DELPHI SURVEY "LEVEL OF SERVICE FOR AVIATION INFRASTRUCTURE MARKETS?"

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Abstract

When considering capacity issues, which normally deal with the balance between traffic demand and supply, the quality of traffic management should not be neglected. It constitutes the actual target figure, which has to be defined for capacity scaling issues. For air transport operation for example the achievable and actual on-time performance or the average delay is used as a quality parameter and can be considered as Level of Service.

When all options for infrastructure capacity extension will be exhausted within the time horizon targeted, then the optimization of resource usage will be focused upon. A thinkable approach with respect to more efficient usage of existing resources is minimising the proportion of capacity consumption evoked by delay. Since scheduled capacity (for example airport slots) becomes useless by disuse, delayed use leads to additional, unforeseen capacity consumption. No monetary balance of the costs for additional resource consumption caused by individuals is currently applied for main parts of the air transport infrastructure. However, the internalisation of these delay costs could be an appropriate incentive to maximise the total system's benefit by improving the individual on-time performance. Whether such a system is working effectively or even efficiently, whether there are losers and winners or it is of common benefit, or whether it is accepted or declined by the air transport industry is strongly dependent on the method of implementation.

The study is intended to clear the picture of this potential internalisation with respect to the issue itself as well as to the best solution. Therefore, an online and offline Delphi survey was applied to find out the experts' view on capacity- and delay-related items and solutions. Experts were confronted with several statements or future scenarios, and they were to rate their level of acceptance with them.

1 Preface

The term Delphi Method refers to a survey technique which was invented by the RAND Corporation [1] in the USA in the middle of the 20th century, and which has become scientifically established since then [2]. The so-called Delphi Method is a multi-step expert group survey focussing on a fuzzy issue, for example likely developments in the future. The method is considered to be appropriate for deriving probable patterns with respect to expected tendencies in a certain knowledge domain, based on the survey outcome.

1.1 The study's method

The method's characteristic is a controlled feedback in between the survey steps by providing the experts with information on the total group's attitude of answering. The feedback enables each expert surveyed to critically review their own opinion, based on awareness of the aggregated group opinion. Normally, the iterative survey process leads to a broader consent among the participants than a single step survey. Thus, for example, the answers of people surveyed who were somewhat unsure about their opinion are gradually replaced by those which are closer to the group's opinion, if the group's opinion was

identified as being plausible. Simultaneously, this method is an opportunity for those whose opinions deliberately differ from the group's opinion to stick to their initial opinions and thus, by their contrary opinions, even evoke a debate with further experts, who then have to critically review their own attitude of answering. Of course, the consent (or dissent) found among the participants is not proof of the outcome's "correctness", since even a majority might be wrong. Therefore, the author recommends careful handling of the study outcome.

A particular advantage of the Delphi Study is the elimination of undesired influence by social or job-related interlacing due to the protection of anonymity. Also group-dynamical influences, as seen during discussions, are eliminated.

Since the Delphi Method is always an expert survey, it does not reflect the opinions of the majority of people. In fact, the expert knowledge in a special discipline is to be utilized in order to be able to assess likely developments and to estimate their probability. Special attention has to be paid to the appropriate expectance of the identified, likely developments. In fact, experts expressed their opinions on probable developments, the implementation of which, however, is dependent on numerous factors (for example political will, regulatory framework, market development etc.). The answers given by the experts reveal the critical points of the discipline reviewed, which have to be discussed in a constructive way in order to arrive at definitely satisfying solutions for the "right" questioning. Therefore, on the second step and beyond, questioning has been omitted. On further steps even clearer answers to individual questions can probably be expected. This enhanced accuracy does not lead to advantages with respect to the identification of relevant research areas, but to putatively accurate results based on an again significantly reduced panel size. The study was carried out in two stages due to considerations of benefit versus effort.

The Delphi Method used in the framework of this study is oriented towards the Type-3 Delphi, which has been described in more detail by M. Häder [3]. This Delphi type is normally used for "finding and assessing an expert group's opinions on a fuzzy issue". The fuzzy issue of the present study is the potential implementation of a service level concept in the air transport infrastructure market, i.e. the quantity of thinkable options, how use and supply of infrastructure resources can be quantitatively and qualitatively evaluated in order to internalise costs caused by delays according to the causative principle.

