



An Empirical Study by:  
Thomas Niehaus, Alexander Knigge

# Enhancing Airline Profits through the Application of Route and Network Profitability Analysis



airport

airline

cargo



**Lufthansa Consulting**

## Table of Contents

<b>1. Executive Summary</b>	<b>3</b>
<b>2. Introduction</b>	<b>3</b>
<b>3. The Concept of Route and Network Profitability Analysis</b>	
3.1. Purpose and General Approaches	4
3.2. Methodology	5
3.3. Relevance for Network Management	9
<b>4. Empirical Study on Route and Network Profitability Analysis</b>	<b>11</b>
4.1. Approach	11
4.2. Findings	12
<b>5. Conclusion</b>	<b>26</b>
<b>6. Authors and Contacts</b>	<b>27</b>



## 1. Executive Summary

The ability to accurately and timely measure the profitability of flights can significantly enhance airline profits and constitutes the basis of a professional network management process of an airline.

Route Profitability Analysis and Network Profitability Analysis represent two common approaches to measure the profitability of flights. The traditional Route Profitability Approach solely focuses on the onboard segment of a single flight and determines its profitability independent of connecting flights. In contrast, the Network Profitability Approach takes all Origin & Destination (O&D) traffic into account which traverses through the analyzed flight. Thus, it assesses the financial contribution of the flight to the airline's overall network profitability.

For airlines with Hub-and-Spoke network structures (network carriers) and hence carriers with a large percentage of interconnected flights, the Network Profitability Approach provides essential network management information. For carriers with mainly or exclusively Point-to-Point traffic, the solely application of the Route Profitability Analysis is adequate.

To further analyze the methodology of Route and Network Profitability Analysis and their impact on the network management process, an empirical study among the top 100 carriers world-wide (ranked by revenue) was conducted.

All 30 carriers that participated in the survey consider profitability data on routes as highly relevant information for their network management related decision making. Moreover, the survey showed that all network carriers apply the Route Profitability Analysis. However, only two thirds of these carriers additionally use the Network Approach.

The remaining one third is likely to derive suboptimal decisions which could lead to poor financial results. Especially against the background that the analyzed airlines assume on average that the application of the profitability analysis will enable them to realize both a revenue and a cost improvement of 4.5% respectively.

## 2. Introduction

Since liberalization and privatization have been initialized in the aviation industry and prices, capacity and traffic rights can be freely chosen or obtained changes in market structure have taken place. Airlines are now operating in a dynamic environment and are facing fierce competition. Hence they need to understand their profit situation on their given network and single routes more accurately to induce strategic and operative adjustments and to optimize the network structure.

The function of network management (NWM) in airline companies deals with these optimizations. NWM in this study is understood as the sum of all planning and controlling processes related to flight operations within an airline. It aims at



efficiently allocating existing resources to the network and also changes the network structure if necessary. Recently management decision-making is often more closely aligned to evaluating networks as a whole rather than on a flight-by-flight basis as contemporary networks are diverting flows to other flights. In order to assess the yield and cost development within such networks the NWM requires powerful instruments.

### 3. The Concept of Route and Network Profitability Analysis

#### 3.1. Purpose and General Approaches

In the context of the competitive market environment the subordinate objective of airlines is profit maximization, i.e. optimization of the processes and decisions of NWM. These NWM processes and decisions are differentiated in three phases (strategic network planning, operational network planning and revenue management) which start up to five years prior to the actual departure of the aircraft (compare Fig. 1):

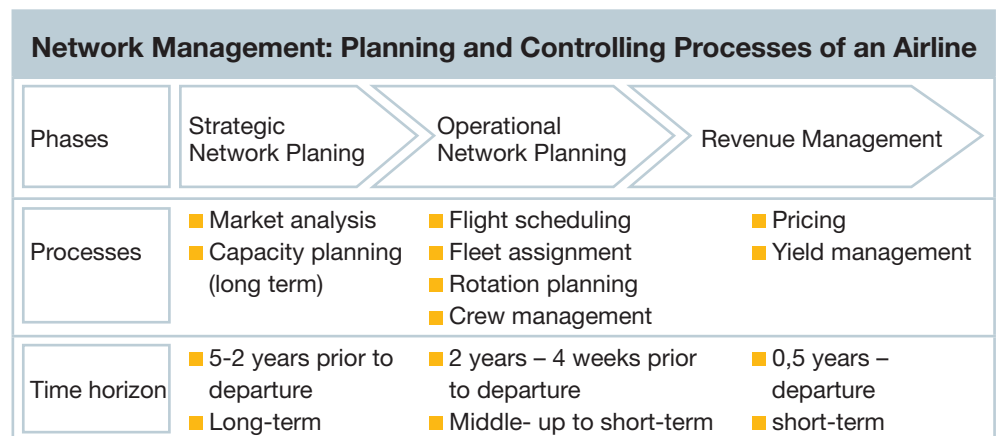


Figure 1: Phases and processes of network management

In order to support profit-oriented decision making throughout these three phases NWM requires profitability data of single flights and information about their profit contribution to the overall network. Moreover, it is important to identify the reasons for the negative financial results and/or to monitor optimization efforts to derive actions related to fleet planning, flight scheduling, fleet assignment etc.

Two distinct profitability analysis methods are differentiated to allow for the particular characteristics of point-to-point and hub-and-spoke networks:

1. Route Profitability Analysis (RPA)
2. Network Profitability Analysis (NPA)

The RPA assumes a point-to-point network. The route result is thus determined independently from any connected flights. It is assumed that only revenues and costs which are generated on the analyzed flight will be at risk if a flight is eliminated. The NPA approach on the other hand examines the analyzed flight as a component of a larger system. It takes into account that hub-and-spoke systems accommodate



high proportions of connecting passengers who use connecting flights in order to get from the origin to the destination of their itinerary (O&D). Consequently the NPA also considers costs and revenues from passengers of these connecting flights. The reason for doing so is the assumption that by cancelling the analyzed flight the contribution of the connecting passengers is not incurred on either the cancelled flight or the connecting flights. Hence, the RPA solely focuses on the profitability of the onboard segment of a single flight whereas the NPA determines the financial importance of the analyzed flight for the overall profitability of the entire airline network.

### 3.2. Methodology

The fundamental idea of both RPA and NPA is to allocate cost and revenues on a flight level basis. However, since not all costs and revenues are caused directly by an individual flight specific allocation formulas or cost and revenue drivers have to be applied. For this quantitative performance data such as number of Block Hours, Flight Hours, Available Seat Kilometers (ASK), Revenue Passenger Kilometers (PPK) or distance flown are used. A basic input for any RPA and NPA therefore are the operating statistics of an airline.

#### Revenues

In addition to the ticket revenues of passengers all other revenues generated on a flight have to be included in the RPA and NPA. These are revenues from excess baggage, sales on board, fuel and security surcharges etc. as well as revenues from belly cargo and transported mail.

In regard to passenger revenues only used coupons are to be included in the calculation and not all sold tickets. Revenues from unflown tickets only are to be considered as revenues for the particular flight when they are used later on or when they expired.

In case of itineraries with multiple legs which are common for network carriers, however, the O&D ticket revenues have to be prorated onto the single flight legs. This prorating is done through applying full fare ratios or through a mileage-based approach. Onboard passenger revenues therefore comprise two components. Firstly revenues from local passengers who's itinerary consist only of the analyzed flight and secondly a portion of the O&D-revenues of the connecting passengers (prorate revenues).

#### Costs

Total operating costs (TOC) are composed of direct operating costs (DOC) and indirect operating costs (IOC). DOC's are further divided into their variable and fixed components. This way three major cost categories are distinguished (compare Fig. 2):

1. direct variable costs
2. direct fixed costs
3. indirect fixed costs



The first major category, namely the direct variable costs, is further subdivided into passenger and flight related variable costs. The former comprise cost items that are caused through a single passenger on a flight such as catering (meals & beverages), passenger insurance, other passenger related expenses and direct passenger related station costs. Flight variable costs on the other hand are those costs that are incurred through conducting an individual flight. They are incurred independent of the number of boarded passengers on the plane. Those are cost items as for example handling costs, landing and parking fees, fuel costs, variable crew costs (e.g. travel expenses) and variable maintenance.

Direct fixed costs, as second major cost category, are referred to as costs for capacity provision. Those are costs mainly for crew and training, aircraft ownership and aircraft insurance as well as for fixed maintenance.

The third major cost category, indirect fixed costs, are further subdivided too. Sub-categories are fixed station costs, sales & marketing costs and administration costs.

Main Cost Categories	Cost Items
direct variable costs	passenger variable costs flight variable costs
direct fixed costs	aircraft ownership costs maintenance costs crew costs
indirect fixed costs	station costs sales costs administrative costs

**Figure 2:** Major cost categories of airlines

Subsequent to the cost categorization the costs are allocated to the single flights which are analyzed in the RPA and NPA. For this the operating statistics mentioned above are used. When choosing a cost driver it is important to identify a driver which resembles the consumption of resources as accurately as possible.

