European airport that could offer it more capacity. However, European airports, although undergoing expansion, face similar capacity constraints as does Schiphol (although their constraints have been caused by a lack of physical infrastructure). Thus, they cannot reasonably be expected to attract airlines, significant levels of air traffic, passengers, or cargo away from Schiphol.

The one exception to the above reasoning is Charles de Gaulle (CDG) Airport in Paris. CDG has surplus capacity, Air France has recently introduced the bank system to facilitate transfers for its connecting passengers, and Air France has recently entered into an alliance with Delta Airlines. These developments have the potential to threaten the market positions of both Schiphol and KLM. However, despite these developments, the future success of Air France is far from assured. Air France is having a great deal of difficulty in reducing labor costs and bringing its cost structure in line with industry leaders such as KLM and British Airways. Furthermore, Air France currently is required to split operations between two airports (CDG and Orly). This makes it very difficult to exploit the advantages of a hub-and-spoke network. These problems are unlikely to disappear overnight. Thus, there is no immediate crisis threatening the position of KLM and Schiphol. Therefore, there is little reason to replace the current PKB-Schiphol with something completely new.
Another reason given for replacing PKB-Schiphol is that the constraints it places on available capacity at Schiphol hinder the development of KLM, as a result of which KLM may decide to move its operations to some other airport. This action by KLM is, however, quite unlikely. First, the Dutch government holds 25% of KLM stock. Any such move would require the approval of the Dutch government. Even assuming that such approval was forthcoming, aeropolitical restrictions make such a move very unlikely. Although air travel within EU member states has been liberalized, intercontinental air travel has not. If KLM moves its operations away from Schiphol, it will not be able to offer services to countries outside the EU (including the United States). Thus, KLM stands to lose more than what it would gain if it were to move its operations to an airport outside the Netherlands, unless there are significant changes in the aeropolitical regimes regulating air travel between EU and other countries.

Finally, as has been mentioned in the sections on corrective and defensive actions, there are several actions that the government can take to shape demand and increase the operational capacity of Schiphol.

The conclusion from this analytical discussion is that, were an APP being used, there might have been a trigger for reassessment given some of the recent changes in the world of civil aviation, but the reassessment might well have concluded that, at this time, there is no immediate need to replace PKB-Schiphol.

The Capacity Gap Problem

The issue of a "capacity gap" deserves special comment, since it is often cited as one of the reasons for contemplating the building of new infrastructure. Some people argue that, even if construction of new infrastructure were to begin immediately, a capacity gap would occur at some time in the future (i.e., that supply would be less than demand). The need for capacity is determined by the growth of demand. Demand has grown very fast for the past five years. If demand continues to grow at this rate for the next ten years, new infrastructure may be needed. However, it is by no means certain that demand will continue to grow as rapidly as it has in the past. Even if demand does continue to grow rapidly, the government might be
able to take corrective and defensive actions that could allow significantly higher demand levels to be accommodated without changing the policy objectives or basic policy.

Even if a capacity gap were to appear, it is not clear that an adaptive policy would result in a decision to build new infrastructure. London’s Heathrow airport is an example of an airport with a capacity gap. Most airlines that currently operate from Gatwick would prefer to operate from Heathrow. However, Heathrow has no plans that would allow it to accommodate significantly more aircraft movements than it currently does. Rather, Heathrow is planning to expand terminal capacity with the construction of Terminal 5. Given that average aircraft size is increasing, this policy makes perfect sense. In fact, a capacity gap may even be advantageous for Schiphol, since this could enable it to charge higher prices for use of the airport, which would produce higher revenues.

On the other hand, avoiding a capacity gap might provide Schiphol with a strong competitive advantage. Currently, most European airports are congested and have few options that would allow them to expand capacity to accommodate future growth. By developing new infrastructure, the Netherlands could provide airport capacity to take advantage of this situation, if it decided that the benefits from such a policy outweighed the negative impacts of the increase in air traffic.

GOING FORWARD IN TIME

The adaptive policy framework consists of three sets of actions that can be taken in response to developments that may affect the outcome of a basic policy. These three sets of actions are defensive actions, corrective actions, and reassessment. In terms of time, defensive actions are probably the easiest and quickest to implement. Corrective actions come next in ease and speed of implementation. A reassessment, because it leads to a change of policy objectives, is both time-consuming and difficult to carry out.

