

EUROCONTROL
Experimental Centre

Frantz Buch Knudsen

**Defining Sustainability in
the Aviation Sector**

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Defining Sustainability in the Aviation Sector

Frantz Buch Knudsen

ISA Software Ltd

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Abstract: A review on how the three fundamental pillars of Sustainability - namely, Society, Environment and Economics - are interpreted by a range of key actors, including international and inter-governmental organisations, airlines, Air Navigation Service Providers, the ATM Industry, aircraft and engine manufacturers. Whilst recognising that air transport is a driver for economic and social development, the weight given to each of the three pillars by the different actors largely reflects the "political" message that they wish to disseminate.						

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Abbreviations

The following abbreviations have been used in the report:

ACI	Airports Council International
ASK	Available Seat Kilometre
ATAG	Air Transport Action Group
ATC	Air Traffic Control
ATM	Air Traffic Management
BA	British Airways
CAA	Civil Aviation Administration
CAEP	Committee on Aviation Environmental protection
CNS	Communication, Navigation and Surveillance
CO2	Carbon dioxide
DOC	Direct Operational Costs
EATMP	European Air Traffic Management Programme
EBITA	Earning Before Interest, Tax and Amortisation
EC	European Commission
EEC	EUROCONTROL Experimental Centre
EHS	Environment, Health and Safety
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
ERA	European Regions Airline Association
EST	Environmental Sustainable Transport
EU	European Union
FAA	Federal Aviation Administration
FOC	Fixed Operational Costs
IATA	International Air Traffic Association
ICAO	International Civil Aviation Organisation
IPCC	Intergovernmental Panel on Climate Changes
Nox	Nitrogen Oxides
OECD	Organisation for Economic Cooperation and Development
RPK	Revenue Passenger Kilometre
SARS	Severe Acute Respiratory Syndrome
SAS	Scandinavian Airlines System
SD	Sustainable Development
SEA	Strategic Environmental Assessment
Sox	Sulphur Oxides
T&E	Transport and Environment
UK	United Kingdom
UZA	Unique Zürich Airport
VOC	Volatile Organic Compounds
WSSD	World Summit on Sustainable Development

Executive Summary

Scope

This document has been produced in the scope of the first phase of research into the *use of economic instruments for the management of sustainable growth in the air transport system*. The project, sponsored by the EUROCONTROL Experimental Centre has a first objective to try to identify the meaning of *sustainability* in the aviation sector from all of the stakeholder viewpoints.

This report on defining sustainability in the aviation sector has been produced as part of a research activity in the field of economics and sustainability, implying de facto a focus on long-term equilibrium between society, environment and economics.

Objectives

The aim of the study is to address the link between pricing options for Air Navigation Services and “sustainability”. As such, the study has been organised in two steps:

- The first one seeking to define what sustainability means for all of the various aviation stakeholders (e.g. Air Navigation Service Providers, Airlines, Airports, Passengers, Lobby Groups etc. as well as for the society as a whole).
- The second step will consist in identifying economic options that are consistent with the definitions of sustainability given in step one and that promote such sustainability.

Summary

In the scope of Phase I the report considers the definitions, approaches, and attitudes regarding the terms sustainability and sustainable development from the perspective of the each of the various stakeholders.

It has become clear from the study that no commonly agreed definition is currently used in the aviation sector or by the stakeholders related to the sector. Most organisations use limited definitions, which meet the organisations’ political ability or the operators’ commercial objectives.

However, despite the fact that they all have slightly different and in some cases quite different interpretations of the priority and range of the sustainability concept, it is important to note that all efforts within this field point in the same direction whether it is a worldwide general political statement from a UN organisation or a commercial objective by an airline in a very competitive market. They all recognise the importance of economic and social growth as well as sustainable and prudent environmental behaviour.

With this in mind, an overall objective for the European aviation sector has been drafted as follows:

“The overall objective of the aviation sector is to meet market demand for air traffic services without sacrificing present and future social and ecological values”.

Whilst this statement remains very general, we believe that it reflects the problem of defining sustainability from all stakeholder viewpoints. In order to address the difficulty of finding a common definition, two approaches have been taken:

- a) Production of a Stakeholder Viewpoints *Score Card* model. This has been developed to include the overall objectives and the subordinated objectives for each group of players in the aviation sector. To establish more measurable criteria, additional indicators have been identified that can be used to evaluate how each of the stakeholder viewpoints might be calculated. The *Score Card* model is shown overleaf.
- b) In addition to the *Score Card* approach, a *Commonality Matrix* has been developed – unlike the *Score Card* approach, which considers each of the stakeholder viewpoints and attempts to find a central commonality, the *Commonality Matrix* attacks the issue from the metrics viewpoint – identifying key indicators and making informed assessments of the level of interest of each stakeholder in that metric.

Preliminary Conclusions

The Stakeholder Viewpoint *Score Card* diagram is a good illustration of the difficulties faced in identifying a common view of sustainability. However this approach does not appear to achieve the desired objective, in that it is difficult to form a common synthesis of all the indicators.

The *Commonality Matrix*, however, offers more promise that a common view of the components of sustainability can be identified. Recalling that the long-term objective of the project is to try to identify economic instruments to help promote sustainability in the aviation sector, using the common elements of the matrix seems to be the best approach for the next phase of the research. Within the matrix it is notable that most of the stakeholders would like to see the same changes in the majority of the metrics (e.g. all stakeholders would like to achieve a reduction in emissions – whether it be directly, as is the case for lobby groups and NGO’s or indirectly as is the case for airlines who would like to burn less fuel to reduce costs). The subsequent phase will review this approach and develop it to produce prototype utility functions that can be tested

Stakeholder Viewpoints Score Card Model

<p><u>General int. org.</u></p> <p>Objective: To secure a balanced development of the world society</p> <p>Indicators:</p> <ul style="list-style-type: none"> • GDP per capita • Unemployment rate • CO2 emission • NOx emissions • Fuel consumption • External costs • Regional development 	<p><u>Int. aviation org.</u></p> <p>Objective: To promote the common interests of the aviation sector and the implementation of for instance the UN protocols.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • EBITA for the sector • CO2 emission • NOx emissions • Fuel consumption • Improvement of ATM efficiency • Safety and security • Yield 	<p><u>Airlines</u></p> <p>Objective: Long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • EBITA • Direct operational costs • CO2 emission • NOx emissions • Fuel consumption • Cabin/load factor • ATM performance • Safety and security • Yield
<p><u>NGOs</u></p> <p>Objectives To protect the environment through reduction of transport services especially air transport.</p> <p>Indicators</p> <ul style="list-style-type: none"> • GDP per capita espec. in dev. countries • Unemployment rate esp. in dev. countries • CO2 emission • NOx emissions • Fuel consumption • External costs • Regional development 	<p><u>The aviation sector</u></p> <p>Overall objective: To meet market demand for air traffic services without sacrificing present and future social and ecological values.</p>	<p><u>Aircraft and engine producers</u></p> <p>Objective: Long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • EBITA • Direct operational costs • CO2 emission • NOx emissions • Fuel consumption • Alternative fuel sources • Cabin/load factor • Safety and security • Indirect interest in ATM and commercial performance
<p><u>Consumers</u></p> <p>Objectives A safe and cost/price efficient air-transport system which satisfy the</p>	<p><u>ATM providers</u></p> <p>Objectives To produce safe and efficient air traffic services</p>	<p><u>Airports</u></p> <p>Objective: Long-term shareholder value by embracing opportunities and</p>

<p>professional and leisure travel needs.</p> <p>Indicators</p> <ul style="list-style-type: none"> • Waiting time • Safety and security • Price • Number of routes • Frequency • Routes to remote places 	<p>Indicators</p> <ul style="list-style-type: none"> • EBITA or cost recovery • Actual distance flown compared to great circle • Flying time • Vertical profile • Delays • Safety and security 	<p>managing risks deriving from economic, environmental and social developments.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • EBITA or cost recovery • CO2 emission • NOx emissions • Noise reduction • Min. delays • Safety and security • Number of routes • Routes at all (for remote airports) • Energy consumption • Waste production
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Table 01a: Score Card model

Indicators	Int. org	Int. aviation org	Airlines	Engine/airframe	Airports	ATM incl. EUROCONTROL	Consumers	NGDs	Society
Macro economic indicators									
GDP per capita	Economic & social growth ↗							Esp. in dev. Countries ↗	Gen. aviation sector ↗
Employment Rate	Increased employment ↗							Esp. in dev. Countries ↗	Gen. from aviation sector ↗
Industry performance indicators									
EBITA	Satisfaction EBITA ↗	Satisfaction EBITA ↗	Satisfaction EBITA ↗	Satisfaction EBITA ↗	Satisfaction EBITA ↗	Satisfaction EBITA (privatised) ↗			
Cost recovery			Want min. DOC ↗	Products with min. DOC ↗	Cost recovery (non-privatised) ↗	Cost recovery (non-privatised) ↗			
DOC per ASK/ATK									
Aircraft performance indicators									
CO2 emission per ASK/ATK	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗		Emission reduction ↗	Emission reduction ↗
NOx emission per ASK/ATK	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗		Emission reduction ↗	Emission reduction ↗
Noise in airport	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗		Noise reduction ↗	Noise reduction ↗
Fuel consumption per ASK/ATK	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗		Fuel reduction ↗	Fuel reduction ↗
Alternative fuel sources	Emission reduction ↗		If more profitable ↗	Are considering					
Capacity use indicators									
Cabin factor			Improve cabin factor ↗	Provision of right size & config					
Load factor			Improve load factor ↗	Provision of right size & config					
ATM procedure indicators									
Actual distance flown		Shortest distance ↗	Shortest distance ↗	Indirect interest in ATM efficiency		Shortest distance ↗			
Flight time		Shortest flight time ↗	Shortest flight time ↗	Indirect interest in ATM efficiency		Shortest flight time ↗			
Div. from great circle distance, short flights		Min. diversion ↗	Min. diversion ↗	Indirect interest in ATM efficiency		Min. diversion ↗			
Div. from great circle distance, long flights		Wind optimal diversions ↗	Wind optimal diversions ↗	Indirect interest in ATM efficiency		Wind optimal diversions ↗			
Vertical profile efficiency		Optimal vertical efficiency ↗	Optimal vertical efficiency ↗	Indirect interest in ATM efficiency		Optimal vertical efficiency ↗			
Delay indicators									
Approach		Min. waiting and delay ↗	Min. waiting and delay ↗		Min. waiting and delay ↗	Min. waiting and delay ↗			Min. waiting and delay ↗
On the ground		Min. waiting and delay ↗	Min. waiting and delay ↗		Min. waiting and delay ↗	Min. waiting and delay ↗			Min. waiting and delay ↗
External cost indicator									
Safety and security	Reduction of external costs ↗	Maintain safety ↗	Maintain safety ↗	Maintain safety ↗	Maintain safety ↗	Maintain safety ↗		Reduce external costs ↗	Reduce external costs ↗
Demand indicators									
Yield		Satisfaction for sector ↗	Max. yield ↗	Indirect interest in market demand					
Price per ASK/ATK			Competitive mix of prices	Indirect interest in market demand					Min. price ↗
Routes (city pairs)			Competitive network	Indirect interest in market demand					Max. routes choice ↗
Frequency			Competitive connections	Indirect interest in market demand					Max. frequencies to choose* ↗
Subsidised routes	Regional development		Interest to operate such routes	Indirect interest in market demand	Interest from remote airports ↗				for remote destinations ↗
Airport indicators									
Energy consumption				Min. energy consumption ↗					
Waste production				Min. waste production ↗					

Table 01b: Commonality Matrix for Aviation Sector

1. Introduction

1.1 Development trends in the aviation sector

Following a year of decline in 2001 and two successive years of stagnation, world airline passenger traffic is forecasted to rebound with 4.4 per cent growth in 2004 and to continue to expand at 6.3 per cent in 2005, according to the latest forecasts prepared by the International Civil Aviation Organization (ICAO).

ICAO summarises the present status of the civil aviation sector as follows:

“In 2001, the total (domestic and international) scheduled passenger traffic, measured in terms of Revenue Passenger Kilometre performed (RPK), fell by 2.9 per cent as a result of a slowing world economy and the events of 11 September. These effects continued into 2002 and were intensified by the build up to war in Iraq; traffic in that year grew only marginally by 0.4 per cent. Traffic fell in the first part of 2003 because of the war and particularly the impact of concerns regarding Severe Acute Respiratory Syndrome (SARS). Recovery is now under way and traffic for 2003 is expected to be about the same as in 2002 on year-on-year basis.

Total scheduled passenger traffic generated by airlines based in ICAO's 188 Contracting States was 3 017 billion RPKs in 2000, dropped to just under 2 930 billion RPKs in 2001, stayed at that level in 2002, and is expected to remain there for 2003. Traffic is expected to rise to about 3 100 billion RPKs in 2004 and about 3 300 billion RPKs in 2005.

Traffic development will vary in geographical regions because of the impact of local, intra- and interregional factors. Traffic development of both North American and European carriers is stabilizing with an expected “zero growth” in 2003 before recovery gets fully under way in 2004 and 2005. North American carriers were hit the hardest by the shrinking demand following 11 September 2001, and their passenger traffic is expected to recover to year 2000 levels only by 2004. Scheduled passenger traffic of airlines based in Asia/Pacific, which were generally affected the most by the effects of SARS is expected to decline by 0.8 per cent in 2003 but to recover at the rates of 4.9 and 6.8 per cent for the years 2004 and 2005. Carriers of Africa, the Middle East, and Latin America/Caribbean are forecasted to achieve moderate passenger traffic growth in 2003, with increased growth from 2004 onward” (ref. Annex no. 1, doc. no. 22)

The long-term trend can be illustrated as shown overleaf (based on ICAO and Boeing forecasts):

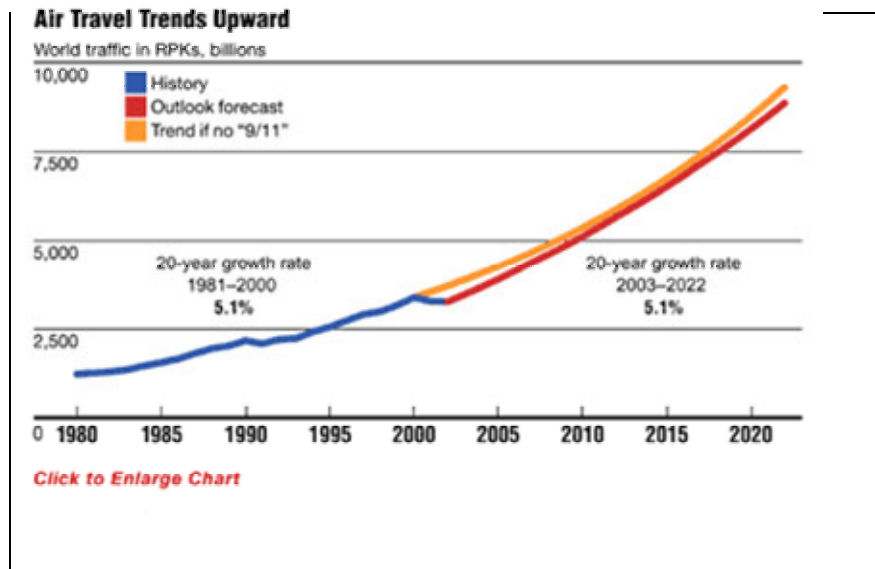


Figure 01: Forecast for air traffic (ref. Annex no. 1, doc. no 25, 33, 37)

The ICAO forecasts assume gradual restoration of passenger confidence in international travel, improved application and facilitation of aviation security measures, an improving world economy, and a stable operating environment. In the longer term, global scheduled passenger traffic growth can be expected to proceed at an average annual rate of around 4 per cent, slightly lower than pre-2001 trend projections and with about a three year time lag. For more detailed forecast for the aviation sector it is recommended to study the forecast prepared by ICAO, IATA, Airbus and Boeing Airplane Company (ref. Annex no. 1, doc. no 25, 33, 37)

Thus it is clear that the air transport sector continues to be a growth industry and it is extremely important to the economic and social growth in both the industrialised countries and the developing countries.