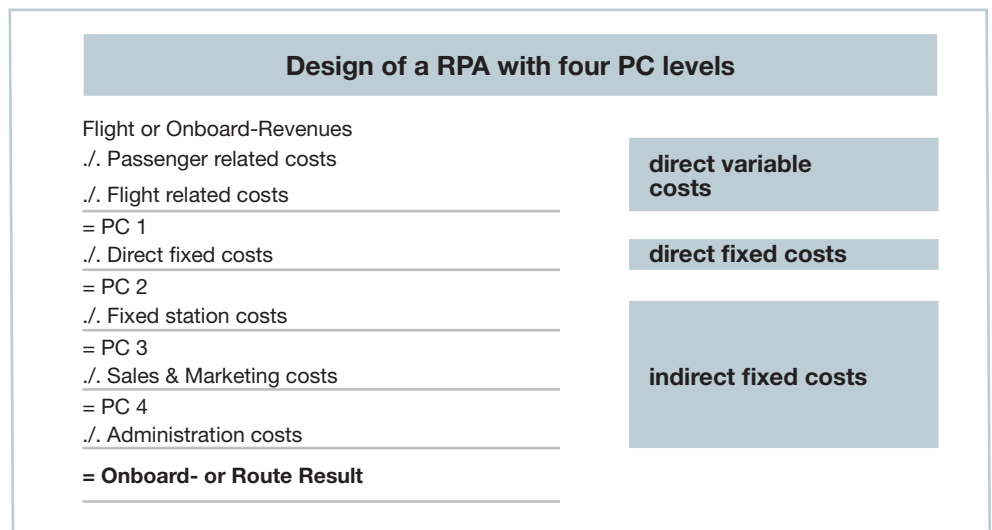
**Profit Contribution Approach**

In order to analyze the profitability of flights airlines usually use the profit contribution approach distinguishing multiple profit contribution (PC) levels. Moreover, most profitability analyses show route results on the basis of fully allocated costs. Differentiating multiple PC levels allows airlines not only to analyze the profitability, but also the different costs components on single flights.

Usually airlines determine profitability data on a monthly basis. However, differences regularly can be seen in regards to the number and type of PC levels applied in the analysis. As an example Fig. 3 shows a RPA distinguishing four PC levels. Starting point of the profitability analysis are the onboard revenues. The single



PC levels (PC 1 – PC 4) are subsequently determined through the above defined cost categories



**Figure 3:** Design of a route profitability analysis with four profit contribution levels

Whereas the RPA analyzes the route result of a single flight through considering only those revenues and cost which are generated by this flight, the NPA on the other hand evaluates the flight with regards to its revenue and cost impact throughout the total network. Therefore an incremental cost and revenue analysis is applied for the NPA. Its underlying assumption is that of a fixed network, meaning that it is assumed that the network will be structured in the same way independent of the individual flight.

Applying this assumption those costs and revenues will be considered additionally to the RPA which are generated by the connecting passengers on the connecting flights. On the revenue side these are the remaining prorated revenues of the connecting passengers, i.e. the proration of the O&D ticket revenues which were allocated onto the single legs of the itinerary. This means that the total O&D ticket revenues are considered for calculating the network profitability. On the cost side only the passenger variable costs of the connecting passengers are added throughout the NPA. These costs and revenues are also referred to as up- and downline costs and revenues.

Taking these up and downline revenues and costs into account – i.e. local revenues and costs from other legs – results in counting those items double throughout the NPA. For example, up- and downline revenues and costs of a flight X are at the same time local revenues and costs for another connected flight Y and vice versa. This double counting is commonly accepted in order to understand the dynamics of a network with interdependent flights. However, double counting has to be taken in to account when interpreting the results of the NPA.

For NPA two methods are distinguished which, however, lead to the same results:



the vertical and the horizontal method. The difference between the two methods lies in point in time when to add the up- and downline revenues and costs to the RPA in order to account for the network contribution and finally to derive the network result (compare Fig. 4).

From Route to Network Profitability Analysis				
Vertical Method		Horizontal Method		
	RPA and NPA	RPA	up- and downline revenues & costs	NPA
RPA	Flight or Onboard-revenues ./ Passenger related costs	Flight or Onboard-revenues ./ Passenger related costs	+ <i>Up- and downline revenues</i> ./ <i>Up- and downline passenger related costs</i>	
	./ Flight related costs	./ Flight related costs	----	
	= PC 1 ./ Direct fixed costs	= PC 1 ./ Direct fixed costs	+ = Incremental-PC ----	= Network-PC 1
	= PC 2 ./ Fixed station costs	= PC 2 ./ Fixed station costs	+ = Incremental-PC ----	= Network-PC 2
	= PC 3 ./ Sales & Marketing costs	= PC 2 ./ Fixed station costs	+ = Incremental-PC ----	= Network-PC 3
= PC 4 ./ Administration costs	= PC 4 ./ Administration costs	+ = Incremental-PC ---	= Network-PC 4	
	<b>= Route Result</b>	<b>= Route Result</b>	+ <b>= Incremental-PC</b>	<b>= Network-Result</b>
up- and downline	+ <i>Up- and downline revenues</i> ./ <i>Up- and downline passenger related costs</i>			
NPA	<b>= Network Result</b>			

Figure 4: Design of a Network Profitability Analysis: vertical and horizontal Method

Within the vertical method the incremental profit contribution (balance of up- and downline revenues and costs) is taken into account only after computing the route result. In order to derive the network result another PC level is added to the RPA.

Throughout the horizontal method, however, up- and downline revenues and costs are already considered throughout the PC levels of the RPA. That implies that up- and downline revenues and costs are added on the specific PC levels. As a consequence it can be stated that the RPA is the necessary basis for deriving the NPA using either the vertical or horizontal method.

Furthermore, the NPA can be enhanced through additionally taking opportunity costs into consideration. The opportunity cost concept factors the load factor of the



connecting flights into the calculation and allows for the possibility that a connecting passenger takes the seat of a potential local passenger. The spilled revenues or opportunity costs on the connecting flight are therefore charged against the main flight being analyzed. For example, not only downline passenger variable costs, but also opportunity costs will be subtracted from the associated downline revenues. Accordingly the respective network contribution of the analyzed flight is lower when applying the opportunity cost concept.

### 3.3. Relevance for Network Management

Both RPA and NPA provide essential profitability information for NWM. Whereas both approaches identify the sources for profit and loss within the network, the conclusions can be different. The RPA on the one hand determines the actual financial result of a single flight which corresponds with the actual accounting data. By double counting certain revenues and costs the NPA on the other hand abandons traditional accounting practices. This, however, enables airlines to illustrate the financial impact of flights within an interdependent route network. Furthermore, both approaches provide the opportunity to analyze the reasons for the respective results in detail which allows NWM to optimize the route network in a profit-oriented way.

#### Interpretation of the Route Profitability Analysis

In order to make specific network management related decisions airlines can refer to each of the single PC levels explained in Fig. 3 above. Every PC level provides detailed information regarding which variable has to be fine tuned by the NWM in order to optimize the route profitability.

As basic principle, however, it is important to be aware of which revenue and cost items are incorporated on each PC level and which allocation keys are applied before drawing conclusions and interpreting the results of the PC levels and the route result.

The PC 1 is an indicator for the ability of a single flight to cover not only its variable costs but in addition to contribute to the incurred fixed costs. Therefore a flight is economically feasible only when it shows a  $PC\ 1 > 0$ . PC 1 is a profitability measure for a single flight event and indicates its absolute bottom price. Due to the fact that only variable costs are introduced in computing the PC 1 it only determines the short-term viability. Thus, network management related decisions can only be drawn for the short-term assuming that capacity and other resources are fixed. In the long-term, however, full cost recovery and a surplus have to be achieved.

PC 2 additionally includes all direct fixed costs of a flight which are mainly driven by the aircraft type operated. The aircraft type, for example, determines the number and the qualification level of the crew as well as the costs for maintenance and aircraft ownership. Moreover, the type of aircraft determines the maximum seat capacity and with that the revenue potential of a flight. Accordingly PC 2 primarily



is an indicator for the profitability of the aircraft which is operated. This contribution level therefore allows to analyze the cost and revenue impact of assigning different aircraft types. Through that PC 2 is the basis for decisions related to capacity and flight schedule.

In order to assess the profitability of the handling and station operations PC 3 is used as an indicator. Since all major costs for network infrastructure are represented on this contribution level it is the basis for major changes in the route structure.

By additionally including sales and marketing costs PC 4 is computed. These costs, however, only have little relation to the actual flight operations or the network structure as such. PC 4 therefore is mainly an indicator for the profitability of the sales organisation.