1.2 Panel Constitution

The panel of this micro survey mainly consists of civil aviation experts. 1036 aviation experts were randomly selected from the existing DLR contact stock and their participation was solicited by e-mail twice within 4 weeks. 64 experts registered for the survey, 52 of them sent the filled questionnaire from the first round. In the second round of the survey, after re-inviting them twice by e-mail, 25 persons participated.

The following answer rates were achieved:
1st Round: 5.0% (1036 experts solicited vs. 52 experts who actively participated).
2nd Round: 39% (64 experts solicited vs. 25 experts who actively participated).

2 Study Outcome

Basic outcome of the survey is outlined on the following pages in the order of emergence of the respective questions or theses. All answers given by the panel are shown, regardless of their weighted frequency[1]. The majority of tables show the relative frequency (as a percentage of all votes), in order to allow for qualitative comparison of both survey rounds. This is mandatory, since the panel size varied between

[1] Weighting factors are random variables, which are to be applied according to the target envisaged. Thus, it would have been a thinkable approach, to apply the experts' self-assessed level of competence as weighting factor. Due to the generally high level expert status of the persons questioned, this approach was waived.

both survey rounds. In the second round, only those questions were repeated which were expected to change the group dynamics with respect to answering and which did not yet show a clear vote. The answers of the first survey round are depicted as grey bars. Answers of the second round, if any, are depicted as blue bars.

Furthermore, an overview of the statistical scale is allocated to each graphically displayed variable. It contains five fields for the following values:

- Mean Value; Arithmetic middle of valid values in a cardinal or interval scale is a calculated mean value (sum of values divided by the number of values).
- Median; The median gives the value in the middle of a sortable list of answers.
- Mode; Mode is the most frequently used value of a spread. Dependent on the spread, several modi are likely to exist. Identical modal values are given.
- Standard Deviation; Standard deviation is a measure for value spread of a (random) variable by its mean value.

Statistical scales are indicated, if feasible, for the respective variable. Additionally, the values N(1) and N(2) indicate the number of values involved in the statistical evaluation. Thus, for cardinal values - these are all values allocated to a numeric expression - but none of those categories like *"I don't know" / no idea"*, to which no mathematical operand can be applied. Whereas, for purely categorial variables (example of answer: *"yes, no, I don't know", no answer at all*) the total number of experts participating in the round is taken as random sampling. For nearly all answer spreading in the second round, which is expressible by statistical scales, the desired effect of answer spreading reduction compared to the first round was observed.

2.1 On-Time Performance

The first survey section provides information on the on-time performance in the range of air transport observed from the surveyed persons' point of view. Thus, on-time performance is considered to be the main indicator for air transport service quality and is accordingly rated by the experts. The estimation of on-time performance appears to be high among the panel members. The evidence for this includes the fact that the majority of experts professionally define the limit of on-time performance to be 15 minutes after scheduled arrival, which is common practice in the industry. In addition, there are a similar number of experts who define this limit as five or 10 minutes after scheduled arrival, and thus show an even higher sensitivity to this issue. Thus, it is no surprise that more than 80% of all persons surveyed vote for the individual flight's, or airline's, on-time performance announcement, although there is currently no extensive transparency in Europe[2]. Thus, a majority of experts would take into consideration the on-time performance achieved in the past when choosing flights of competing airlines – if this information deficiency were removed.

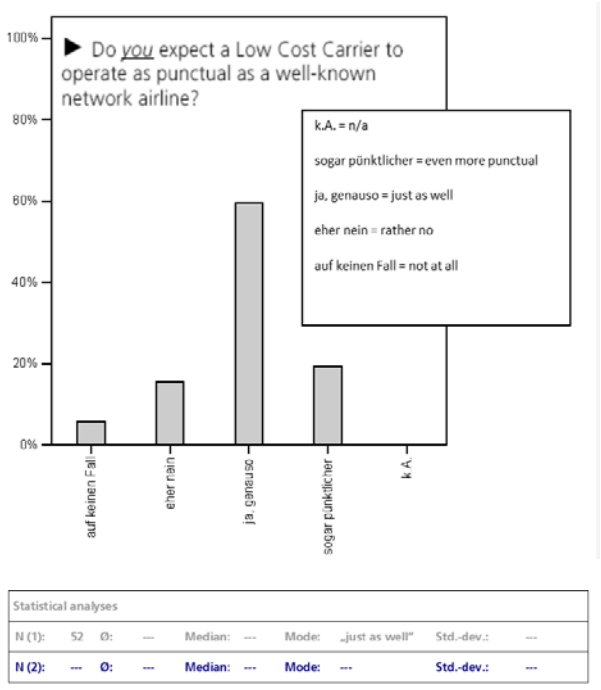
The awareness of on-time performance is subject to various influences. However, different expectations with respect to the airline chosen can be categorised. Thus, in a second round, the majority (approx. 72%) of the experts surveyed at least tendentially agree and 40% fully agree with the thesis: "full service network carriers more actively endeavour on-time performance than budget airlines". Obviously, the experts consider the network carriers' efforts with regard to on-time performance to have little effect. More than half of the panel members consider on-time performance to be as relevant for budget airlines as for traditional network carriers. Approx. one fifth said that they expect a higher level of on-time performance from budget airlines and from network carriers (see Fig. 1) respectively.