The actions in these three categories do not have to be implemented in any particular order. For example, it is not necessary that defensive actions be taken first, followed by corrective actions, and finally by a reassessment. The timing and
sequencing of these actions should be based on the information provided by the signposts that have been defined and by the triggers that have been established as part of the policy. In the case of civil aviation in the Netherlands, for example, some defensive and corrective actions might be undertaken at the same time as a reassessment is undertaken.

Figure 3 provides a hypothetical graphical example of going forward in time. In 1995, 25 million passengers were accommodated at Schiphol. The two dotted lines that diverge after 1996 represent possible growth in passengers at Schiphol with and without defensive actions -- the higher dotted line represents growth without defensive actions, and the lower dotted line represents growth with defensive actions. As the figure shows, defensive actions delay the need for action by slowing down the growth in the number of passengers at Schiphol.

![Figure 3-Going Forward in Time](image)

Assuming that defensive actions are successful in slowing the growth rate, there might still come a point in time when the capacity constraint -- 44 million passengers -- is reached. At this time,
corrective actions could provide a solution to the need for capacity -- a solution that does not require the existing policy objectives to be changed or new infrastructure to be built. One corrective action that could be taken would be to change the capacity constraint -- increasing the number of passengers that can be accommodated at Schiphol from 44 to 55 million. Another corrective action would be to remove the capacity constraints altogether, while leaving the noise regulations in place. If the latter corrective action were implemented, Schiphol would be able to accommodate higher levels of demand without the construction of new infrastructure or changes in policy objectives. (It would not even require changing the objective of improving environmental quality.)

However, defensive and corrective actions would not allow Schiphol to accommodate growth in demand for an indefinite period of time. If demand were to continue to grow, there would come a time when growth could no longer be accommodated at Schiphol. At this point, existing policy would have to be modified or replaced. Given the long lead times that are required for building new infrastructure, the reassessment of existing policy should not be delayed until demand comes close to or exceeds available capacity. If it were delayed this long, there would come a time at which there was not enough capacity at Schiphol to accommodate the demand; i.e., there would be a capacity gap. Conversely, if the reassessment were started too early, there would be a danger that a decision might be made to build new infrastructure that may not be needed. For example, the figure shows that, if there were no hub carrier at Schiphol, demand could decline. Because of uncertainties like this, there is no way to know the right time to start construction of new infrastructure. Even the best laid plans can go awry. However, an adaptive policy provides a way of achieving the best possible outcomes, even when the future turns out to be different from what was expected.

Suppose that a reassessment were triggered based on continued strong growth in demand. Further, suppose that the reassessment were to find that demand could not be accommodated at Schiphol without violating the noise constraints. Given these two assumptions, the government would have at least the following three courses of action. First, it could decide not to accommodate growth in excess of what
can be accommodated within the 35Ke noise contours. (Whether this meant 55, 65, or 75 million passengers is not important.) Depending on what was happening at other European airports, it might turn out that an airport limited to 55 million passengers would be too small to be a mainport serving as a base for one of the dominant European airlines. If this turned out to be the case, the objective of developing of Schiphol as a mainport might have to be changed.

Second, the government might decide to accommodate all future growth at the current location of Schiphol. This would require lifting the noise constraints currently in place. Third, the government might decide that it wants to accommodate future growth, but not at Schiphol. It could then decide to close down Schiphol and build a new airport at another location.

Assembling a new basic policy would require a detailed comparison of the costs, benefits, and vulnerabilities of each of these three courses of actions. After carrying out this analysis, a new basic policy would be assembled and implemented, its vulnerabilities identified, mitigating and hedging actions put into place, signposts set up, monitoring begun, and triggers established. Then the process of defending, correcting, and reassessing the new policy would be restarted.