Finally the route result considers all costs including the remaining administration costs. Hence, the route result shows the operating result for each flight on the basis of fully allocated costs. It indicates whether a flight has the ability to cover not only its variable costs but also all allocated direct and indirect fixed costs as well as whether it contributes to the overall profit of the airline. The route result therefore is highly relevant for long-term analyses and is the decision basis for major changes in the network and company strategy

#### Interpretation of the Network Profitability Analysis

As already demonstrated RPA gives insufficient insight for complex network management related decisions of network carriers, as it has a strict onboard focus. Optimization efforts solely based on RPA data will thus usually result in suboptimal decisions which could lead to poor financial results for the carrier as a whole.

In the context of an O&D driven network, however, it might be necessary to continue a flight which is unprofitable on the basis of the RPA, but generates considerable traffic for connected flights. This situation can regularly be observed with feeder flights of a network carrier.

In general, the meaning of the different PC levels as profitability indicators is the same for the NPA as for the RPA. Due to the O&D focus of the NPA, however, the financial results will differ from the RPA and thus possibly also the recommended actions.

Moreover, when drawing conclusions from the financial results of the NPA it is important to keep in mind that revenue recapture is not allowed for in the analysis. By discontinuing a flight, though, it is reasonable to assume that a network carrier has the possibility to regain some of the lost passengers (and hence revenues) via another flight.

Furthermore it has to be taking into account that through including up- and downline



revenues and costs nearly every route result, especially those of the unprofitable feeder flights in the context of a the RPA, will turn positive within the NPA. However, not all flights can be justified by showing a positive network contribution only. This situation should rather be the exemption since the network has to be financially viable as a whole.

#### 4. Empirical Study on Route and Network Profitability Analysis

##### 4.1. Approach

To gain an in-depth understanding of the implementation, structure and incorporated revenue and cost drivers of RPA and NPA as well as their relevance for NWM-related and other planning processes, an empirical study was conducted during May to July 2006. The passenger airlines chosen for this census were the world's top 100 hub-and-spoke airlines measured by realized revenues in the fiscal year of 2004. Additionally, only passenger airlines which offered scheduled services were contacted. Hence, Low Cost Carriers and Charter Carriers were not part of this survey.

Basis of the survey was a questionnaire which was sent to the airlines during May to July 2006. The return rate was 30%.

The main findings of the survey are discussed in the chapter below. In principal the examination of the answers refers either to all 30 airlines or to the total number of answers received for the particular question ( $N \leq 30$ ). In certain cases the airlines are further categorized into three different revenue groups and analyzed respectively:

Size of airline	Revenues generated	Absolute number and share of airlines in category
small airlines	up to 1 billion US \$	13 (43%)
medium airlines	up to 5 billion US \$	9 (30%)
large airlines	more than 5 billion US \$	8 (27%)

**Figure 5:** Categorization of airlines by revenue

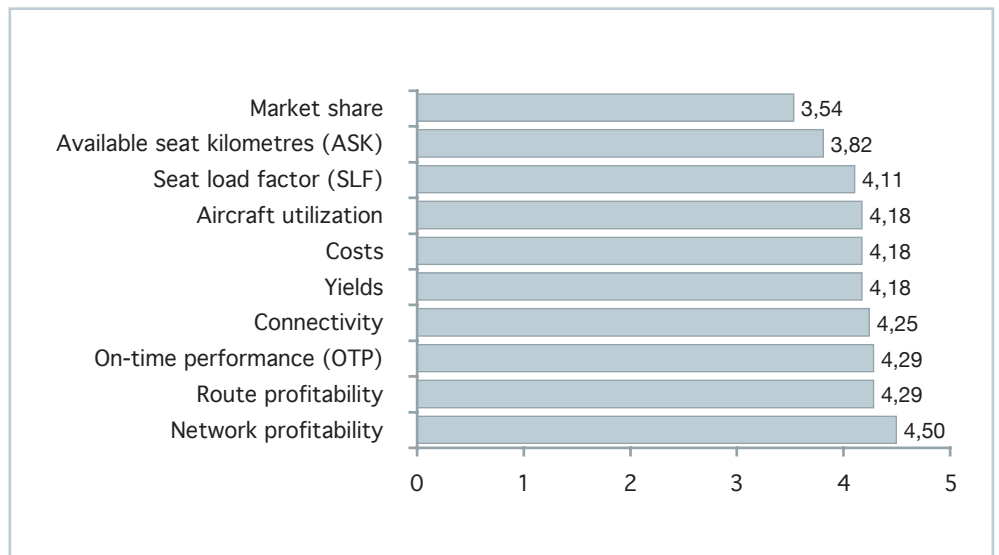
The questionnaire consisted mainly of questions with predetermined answers which had to be check-marked when appropriate (partly multiple answers possible). Moreover, it contained various questions where an evaluation of the statement was required (scale ranging from 1 = "not important" to 5 = "very important") and also open questions which had to be answered in written form.

##### 4.2. Findings

###### General Information

Asked about the importance of different objectives for planning the airlines gave the following responses which are illustrated in Fig. 6. It can be observed that "maximization of the network result" is the most important and that "maximization of the route result" is the second most important objective for airlines. Hence, the focus on profitability is clearly evident.





**Figure 6:** Importance of objective for planning

### Application of Route and Network Profitability Analysis

All of the analyzed 30 airlines conduct a profitability analysis. 10 (33.3%) of the airlines state that they apply the RPA, whereas 20 (66.7%) of the airlines have additionally implemented the NPA. Furthermore a correlation between size of the airline and implementation of the NPA can be stated. All large airlines except one, two thirds of the medium sized airlines, but only approx. 50% of the small airlines have implemented the network approach.

The RPA was implemented from around 1970 onwards whereas the NPA first was introduced in 1990. In a more detailed analysis it can be seen that small and medium airlines (by revenue category) followed the large airlines since they introduced the RPA mostly during the nineties and the Network Approach from the year 2000 until present.

The initiative for developing a profitability analysis in most cases came from the top management of an airline (compare Fig. 7). This shows the strategic importance of this topic.



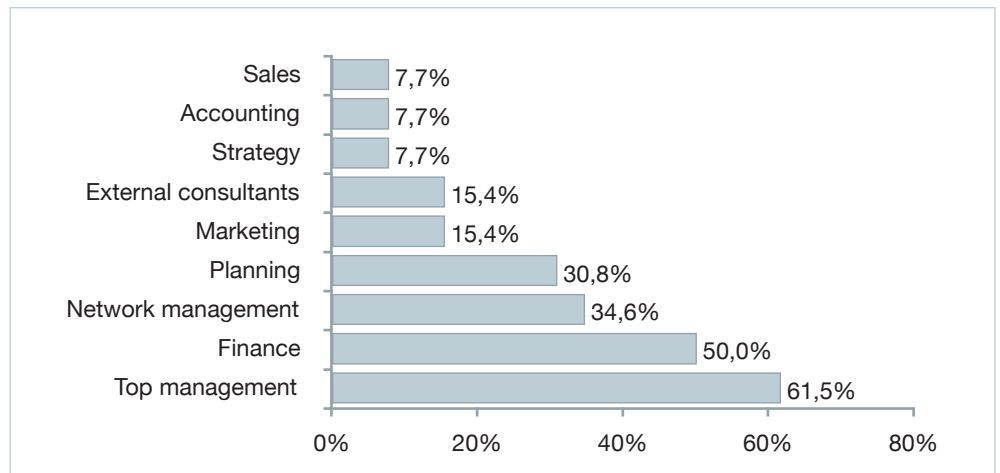


Figure 7: Initiator of the development of a route profitability system

Analyzing the main motivation for introducing a route profitability system shows that most airlines try to establish a closed loop process: the historical route performance is measured in order to enhance future planning processes and through that to optimize the overall profitability of the airline. This result is in line with the statement that the main objective of the analyzed airlines is to improve their profitability (compare Fig. 8). Therefore the RPA can be seen as important instrument to achieve this objective.

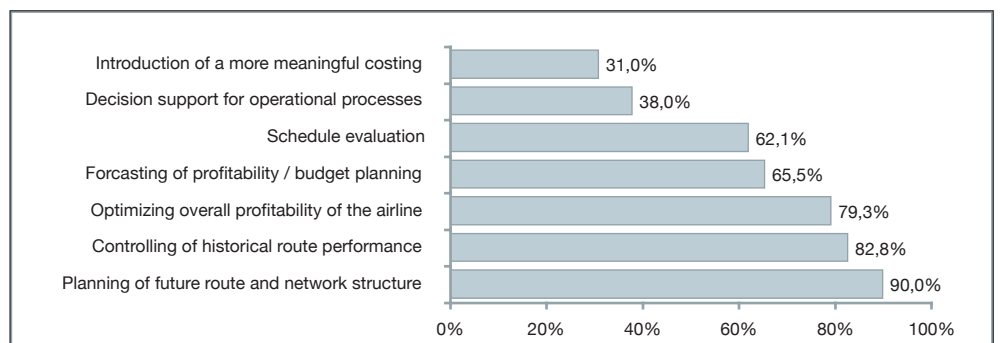


Figure 8: Motivator for introducing a route profitability system

The responsibility for computing the profitability data lies mainly within the finance (63.3%) and the accounting department (30%). Only in few cases (6.7%) the NWM department is responsible for conducting the RPA and NPA.