However, the rate of growth of the aviation industry is faster than the rate of introduction of technological and operational advances that reduce environmental impact at their source. Consequently, the overall environmental impact is expected to grow, since the gap between the rate of growth and environmental improvements appears to widen, especially with respect to greenhouse gases and noise. This trend is unsustainable and must be reversed in order to secure improvements that outweigh the environmental impact of the growth in the sector.

In general this imbalance has been recognised by all stakeholders in the aviation sector but the objectives and actions to solve the problem are neither

fully agreed upon nor coordinated. This problem will be discussed further within the subsequent chapters of this paper.

1.2 Objectives of Phase 1

In the Terms of Reference and in the ISA Software proposed approach for the project it is stated that the overall objective is to study the complex subject of using economic instruments to manage the sustainable growth of the air transport system.

At the kick-off meeting August 5, 2003 the overall objective was discussed and an expanded Terms of Reference for the two phases was agreed. The following specific objectives were defined for Phase 1:

“Phase 1 will include a draft definition of sustainability, especially in light of the need for a common understanding of sustainability from all of the stakeholder viewpoints”.

During the execution of the project it has become clear that few organisations and stakeholders in the sector have a clear definition of sustainability, but most stakeholders have an approach, a policy, an attitude, or some strategy in the field of sustainability or environmental issues. In light of this additional information, the various stakeholder viewpoints and policies toward the sustainability issue are also considered in order to help clarify the situation.

It is also recognised that the EU work currently being carried out in conjunction with EUROCONTROL to perform a *‘study on the implementation rules of economic regulation within the framework of the implementation of the Single European Sky’* (ref. Annex no. 1, doc. no 16) will form an important input especially for Phase 2.

1.3 Data sources

Studies, documents, research results and statements from UN, ICAO, ACI, IATA, OECD, EU, EUROCONTROL and others as well as from commercial aviation operators, NGOs and research organisations have been taken into consideration in defining sustainability in the aviation sector. The complete list of documents is attached in Annex 1.

2. Semantics of sustainability

2.1 The Oxford English Dictionary

The Oxford English Dictionary defines sustainable as follows:

sustainable (adj):

1. *Capable of being borne or endured; supportable, bearable*
2. *Capable of being upheld or defended; maintainable*
3. *Capable of being maintained at a certain rate of level*

Thus the Oxford English Dictionary meaning of the word and its synonyms is clear, but when linked to development or to emerging environmental and social policy, confusion sets in.

Far from being defined, sustainability is subject to a wide range of general and specific interpretations both in the general political debate and specifically within the aviation sector and among its stakeholders.

The Indian Director of St. Joseph's College, Darjeeling, India, Milindo Chakrabarti, (ref. Annex no. 1, doc. no 54) has correctly pointed out that sustainable development is an oxymoron like "bright darkness" or an "honest liar". A typical textbook defines development as "growth with change", which is basically contradictory to sustainability, which implies an uninterrupted continuous process or condition. Sustainable development becomes a truism if, and only if, we accept development to cover changes in certain social and environmental factors within its ambit.

This report is not supposed to be an academic paper on semantics but it is important to understand that the concept "Sustainable Development" (the abbreviation SD is often used) has a built-in contradiction, which of course gives basis for a wide range of interpretations and definitions both in the aviation sector and in general.

In many respects SD has become a buzzword without a clear communicative meaning – it is often used to show politically correct attitudes and behaviour.

Mr. Chakrabarti has illustrated the contradiction of SD in the following chart:

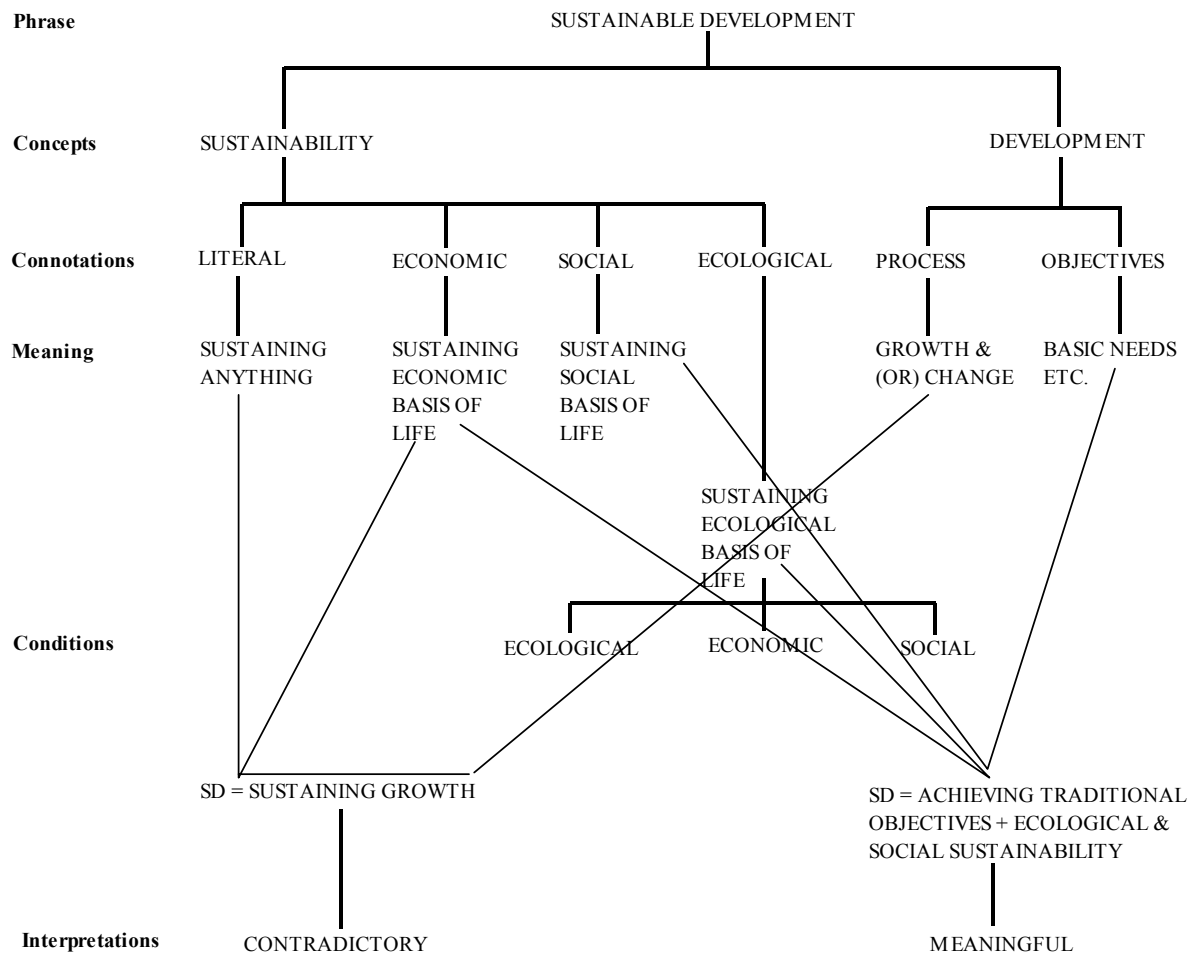


Figure 02: Semantics of sustainable development (ref. Annex no. 1, doc. no 54)

2.2 Eco-efficiency and sustainability

It will become apparent in the subsequent chapters of this report that SD is often used as a synonym for eco-efficiency or environmental efficiency and mitigation in the sense of reducing environmental impact per unit of business performance, for instance per RPK or ASK or aircraft movement. The aim is to “do more with less”.

The pursuit of eco-efficiency does not imply a constraint on growth in the scale of an activity. Eco-efficiency is a win-win activity for both corporate growth and the environment, provided that the environment is defined only in few measurable terms such as noise and emissions.

In this respect it could be mentioned that noise is often pointed out as one of the key factors in the SD. However, “even the biggest bang or the noisiest old jet engine has absolutely no impact on the natural environment” (ref. Annex no. 1, doc. no 45). When the noise is over the nature will be completely untouched and even animals often choose for themselves to live next to airports or railway lines. However, noise can of course be disturbing to man for a short period of time.

True SD is not the same as eco-efficiency but requires product and life cycles linked to protocols for allocating consumption of resources and emission quotas and indicators for social and economic growth.

2.3 External costs

A third concept often related to SD is the concept of “External costs”. These are generally defined as the costs that are not reflected in the price paid by the user/traveller and are not factors put attention to in the market (ref. Annex no. 1, doc. no 43). Individuals using a given form of transportation are not generally aware of the external costs generated and it is possible that many of these costs may have never even been defined. Broadly, the external costs can be defined as costs due to:

- Accidents
- Air pollution
- Climate change
- Noise
- Congestion
- Other environmental side effects

In the Journal of Air Transport Management, Volume 7, 2001 the Environmental externalities in the air transport markets are discussed. It is stated that the external effects can be categorised as follows:

- External effects depending directly on the output in airline markets: Local air pollution, global pollution, soil pollution, noise annoyance, accident risks, and congestion.
- Indirect external effects, upstream or downstream: Pollution associated with aircraft and kerosene production, disposal of scrapped aircraft, over exploitation of carbon-based fuels, airport waste, and environmental harmful materials used in aircraft servicing and maintenance.

- External effects associated with presence of infrastructure: Deterioration of eco-systems through airport construction, water and soil pollution through airport operation.

2.4 The semantic mix-up

Even though SD, eco-efficiency, and external costs and derivations of these terms can be defined in a more or less precise way from a scientific point of view it has become clear from our research that the words and concepts are often used at random and interpreted in many different ways depending on the interests and framework of the stakeholders in the aviation sector itself, and depending on the political and attitudinal interests of external stakeholders to the sector. Again, this will be considered in greater detail in the rest of this document.

Summary of Chapter 2: Semantics of sustainability

- The word sustainable and the concept sustainable development are very often used at random and with different meanings and interpretations.
- The concept “Sustainable Development” has a built-in contradiction, which gives basis for a wide range of interpretations and definitions both in the aviation sector and in general.
- Furthermore, the concept sustainable development is very often used in a restricted way meaning eco-efficiency with respect to a few parameters – most often greenhouse gas emissions and noise.
- In academic transport research papers the issue of external costs is often addressed but it is rarely considered in the operational part of the aviation sector.

3. International Organisations

3.1 United Nations – UN

The term “Sustainable Development” or SD came to prominence in the UN publication “Our Common Future” from 1984, better known as the **Brundtland Report**. The report coined the most widely accepted definition of SD:

“Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs”.

The definition is of course open to wide discussion and interpretation but the main achievement was no doubt that SD was put on the political agenda promoting focus on the issues related to SD.

The next step within the UN was the Rio Conference in 1992, also known as the *Earth Summit*. In general, many of the findings in the Brundtland report were endorsed at the Rio Conference. In particular it was acknowledged that:

- Poverty is a major cause of environmental degradation and thus any sustainable future needs to address the social and economic factors underpinning world poverty.
- Past economic growth was responsible for substantial improvements in the quality of life for many of the world’s citizens; however, this has been achieved at a considerable cost to the natural environment.
- Solutions to the development problems identified will require action of all the people of the planet at every organisational and regional level, given the interrelated and interdependent nature of many of the environmental, economic, social, and political challenges presented.

It is important to note that the Rio Conference acknowledged growth as the main vehicle for combat of poverty and continued improvement of the quality of life but without degradation of the capacity for future development. Thus the Brundtland report and the Rio Conference acknowledge the dynamic part of SD and put a stronger emphasis on development and improvement of life rather than on sustainability or preservation of the present conditions.

The UN resolutions are by nature rather general while the more specific issues are dealt with by UN sub-organisations and specific conferences. In the case of aviation the issues are managed by the UN agency ICAO.

The different general UN initiatives in the field of sustainability and environmental protection can be summarised as follows:

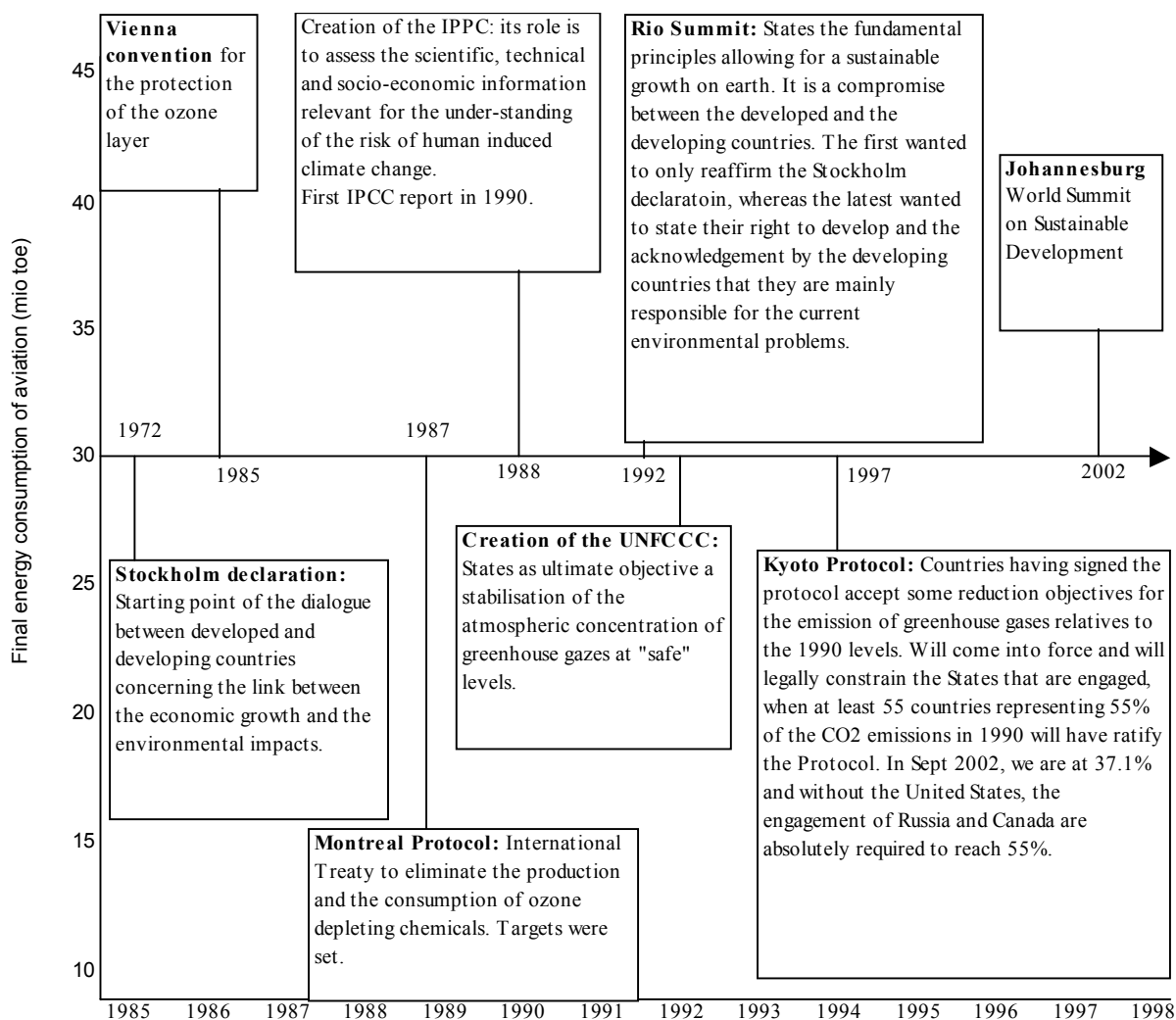


Figure 03: UN initiatives in the field of sustainability (ref. Annex no. 1, doc. no 7)

ICAO has presented several different documents to the UN, among others: Background Paper No. 9, Aviation and Sustainable Development to the Ninth UN Session in New York 16-27 April 2001. The content of this document will be dealt with in detail in Chapter 5.1 in this report (ref. Annex no. 1, doc. no 21)

3.2 Intergovernmental Panel on Climate Change – IPCC

In 1999, under the UN umbrella the Intergovernmental Panel on Climate Change (IPCC) was requested by ICAO and the parties to the Montreal Protocol on

Substances that deplete the Ozone Layer to carry out a study on “Aviation and the Global Atmosphere”.