The majority of experts think that it is barely imaginable to budget airline passengers that their flights could have a higher level of on-time performance than those of a corresponding

[2] So far, European airlines have only made voluntary announcements, often in an aggregated way and not in a timely manner.

network carrier. More than half of the total number of experts think that budget airline passengers don't distinguish as to the level of on-time performance expected, however, approx. 40% of the experts are of the opinion that budget airline passengers rather expect a lower level of on-time performance (see Fig. 2).

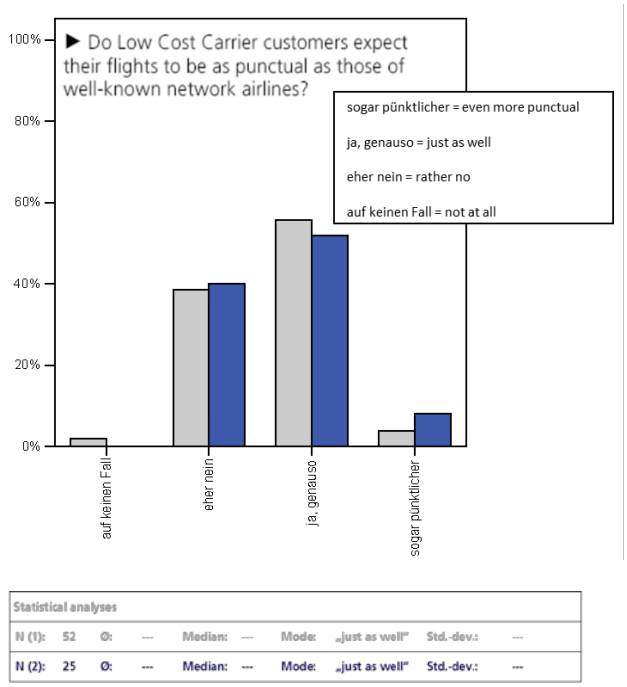
Fig. 1. Response to question I3_D1



On-time performance is to be assessed on the basis of comparable parameters. Since flight schedules – depending on the airline – contain different time supplements in the form of buffer time, this does not necessarily mean that a competitor's higher level of performance measured leads to arrival ahead of schedule, even when assuming the same time of departure.

Thus, the buffer time contained in the flight schedules can be seen as already internalised delay and thus to be relevant for the purchase decision. The experts' answers reveal that the experts acquaint themselves with the durations of various flights; only one third neglect this comparison. Moreover, when raising this issue, one must assume that some experts solely compare departure and arrival time, but not the actual duration of the flight.

Fig. 2. Response to question I3_D2

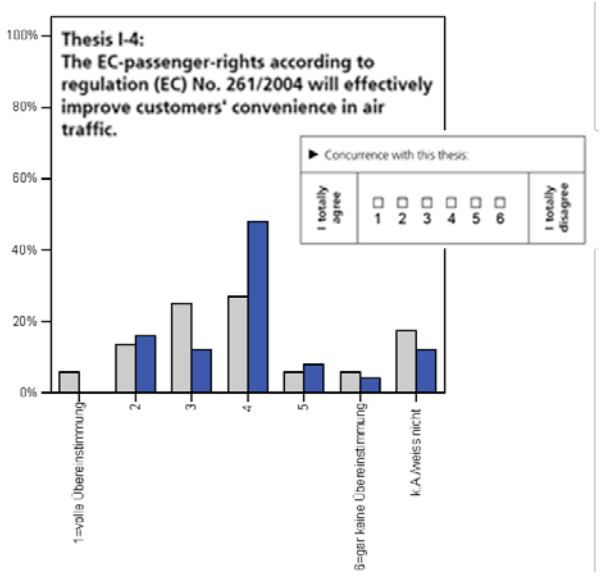


Passenger rights' improvement according to EU-act 261/2004 [4] is seen critically by the experts. In the second round of the survey, only 28% of the experts involved were confident that the passenger rights granted by this act have a positive effect on consumer satisfaction. 48% tentatively disagreed; the remainder expressed even more pessimism (see Fig. 3).