Large differences are prevalent in regards to the IT implementation of RPA and NPA: 75% of the smaller airlines use stand-alone systems where data is entered completely manually or where only some interfaces to other systems exist. 71% of the large and medium carriers, on the other hand, have integrated systems with a medium or high level of data input automation.



### Methodology of Route and Network Profitability Analysis

A high percentage of the airlines (86.8%) conduct the profitability analysis on a monthly basis. Only 9.9% of the carriers compute the route results in shorter intervals namely weekly or daily. Just one airline (3.3%) analyzes the route performance quarterly. In order to be able to optimize planning processes on a short term basis a monthly profitability analysis, however, is mandatory. On the other hand a shorter time period than a month probably is too complex and can not be realized at most airlines.

In conducting the analysis the majority of the airlines compute profitability data down to the level of a single flight or leg (83.3%). Only 6.7% of the examined airlines use O&D's for performance measurement. Furthermore, 10% of the carriers use destinations as a basis for profitability analysis. For establishing an efficient profitability analysis the latter, however, is not detailed enough. The aim should be to measure flight-level profitability since the production unit of an airline is a single flight.

In order to compute profitability data within the RPA and NPA all relevant operating cost and revenue items have to be included. In the survey 70% of the airlines stated that they consider not only operating, but also non-operating costs and revenues in the analysis. This finding is quite surprising since the objective of a profitability analysis usually should be an evaluation of the operating performance. However, only 30% of the carriers focus solely on operating costs and revenues in the analysis.

In regard to the operating result the airlines take the main revenue items such as cargo revenues or excess baggage into account (Fig. 9). The low value of certain items such as the security surcharge is to be seen against the background that not all airlines impose those charges.

Revenues	Absolute number	Value in %
Cargo	30	100,0%
Excess Baggage	28	93,3%
Fuel Surcharge	25	83,3%
Security Surcharge	20	66,7%
Sales on board	14	46,7%

**Figure 9:** Included revenue items in the profitability analysis

As mentioned above the product of a network carrier which is sold to a customer usually is an itinerary that involves two or more flights. In order to calculate the operating profit of a single flight the fare of a passenger therefore has to be allocated between the different flights. For this the examined airlines mainly use mileage-based proration methods (75%). Only 25% use full-fare ratios.



Concerning the cost information it can be observed that almost all analyzed airlines exclusively (33.3%) or mainly (56.7%) use actual cost data for cost accounting. Only a minority uses mainly unit cost data (10%). In general actual cost data should be used in order to show a realistic picture of the actual route performance.

Furthermore, the airlines distinguish total operating costs into DOC and IOC and additionally subdivide them into their fixed and variable components. Applying this differentiation the profitability system derives the three major cost categories described above. This distinction is the necessary basis for applying a detailed PC approach. Only one airline states not to further subdivide operating costs into variable and fixed costs.

Airlines differentiating the three cost categories have on average surprisingly high variable DOC's (63.3%) (compare Fig. 10). Only about one third of the costs are fixed. Therefore the airlines have managed to establish a high variability of their costs which in turn makes them more reactive to changes in demand.

Operating cost category	Average (in %)	Minimum (in %)	Maximum (in %)
variable direct costs	63,3%	50%	79%
fixed direct costs	22,5%	9%	37%
fixed indirect cost	14,2%	3%	25%

**Figure 10:** Cost structure of the airlines (in %)

Conducting a flight level profitability analysis makes it necessary to allocate cost items on the basis of a cost driver. Fig. 11 shows whether certain costs are allocated within the profitability analysis and if so, which cost driver is used. The survey shows that the majority of the airlines apply a sophisticated profitability analysis where all relevant cost items are allocated. However, some systems are less detailed and leave out certain direct variable and indirect fixed cost items. Only one airline does not allocate fixed indirect costs at all and hence applies a sole analysis of direct costs.

With respect to the applied cost driver it can be seen that variable direct costs are mainly allocated on the basis of a passenger, flight or landing. For fixed direct costs airlines mostly use Block Hours as the cost driver whereas fixed indirect costs are allocated mainly by ASK or ASM.



Cost item	Used cost driver (in %)									
	Not allocated	Passenger	Flight	Landing	Block Hour	Flight Hour	ASK/ ASM	RPK/RPM	% of Revenues	Other
<b>direct variable costs:</b>										
Passenger insurance	-	<b>50.0</b>	-	-	8.3	-	8.3	29.2	4.2	-
Reservation	3.7	<b>85.2</b>	-	-	-	-	3.7	3.7	3.7	-
Catering	3.7	<b>74.1</b>	7.4	3.7	-	-	-	7.4	-	3.7
Credit card	12.6	33.3	-	-	-	-	8.3	-	<b>45.8</b>	-
Fuel	3.8	-	19.3	-	<b>50.0</b>	11.5	-	-	-	15.4
Landing fees	3.8	-	15.5	<b>69.3</b>	3.8	-	-	-	-	7.6
Aircraft parking fees	8.0	-	28.0	<b>48.0</b>	-	-	-	-	-	16.0
Ground handling	3.8	7.7	23.2	<b>53.8</b>	-	-	-	-	-	11.5
Air Traffic Control	11.5	-	<b>53.8</b>	7.8	3.8	7.8	3.8	-	-	11.5
Crew travel	-	15.4	23.1	3.8	<b>30.8</b>	15.4	-	-	-	11.5
Variable maintenance	-	-	7.7	11.5	<b>42.3</b>	26.9	7.8	-	-	3.8
Cargo costs	15.8	15.8	15.8	-	-	-	5.2	5.2	15.8	<b>26.4</b>
<b>direct fixed costs:</b>										
Aircraft insurance	-	-	8.3	4.2	<b>45.8</b>	4.2	29.1	4.2	-	4.2
Ownership costs	-	-	4.0	8.0	<b>68.0</b>	12.0	8.0	-	-	-
Crew salaries	-	3.8	11.5	7.7	<b>38.5</b>	19.0	11.5	-	-	7.7
Fixed maintenance	-	-	4.0	12.0	<b>48.0</b>	28.0	8.0	-	-	-
<b>indirect fixed costs:</b>										
Station costs	3.7	18.5	14.8	11.2	3.7	-	<b>22.2</b>	3.7	14.8	7.4
Sales organization	7.7	11.5	-	-	3.8	-	<b>34.7</b>	11.5	30.8	-
Marketing	11.1	11.1	11.1	-	3.7	-	25.9	-	<b>37.1</b>	-
Administration	15.4	7.7	7.7	3.8	3.8	3.8	<b>26.9</b>	3.8	2	3.8

Figure 11: Used cost driver for cost allocation (main cost drivers: bold letters)

### Design of Route and Network Profitability Analysis

As a management accounting system, RPA and NPA can be modelled according to the special needs of an airline. Therefore the design and the profitability measures that are applied differ quite considerably between airlines. However, all airlines basically adopt a more or less detailed PC approach.

For the RPA most carriers distinguish two (58.3%) or three (20.8%) contribution levels. Only 12.5% of the airlines use an approach with one PC level and 8.4% distinguish four PC levels. Independent of the number of PC levels applied in the analysis all airlines subtract variable direct costs on the first level. The variable cost category contains passenger variable and flight variable costs. Only one airline builds a separate contribution level for either one of these variable cost elements.

Airlines which distinguish two PC levels most commonly structure their profitability analysis as shown in Fig. 12 on the left hand side. They differentiate the three basic cost categories: variable direct, fixed direct and fixed indirect costs. Quite a few

--	--	--	--	--

airlines, however, dedicate a separate PC level to ownership costs (compare Fig. 12 right hand side).

Structure of a Route Profitability Analysis with two Profit Contribution Levels (PC)		
Most prevalent structure:	Alternative Structure:	
Revenues	Revenues	Revenues
./. Variable direct costs	./. Variable direct costs	./. Variable direct costs
= PC 1	= PC 1	= PC 1
./. Fixed direct costs	./. Ownership costs	./. Fixed costs
= PC 2	= PC 2	= PC 2
./. Fixed indirect costs	./. Fixed costs	./. Ownership costs
<b>= Onboard Profit</b>	<b>= Onboard Profit</b>	<b>= Onboard Profit</b>

Figure 12: Methodology of the route profitability analysis with two profit contribution levels

Furthermore the survey shows that profitability systems with only one contribution level just distinguish between variable and fixed cost whereas systems with three levels further subdivide the different fixed cost categories. Generally speaking the more PC levels are distinguished in the analysis the more information can be extracted and hence, better decisions can be derived in order to optimize profitability.

As mentioned above airlines additionally consider up- and downline revenues and costs in order to evaluate the network contribution of a flight. On the revenue side the airlines add the remaining prorated revenues of the connecting passengers to the onboard revenues. On the cost side, though, the approach varies between airlines. In the survey 43.75% of the analyzed airlines indicate that they only consider the passenger variable costs of the connecting passengers as up and downline costs. Another 43.75% of the carriers additionally deduct variable flight related costs, whereas 12.5% of the companies even further subtract aircraft ownership costs. With the assumption of a fixed network airlines should, however, only consider passenger variable costs for calculating the network contribution of a flight.