The resulting report does not deal with definitions or the broad scope of sustainability issues. It is merely a technical and scientific report that throws light on the expected levels of emissions under different growth scenarios and technical assumptions for the future development in the aviation sector. One aspect that should be mentioned about the study is that it foresees a *reduction of aviation fuel burn* of 6-12% within the next 20 years due to improved Air Traffic Management systems. It is assumed that this will mainly come from new institutional arrangements at an international level.

The report itself, however, does not contribute to the issue of defining sustainability but it is an important document as it is used as a basis for the ICAO SD policy and as input for discussions and studies in other environmental contexts.

3.3 Organisation for Economic Cooperation and Development – OECD

The Environment Ministers of the OECD member countries endorsed the Guidelines for moving towards Environmentally Sustainable Transport (*EST*) at their meeting in May 2001. These Guidelines are based on the results and conclusions of the *EST* project involving many OECD and non-OECD countries and provide a solution to making transport policy more sustainable and enhancing quality of life. They have been created to enable economic development and individual welfare without causing undue health and environmental impacts and depletion of finite resources.

Even though the OECD approach for the transport sector cannot be considered as a definition, the guidelines have a broad sustainable perspective including both the economic and social benefits as well as the environmental impacts. OECD has not carried out specific studies for the aviation sector but has focused on surface transportation and in particular railway transportation. The OECD guidelines read as follows:

The EST Guidelines

The EST Guidelines were endorsed by OECD Environment Ministers at their meeting in May 2001 to assist governments at all levels in the development and implementation of strategies towards EST.

Guideline 1. *Develop a long-term vision of a desirable transport future that is sustainable for environment and health and provides the benefits of mobility and access.*

Guideline 2.	<i>Assess long-term trends, considering all aspects of transport, their health and environmental impacts, and the economic and social implications of continuing with ‘business as usual’.</i>
Guideline 3.	<i>Define health and environmental quality objectives based on health and environmental criteria, standards, and sustainability requirements.</i>
Guideline 4.	<i>Set quantified, sector-specific targets derived from the environmental and health quality objectives, and set target dates and milestones.</i>
Guideline 5.	<i>Identify strategies to achieve EST and combinations of measures to ensure technological enhancement and changes in transport activity.</i>
Guideline 6.	<i>Assess the social and economic implications of the vision, and ensure they are consistent with social and economic sustainability.</i>
Guideline 7.	<i>Construct packages of measures and instruments for reaching the milestones and targets of EST. Highlight ‘win-win’ strategies incorporating, in particular, technology policy, infrastructure investment, pricing, transport demand and traffic management, improvement of public transport, and encouragement of walking and cycling; capture synergies (e.g., those contributing to improved road safety) and avoid counteracting effects among instruments.</i>
Guideline 8.	<i>Develop an implementation plan that involves the well-phased application of packages of instruments capable of achieving EST taking into account local, regional, and national circumstances. Set a clear timetable and assign responsibilities for implementation. Assess whether proposed policies, plans, and programmes contribute to or counteract EST in transport and associated sectors using tools such as Strategic Environmental Assessment (SEA).</i>
Guideline 9.	<i>Set provisions for monitoring implementation and for public reporting on the EST strategy; use consistent, well-defined sustainable transport indicators to communicate the results; ensure follow-up action to adapt the strategy according to inputs received and new scientific evidence.</i>
Guideline 10.	<i>Build broad support and co-operation for implementing EST; involve concerned parties, ensure their active support and commitment, and enable broad public participation; raise public awareness and provide education programmes. Ensure that all actions are consistent with global responsibility for sustainable development.</i>

Table 02. OECD guidelines for sustainable transport (ref. Annex 1 doc. no.61)

3.4 European Union / European Commission – EU/EC

3.4.1 General policy

The Treaty of Amsterdam calls for a policy of integration of environmental concerns into sectoral policies. The Commission has identified four main pillars of a strategy integrating environmental concerns into air transport policy. They are:

- improving technical environmental standards on noise and gaseous emissions
- strengthening economic and market incentives
- assisting airports in their environmental endeavours
- advancing long-term technology improvements (Research and Development)

The Commission presented the details of this strategy in its communication COM (1999) 640 "Air Transport and the Environment. Towards meeting the Challenges of Sustainable Development".

Despite the fact that all four issues are important for the reduction of environmental impacts from the aviation sector, the strategy does not include a sustainable approach taking both the benefits and costs of air traffic into consideration. Using the previous mentioned broad definitions of sustainability the EU approach is more an eco-efficiency approach than a balance of both sides of the equation.

In the document “Air Transport and the Environment Towards meeting the Challenges of Sustainable Development” it is stated:

”Air transport is a growth industry. This implies that this industry is important for the economies of the European Union. But the air transport industry is growing faster than we are currently producing and introducing technological and operational advances which reduce the environmental impact at source. The overall environmental impact is bound to increase since the gap between the rate of growth and the rate of environmental improvement appears to widen in important fields such as emissions of greenhouse gases. This trend is unsustainable and must be reversed because of its impact on climate and the quality of life and health of European citizens. The long-term goal, therefore, must be to achieve improvements to the environmental performance of air transport operations that outweigh the environmental impact of the growth of this sector. Meeting this challenge necessitates, in line with the provisions of the Amsterdam Treaty, significantly enhanced integration of environmental requirements into sectoral policies as part of the European Community's

responsibilities for the promotion of sustainable development and of its responsibilities for securing an efficient functioning of the internal market.”

Whilst the word sustainable is used in the communication from the Commission it is only used as a buzzword without any associated explanation of its meaning in the proposed environmental strategy. At most it could be interpreted that the Commission imply a definition of “sustainability” as eco-efficiency.

The main focus of the strategy is aimed at noise reduction and reduction of emissions. In this connection the Commission is fully in line with the ICAO definition and approach (see chapter 5.1) (ref. Annex no. 1, doc. no 20 and 21). In 1992 the EC adopted a directive on aircraft noise and banned so-called Stage 2 aircraft (as defined in the ICAO Annex 16) from European airports. This was followed by a new directive in 1998 regarding hush-kitted Stage 1 and 2 aircraft. In March 2002 a third directive was adopted regarding noise related operating restrictions at Community airports. In this regard it should be mentioned that the EC proposes a modulation of airport charges on the basis of environmental criteria (reward the best and punish the worst principle).

In the document from 1999 the Commission summarises the proposed actions to be implemented as shown in Table 3. It should be noted that in this document the ATM is only one out of several measures proposed by the EC though this issue has got a dominant attention in recent years.

ACTION PLAN – SUMMARY

AREA	OBJECTIVES/TARGETS/ACTIONS	TARGET DATES
I. IMPROVING TECHNICAL STANDARDS AND RELATED RULES		
1. Noise	More stringent international standards and rules for transition	By 2001 (33 rd ICAO Assembly)
2. Gaseous Emissions		
NOX	More stringent international rules	By 2001 (33 rd ICAO Assembly)
CO₂ and other greenhouse gases	Reductions according to the targets of the Kyoto protocol.	2001 for review and update (33 rd ICAO Assembly)
LTO emissions	Provide proposal for an equivalent charge	By 2001 (33 rd ICAO Assembly)
Emission methodologies	To be improved, in co-operation with SBSSTA and CAEP	By 2001 (33 rd ICAO Assembly)

3. Operational Measures		
Air Traffic Management	Improve ATM efficiency	Communication end 1999
II. STRENGTHENING MARKET INCENTIVES		
1. Economic Incentives		
Aviation charges	Proposal for an aviation charge	By early 2001 (after CAEP 5)
Emission trading	Explore benefits/risks	By 2001
Carbon offsets	Explore benefits/risks	By 2001
2. Encouraging Industry Initiatives		
EMAS	Encourage airports/airlines to register under the new EMAS regulation (upcoming)	New EMAS regulation (mid 2000)
Voluntary agreements	Suggest voluntary agreements on emission reductions.	Early 2000 launch of substantive discussions
III. ASSISTING AIRPORTS		
1. A Common Noise Classification Scheme	Proposal for a Community framework on noise classification	By 2000
2. A Framework for Noise Measurement	Proposal for a common noise measurement index, a methodology for noise calculation and minimum requirements for noise monitoring	By 2001
A Framework for Land-use Rules	Guidance on best practices for land-use decisions	By 2001 (Report)
3. A Community Framework for Operating Rules	Framework for procedural rules, best practices dissemination	By 2001 (Report)
4. Introducing More Stringent Noise Rules at Individual Airports	Analyse appropriateness of a Community system for identifying noise-sensitive airports	By 2001 (Report)
5. The role of other modes	Working towards for more effective air/rail intermodality	Ongoing

IV. ADVANCING TECHNOLOGICAL IMPROVEMENT (R&D)		
Monitoring	Develop inventories of statistics and indicators through the Transport and Environment Review Mechanism (TERM) process.	TERM-Zero report to be published in early 2000, review by 2002

Table 03: EC action plan in “Air transport and the environment 1999” (ref- Annex 1, doc.13)

3.4.2 European Transport Policy for 2010

In 2001 the EC published the white paper “European Transport Policy for 2010 – time to decide” (ref. Annex 1 doc. no.19), which did not only include the aviation sector but addressed all modes of transport.

In the general introduction in the report the Commissioner for Transport addresses the importance of transport as a means of economic and social development in the Community and points out that a balance with the environment is of great importance.

When it comes to the aviation sector the focus is entirely on the issue of a more efficient use of the airspace and airport capacity. It is in fact a draft policy for the subsequent work for the implementation of the Single Sky concept. Only a short paragraph addresses the importance of noise reduction implemented in cooperation with ICAO. Finally, the subject of taxation of kerosene is raised. It is recognised that the EC is not in agreement with ICAO about this issue.

3.4.3 The single European sky

The policies behind the European Community’s accession to EUROCONTROL with respect to the implementation of a Single European sky must of course be addressed in an environmental context.

The preconditions for the EC initiative are as follows (ref. Annex 1 doc. no.12) :

“Up till 2000, there has been a sharp and steady rise in delays to aircraft. This had major repercussions for users and placed a substantial financial burden on airlines. The delays were caused in particular by the air traffic control system, which appeared to be less and less capable of handling the phenomenal growth in air travel.

In 2001, one flight in four was delayed due to air traffic problems. Despite a temporary slowdown following the attacks on 11 September, estimates are that air traffic will grow by 4% a year over the next 15 years. Delays cost airlines between €1.3 and €1.9 billion a year.

While there has been a constant increase in air traffic control capacity in Europe since 1990, it is now trailing three years behind the growth in air traffic. The technical improvements made by EUROCONTROL, the international organisation for the safety of air navigation, have not been enough to reverse the trend and delays continue, in particular, in the more central areas of the European Union of 15 Member States.”

The objectives of the Single Sky concept are:

- Enhancement of safety and efficiency
- Better use of scarce airspace and airports capabilities
- Less delays and improved service to air transport passengers

The objectives are no doubt extremely important for the future European air traffic management but the objectives are not directly related to any sustainability or environmental strategy, even though it is recognised in some of the presentations from the Commission that the implementation of the Single Sky concept will also reduce fuel consumption due to less delays and waiting time. This is of course a positive spin-off effect. The objectives are clearly efficiency related and aim mainly at a better use of the airspace capacity.

Summary of Chapter 3: Definitions used by organisations for international cooperation:

- The overall definition of sustainability is the UN - Brundtland definition, which reads as follows: “Sustainable Development meets the needs of the present without compromising the ability of future generations to meet their own needs”. The interpretation of this definition for specific sectors has been delegated to the different organisations in the UN system. For the aviation sector it is ICAO.
- OECD has developed a set of 10 guidelines for the transport sector, which have a broad sustainable perspective including both the economic and social benefits as well as the environmental impacts.
- The Commission has identified four main pillars of a strategy integrating environmental concerns into air transport policy. They are: Improving technical environmental standards on noise and gaseous

emissions, strengthening economic and market incentives, assisting airports in their environmental endeavours and advancing long-term technology improvements.

- In the white paper “European Transport Policy for 2010 – time to decide” the Commissioner for Transport addresses the importance of transport as a means of economic and social development in the Community and points out that a balance with the environment is of great importance. The practical implication of this overall policy is on the issue of a more efficient use of the airspace (the Single Sky policy) and airport capacity.

4. International Aviation Organisations

4.1 International Civil Aviation Organisation – ICAO

ICAO has acknowledged that international air-transport like most other economic activities gives rise to environmental problems. In 1999 ICAO worked out a list of environmental problems related to air traffic in order to prioritise the future work in this field.

The list contains the following:

- Aircraft noise
- Air pollution near airports
- Global phenomena (mainly Green-house effects)
- Airport and infrastructure construction
- Water and soil pollution near airports
- Airport waste management

Environment was defined as those man-made surroundings that may be adversely affected by the presence of civil aviation but are not directly involved in the aviation itself (ref. Annex no. 1, doc. no 20, 21).

It was soon realised that policymaking for environmental issues is very complex since 188 contracting states are rarely going to agree on common policies and actions.

Despite this, the overall environmental policy for ICAO was expressed as follows at the World Summit on Sustainable Development in Johannesburg 26 August – 4 September 2002:

“ICAO’s responsibility is to achieve maximum compatibility between the safe and orderly development of civil aviation and the quality of the environment”.