In order to avoid general dismissal due to ignorance, the awareness of the act was asked. 80% of the persons surveyed in the second round were at least roughly acquainted with the contents of the act. Approx. 20% of the persons surveyed had raised a claim according to this act. Due to the panel members' fairly high level of expertise, weighting the answers to the awareness of the topic "passenger rights" was waived.

The expert group does not consider the compensation according to act 261/2004 to be an adequate refund for inconveniences caused by considerable delays. 36% consider the refund to be tendentially appropriate, 52% rather disagree with the adequacy. The group of persons surveyed consider the likely effect of the foreseen on-time performance act (see Fig. 4) similarly pessimistically.

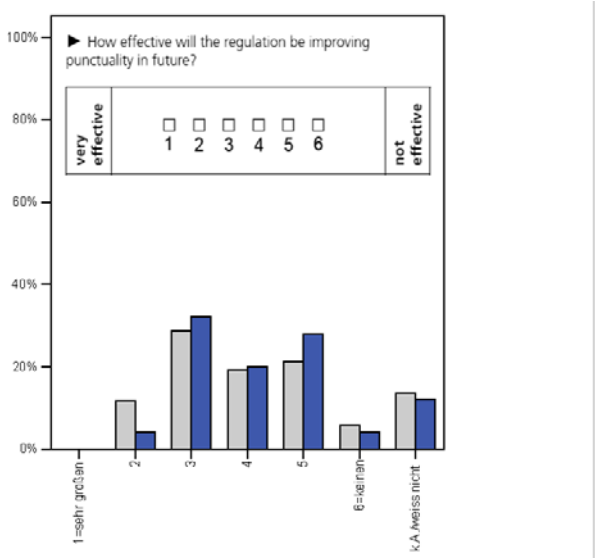
Fig. 3. Response to thesis I-4



Statistical analyses (without „n/a")									
N (1):	43	Ø:	3,37	Median:	3	Mode:	4	Std.-dev.:	1,254
N (2):	22	Ø:	3,68	Median:	4	Mode:	4	Std.-dev.:	1,041

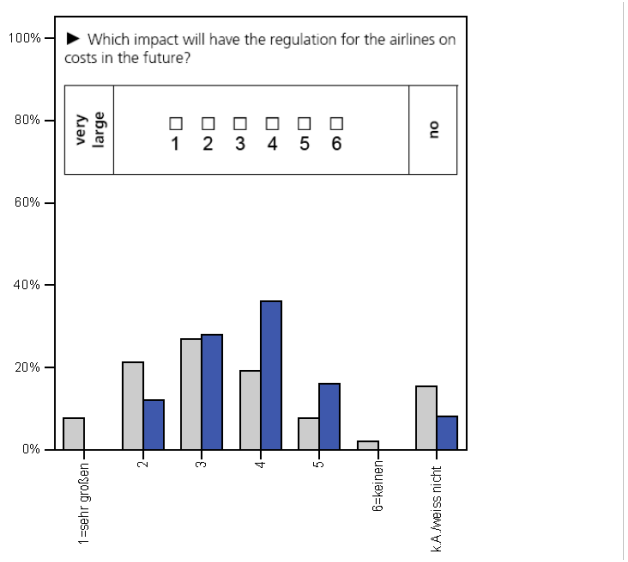
Instead, the experts assume moderately rising costs for the airlines (see Fig. 4), which will lead to a slightly over-proportional increase of flight prices (Fig. 5).