The survey shows that those airlines which apply the NPA 78.6% use the vertical method to derive the network result. Only the remaining 21.4% of the carriers have introduced the horizontal method. Given the fact that the vertical method provides additional profitability information a change in method is recommended.

Further insights can be drawn from applying the concept of opportunity costs. 30% of the NPA users state in the study that they do so. From this it can be seen that quite a few carriers have a highly sophisticated NPA system already.

Additionally to the route and network profitability analysis, 83.3% of the carriers separately analyze profitability information based on the nature of the business, i.e.



scheduled traffic, charter, cargo etc. This way not only the performance of a route, but also the profitability of different products (passenger operations, cargo operations etc.) can be examined. The product profitability analysis can be calculated easily on the basis of the RPA / NPA data and therefore is easy to implement. It provides important information for network management in terms of the absolute bottom price for individual products.

Questioned about KPI's that the route profitability system determines additionally to the route result the carriers gave the answers shown in Fig. 13. It can be seen that besides various unit cost and revenue ratios especially the break-even Seat Load Factor (SLF) is being analyzed.

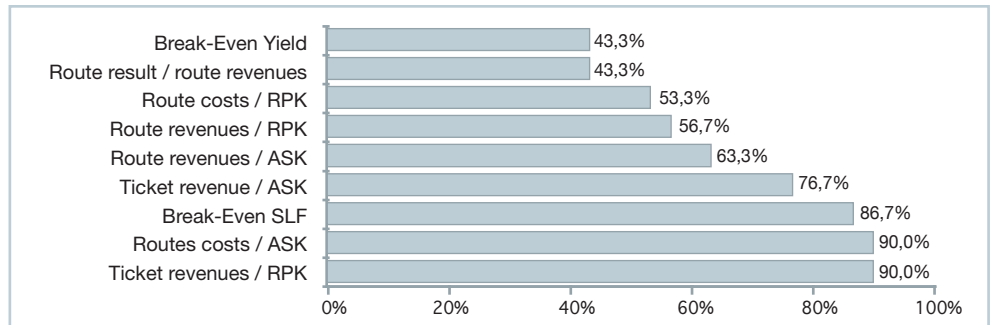


Figure 13: KPI's determined on the basis of the profitability data

### Interpretation of the Profit Contribution Levels

Besides analyzing the design of the RPA and NPA one key part of the survey was to determine how the airlines apply the obtained profitability data within NWM. It can be observed that all carriers initiate similar actions if a route shows a negative or insufficient result. Depending on how many PC levels are being distinguished within the profitability analysis those actions are implemented more precisely.

Due to the fact that most airlines distinguish two PC levels within the profitability analysis (RPA and NPA) this design will be discussed in more detail in the following paragraphs. In the context of the RPA all analyzed carriers subtract direct variable cost from route revenues in order to derive the PC 1. In case that the PC 1 shows a negative result over a longer time period all airlines state to discontinue the flight.

When a flight, however, shows a positive PC 1 but a negative PC 2 result airlines will maintain the flight. This is reasonable since the flight at least covers its variable costs and possibly a portion of the allocated direct fixed costs. Actions that will be introduced in order to optimize the result are mainly capacity related such as change of frequency or aircraft type. Some airlines also initiate specific marketing efforts for these routes or will adjust departure times. Only few airlines also apply PC 2 data for fleet planning purposes.

Finally, if a flight shows a negative route result the airlines state that they will evaluate more fundamental optimization measures as for example reorganizing the



companies' administration or implementing cost reduction programmes concerning sales and staff. Since flights have to achieve full cost recovery on a long-term basis airlines use the route result level as a decision basis for major changes in route and company strategy.

Fig. 14 displays the most frequent answers regarding the actions initiated if a certain PC level shows a negative result (shown at the example of a RPA with two PC levels). Airlines that compute a different number or different types of PC levels state the same optimization efforts, however, adapted to the design of their RPA.

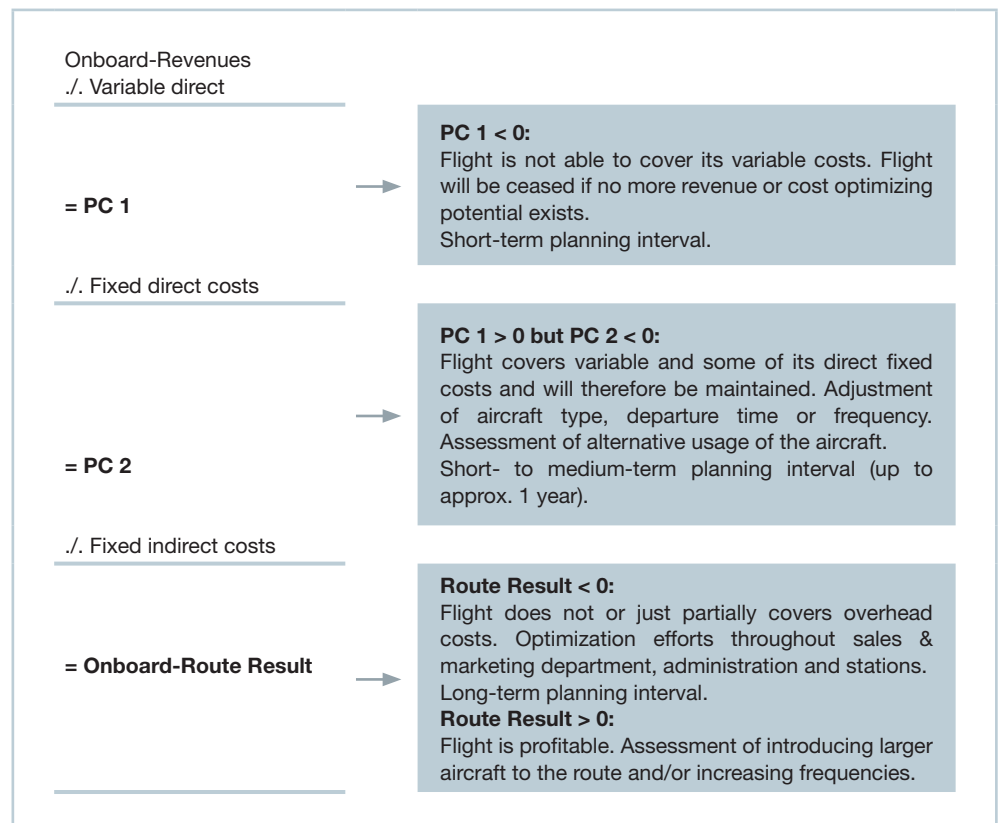


Figure 14: Exemplary interpretation of a Route Profitability Analysis with two profit contribution levels

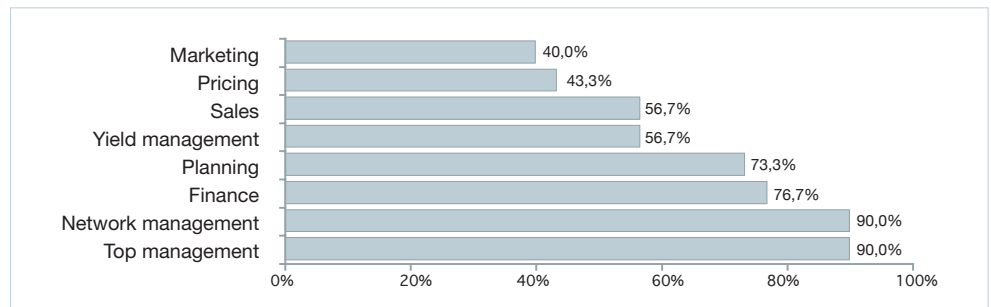
Airlines applying the NPA generally indicate the same answers. Reflecting the concept of the NPA this fact is quite reasonable since the NPA simply is an extended RPA which evaluates the network contribution of a flight. Accordingly only in those cases where a flight shows a negative result on PC or route result level within the RPA, but a positive result within the NPA the consequences derived from the analysis will be different. Only in this special case, i.e. when a flight provides significant traffic to other flights within the network, the airlines state not to eliminate the flight but to maintain it.