ICAO ended up defining a reduced list of environmental problems as follows:

- Aircraft noise
- The impact of aircraft engine emissions, at ground level and globally
- Other local problems at airports

The ICAO policy and actions focus on the two main issues that the Governments have mandated ICAO to deal with, namely aircraft noise and aircraft engine emissions. More practically, ICAO’s activities in the environmental field primarily focus on those problems that benefit most from this common, harmonised approach, namely aircraft noise and the impact of aircraft emissions. The work in

this field is mainly undertaken by the Committee on Aviation Environmental Protection (CAEP).

It is clear that ICAO is for practical purposes not using the broad approach expressed in Johannesburg but has chosen to adopt some kind of limited eco-efficiency approach by focussing on noise and emissions, which can be supported by all member states.

With respect to noise ICAO's two achievements have been reached by the adoption of new noise standards for jet engines (Chapter 4 standards) and for a balanced approach to aircraft noise management.

As regards emissions the work is primarily based on the previously mentioned IPCC report. The proposed activities include reduction of fuel burn and emissions through new technology, operational measures, and market based measures. The last two issues include the possibility of new ATM systems and emission related levies.

The development of new ATM systems relates to the implementation of improved CNS/ATM systems, which is a coordinated effort in cooperation with FAA and EUROCONTROL. The study methodology and an initial global assessment have been completed. The initial study quantifies the environmental reductions and benefits, which can be achieved, as well as baseline assessments of various ICAO regions on which to base future improvements.

In order to promote the implementation of noise reduction and emissions reduction ICAO has also proposed the use of economic instruments, i.e. noise related charges and environmental charges and taxes, which are in fact emissions charges. The specific resolutions, approach and methodology will be addressed in Phase 2 of this project.

4.2 International Air Traffic Association – IATA

With an overall view IATA has chosen a broad understanding of sustainability in the following statement from its Internet presentation regarding environmental issues (http://www.iata.org/industry_issues/environment/index.htm):

“Sustainable Development – a Balancing Act

Sustainable development seeks to balance social, economic and environmental objectives in order to secure the well-being of present and future generations. These objectives are interdependent and thus equally important. Finding the optimum balance means that difficult choices sometimes have to be made and concessions may be required.

Aviation is a good example of this: it is a consumer of non-renewable resources, a contributor to climate change and local noise problems but at the same time it makes a very valuable and unique contribution to the sustainable development of our global society.

Aviation's Role in Society, Economy and the Environment *Society*

Aviation is the safest, most efficient means of public transportation. Over long distances and across geographical barriers, no alternative means of transport exist. Aviation's vast network of affordable transportation services offers freedom to travel for nations, regions and individuals and facilitates the exchange of cultural and educational experiences. Many outlying communities would be isolated without access to air services.

Economy

Aviation fosters economic development by providing and enhancing access to regional and global markets. It is a key driver of business, travel and tourism exports and it creates employment around the globe. It raises living standards and alleviates poverty, which is conducive to less environmental degradation and a more sustainable society.

Air transport provides 28 million jobs world-wide – and is expected to provide 31 million by 2010. The total economic impact of air transport on gross world output is at least US\$1,360 billion.

Environment

Environmental performance has always been high on the aviation industry's agenda – levels of noise and emissions have come down dramatically since the start of the jet age in the early 1960's.

The world fleet has more than tripled in size over the last 25 years, but the average fleet age has remained constant at around 11 years. The "noise footprint" of a modern jet aircraft is less than 15% of that of the aircraft it replaces.

Today's newest aircraft often match the energy consumption of modern cars and in some cases – depending on speed and distance – even of high speed trains. Fuel consumption as low as 3 litres per passenger per 100 kilometres is no longer uncommon

Aviation in a Sustainable Context

Public demand for air travel is continually growing. Efforts within the industry to improve the environmental performance of its economic activities, however, must and will continue.

To interpret sustainable growth as "growth without environmental impact" – as advocated in some circles – ignores the significance of socio-economic values in the sustainability equation, thereby corrupting the very essence of the concept. Sustainable development should not be confused with environmental conservation; although closely linked, they are not the same. Environmental issues should be firmly placed in the wider context of sustainable development, striking a balance with social and economic objectives."

The IATA approach can hardly be called a definition but is clear that the organisation has chosen the wide interpretation of sustainability by including both the economic and social aspects as well as of course the environmental impact.

IATA has defined its role and strategies in relation to the above-mentioned statement as follows:

- *“Develops and promotes industry strategies for improving the environmental performance of air transport whilst enhancing its role in the sustainable development of society.*
- *Works to promote global solutions to environmental concerns whilst protecting the interests of its Member airlines.*
- *Assesses the potential impact of regulatory measures on the industry, formulates strategies and co-ordinates lobbying efforts.*
- *Enhances and expands aviation's contribution to the sustainable development of our global society.*
- *Promotes capacity improvements in an environmentally responsible manner. The Aviation Environment department works closely with the Air Transport Action Group (ATAG) on sustainability issues, such as intermodality and sustainable growth.*
- *Co-ordinates the activities of IATA's Environment Task Force (ENTAF).*
- *Brings together industry experts working to improve environmental performance.*
- *Stimulates and supports the publication of environmental good practice guidelines and programmes.*

- *Acts as a catalyst for environmental studies and research.*
- *Promotes and contributes to the development of global solutions and uniform standards through the International Civil Aviation Organization (ICAO), as well as ensuring recognition of the industry's needs and views.*
- *Participates in the activities of the Committee on Aviation Environmental Protection (CAEP), which undertakes the environmental work of ICAO. IATA is an observer to CAEP.*
- *Monitors and evaluates regional, local and international regulatory developments.*
- *Works with airlines and other industry stakeholders to formulate strategies and co-ordinate lobbying efforts when necessary”.*

IATA is mainly a member organisation for airlines and has chosen to carry out its efforts in the environmental respect through participation and influence through other international airline organisations like ATAG, ICAO/CAEP and others.

4.3 Air Transport Action Group – ATAG

ATAG is an independent coalition of aviation organisations and companies throughout the aviation industry, which have united to drive aviation infrastructure in an environmentally responsible way. It has 80 members including organisations such as IATA, Boeing, Airbus, engine producers, and many others.

The organisation has been very active in the debate about sustainability and environmental improvements. It presented a pioneering document at the World Summit on Sustainable Development (WSSD) in Johannesburg and made a follow up at the 4th Annual Aviation and Environmental Conference in Stockholm in 2003.

The starting point for the ATAG approach and definition of sustainability is that transport (or the ability to be mobile) is a precondition for the economic growth and social development. The basis is the definition proposed by the World Business Council for Sustainable Development stating that:

“Sustainable mobility can be defined as the ability to meet societies need to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human and ecological values, today and in the future”
(ref. Annex 1 doc. no.35).

The operational interpretation of this definition is a set of absolute and relative terms in order to benchmark and measure the trade-offs. These criteria are drafted as follows:

- Does aviation meet the aims and specific targets in absolute and relative terms (for example aims for regional development, quantitative standards and reduction protocols)?
- Has the performance improved in the past and is it likely to improve in the future?
- How does air transport perform in relation to other transport modes and other industries?
- Are there explicit instruments, which support the improvement in the future?

At the Stockholm meeting the approach was further developed as ATAG proposed a three-legged model:

- The sustainable approach by the aviation sector should include the link between wealth creation, environmental protection and poverty
- An improved dialogue and strengthening of partnership with external stakeholders
- The use of environmental indicators, voluntary agreements and good practices.

The important difference between the ATAG approach and the one of ICAO and IATA for instance, is that ATAG focuses more on the aviation sector as one of the important drivers for economic growth and social development. In this sense ATAG has a special focus on the developing countries, for instance Africa and South America where air traffic is the only efficient means of transportation to support economic growth, improved quality of life, and poverty reduction.

Furthermore, ATAG urges a stronger partnership with external stakeholders due to the fact that no single organisation or company is in charge of sustainability, neither in the aviation sector nor in the broader society.

Finally, ATAG is of course in line with the generally accepted aims for reduction of noise and emissions based on voluntary agreements and good practices, again balancing the benefits with the environmental costs. One or two weekly connections with an old noisy Caravelle or Boeing 737-100 aircraft with a lot of undesirable emissions can be the lifeline and basis for economic and social growth and of remote regions in a developing country. The balance has to be taken into consideration.

Although the ATAG approach remains somewhat theoretical and not very operational, it is a clear definition of sustainability which puts direct focus on the

benefits of aviation as a driver for improvement of the quality of life through economic and social growth without disregarding the importance of environmental reductions and improvements.

4.4 Airports Council International – ACI

Airports Council International (ACI) has also dealt with the environmental problems and has published a Policy Handbook with a proposed specific and detailed policy regarding airports and the environment. The overall recommendation for implementation of an environmental management system reads as follows(ref. Annex 1 doc. no.28):

“Airports should adopt an environmental management system to enable a systematic approach to the management of environmental issues associated with their operation, development and decommissioning”.

ACI also proposes detailed objectives, standards and practices for noise, emissions, air quality, fire-fighting, storm-water, de-icing of aircraft and runways, resource management and productivity, waste management, wildlife management at airports and land use.

Special attention should be aimed at ACI’s recommendations regarding airport capacity development(ref. Annex 1 doc. no.28):

“ACI supports an integrated, environmentally compatible approach to airport capacity development, consisting of reduction noise at source, strict land use planning controls around airports, aircraft/airport operational measures, as well as an efficient ground access and intermodal transportation complementarity, so as to help airports develop capacity and meet the growing demand”

While ICAO is interpreting and limiting “environmental issues” to noise reduction and emissions it is clear from the above recommendation that the international airport organisation ACI has chosen a much wider definition and approach for airport related issues than ICAO.

4.5 European Regions Airline Association - ERA

ERA is a member organisation for European Regional Airlines and the basic objective is of course to promote the interests of the member airlines.

In the general environmental info from the association ERA focuses on the value of external trade, and GDP generated and supported by the airline industry. Thus it is more a political statement than a contribution to a sustainable definition.

ERA supports the work in ICAO and ICAC with respect to noise and emissions reduction. However, the main issue for ERA is to focus on the mismatch between demand and infrastructure supply as regards both airport capacity and an efficient use of the airspace. It is the opinion of ERA that the European politicians do not take urgent and aggressive actions to increase capacity in order to meet the present and future needs.

4.6 EUROCONTROL

The EUROCONTROL Convention reads:

“ In order to achieve harmonisation and integration with the aim of establishing a uniform European ATM system, the contracting parties agree to strengthen their cooperation and to develop their joint activities in the field of air navigation, making due allowance for defence needs and provide maximum freedom for all airspace users consistent with required levels of safety in the provision of cost effective air traffic services, and taking into account the need to minimise, where it is feasible, inter alia, in operational, technical and economic terms, any adverse environmental impact” (ref. Annex no. 1, doc. no 54).

The EUROCONTROL environmental policy statement reads:

“The EUROCONTROL Agency will, in processing its work towards a uniform European ATM system, take fully into account the need to mitigate, where feasible, any adverse environmental impact. Furthermore it is reflected in the EUROCONTROL ATM Strategy 2000+, that the Agency’s general environmental objective will be to work closely with ICAO, The European Union and other relevant international and national bodies to obtain those improvements in ATM which, while providing significant operational, technical and economic benefits, mitigate the environmental impact” (ref. Annex no. 1, doc. no 54).

The following objectives can be extracted from the EUROCONTROL Environmental Policy and Strategy, approved by the EUROCONTROL Provisional Council, April 2001:

- Contributing to progressive improvements to aviation's environmental performance on an ECAC-wide basis;
- Promoting and implementing (MUAC) the use of new ATM concepts, procedures and systems that, while enhancing safety, capacity and flight efficiencies, will bring environmental benefits, including improved environmental assessment methodologies and inventories;

- Encouraging more effective air traffic operations at airports that also serve to reduce or limit the ATM-related impact of noise and gaseous emissions in the airport vicinity;
- Developing and implementing enhanced ATFM tools and practices to shorten flight times, optimise flight profiles and reduce airborne holding, thereby improving aviation's environmental performance;
- Analysing the impacts of introducing environmental charges or modulation of existing charges and implementing, as required, such arrangements into the route charges system;
- Taking into account the consequences of, inter alia, ICAO, ECAC and EU activities on environmental issues related to ATM; and
- Contributing to more efficient ATM in order to help achieve global solutions and targets to minimise aircraft emissions, which have been agreed in international conferences and appropriate bodies, such as the Kyoto Protocol and ICAO”.

More specifically, the EUROCONTROL ATM 2000+ Strategy considers that environmental implications are an essential part of the ATM decision-making process, and that, wherever possible, the most environmentally friendly solutions should be adopted. Accordingly, the following specific environmental objectives for ATM are set:

- *“To permit daily aircraft operations in such a way that all ATM-related environmental impact is minimised,*
- *To be compliant with the appropriate international standards, statutory and regulatory requirements in respect of environmental demands,*
- *To support actions which will contribute to reduce or limit noise and aircraft emissions”.*

The ATM 2000+ Strategy gives the Agency a clear mandate to work on ECAC-wide ATM-related environmental issues. This will require close co-operation with ICAO, ECAC, EU, Member States, airframe and engine manufacturers, airline operators, airports and others stakeholders to address the growing environmental concerns so as to meet these challenges with every chance of success.

Furthermore, EUROCONTROL through the European Air Traffic Management Programme (EATMP), is taking practical, operational steps towards meeting the safety, capacity, efficiency and environmental objectives of ATM 2000+. The implementation of Basic Area Navigation, Flexible use of

Airspace and Reduced Vertical Separation Minima, coupled with improvements to the route network, flow management and airport operations will result in optimised aircraft circulation on the ground, improved flight trajectories, allocation of more optimum flight profiles, shorter routes and less delays. These improvements will save fuel, reduce emissions and mitigate the impact of noise.

The EUROCONTROL EATMP programme is designed to develop and implement a broad range of projects and actions.

The objectives of the EATMP programme are:

- Increase Safety: To improve safety levels by ensuring that the number of ATM-related accidents and serious or risk-bearing incidents is reduced in real terms;
- Increase Capacity: To provide sufficient capacity to accommodate the demand in peak periods without imposing significant operational, economic or environmental penalties under normal circumstances. To enable airports to make the best use of potential capacity.
- Reduce Costs: To reduce the total Air Navigation Service cost per unit of aircraft operation
- Respect Environment: To work with ICAO (International Civil Aviation Organisation) and its Member states to obtain improvements in ATM, in particular the accelerated implementation of CNS/ATM (Communication, Navigation, Surveillance / Air Traffic Management) concepts, procedures and systems which help to mitigate the impact on the environment

There is no doubt that environmental objectives and considerations are integrated in the overall objectives for EUROCONTROL and in the specific objectives for different EUROCONTROL programmes and projects. However, there is also no doubt that the primary objectives for EUROCONTROL are to provide an efficient and safe ATM system to the airline operators and to meet the efficiency demands from among others the European Commission, which has put strong pressure on EUROCONTROL in this respect within the last couple of years.

The environmental issues and objectives are to a wide extent a spin-off of the primary objectives as shorter flying distances, and less taxi and waiting time in the airports will contribute to less emissions and noise. The objectives of environmental issues are subject to wordings like “whenever feasible” and “respect”, which means that environmental issues are subordinated to the overall objectives of efficiency and safety.