Fig. 4. Response to question I4_D2



Statistical analyses (without „n/a")									
N (1):	45	Ø:	3,78	Median:	4	Mode:	3	Std.-dev.:	1,166
N (2):	22	Ø:	3,95	Median:	4	Mode:	3	Std.-dev.:	1,046

Fig. 5. Response to question I4_D3

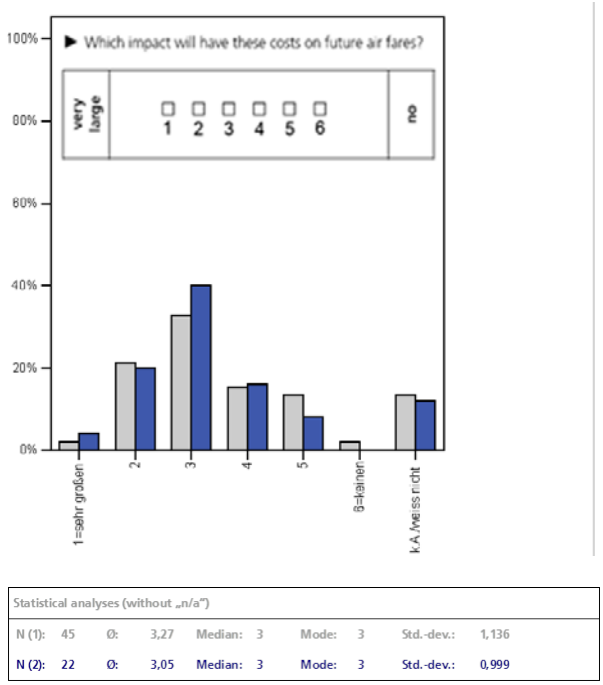


Statistical analyses (without „n/a")									
N (1):	44	Ø:	3,05	Median:	3	Mode:	3	Std.-dev.:	1,200
N (2):	23	Ø:	3,61	Median:	4	Mode:	4	Std.-dev.:	0,941

Overall, the experts even assume an extension of passenger rights in the future. Most experts think that act 261/2004 will be adapted in order to achieve this. Higher compensation will mainly be agreed upon while preserving the currently valid pre-conditions for compensation. Some experts even consider lowering the compensation thresholds to be the more probable development. However, there is consent on the statement that changes will rather be in favour of the passengers.

The experts represent individual elements of air transport, such as representatives of airports, control bodies or passengers. The resulting tension with respect to the topic "passenger rights" and Act (EG) 261/2004 can thus be used to reveal the attitude of various institutes towards this topic. In order to show the acceptance of Act 261/2004, the experts were asked to assign a basic attitude toward the extension of passenger rights to the individual actors or legislators.

Fig. 6. Response to question I4_D4



Statistical analyses (without „n/a")								
N (1):	45	Ø:	3,27	Median:	3	Mode:	3	Std.-dev.:	1,136
N (2):	22	Ø:	3,05	Median:	3	Mode:	3	Std.-dev.:	0,999

Advocates (as identified by the experts) are: *(National) Government, EU (Commission, Parliament, and Council), Passengers, Travel Business, and Consumer Associations.*

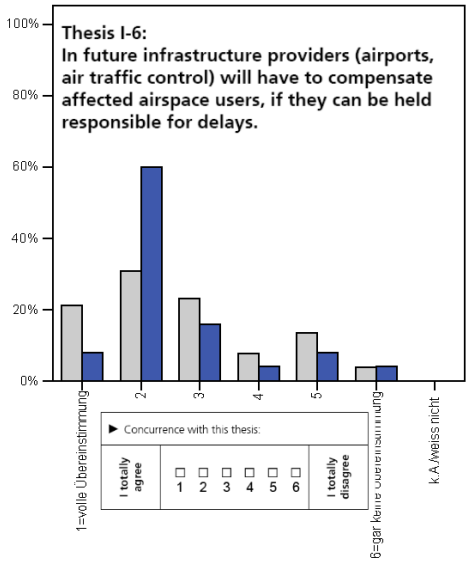
A dismissive attitude is assigned to the following actors: *Low Cost Carriers, Charter Carriers, Network Carriers, and Hub Airports.*

A mainly neutral attitude is assumed for: *Air Traffic Control (Providers), and Regional Airports.*

Furthermore, the experts were confronted with the theses which outlined the statement that costs resulting from delays would be internalised according to the costs-by-cause principle.