### Use of the Profitability Data for Optimizations in Planning and Controlling

Fig. 15 displays the main users of the information provided by the profitability analysis. It can be seen that the data is of high strategic importance since Top

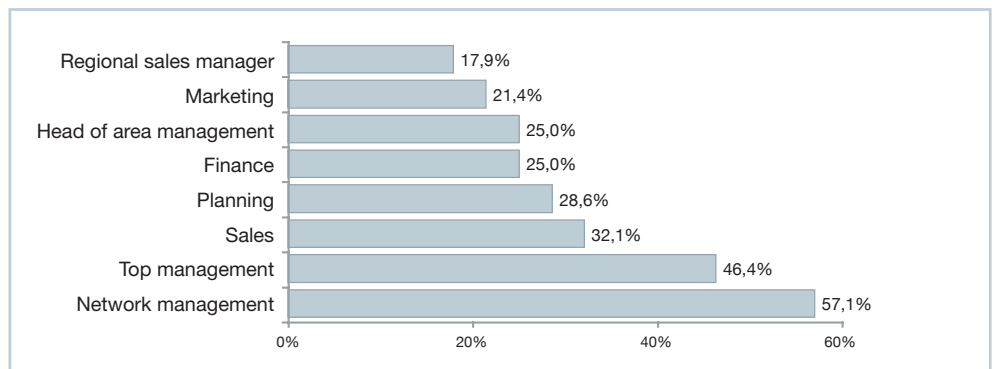


Management receives the data at 90% of the analyzed carriers. But also the NWM (90%), Finance (78%) as well as the Planning Department (73.3%) are major recipients for profitability information. For Revenue Management and Sales & Marketing, however, the data is less important.

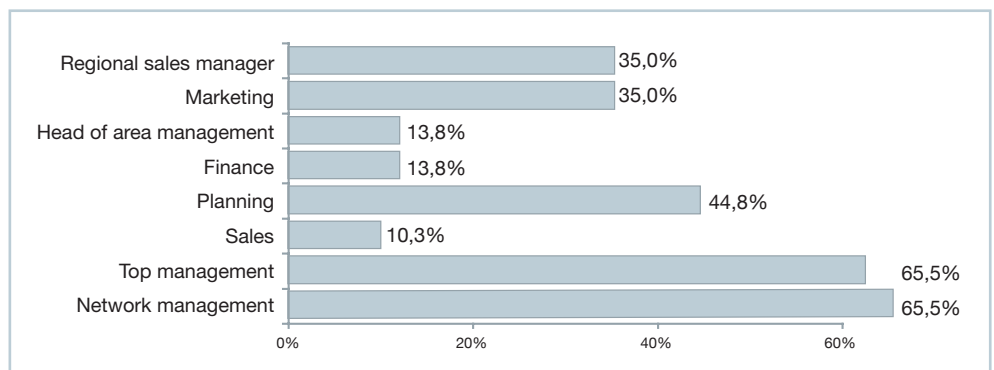


**Figure 15:** Main users of the information provided by Route and Network Profitability Analysis

When analyzing the profit responsibility for single flights a mixed picture can be observed (compare Fig. 16 left hand side). At 57.1% of the airlines this responsibility lies with the NWM and in 46.4% directly with the Top Management. However, Sales (32.1%), Planning (28.6%) and Finance (25%) are responsible for financial route results as well.



**Figure 16 a.** Profit Responsibility



**Figure 16 b.** Operational Responsibility

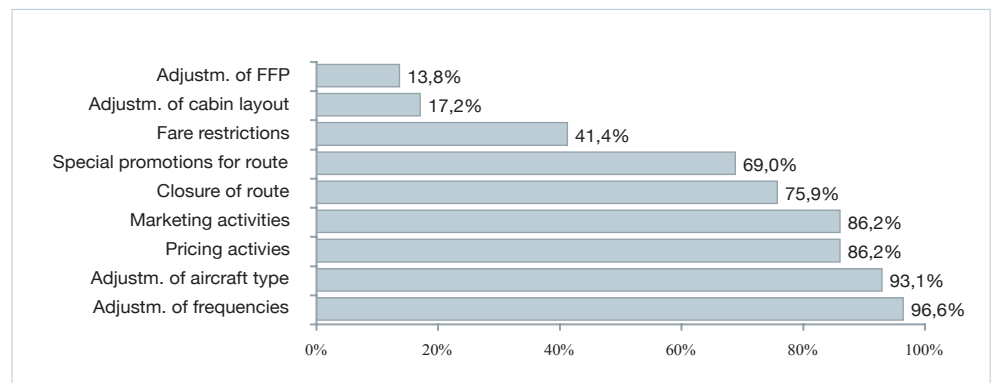
**Figure 16 a and 16 b:** Comparison of profit responsibility and responsibility for adjusting routes



Concerning the adjustments of routes with a negative or insufficient financial result, however, mainly the planning functions are responsible (compare Fig. 16 right hand side). Naturally also Top Management is involved in decisions regarding network adjustments (65.5%).

Thus comparing the profit responsibility on the one hand and the responsibility for adjusting the route structure on the other hand differences can be observed. In terms of financial accountability, for example, Sales, Marketing and the respective Head of Area Management have a relatively high responsibility. At the same time these departments widely lack the authority to introduce adequate adjustments on single routes. In order to avoid problems concerning competencies and interfaces it should thus be the goal to harmonize both responsibilities.

Furthermore it was analyzed which actions are discussed in general if a flight shows a negative or insufficient result and also which actions are actually initiated if a flight is unprofitable and no potential for optimization is left. Potential actions that are discussed are shown in Fig. 17.

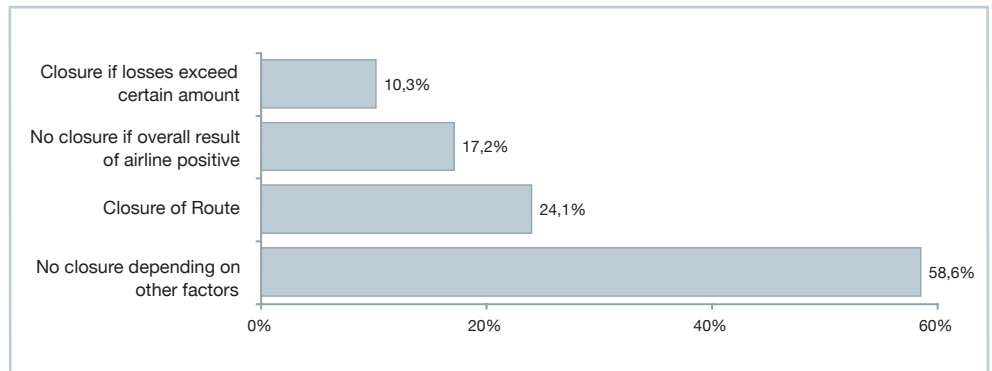


**Figure 17:** Actions which are generally considered if a flight shows a negative or insufficient result

The carriers state that the primary variables for optimizing a flight with a negative or insufficient result are frequency (96.6%) and aircraft type adjustments (93.1%). But pricing and marketing activities (both 86.2%) are also taken into consideration frequently. Finally 75.9% of the airlines discuss that ceasing operations is potentially an option as well. This emphasizes the statement mentioned above that profitability is a very important objective for the analyzed airlines.

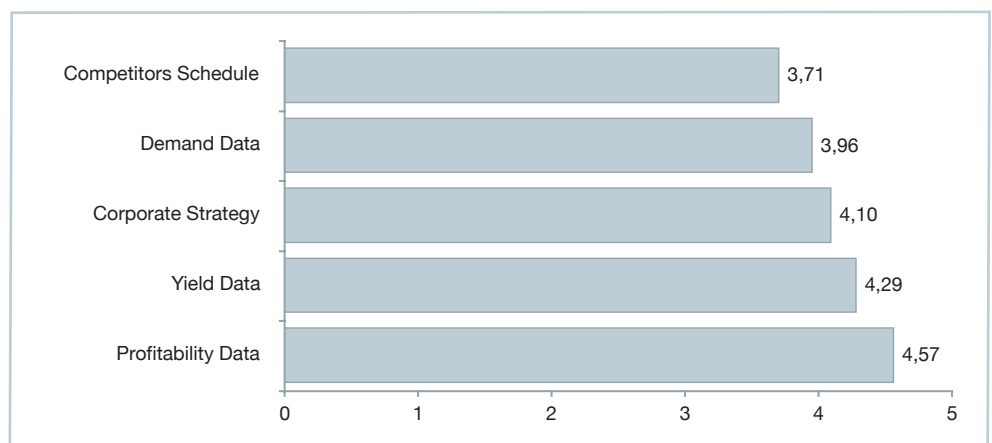
With reference to the question which actions will actually be initiated by carriers if a route is unprofitable, however, different answers can be observed compared to those stated above. The elimination of a flight is considered only at 24.1% of the airlines directly and at 10.3% of the carriers if losses exceed a previously defined threshold. 58.6% of the airlines, however, indicate that they will maintain the flight due to other factors such as the long-term strategy to enter a market, the competitive situation or – in case of applying the NPA – a positive network result of the respective flight. 17.2% of the carriers will even maintain unprofitable routes only if the overall result of the airline is positive (compare Fig. 18).





**Figure 18:** Actions which are actually initiated if a route shows a negative or insufficient result and no potential for optimization is left

This finding is also reflected in Fig. 19. The airlines declare that the financial result of a flight – illustrated by yield or profitability data – is the main indicator for initiating actions in regards to adjusting or discontinuing a flight. The corporate strategy and/or demand data, however, are highly important at the same time and can justify divergent conclusions.