In this regard it is observed that the EUROCONTROL definition of sustainability and environmental responsibility is limited to the issues of emissions and noise – exactly the spin-off of the overall EUROCONTROL policy. However, this is in full compliance with the ICAO interpretation of sustainability.

Summary of Chapter 4: Definitions used by international aviation organisations

- ICAO’s responsibility is to achieve maximum compatibility between the safe and orderly development of civil aviation and the quality of the environment. From a practical point of view ICAO has ended up defining environmental problems as aircraft noise and the impact of aircraft engine emissions, at ground level and globally.
- IATA has a very broad theoretical definition of sustainability close to the Brundtland definition, but when it comes to practical implementation IATA has chosen to carry out its efforts in the environmental respect through participation and influence through other international aviation organisations like ICAO/CAEP.
- ATAG’s approach and definition of sustainability is that transport is a precondition for the economic growth and social development. The basis is the definition proposed by the World Business Council for Sustainable Development stating that: “Sustainable mobility can be defined as the ability to meet societies need to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human and ecological values, today and in the future”.
- ACI has proposed a management definition to its members, which reads as follows: “Airports should adopt an environmental management system to enable a systematic approach to the management of environmental issues associated with their operation, development and decommissioning”.
- ERA puts focus on the value of external trade, and GDP generated and supported by the airline industry. Thus it is more a political statement than a contribution to a sustainable definition.
- EUROCONTROL has included environmental issues in the revised Convention and has drafted an environmental policy statement. Environmental issues are also included in the objectives of the different working programmes, for instance ATM 2000+, EATMP, etc. The environmental effects considered are limited to noise and emissions and the environmental issues are subordinated to cost and system efficiency and, of course, safety.

5. Aviation Operators (Airlines, Airports & ATM Service Providers)

5.1 General commercial definition of sustainability

Within the last decade the international commercial companies have chosen or have been forced to apply a more sustainable business strategy in order to satisfy the shareholders and the internal and external stakeholders related to the companies.

Increasingly, investors are diversifying their portfolios by investing in companies that set industry-wide best practices with regard to sustainability. The Dow Jones Indexes, STOXX Limited, and SAM have even drafted a definition of proper sustainable behaviour from companies with good shareholder governance:

“Corporate Sustainability is a business approach that creates long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments. Corporate sustainability leaders achieve long-term shareholder value by gearing their strategies and management to harness the market's potential for sustainability products and services while at the same time successfully reducing and avoiding sustainability costs and risks.

The quality of a company's strategy and management and its performance in dealing with opportunities and risks deriving from economic, environmental and social developments can be quantified and used to identify and select leading companies for investment purposes” (ref. Annex no. 1, doc. no 59).

In general the airlines pay a lot of attention to the environmental issues mainly because of more strict international and national restrictions, especially with respect to aircraft noise and emissions. Airlines have met these restrictions with a strong pressure on the aircraft and engine producers in order to comply with the new regulations and standards in such a way that not only environmental demands are met but also a demand for improved cost efficiency. This has to a wide extent been achieved. But the airlines also use the general commercial sustainability approach as proposed by the Dow Jones Indexes, STOXX Limited, and SAM. Only a few airlines have been researched in this project but it is clear from their overall management strategy and policy that they put a strong focus on sustainability as defined in the commercial standard mentioned above.

We can illustrate this using some example case, from British Airways and SAS.

5.2 Airlines

5.2.1 Case History: British Airways - BA

On an overall basis BA has a very broad approach to sustainability. In the Social and Environmental Report for 2002 /2003 BA defines the “Responsible Management” in the following way:

- sound corporate policies effectively communicated
- robust management systems for social and environmental issues
- open and honest reporting
- engagement with stakeholders

It is important to note that BA considers its economic performance as a sustainability factor and even the firing of staff as a necessary factor in order to stay competitive and survive in the very tough airline market.

Considering social performance as part of its operating policy involves ensuring and enhancement of the welfare of the people that BA employs, as well as the customers they serve, and the communities in which BA operates. BA includes for instance the training of staff in the evaluation of this component.

With respect to the environmental effects BA focuses on the local effect of aircraft noise and emissions around airports and on the global climate change effects of emissions in upper airspace.

Thus BA has actually integrated the three main components of the broad international definitions (economic and social growth, social issues, and environmental issues) and the Dow Jones approach in the overall company strategy. Of course economic profitability and survival is a precondition and remains the main element for the airline company.

Heathrow is the main hub for BA and consequently the company takes a strong interest in the airport including the environmental issues in a broad sense. Actually, BA uses a very true sustainability definition in this assessment of Heathrow by the adoption of the following model:

British Airways' impact around Heathrow		
Economic	+ Air services Employment Trade/Investment Local economy	-
Social	Stakeholder dialogue Employment diversity Community initiatives Harmondsworth Moor Public transport	Road congestion
Environmental	Improving performance Green Travel Plan	Noise Air quality

Figure 04: British Airways impact in Heathrow (ref. Annex 1, doc. 38)

5.2.2 Case History: SAS

SAS has defined a clear sustainability policy, which does not only apply for the company itself but also for its sub-contractors.

In SAS terms, sustainable development means “a simultaneous pursuit of economic growth, environmental improvements and social responsibility”. Just as in the case of BA the overall precondition for the three-legged policy is the long-term growth in the shareholder value to ensure that the subordinated policies can be implemented.

Each business unit and department in SAS is requested to define goals and policies to meet the overall sustainability policy. In this regard the Brundtland definition is specifically mentioned as a guideline for this work.

SAS also pays special attention to the company compliance with international regulations, standards, and practices with respect to aircraft noise and emissions.

Finally, SAS defines the social responsibility as the responsibility towards both its passengers and its staff including a continuous training and education of its employees.

Even though the wording is slightly different in the BA policy and the SAS policy it is clear that the two airlines have the same approach and have integrated the commercial sustainable approach in their overall management objectives and policies.

5.3 Airports

All major airports have addressed the issue of environmental management or management performance in a sustainable way. Some airports link environmental management closely to necessary compliance with rules and regulations or simultaneously assessment of cost and benefits. However, many of them only do what is required and financially beneficial.

There are some airports that apply a more ethical approach and include the environmental issues in their overall airport management model. A very good example of this approach is provided by Unique Zürich Airport (UZA), which has developed a special Balanced Score Card environmental/sustainable management model:

5.3.1 Case History: The UZA environmental airport management model

The overall framework for the UZA model is based on the Brundtland Commission from 1987 in which it is stated:

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.

The actual environmental management model from UZA reads as follows (ref. Annex 1, doc. 58):

The Triple Bottom Line Approach

The triple bottom line (TBL) focuses corporations not just on the economic value they add, but also on the environmental and social value they add – and impact. At its narrowest, the term 'triple bottom line' is used as a framework for measuring and reporting corporate performance against economic, social and environmental parameters.

At its broadest, the term is used to capture the whole set of values, issues and processes that companies must address in order to minimize any harm resulting from their activities and to create economic, social and environmental value. This involves being clear about the company's purpose and taking into consideration

the needs of all the company's stakeholders – shareholders, customers, employees, business partners, governments, local communities and the public.

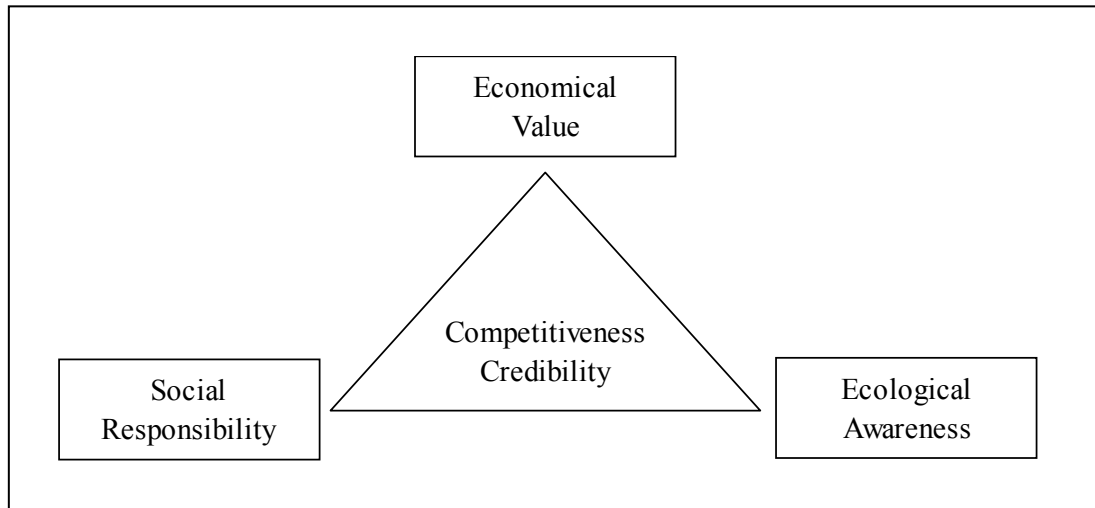


Figure: The three elements of the triple bottom line approach

Many definitions have been given to the term of sustainability and even more interpretations of these definitions. It is generally acknowledged that sustainability refers to sustainable development and means the capability to operate a system in the present in such a way that permits its use in the future (and for future generations). It is understood that sustainability consist of the three pillars of economic benefits, environmental care and social chances, thus leading to public welfare.

Corporate Sustainability

"Sustainability on a long-term basis requires businesses to satisfy the needs of their clients in a way that their products and the organization of their services (the value chain) follow the dynamic system rules of ecological and socio-cultural systems. Since societal, cultural and ecological systems are not stable, their dynamic balances are in state of permanent change. The challenge of enabling sustainable economic growth, in the broad sense, offers new opportunities for companies to enhance their shareholder value by aligning with the emergent realities of the environment in which they operate. In line with this philosophy, SAM defines "Corporate Sustainability":

"Corporate Sustainability is a business approach to create long term shareholder value by embracing opportunities and managing risks deriving from economic, environmental ecological and social developments or changes."

These economic, environmental and social developments or changes are trends that need to be considered and effectively managed, by maximizing the opportunities and by minimizing the risks they present, if a company is to contribute to a sustainable future for itself and the part of the systems in which the business is embedded.

(Source: www.sam-group.com, 5/2003)

Airports and Sustainability

Airports are systems that are part of the today’s society and an integral part of this society’s demand for mobility. While it is well understood that airports create impacts on the environment it is also acknowledged that they contribute to regional economic benefits and that they affect society in offering chances. This system “airport” is operated by using products or services and environmental goods like resources. It produces products or services and environmental impacts. These operations are part of the economy – whether locally or regionally – and they interact with the surrounding society.

It’s the goal of the airport to keep these aspects in a balance that secures future operations.”

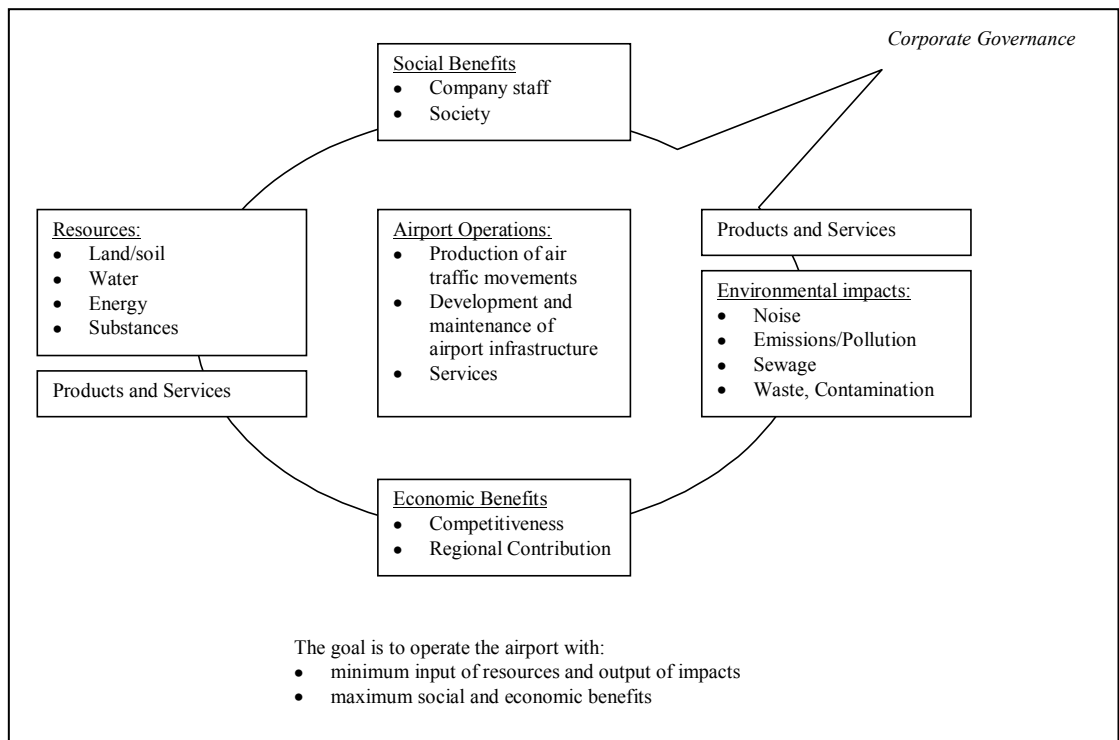


Figure: Sustainable Operation of an Airport

Thus UZA has not only made a definition of sustainability but has also developed an integrated “balanced score-card” management model for the sustainable

management of the airport. It is also worth while noticing that the model includes both the benefits and the costs of the sustainability equation.

5.3.2 Case History: Copenhagen Airport

The overall policy of Copenhagen Airport is to operate and develop the airport with a view to continually improve environmental results. A special department, “Environmental Affairs”, monitors the improvement actions.

Improvements are provided through:

- Environmental considerations in all decisions
- Preventive actions and the use of cleaner technology
- Increased environmental awareness by employees and partners
- An open dialogue on the environmental state of the airport

Based on this overall policy Copenhagen Airport has identified a number of focus points, which are benchmarked every year for monitoring of the improvements achieved. The benchmarks are illustrated in the Environmental report for 2002 as follows (see next page):

Scope of Environmental Report 2002		
Aircraft activities	Activities on runways, aprons and other areas	Terminal activities
Takeoff and landing, aircraft taxiing to terminals. De-icing, wash and other aircraft maintenance. Catering and cargo.	Maintenance of areas, including snow cleaning.	Passenger activities in terminal area, including restaurants, shops, toilets and offices.
Input →	Input →	Input →
Glycol for aircraft de-icing	Runway de-icing	Water for passengers areas
Aircraft fuel	Energy for lighting	Electricity and heating for passengers areas
Water	Herbicides	Water for restaurants, shops, etc.
Electricity and heat	Fuel for CPH vehicles	Electricity and heating for restaurants, shops, etc.
	Fuel for CPH vehicles	
Output →	Output →	Output →
Wastewater	Surface water	Wastewater
Collected glycol	Waste	Waste
Noise	Air quality	Air quality
Air quality		
Oil and fuel spills		
Waste		
CPH is responsible		
CPH monitors and inspects		
Leasees and operators are responsible		

Figure 05: Environmental benchmarking in Copenhagen Airport (ref. Annex 1, doc 42)

The focus points are measured in relation to aircraft activities, runway activities, aprons and other areas, and terminal activities respectively.