Thesis I-6 (Fig. 7) describes the option that infrastructure suppliers (airports) could be committed to compensate air space users, if the infrastructure had not been made available on time. A clear majority of experts agree to this thesis; only a few experts doubt the implementation. However, the majority of experts assume the expected resistance of the individual actors to be considerable. The question of which actors are concerned was not asked. Instead this is revealed by the observation of those parties who would have to face rising costs when implementing this compensation innovation. A common statement on the influence of the transaction costs which might arise by the implementation was not made by the group of experts; however, there were neither extremes for nor against. When raising the issue of obstacles in the form of technical barriers which have to be overcome, the majority of experts do not see many reasons for concern. However, there are some experts who deliberately deviate from the group opinion and foresee considerable difficulties. The juridical contestability turns out to be a considerable obstacle for the implementation. From today's point of view, the legislator would have to put considerable effort into making the implementation according to thesis I-6 possible.

Fig. 7. Response to thesis I-6

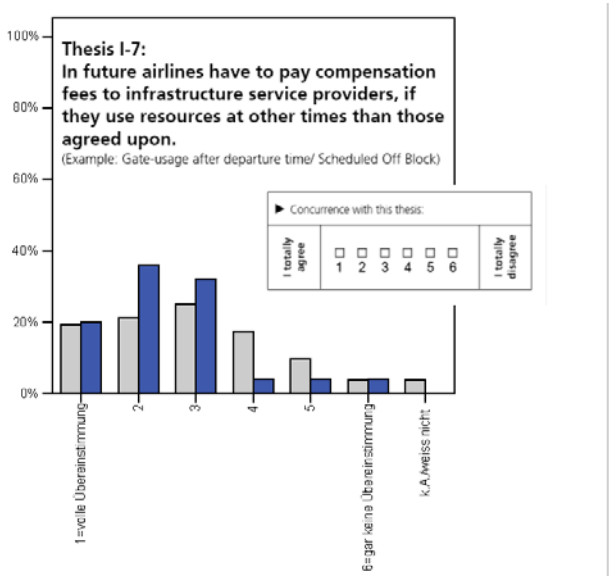


Statistical analyses (without „n/a")								
N (1):	52	Ø:	2,73	Median:	2	Mode:	2	Std.-dev.:	1,443
N (2):	25	Ø:	2,56	Median:	2	Mode:	2	Std.-dev.:	1,227

Analogue to thesis I-6, in thesis I-7 (Fig. 8) actors were exchanged. The thesis predicts the airlines' compensation commitment towards the infrastructure service suppliers, if the respective resources were used at a different point in time than at the agreed one. The questionnaire gives the example of a plane staying longer than agreed in the parking position (thus causing potential resource conflicts for the airport operator). 88% of the experts rather agree to this

thesis, 12% do not agree with the implementation. The highest barrier for the implementation of thesis I-7 is considered to be the threat of the individual actor's resistance. The group of actors referred to here most probably represents those who are in favour of a unilateral implementation of thesis I-6. A harmonized solution could be coupling the implementation of thesis I-6 and I-7 in such a way, that there are no losers on one side and only winners on the other side. A clear majority of experts assume that the implementation, according to theses I-6 and I-7, will not necessarily lead to a target conflict with the safety requirements.

Fig. 8. Response to thesis I-7



Statistical analyses (without „n/a")								
N (1):	50	Ø:	2,88	Median:	3	Mode:	3	Std.-dev.:	1,409
N (2):	25	Ø:	2,48	Median:	2	Mode:	2	Std.-dev.:	1,229

Moreover, the expert group has been asked to submit proposals in the form of key points as to the way of enhancing on-time performance of air transport. In order to mobilise the people surveyed, thesis I-8 was given, stating that the level of on-time performance could only be raised by increased resource supply. The majority of experts (64%) tendentially concur with this thesis, however, 36% of the experts dismiss it, at least partly. The dismissive experts probably assume that it might be possible either to gain better results by using the same amount of resources – when supplied in a different way – or basically consider the alternative methods to be more effective (or at least to be equivalent).

Overall, the experts assume a slightly improved on-time performance situation for the year 2017 (the year of the survey + 10 years). 76% of the experts surveyed in the second round concur with this scenario, whereas 12% predict significant improvement with respect to on-time performance. Only 8% prophesize significant degradation of the on-time performance level. Taking into account the forecasted air transport growth of about 5% per year (reference: Airbus 2008 [5] and 2009 [6], Boeing 2007 [7]) and the according growth of traffic, the majority of experts jointly agree to the necessity of a feasible solution for the expected capacity problems.