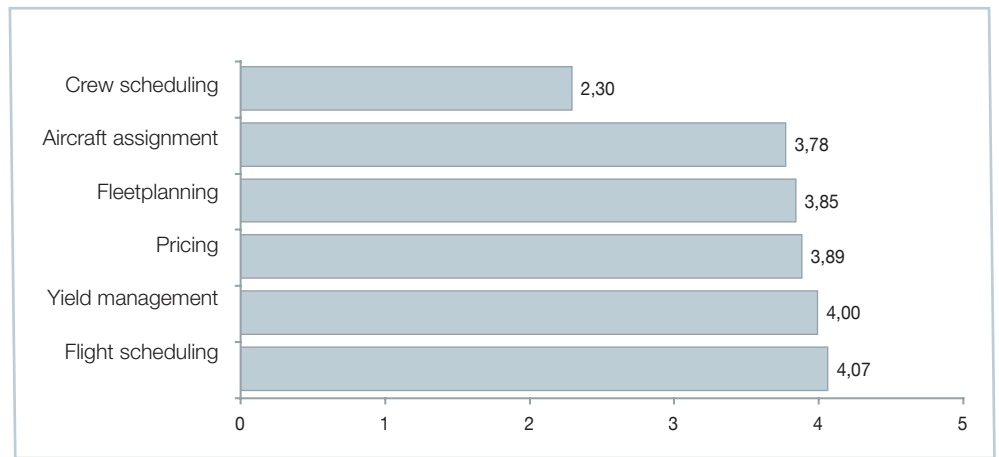
**Figure 19:** Relevance of different data sets for decisions regarding the adjustment or closure of flights

79.3% of the airlines state that they initiate the above network adjustments not only once after computation of the route or network profitability analysis but also on the basis of intermediate profitability data. Only 20.7% of the carriers take actions on the basis of negative or insufficient route results after the final calculation of the profitability data.

### Relevance for Network Management

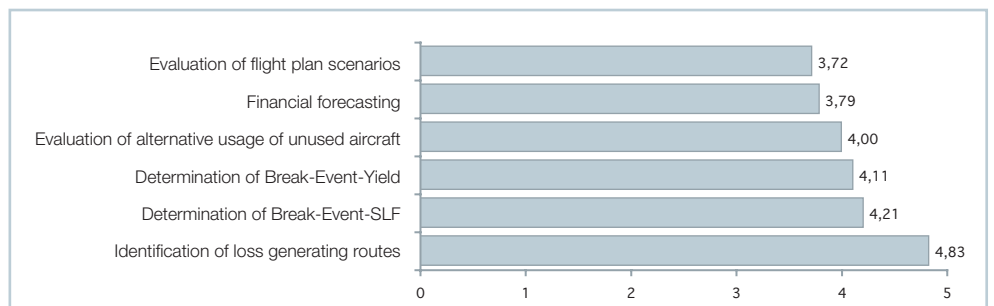
Moreover, the airlines were requested to indicate the relevance of the profitability data for various processes and decisions. Fig. 20 shows the assessment for different processes throughout NWM. According to the answers profitability data is of particular importance for flight scheduling (average of 4.1) and yield management (4.0) but of minor importance for crew planning (2.3).





**Figure 20:** Relevance of RPA and NPA data for decisions throughout various processes

In another question the airlines were asked to evaluate the relevance of profitability data of RPA and NPA for NWM related analyses (compare Fig. 21). The high parameter value of 4.8 indicates that RPA and NPA are mainly used for identifying loss generating routes. But RPA and NPA data also is highly relevant for different analyses throughout yield management, as for instance for determining Break-Even SLF and Break-Even Yield (4.2 and 4.1).

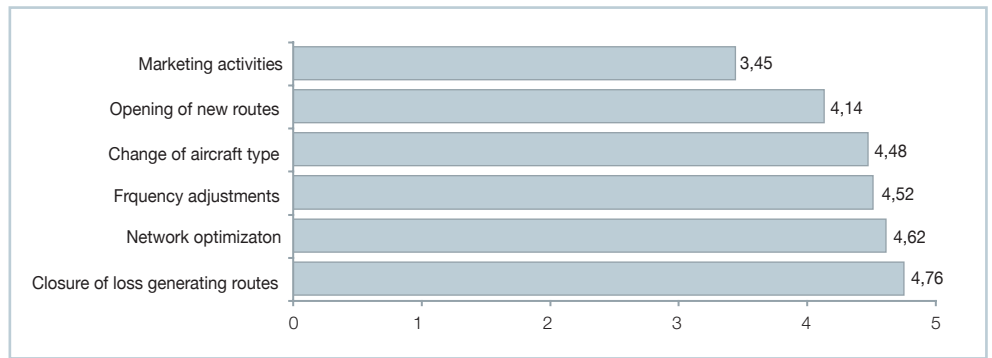


**Figure 21:** Relevance of RPA and NPA data for network management related analyses

As already analyzed the main function of RPA and NPA is to determine unprofitable flights. Fig. 22 shows that RPA and NPA additionally are highly relevant in order to deduce network optimization efforts (4.6). Such optimization efforts can be adjustments of frequencies and the appointed aircraft type (both 4.5). For initiating marketing activities RPA and NPA data on the other hand is only partially of relevance (3.5).

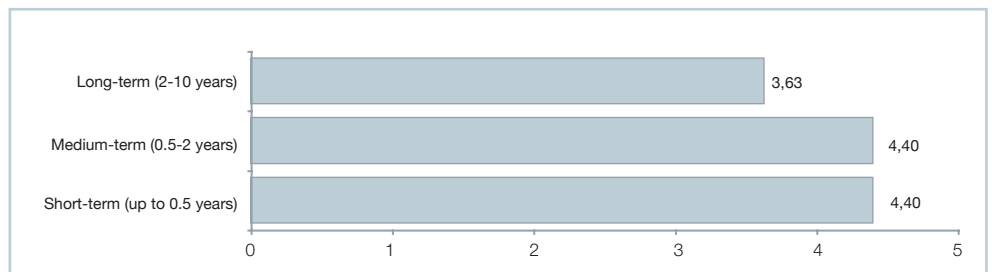
However, when no further optimization potential is left profitability data is one of the principal reasons to cancel flight operations on a route (4.8). These findings comply with earlier results. Nevertheless, it has also to be recognized that the cancellation of a flight often is not realized due to other non-financial reasons.





**Figure 22:** Relevance of RPA and NPA data for network management related actions

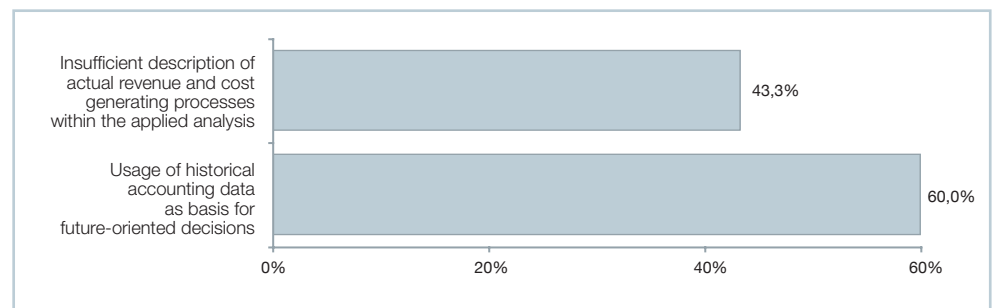
As a conclusion it can be observed that the importance of profitability data is assessed to be “high” or “very high” for the short- and medium-term planning interval (compare Fig. 23). For long-term planning RPA and NPA data on the other hand has only a parameter value of (3.6).



**Figure 23:** Relevance of RPA and NPA data for different planning intervals in network management

### Assessment of the Route and Network Profitability Analysis

The carriers also provided answers to the question which general limitations of the RPA and NPA concept are perceived. 60% of the airlines reflect that the usage of historical accounting data as a basis for future-oriented decisions is problematical. Another problem lies in the insufficient description of actual revenue and cost generating processes within the applied analysis (43.3%). This problem is seen in particular as to the allocation of indirect fixed costs onto single flights. However, this is the typical criticism expressed when fully allocating costs (compare Fig. 24).



**Figure 24:** General limitations in the application of RPA and NPA



Besides general reservations concerning the concept of RPA and NPA the airlines also addressed certain specific limitations (compare Fig. 25). The fundamental problem is seen in the correct interpretation of the output information (66.7%). Double counting of revenues and costs throughout the NPA is one item mentioned within this context at 35% of those carriers which apply a NPA. Furthermore, the interviewees complained about the lack of a clear accountability for route or network results within the airline as well as diverging perceptions between different departments on consequences that have to be taken once a result is negative (both 60%). Despite the aforementioned limitations, however, only 20% of interviewees address the lack of a superior authority that it responsible for a holistic optimization of the total network. And as a matter of fact only 23.3% of the carriers see a problem in the credibility of the results of RPA and NPA. This comparatively low parameter value thus reveals that the concept of RPA and NPA is generally accepted and is judged as appropriate basis for NWM related decisions.