The environmental work in Copenhagen Airport focuses very much on the strict environmental issues, which the airport controls itself, while external relations and social relations are not considered a part of the environmental policy. However, working environment influenced by pollution etc. is of course included in the environmental policy.

5.4 ATM Service providers

A selected number of ATM Service providers have been studied in order to identify any sustainability approach in their objectives or policies. In general policies that specifically address sustainability issues have not been found. A few examples will illustrate this (the objectives and statements from each service provider are downloaded from the Internet):

5.4.1 Naviair, Denmark

The following mission and vision applies to the work of Naviair:

“It is Naviair’s mission to provide Air Traffic Management safely and efficiently for the benefit of airspace users.

Relying on international alliances, NAVIAIR’s vision is to develop its business to match the best in air navigation services in Europe in terms of:

- *Safety*
- *Efficiency*
- *Regularity*
- *Environment*

The focus on environment is almost excused in the mission statement “because there is a national as well as international pressure to find a balance that meets the demand for environmental improvements co-existent with a room for a steadily increasing air transport sector”.

5.4.2 Luftfartsverket, Sweden

The Swedish national ATM provider has defined the following responsibilities:

“The Air Navigation Services Division is responsible for all LFV's air traffic services in Sweden.

It is the responsibility of the air traffic services to prevent collisions and maintain orderly traffic by guiding aircraft at the airports and through the airspace. The air traffic service is a complicated interplay between specially trained personnel, advanced technical equipment and precisely tested work methods. The organisation is built upon international regulations and agreements and a common language, English.”

No environmental considerations are mentioned.

5.4.3 NATS, UK

In the UK, NATS has defined the following objectives:

“National Air Traffic Services (NATS) provides safety by ensuring aircraft flying in UK airspace, and over the eastern part of the North Atlantic, are safely separated. Safety is NATS' first and foremost priority but it also aims to provide its service in an efficient and expeditious way”.

Annual reports from NATS have been studied. They are very much in compliance with the above-mentioned objective, which means that the management focus is entirely on safety and efficiency and of course on profitability, especially because of the recent restructuring of NATS.

No environmental considerations are mentioned.

5.4.4 Deutsche Flugsicherung, DFS, Germany

In Germany DFS has more or less the same approach as the sister organisations in the previously mentioned countries:

“The employees of DFS ensure the safe, orderly and expeditious handling of civil and regional military air traffic in Germany. While observing the principles of user neutrality, DFS offers its customers high-quality air navigation services with a balanced cost-benefit ratio.

The integration of civil and regional military air traffic control into one system paved the way for the reorganisation and efficient use of airspace in the interests of all airspace users.

DFS Deutsche Flugsicherung GmbH is responsible for ensuring air safety. Safety is ensured first and foremost by air traffic controllers when handling air

traffic. In the background, air navigation services specialists in numerous DFS departments are there to ensure that the sovereign tasks assigned to DFS by the German government are duly fulfilled, and to plan flight routes, approach and departure procedures, plus a lot more.

DFS performs the difficult task of balancing the obligation to observe rules and regulations with the desire to reach compromises which are reasonable and acceptable for all parties involved.”

No environmental considerations are mentioned.

5.4.5 Austro Control, Austria

Austro Control has the following mission statement:

- *We are playing our part in shaping European Air Traffic management of the future.*
- *We are meeting the expectation of our shareholders, the Republic of Austria.*
- *Our attitudes and operations are customer based, and we offer our services at fair and transparent prices.*
- *We are aware of our responsibilities to the environment, and are making an important contribution to reducing environmental loading by air traffic.*
- *The quality of our services ensure a safe and reliable air traffic.*
- *We are competent and goal driven and ready to accept responsibility.*
- *We are an employee oriented company.*

As it appears from the above Austro Control has a very commercially oriented corporate statement and in contrast to the other above-mentioned ATM providers Austro Control includes the environmental responsibility in the corporate mission.

5.4.6 Environmental responsibility with the ATM providers

In general the national ATM providers have strong focus on safety, efficiency, and improved management of the available air space and capacity. Although the present study is not a complete survey of the mission statements of all European ATM providers, only one of the included organisations (Austro Control), has an environmental statement in the set of corporate mission statements.

Even though there is a clear lack of environmental focus among the ATM providers it is obvious that improved efficiency and better use of the air space will lead to reduced waiting time at the ground and in the air, and more direct flights

will reduce the transport work carried out. Indirectly all these measures will all other things being equal lead to reduced emissions and noise at the ground.

5.5 Aircraft and engine producers

5.5.1 Case story: Airbus

According to the companies Internet presentation:

“Airbus is totally committed to ensuring that air transport continues to be one of the safest, most efficient and environmentally friendly means of mass transportation. Consequently, environmental, health and safety (EHS) considerations have long been an integral part of its activities and are a key priority in the development of all new techniques, products and processes. This ensures an ongoing and steadfast commitment to improving EHS performance at all levels of the company. Airbus' approach has always been to take EHS concerns into account right from the earliest stages of product and process design, through to manufacturing and then to aircraft operations.

The new Airbus-wide policy formalises this approach, listing key commitments with regard to EHS and ensuring that all Airbus functions, national entities and subsidiaries are responsible for the policy's implementation. Indeed, Airbus is committed to going beyond the mere fulfilment of its legal obligations and to continuously improve its performance in all areas of EHS.

In particular, Airbus is working towards the implementation of a company-wide Environmental Management System (EMS) based on the ISO 14001 standard. This will ensure that consistent measures for the improvement of Airbus' environmental performance are systematically adopted in all sectors of activity and covering the entire life cycle of the product.”

The definition of sustainability or environmental policy as expressed by Airbus has given a new dimension to the definition of sustainable behaviour, namely the focus on external costs of aircraft production and also final recycling of the products. In addition Airbus focuses on the environmental performance of their aircraft, especially with respect to noise and emissions. This is of course carried out in close cooperation with the engine producers.

5.5.2 Case History: Pratt & Whitney and GE Aircraft Engines

Pratt & Whitney (P&W) is one of the World's leading aircraft engine producers.

The overall environmental commitment reads as follows:

“Pratt & Whitney is taking steps today to protect the natural environment for future generations”.

This overall statement is clearly influenced by the Brundtland definition of sustainability.

P & W has provided the following overview of the practical steps towards the achievement of this definition:

“The newest engines burn less fuel, reducing emissions into the air. They're also quieter than international standards require. Future engine models are being designed and assembled with few or no environmental, health or safety hazards. We call these our "green engines.

We're also working with our parent company, United Technologies Corp., to reduce -- by 60 percent by 2007 -- the amount of waste that is generated to produce and repair engines and parts. We also have a goal to reduce energy and water use by 25 percent.

We're making progress. Conservation programs and more efficient lighting and equipment have helped us to reduce energy consumption by 15 percent since 1997. And Pratt & Whitney generates 86 percent less hazardous waste than 10 years ago, thanks in part to using more environmentally friendly materials and better manufacturing methods.

The safety of our employees also is vital to Pratt & Whitney. Protective equipment, machinery guards and other safety programs are just some of the reasons on-the-job injuries have decreased more than 50 percent since 1996.

Our environmental, health and safety policy is very straightforward:

Pratt & Whitney will not be satisfied until its workplace is safe from hazards, its employees are injury-free, its products and services are safe, and its commitment and record in compliance, pollution prevention, and protection of the natural environment are unmatched."

Just as in the case of Airbus, P&W focuses not only on the environmental performance of their products, especially regarding emissions and noise, but also on the environmental issues of the production process itself, and on the health and safety of their employees.

Other aircraft engine producers apply the same approach to the environmental issues. For instance GE Aircraft Engines has applied the following commitment to the environmental matter:

“GE Aircraft Engines produces the quietest, cleanest, and most fuel-efficient jet engines in the world--in some cases, by a long shot. Over the past several years, GE has invested hundreds of millions of dollars in breakthroughs to make our engines more environment-friendly than ever. Simply put: There are "green" technologies in GE engines found nowhere else.”

Summary of Chapter 5: Definitions used by commercial aviation operators

- British Airways has integrated the three main components of the broad international sustainability definition (economic and social growth, social issues, and environmental issues) in the overall company strategy. Economic profitability and survival are a precondition and main element for the airline company. SAS thinks the same way and have integrated the sustainability approach in the overall management objectives and policies.
- Some airports link environmental management closely to necessary compliance with rules and regulations or with a simultaneous assessment of cost and benefits. They only do what is required and financially beneficial. Other airports apply a more ethic approach and include the environmental issues in the overall airport management model. Unique Zürich Airport is a good example of the latter and for instance Copenhagen Airport has developed a comprehensive monitoring and benchmarking system for environmental performance.
- In general the ATM providers do not include environmental objectives in their mission statements. The entire management focus is on safety, efficiency, and the best use of the airspace. Only one provider (Austro Control) focuses on the environmental responsibilities. However, the indirect effect of improved efficiency is less waiting time and more direct flights, which all other things being equal will reduce emissions.
- Basically, the aircraft and engine producers have strong focus on the performance of the products with respect to reduction of emissions and noise. Furthermore, all major manufacturers focus on the environmental responsibility related to the actual production of aircraft hulls and engines, and also to the recycling of materials both during the production process and when the products are scrapped. They also include external costs.

6. NGOs & Lobby Groups

A number of national and international NGOs have addressed the environmental impact of aviation, especially with respect to emissions and noise. It is also quite common that local environmental organisations protest when airports are planning expansions and/or increased traffic volumes. An illustrative example is the expansion of Heathrow terminal 5 where the public hearing took almost four years.

The more powerful international NGOs, which have an interest in the transport and aviation sector, have established an umbrella organisation called “Transport and Environment” or T&E, which has published publications especially about the negative effects of emissions, noise, and external costs. The organisation is quite important as an environmental lobby organisation within the EU / EC system.

T&E does not provide a definition of sustainability or sustainable development but focuses strongly on the emission and noise problems related to the aviation sector. Furthermore, T&E argue that the aviation sector has such a strong growth rate due to exemption from fuel tax and due to state subsidies for its infrastructure.

In the report “Aviation and its impact on the environment” T&E refers to the OECD definition of sustainability (see chapter 4.3) but questions whether the benefits of additional air transport are in justifiable proportion to the additional consumption of resources and harm to the environment entailed.

In the document “Final Boarding Call” (ref. Annex 1 doc. no.31) from July 2002 T&E still focuses on the negative environmental effects of the aviation sector without paying attention to the benefits. However, the technical improvements of engines with respect to noise and emissions are recognised and the organisation recommends a closer cooperation between public and private stakeholders in the sector in order to find the balance of the three pillars in the sustainable development.

When requested to clarify the basic definition or approach used for assessment of the effects of the transport sector and specifically of the aviation sector, T&E replied: “Typically we use the WCSD (so-called Brundtland) definition as our starting point”.

Summary of Chapter 6: Definitions used by other NGOs

- Local NGOs and environmental organisations often engage themselves in development plans for airport extension and increase of traffic volumes at airports in order to protect the environment and the neighbourhood from increased noise impact.
- The international NGO umbrella organisation for the transport sector (T&E Transport) apply a Brundtland type of definition. However, based on studies of selected publication from T&E Transport regarding the airport sector it is clear that the focus is very much on the negative environmental effects of the sector rather than on the positive effects concerning economic and social growth generated by the aviation sector. The Brundtland definition is not used in a balanced way.

7. Other Interested Stakeholders

7.1 UK Department for Transport

The UK Parliament focuses heavily on the environmental issues of the transport sector in general and on the aviation sector in particular. The present and expected future levels of emissions are considered unacceptable and a range of fiscal and other policy instruments are considered to manage and change the present behaviour of the sector. This approach also includes cost of externalities.

The UK Government has four main aims in its strategy for sustainable development (SD):

- social progress that recognizes the needs of everyone
- effective protection of the environment
- prudent use of natural resources
- maintenance of high and stable levels of economic growth and employment

This political interpretation is based on a three-legged stool of economic growth, social progress, and environmental protection. For the aviation sector, SD means: “the level of aviation growth and development that the public opinion is prepared to consider compatible with preservation of tolerable living conditions for the population in general”.

As mentioned before the UK Government pays a great deal of attention to environmental issues. A special Sustainable Development Commission has been established reporting to Mr. Tony Blair. In the document “Air transport and sustainable development” the following is stated by that Commission (ref. Annex 1 doc. no.52):

1. In approaching all subjects related to sustainable development, the Commission seeks to apply a consistent approach based on six fundamental principles:

- *Putting Sustainable development at the Centre*
- *Valuing Nature*
- *Fair Shares*
- *Polluter Pays*
- *Good Governance*
- *Adopting a Precautionary Approach*

2. *In the Commission's view, the approach set out by the aviation sector falls seriously short of sustainability in respect of all of these basic principles. It appears to be based on a classic "predict and provide" model for planning major developments, and to avoid the much deeper analysis which a truly sustainable approach would require.*

3. *Taking each of our six principles in turn, the approach falls short in that:*
 - *They give over-riding importance to the economic significance of airport development, and do not give adequate weight to the social and environmental impacts of such developments - in other words, they do not put sustainable development at the centre of the approach;*
 - *They do not make an adequate assessment of the damage that may be done to the natural environment both in the locality of the proposed airport developments and more widely through the impacts of increased air traffic;*
 - *They place great emphasis on the employment generating effects of airport development and the benefits to those who will work there and those who will be able to travel by air more easily, but much less weight to those whose quality of life will be adversely affected by the developments;*
 - *They do not provide a full analysis of how to ensure that the aviation industry and airports (and their users) can be made to pay a proper price to reflect the environmental and social costs they impose on others, and of how far such measures might moderate the predicted growth in demand;*
 - *They envisage a speeded-up planning process to press the developments through rather than an extended national debate on the best aims of policy and development on these issues which would provide a better model for consensual governance;*

Finally, they take much too little account of the very real dangers of climate change being exacerbated by the continuing growth of air traffic around the world, and the dangers which the world as a whole faces if we make our economies ever more dependent on continuing growth of air traffic” (ref. Annex no. 1, doc. no 52).

Thus the Sustainable Development Commission expresses a strong criticism in their consultation paper, which focuses on the economic importance of the aviation sector, and the Commission advises the Prime Minister and the Government to adopt a much more environmentally friendly approach taking the expected increase in environmental and social costs into consideration. The commission even suggests that the future economies should be developed so as to become less dependent on air traffic.

7.2 Research and scientific organisations

A substantial number of international research and scientific organisation have carried out numerous studies on behalf of international organisations and specifically aviation organisations regarding sustainable development, environmental issues (especially emissions) and other topics related to the objective of this report. Several of these studies have been referred to in the previous chapters of the report.

It is clear that within our study we have not been able to consider all the general research and studies that have been undertaken in the field of sustainability and sustainable development (a literature search shows more than 5.000 titles related to sustainability and sustainable development) but a few key works should be mentioned:

With respect to a general definition of sustainability an interesting paper has been published by Mr. Milindo Chakrabarti, St. Joseph college, North Point, Darjeeling, India (ref. Annex 1 doc. no.54). The paper was referred to in chapter 3.1 and is recommended for a more academic and scientific study of the semantics of the definition of sustainability.