The question of self-rating with respect to their own expertise for the subject to be considered proves the panel's level of expertise. 80% of the people questioned rather consider themselves to be expert for this subject, only 4% answered: "not my subject".

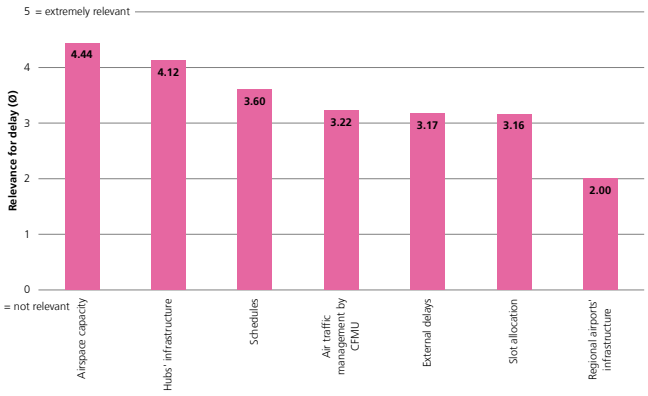
2.2 Resource Allocation and Management

In the scope of the study, the experts were asked to assess some essential processes, or resources, of the air transport system with respect to their relevance to delays. The list cannot be considered to be comprehensive here. The rating is to be performed according to the six-step rating scheme as already described; in this case, however, by scaling from 0 to 5. For the intuitive concurrence with the category, the value "0" is allocated to the statement "not causal". In Fig. 9 the arithmetic medians of the experts' opinions with respect to the second survey round are shown.

Correspondingly, the experts consider the availability of air space to be the main reason for delays. Next priority is given to critical infrastructure at international airports. Flight scheduling is number three, with traffic flow management performed by CFMU, the increment of subsequent delays caused by third parties and slot allocation at airports close

behind. Only the infrastructure of regional airports is scarcely considered to be a reason for delays.

Fig. 9. Relevance of Delay quantified by the Experts with respect to individual Resources/Processes (Medians)



The expert group consider the strategy "first come first served" to be a guarantee for avoidance of discrimination, however, they conclude that for resource allocation the consideration of individual features is more desirable (according to the equity principle) than disregard (according to the equality principle). Potential alternative allocation procedures foreseen by the experts might be those which allow for higher efficiency of resource usage than the strategy "first come first served". Overall, the experts welcome their expectation, that resource allocation would be performed by means of market-based tools in the future. Here, the experts assume a medium-term implementation phase, which will approximately take until 2015.

If resource allocation were performed under consideration of, for example, market prices, experts think the airlines would associate higher expectations with the slots allocated (or other resources). For instance, the right of free trade or the expectation of an analogy with the responsibility for damages, in case of less or inferior resource supply than agreed upon (for example delayed supply of a resource). Overall, the experts think that the implementation of service categories to be applied to the infrastructure service supply would positively influence competition. According to the experts' assumption, the agreement on variable service categories between suppliers and users of air transport infrastructure will not interfere with the safety requirements of air transport.

2.2 Market Reaction

This part of the questionnaire deals with further ascertainment of creative solutions with respect to an alternative resource allocation system. The implementation of market-oriented service categories for supply and use of mutually shared resources constitutes an innovation for air transport. In order to gain acceptance, the advantages have to be communicable. If the advantages of the innovation were recognized and were identified to be beneficial for the potential user, the first step toward absorption of the individual consumer surplus is achieved. In the present case, the passenger whose transport contract has been signed by the airline is the consumer. Thus, it should be possible to turn the innovation of abstract service categories into an added value, which is much more meaningful for the passenger. This added value relates to the personal preferences of the individual passenger which are decisive for the purchase. The goal of each market-oriented action is to maximise the consumer surplus, thus to extensively absorb the maximal willingness to pay. The potential for marketing activities corresponds to the implementation of service categories in the air transport infrastructure market by the expected negative correlation between price and service quality; here in particular the value of on-time performance expected.

The experts assume that the innovation "Service Categories" will generally be marketable in the air transport infrastructure market. However, there is only moderate consent. This indicates a complex potential task, i.e. compliance with customer requirements when applying service levels. As already outlined before, the experts expect re-animation of competition through the implementation of variable service level agreements between suppliers and users of air transport infrastructure. On the other hand, the experts think that increasing competition might boost

the suppliers' readiness for service level application.

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