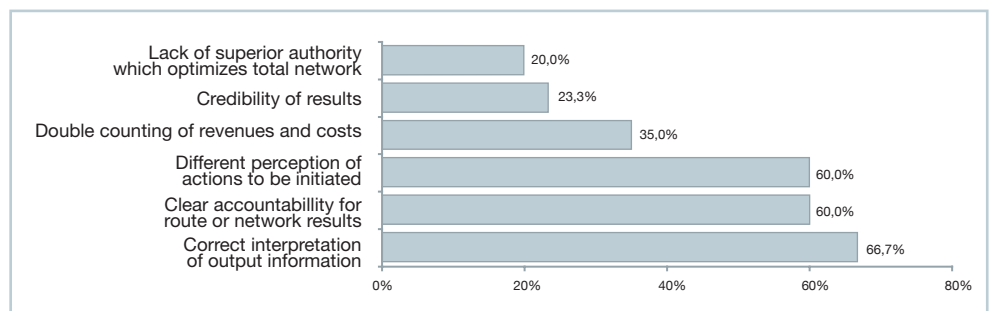


Figure 25: Specific limitations in the application of RPA and NPA

Throughout the survey the airlines were supposed to highlight the strengths and advantages of the concept as well (compare Fig. 26). The main benefit is seen in the possibility to monitor the profitability of single flights and the overall network. The airlines also positively assess that the analysis provides relevant information for future-oriented planning (83.3%) and for current optimization requirements as well (70%). Thus the data is highly relevant not only for monitoring the profitability ex post, but especially for planning and controlling purposes throughout the NWM process.

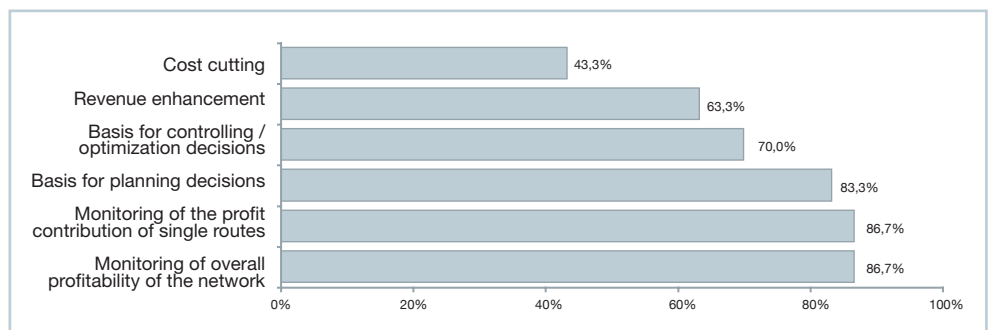


Figure 26: Strengths of the Route and Network Profitability Analysis



In the evaluation of cost reduction or revenue enhancement potential through applying the RPA and NPA the airlines are, however, more conservative. Only 63.3% see such potential on the revenue side whereas even less airlines, namely 43.3%, assume that applying the RPA and NPA can lead to significant cost reductions (compare Fig. 26).

Asked to specify on the potential in revenue enhancement or cost reduction the airlines, though, derive a more optimistic assessment. Both on the revenue and on the cost side the carriers expect an improvement of 4.5% on average (compare Fig. 27). The majority of the airlines even assume that the potential for enhancing revenues through applying the profitability analysis is as high as “more than 5%”.

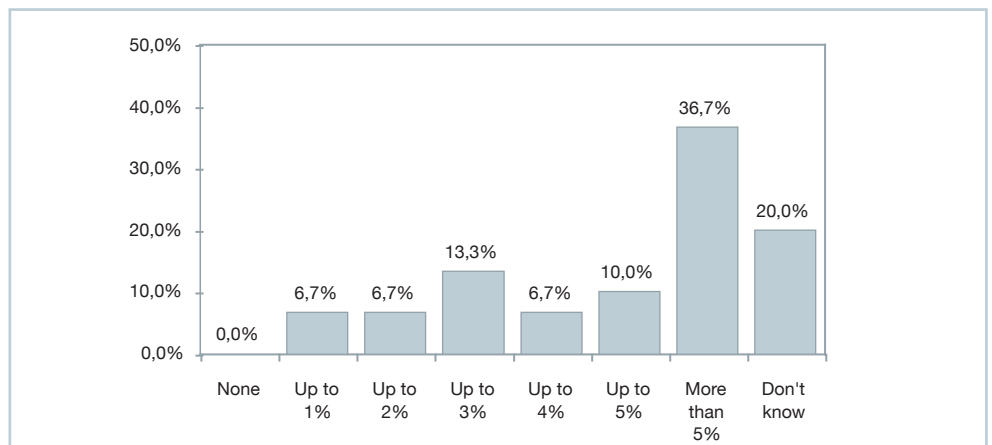


Figure 27 a Revenue enhancement potential

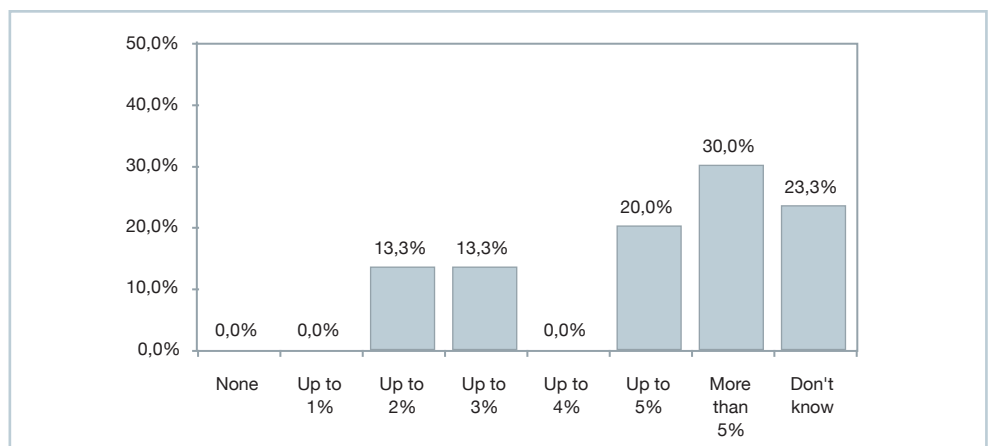


Figure 27 b Cost reduction potential

Figure 27a and b: Revenue enhancement and cost reduction potential due to the application of Route and Network Profitability Analysis

Finally the airlines were requested to assess whether the ability to accurately and timely measure the profitability of flights can constitute a sustainable competitive advantage. A total of 28 of the 30 airlines gave a positive answer to this question



which corresponds to 93%. The remaining two carriers (7%) stated that they were not able to give a valid judgment on this question.

## 5. Conclusion

A detailed analysis of the revenue and cost structure of a network is one of the primary tasks when running an airline. It is the basis for making operational or strategic decisions with regard to the configuration of a route network in a profit-oriented way.

From the survey it can be seen that RPA and NPA in this regard provide fundamental information for NWM. This is especially true for processes and decisions throughout operational network planning (phase 2) and revenue management (phase 3). For strategic network planning (phase 1), though, profitability data from RPA and NPA only has limited relevance.

Information from RPA and NPA therefore is highly relevant in the short- and medium-term, i.e. from two years prior to departure of the plane on. During this period important network structure and capacity related adjustments can be made in the existing network.

Even though considerable differences can be observed concerning the implementation and sophistication of RPA and NPA all airlines state that the applied profitability analysis supports NWM in efficiently allocating their resources which in turn helps them to achieve the profit maximization objective.

Against the background that some carriers already have a highly sophisticated NPA whereas other network carriers have not even implemented a basic NPA yet the above statement, however, has to be questioned critically. The findings of the survey rather suggest that some carriers have taken the lead in terms of profitability analysis. Only these carriers will be able to realize a competitive advantage.



## 6. Authors and Contacts

The authors are:

Mr. Thomas Niehaus: Graduate in Business Administration from the University of Cologne, Germany

Mr. Alexander Knigge: Consultant at Lufthansa Consulting GmbH, Germany

For further information on this study, please contact:

Mr. Thomas Niehaus  
Lufthansa Consulting GmbH  
Von-Gablenz-Str. 2-6  
50679 Cologne  
Germany

Phone: +49 (0)221 88 99 6-852

Fax: +49 (0)221 88 99 6-75

E-Mail: [Thomas.Niehaus@lhconsulting.com](mailto:Thomas.Niehaus@lhconsulting.com)

Internet: [www.lhconsulting.com](http://www.lhconsulting.com)



 **Lufthansa Consulting**

Von-Gablenz-Straße 2-6  
50679 Cologne  
Germany  
Telephone +49 (0)221/88996-809  
Telefax +49 (0)221/88996-60

MAC/Main Airport Center  
Unterschweinstiege 2-14  
Building A, 1st floor  
60549 Frankfurt/M.  
Germany  
Telephone +49 (0)69-696 20850  
Telefax +49 (0)69-696 20830



[www.lhconsulting.com](http://www.lhconsulting.com)