A similar web page has been drafted by Mr. Michael Mahaffy, at Washington State University (www.arch.wsu.edu/sustain/defnsust.htm).

The Journal of Transport Economics and Policy often deals with the environmental issues and impact of different means of transport including aviation.

The National Institute of Water & Atmospheric Research in New Zealand is deeply involved in the sustainability issue and suggests in “FRST Sustainability Review” that,

“ecological sustainability is the starting-point for any derivation such as “economic sustainability” (or “sustainable economy”), “social sustainability” (or “sustainable society”) and “technological sustainability” (or “sustainable technology”). For this reason, any research needs to reflect the meaning and importance of “ecological sustainability”, i.e. the relationship between technology, science, economics, society etc. and ecological sustainability. This relationship is ethical, in nature (not “scientific” or “technical”). Let every researcher be aware of this and make her/him to demonstrate how her/his research contributes to “ecological sustainability” (ref. Annex no. 1, doc. no 60).

Actually New Zealand is in many ways a front-runner in the environmental debate and associated research.

In Europe at least two research organisations have been heavily involved in the study of external costs in the aviation sector, namely “CE, Solutions for environment, economy and technology” in Delft and “INFRAS” in Zürich. Both organisations have studied the external costs in a very detailed and scientific way and with comparison of air traffic with different means of surface transportation.

Finally it should be mentioned that the textbook “Towards sustainable Aviation” published by Earthscan in 2003 is a very useful introduction to the subject. The book is a collection of 15 articles all related to the issue of sustainability in the aviation sector.

These examples of scientific research are in no way exhaustive, but it shows that the issue of sustainability and sustainable development is widely studied in all parts of the world and from many different angles of approach.

Summary of Chapter 7: Definitions used by other stakeholders

- As an example the UK Government has in general applied a “Brundtland” policy for sustainable development. However, the UK Sustainable Development Commission advises the Prime Minister and the UK Government to adopt a much more environmental friendly approach with respect to the aviation sector taking the expected future increase in environmental and social costs into consideration. The Commission is even warning that the future economies should be developed into becoming less dependent on air traffic.

- The term sustainability and sustainable development has been studied in depth by many international research and scientific organisations and institutes. Some of these studies have been commissioned by the aviation industry itself or by stakeholders in the aviation sector or NGOs. A lot of studies have been developed from a pure scientific point of view or by initiatives in other sectors.
- It is believed that the primary operational studies and findings of sustainability and sustainable development related to the aviation sector have been included in this report. However, more than 5.000 titles are related to the subject in general so it cannot be excluded that some reports or interesting findings have omitted our attention.

8. The Stakeholder Viewpoints Score Card model

8.1 General introduction

The previous chapters have put light on the definitions, approach and policies regarding sustainability, sustainable development and environmental issues applied by different stakeholders in the aviation sector.

Despite the fact that they all have slightly different and in some cases quite different interpretations of the priority and range of the sustainability concept, it is important to note that all efforts within this field point in the same direction whether it is a worldwide general political statement from a UN organisation or a commercial objective by an airline in a very competitive market. They all recognise the importance of economic and social growth as well as sustainable and prudent environmental behaviour.

Apart from some of the definitions used by the environmental NGO's there is no conflict of interest as such between the different stakeholders. It is not a matter of compliance or non-compliance to the overall objective – to protect the environment and the society for the present and future generations. The differences tend to relate to the range of issues and the degree of commitment that is put into the sustainable management.

Even the EC's Single Skies policy and to some degree the business objectives of the ATM providers, which do not focus specifically on environmental issues, are in compliance with the overall sustainability definitions and objectives because a more efficient Air Traffic Management system means less transport work for a given production volume. Thus the indirect effect contributes to the overall definition and objective for a responsible sustainable development.

It should be mentioned that this conclusion is of a general nature. There are still airlines and airports especially in the third world, which do not pay much attention to environmental or sustainability issues. They are driven by a specific traffic need, by profit only or by other one-sided objectives or policies.

Bearing all this information in mind, and in a first attempt to derive a common view on sustainability in the aviation sector, we provide overleaf a high level view of sustainability, which combines the majority of the stakeholder views as illustrated in the Score Card model overleaf.

**Stakeholder Viewpoint Score Card for
integrated definitions of sustainability in the aviation sector**

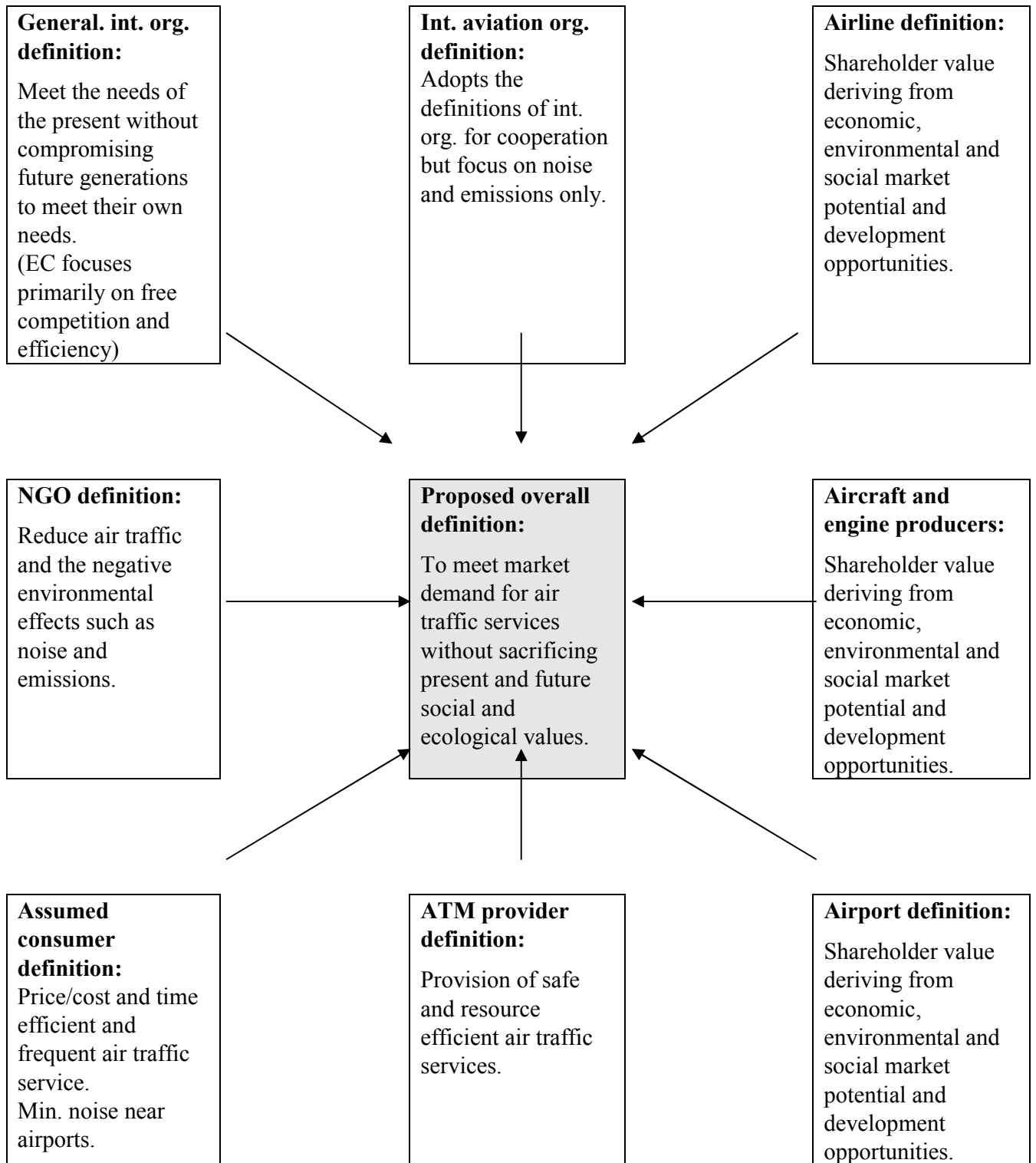


Figure 6: Score Card model with sustainability definitions and approach

8.2 The *Balanced* Score Card as a management tool

The *Balanced* Score Card model was introduced by the two Harvard professors Kaplan and Norton in 1992 in order to provide a management tool for integrated management of big commercial companies. Later on the model has also been applied by public companies and service organisations.

The idea of the *Balanced* Score Card is to integrate overall objectives of the company with more specific objectives for the key activities, which would contribute to the achievements of the overall objectives. These subordinated objectives could be objectives for marketing and sales, development of human resources, level of capital employed by the company and of course environmental commitments.

To make the *Balanced* Score Card operational a number of specific indicators are related to each sub-objective so that the actual performance can be measured and benchmarked towards these indicators.

In the following chapters we have proposed a Stakeholder Viewpoints Score Card model for sustainable development of the aviation sector that is loosely based on the balanced score card approach. Although the model could be applicable worldwide we have focussed on Europe only. The model will be the same for other regions and countries but the parameters and indicators will have different values due to different economies, different social and environmental structures and political priorities. For instance will noise be less important for development countries with less traffic and frequencies than in a major congested European airport. The existence at all of an airline connection in a development country will take priority over some short-term secondary noise impacts.

8.3 Definition of objectives and indicators

8.3.1 The overall objective for the sector

The overall objective for the aviation sector in Europe is recommended to include the three-legged stool as expressed in the UN/Brundtland definition and in the commercial Dow Jones/STOXX index. The overall objective for the sector is proposed as follows:

The objective of the aviation sector is to meet market demands for air traffic services without sacrificing present and future social and ecological values.

The proposed overall objective does not restrict the production volume of the aviation sector. On the contrary it is important that market demands for air traffic services are met in order to contribute to economic growth and social welfare, which can only be achieved through economic growth (ref. the Brundtland definition of sustainability).

The contents of the boxes in the Score Card with specification of subordinated objectives and indicators will be dealt with in the following chapters moving clockwise in the chart shown in Chapter 8.1, figure 6.

8.3.2 Indicators for the international organisations

The overall aim for the international organisations like the UN organisations, OECD, EU/EC and others is to define the political directions with respect to economic, social and environmental development in the world community or in a specific region like in the EU.

The indicators are related to these standards and protocols and the success will be benchmarked towards the international political declarations and protocols.

The international aviation organisations – especially ICAO, IATA and ATAG follow the overall standards and protocols from the international organisations and define the objectives and indicators specifically for the aviation sector. The objectives are often rather broad and “soft” due to the need for political consensus in these organisations.

As mentioned earlier in this report ICAO has based on the Rio and Kyoto protocols declared that emissions should be reduced substantially and the noise objectives have been translated into the

General int. org.

Objective:

To secure a balanced economic, environmental and social development of the world society.

Indicators:

- GDP per capita
- Unemployment rate
- CO2 emission
- NOx emissions
- Fuel consumption
- External costs
- Regional development

Int. aviation org.

Objective:

To promote the common interests of the aviation sector and the implementation of for instance the UN environmental protocols.

Indicators:

- EBITA for the sector
- CO2 emission
- NOx emissions

operational emission standards and noise requirements for Stage 3 and Stage 4 aircraft. Furthermore ICAO, IATA and other aviation organisations have taken an interest in the development of new ATM concepts such as the CNS/ATM for traffic efficiency and environmental improvements. Safety and security is put high on the agenda. Finally the aviation organisations take a natural interest in the economic performance of the sector expressed by the EBITA or yield indicators.

- Noise reduction
- Fuel consumption
- Improvement of ATM efficiency
- Safety and security
- Yield

8.3.3 Indicators for the airlines

The airlines have no doubt an overall objective of survival which means that a profit acceptable to the shareholders has to be produced. This is often expressed by the EBITA key figure (Earning Before Interest, Tax and Amortisation) or the yield. The DOCs (Direct Operational Costs) are also an important short-term key figure for financial performance.

Most major airlines have committed themselves to environmental objectives in order to meet the share-holders value criteria and also to meet the values by the customers and the employees. Thus it is reasonable to put these political environmental objectives and commitments into indicators, which will counterbalance the general traffic growth.

The primary criteria will of course be related to emissions and noise but it could also for instance be considered to use indicators for fuel consumption and cabin/load factors.

Airlines

Objective:

Long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments.

Indicators:

- EBITA
- Direct operational costs
- CO2 emission
- NOx emissions
- Fuel consumption
- Cabin/load factor
- ATM performance
- Safety and security
- Yield

8.3.4 Indicators for the aircraft and engine producers

The aircraft and engine producers are public companies, which have to apply to the same shareholder value definition as the airlines. The shareholders and the potential investors will maybe put even more focus on the environmental parameters

Aircraft and engine producers

Objective:

Long-term shareholder value by embracing

of the airframe and engine producers than on the airlines. This is due to the fact that the success of the aircraft and engine producers is very much related to the environmental and cost efficiency performance of the products. These are very important competitive parameter. The airline operators will simply not choose new airframes and engines, which do not show substantial environmental improvements and cost efficient performance. Reference can be made to the new aircraft A 380 and Boeing 7E7, which are planned to show up to 20% fuel reduction per production unit.

Similarly the engine and airframe producers also pay much attention to the future ATM structures and development trends and to the commercial performance of the present and potential clients. They simple have to meet customer needs in the best way.

opportunities and managing risks deriving from economic, environmental and social developments.

Indicators:

- EBITA
- Direct operational costs
- CO2 emission
- NOx emissions
- Fuel consumption
- Alternative fuel sources
- Cabin/load factor
- Safety and security
- Indirect interest in ATM and commercial performance

8.3.5 Indicators for the airports

Many big airports are public entities or run as autonomous governmental or municipal companies. The privatised and/or public corporations have the same requirements as the airlines and aircraft producers which means that they have to show a profit to the share-holders and for financial consolidation for future investments. The minor airports with small traffic volumes are often owned by the state or by some regional stakeholders. These airports may not be able to show a profit but have an objective of cost recovery or minimisation of the deficits.

The environmental parameters are related to the airport operation with respect to emissions from aircraft on the ground, noise reduction, reduction of delays, safety and security, consumption of energy resources and production of waste.

Airports

Objective:

Long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments.

Indicators:

- EBITA or cost recovery
- Direct operational costs
- CO2 emission
- NOx emissions
- Noise reduction
- Min. delays
- Safety and security
- Waste

- Energy consumption
- Number of routes
- Routes at all (for remote airports)

8.3.6 Indicators for the ATM providers

A few ATM providers are privatised and aim at a satisfactory EBITA while most ATM providers are still considered a part of the public aviation infrastructure with the aim of cost recovery.

As mentioned before ATM providers are not in general concerned with environmental parameters. They aim at providing safe and efficient ATM systems.

However, the indirect effect of more direct flying distances, optimal aircraft speed and vertical profile, a gate-to-gate concept without waiting time in the air and on the ground will contribute to the improvement of the overall equation simply due to a shorter and more efficient transport production per production unit for instance ASK or ATK.