Thus, the adaptive policy framework provides a way to link information and events to actions in a systematic way in order to try and achieve the government’s policy objectives in a very uncertain world.
### Table 2

**Elements of the Illustrative Adaptive Policy**

<table>
<thead>
<tr>
<th>Policy Objectives:</th>
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<tbody>
<tr>
<td>Development of Schiphol as a mainport</td>
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<tr>
<td>Improvement in the environmental quality around Schiphol</td>
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</tbody>
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**Definition of Success:**
- Presence of a dominant European carrier at Schiphol
- Reduction in the number of disturbed or annoyed people near Schiphol
- Reduction in aircraft exhaust emissions and ground access emissions
- No increase in third party risk

**Constraints:**
- 44 million passengers
- 3.3 million tons of cargo
- Geographic boundaries of the 35Ke contour defined in PKB-Schiphol
- No new construction within the 35Ke contour
- Reduction of dwellings within the 35Ke contour to specified levels

**Basic Policy:**
- Construct fifth runway
- Install new radar and landing systems to increase capacity of runways during low visibility conditions.
- Implement measures to ensure that the actual noise produced does not exceed permitted levels

**Conditions for success:**
- Availability of measures to meet the noise constraint
- Continued viability of KLM.
- Growth in passenger and cargo demand no higher than the 5% assumed in setting the capacity constraints.

**Vulnerabilities:**
- Schiphol is unable to stay within the 35Ke noise contour.
- Growth in demand at Schiphol is more than 5% per year.
- People become more bothered by the noise around Schiphol
- Uncertain future of KLM

**Signposts:**
- Size of the actual 35Ke noise contour
- Number of dwellings in 35Ke noise contour
- Number of persons exposed to third party risk
- Trends in aircraft size and load factors
- Growth in KLM passengers
- Actual and forecast growth of transfer passengers at Schiphol
- Actual and forecast growth of air travel in Europe
- Actual and forecast growth of air cargo market at Schiphol
- Level of use of full freighter aircraft at Schiphol
- Capacity developments at other European airports
- Excess capacity at major European airports
- Emergence of low-cost airlines
- Changes in the aeropolitical restrictions regulating air travel between the EU and other countries
Selective Triggers:
KLM grows at 10-15% per year for the next five years.
Proportion of transfer passengers at Schiphol increases to more than 60%.
Air travel forecasts predict continuation of growth at 5-6% per year for the coming decade.

Defensive Actions:
Institute differential fees for airlines based on their contribution to the noise load.
Be more selective in the accommodation of demand.
Raise passenger taxes on transfer passengers.
Move commuter and cargo flights to regional airports.

Corrective Actions:
Relax the constraints on passengers and cargo at Schiphol.
Allow the geographic boundaries of the 35Ke noise contour to be changed.

Reassessment:
Change policy objectives (e.g., so that developing Schiphol as a mainport is not an objective).

Note: This list is not intended to be exhaustive; it is merely illustrative.
4. CONCLUSIONS

In the past, the growth of commercial civil aviation was more or less certain, so decisions about investments in physical infrastructure for accommodating this demand were relatively easy. Global demand for air transport was growing steadily and so was demand at individual airports. But, the world is changing. Although most people still expect global demand for air transport to grow, the growth of demand at individual airports is far less certain. This poses a problem for policymakers who have to decide if infrastructure investments should be made at an individual airports and, if so, how much capacity the airport should have. The adaptive policy framework and adaptive policymaking process presented in this paper is intended to help deal with this problem.

The essence of adaptive policymaking can be stated in two words: flexible and dynamic. As illustrated in Fig. 2, adaptive policymaking is a dynamic process that cycles among defining objectives, measures of success, and policy actions. It starts out by defining the policy objectives and ways of measuring the performance of policy actions against these objectives. The policy objectives are a statement of where a policymaker would like to be in the future. Policy actions are specified, as is the way they will be implemented over time. (The wide range of policy options available to policymakers are described in Sec. 1.) The process begins with the development of a basic policy. Mitigating and hedging actions are added to the policy in order to address certain and uncertain vulnerabilities in the base policy (see Sec. 2). The measures of success track the progress of the policy actions in attaining the desired objectives.

Once the implementation of policy actions is started, nothing much needs to be done if everything proceeds according to plan. However, if things do not go as planned, and they rarely do, some additional actions will be needed. These actions can be in the form of changes to the policy already in place, additional actions to increase the likelihood of achieving the policy objectives with the current policy, or a reassessment of the policy objectives and measures of success, which could lead to a new policy. A key component of the adaptive policy framework is a monitoring mechanism
that tracks developments that can affect the odds of success of the policy. Signposts and triggers are made an integral part of a policy's implementation.

The adaptive framework provides a way of integrating all of the elements of the policy in a systematic and coherent manner.
REFERENCES