ATM providers
Objectives
 To produce safe and efficient air traffic services

- Indicators**
- EBITA or cost recovery
 - Actual distance flown compared to great circle
 - Flying time
 - Vertical profile
 - Delays
 - Safety and security

8.3.7 Indicators for the consumers

No known research project or studies have addressed the issue of consumer preferences with respect to decision criteria related to environmental sustainable airlines and airports. Most seldom the consumer will know what type of aircraft he is going to fly and even more seldom he will know the environmental performance of the specific aircraft he is flying.

It is assumed that the primary decision criteria for the consumers are reliability, safety and security, price efficiency, a satisfactory number of routes, connections and frequencies. For remote places the existence at all of a connection is considered most important for economic development in such places.

Consumers
Objectives
 A safe and cost/price efficient air-transport system which satisfy the professional and leisure travel needs.

- Indicators**
- Waiting time
 - Safety and security
 - Price
 - Number of routes
 - Frequency
 - Routes to remote places



8.3.8 Indicators for the NGOs

The NGOs include a great number of local organisations, which focus on the environmental and social issues in a specific airport and a few national and international umbrella organisations – first of all T&E (Transport & Environment) in Brussels.

It should be mentioned that some of these organisations have a clear objective to reduce air traffic especially on short-haul routes, where air-traffic can be substituted by surface transportation. At the same time several of the NGOs work for a more even distribution of wealth and welfare to the benefit of the developing countries expressed by GDP development and reduction of the unemployment rate in these countries.

Naturally the NGOs support a reduction of all emissions and environmental impacts from the aviation sector. The difference from the other stakeholders in the aviation sector is that many NGOs want to reduce emissions by reduction of the present and future air-traffic production in order to achieve a higher rate of reduction.

<p><u>NGOs</u></p> <p>Objectives To protect the environment through reduction of transport services especially air transport.</p> <p>Indicators</p> <ul style="list-style-type: none">• GDP per capita espec. in dev. countries• Unemployment rate esp. in dev. countries• CO2 emission• NOx emissions• Fuel consumption• External costs• Regional development

As it can be seen from the different boxes for each group of stakeholders a lot of similarities are found pointing in the same direction of sustainable behaviour. The above mentioned objectives and indicators are summarised in the Stakeholder Viewpoints Score Card model and in a Commonality Matrix that provides a set of principle metrics for the domain and makes informed judgements for the levels of interest of each of the major stakeholders.

8.3.9 Summary of the Stakeholder Viewpoints Score Card – including indicators

<p><u>General int. org.</u></p> <p>Objective: To secure a balanced development of the world society</p> <p>Indicators:</p> <ul style="list-style-type: none"> • GDP per capita • Unemployment rate • CO2 emission • NOx emissions • Fuel consumption • External costs • Regional development 	<p><u>Int. aviation org.</u></p> <p>Objective: To promote the common interests of the aviation sector and the implementation of for instance the UN protocols.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • EBITA for the sector • CO2 emission • NOx emissions • Fuel consumption • Improvement of ATM efficiency • Safety and security • Yield 	<p><u>Airlines</u></p> <p>Objective: Long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • EBITA • Direct operational costs • CO2 emission • NOx emissions • Fuel consumption • Cabin/load factor • ATM performance • Safety and security • Yield
<p><u>NGOs</u></p> <p>Objectives To protect the environment through reduction of transport services especially air transport.</p> <p>Indicators</p> <ul style="list-style-type: none"> • GDP per capita espec. in dev. countries • Unemployment rate esp. in dev. countries • CO2 emission • NOx emissions 	<p><u>The aviation sector</u></p> <p>Overall objective: To meet market demand for air traffic services without sacrificing present and future social and ecological values.</p>	<p><u>Aircraft and engine producers</u></p> <p>Objective: Long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments.</p> <p>Indicators:</p> <ul style="list-style-type: none"> • EBITA • Direct operational costs • CO2 emission • NOx emissions

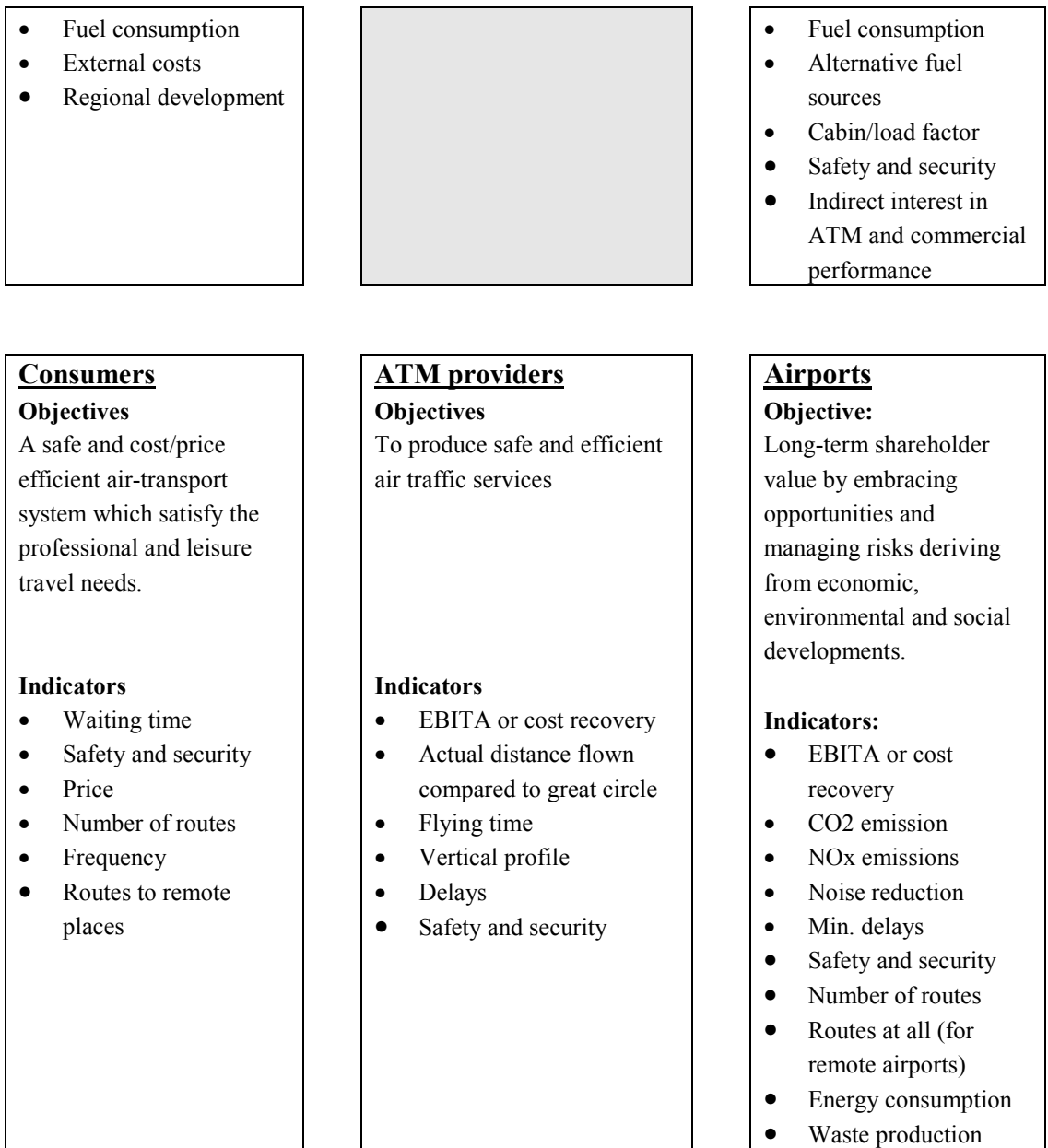


Figure 8: The overall Score Card model for the aviation sector

8.3.10 Commonality Matrix for aviation sector

Indicators	Int. org	Int. aviation org	Airlines	Engine/airframe	Airports	ATM incl. EUROCONTROL	Consumers	MGDS	Society
Macro economic indicators									
GDP per capita	Economic & social growth ↗							Esp. in dev. Countries ↗	Gen. in aviation sector ↗
Employment Rate	Increased employment ↗							Esp. in dev. Countries ↗	Gen. from aviation sector ↗
Industry performance indicators									
EBITA	Satisfaction/EBITA ↗	Satisfaction/EBITA ↗	Satisfaction/EBITA ↗	Satisfaction/EBITA ↗	Satisfaction/EBITA ↗	Satisfaction/EBITA (normalised) ↗			
Cost recovery			Want min. DDC ↗	Products with min. DDC ↗	Cost recovery (normalised) ↗	Cost recovery (normalised) ↗			
DDC per ASK/ATK									
Aircraft performance indicators									
CO ₂ emission per ASK/ATK	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗
NOx emission per ASK/ATK	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗	Emission reduction ↗
Noise in airport	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗	Noise reduction ↗
Fuel consumption per ASK/ATK	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗	Fuel reduction ↗
Alternative fuel sources	Emission reduction ↗	If more profitable ↗		Are considering					
Capacity use indicators									
Cabin factor		Improve cabin factor ↗		Provision of right size & config ↗					
Load Factor		Improve load factor ↗		Provision of right size & config ↗					
ATM procedure indicators									
Actual distance flown	Shortest distance ↗	Shortest distance ↗	Shortest distance ↗	Indirect interest in ATM efficiency ↗		Shortest distance ↗			
Filing time	Shortest filing time ↗	Shortest filing time ↗	Shortest filing time ↗	Indirect interest in ATM efficiency ↗		Shortest filing time ↗			
Div. from great circle distance, short flights	Min. diversion ↗	Min. diversion ↗	Min. diversion ↗	Indirect interest in ATM efficiency ↗		Min. diversion ↗			
Div. from great circle distance, long flights	Wind optimal diversions ↗	Wind optimal diversions ↗	Wind optimal diversions ↗	Indirect interest in ATM efficiency ↗		Wind optimal diversions ↗			
Vertical profile efficiency	Optimal vertical efficiency ↗	Optimal vertical efficiency ↗	Optimal vertical efficiency ↗	Indirect interest in ATM efficiency ↗		Optimal vertical efficiency ↗			
Delay indicators									
Approach	Min. waiting and delay ↗	Min. waiting and delay ↗	Min. waiting and delay ↗		Min. waiting and delay ↗	Min. waiting and delay ↗	Min. waiting and delay ↗		
On the ground	Min. waiting and delay ↗	Min. waiting and delay ↗	Min. waiting and delay ↗		Min. waiting and delay ↗	Min. waiting and delay ↗	Min. waiting and delay ↗		
External cost indicator									
Safety and security	Reduction of external costs ↗	Maintain safety ↗	Maintain safety ↗	Maintain safety ↗	Maintain safety ↗	Maintain safety ↗	Maintain safety ↗	Reduce external costs ↗	Reduce external costs ↗
Demand indicators									
Yield			Max. yield ↗	Indirect interest in market demand ↗					
Price per ASK/ATK		Satisfaction for sector ↗	Competitive mix of prices ↗	Indirect interest in market demand ↗			Min. price ↗		
Routes (city pairs)			Competitive network ↗	Indirect interest in market demand ↗			Max. routes choice ↗		
Frequency			Competitive connections ↗	Indirect interest in market demand ↗			Max. frequencies to choose ↗		
Subsidised routes	Regional development ↗		Interest to operate such routes ↗	Indirect interest in market demand ↗			Interest from remote destinations ↗		for remote destinations ↗
Airport indicators									
Energy consumption				Min. energy consumption ↗					
Waste production				Min. waste production ↗					

8.4 Comments to the proposed sustainability indicators

The indicators in the Score Card and in the first column in the Matrix (shown previously) can be commented as follows:

Indicators	Comments
Macro economic indicators	
GDP per capita	Gross Domestic Product (GDP) is a commonly accepted indicator for economic development and many studies have established the close relationship between air-traffic and GDP development.
Unemployment rate	The unemployment rate is another important indicator for the economic development. The relationship with the aviation sector is mainly established in relation to airports.
Industry performance indicators	
EBITA	Earning Before Interest, Tax and Amortisation (EBITA): A commonly accepted key figure for profit. Used by airlines and airports and other commercial entities in the sector.
Cost recovery	A key objective and indicator for non-profit organisation for instance ATM providers and non-privatised airports.
DOC per ASK/ATK	Direct Operational Costs (DOC): A sub-ordinated key figure for short-term cost performance in the airline sector.
Aircraft performance indicators	
CO2 emission per ASK/ATK	A generally accepted indicator for CO2 emission from aircraft.
NOx emission per ASK/ATK	A generally accepted indicator for NOx emission from aircraft.
Noise in airport	Has not been defined in quantified terms yet. Certain ICAO db standards can be applied.
Fuel consumption per ASK/ATK	A generally accepted indicator for fuel consumption by aircraft.

Alternative fuel sources	Not defined yet.

Capacity use indicators	
Cabin factor	Measurement of number of seats occupied compared to seat capacity.
Load factor	Measurement of actual load compared to load capacity.
ATM procedure indicators	
Actual distance flown	Actual distance flown
Actual flying time	Actual flying time
Div. from great circle distance, short flights	Deviation from the great distance on short flights (<800 km) is considered less efficient than the great circle.
Div. from great circle distance, long flights	Deviation from the great distance on long flights (>800 km) may be efficient considering the wind component.
Vertical profile efficiency	The profile for optimal altitude during the flight.
Delay indicators	
Approach delays	Unscheduled waiting in the air due to ATM and airport congestion.
Delays on the ground	Unscheduled waiting on the ground due to ATM and airport congestion.
External cost indicator	
Safety and security	Can for instance be defined by number of fatal accidents per 1 million ASK
Demand indicators	
Yield	Total income for an airline based on different mix of fares and rates.
Price per ASK/ATK	Actual price offered to the consumer.

Routes (city pairs)	Number of routes within the airlines own network or in an alliance with internal code shares.
Frequency	Number of flights at a specific route during the day or week.
Subsidised routes	Non-profitable routes performed on a service contract subsidised by a government or a region.
Airport indicators	
Energy consumption	Consumption of power, fuel and other sources of energy.
Waste production	Solid and fluid waste from the airport operation including waste from the aircraft for instance catering disposal.

9. Conclusion for Phase 1

The overall objective of this project is to study the complex subject of using economic instruments to manage the sustainable growth of the air transport system.

The following specific objectives have been defined for Phase 1:

Phase I includes a draft definition of sustainability, especially in light of the need for a common understanding of sustainability from all of the stakeholder viewpoints.

Thus the research in Phase I has focussed on the definitions, approaches, and policies regarding sustainability, sustainable development, and environmental issues applied by different stakeholders in the aviation sector. Furthermore, the overall findings have been presented in a Balanced Score Model and in a complimentary matrix overview.

Based on this first step a number of sub-objectives and indicators have been defined for the sector, and the commitment from and compliance by each group of stakeholders to these indicators have been assessed and commented.

The analysis in Phase I has confirmed that despite the fact that all stakeholders have different and in some cases quite different interpretations of the priorities and the range of the sustainability concept, all efforts within this field point in the same direction whether it is a worldwide general political statement from a UN or an aviation organisation, or commercial objectives by an airline or airport in a very competitive market. They all recognise the importance of economic and social growth as well as sustainable and prudent environmental and social behaviour.

In Phase II a balanced utility function will be developed and various scenarios will be identified and defined to drive different strategy options. Furthermore, different already existing models for simulation of the scenarios will be assessed.

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