ASICBA is a two-year EU-funded research project under FP6, which started on 15th January 2005. The partners in the consortium are: Airclaims, D’Appolonia (project leader), ECORYS, Geasar, LOT, Meridiana, NLR and PoliMi.

The application of cost-benefit analysis theory is widespread in the transport sector and decisions about investments in new infrastructure are often supported by this technique. However, cost-benefit analysis of safety measures is a relatively new concept in the aviation community. Decisions on safety related matters are often taken without knowing precisely how safety benefits relate to the costs they induce. In this project a methodology has been developed to assess the effects of safety improvement measures. These effects concern both safety and economic effects. The methodology gives the opportunity to make a balanced trade-off between safety and investment costs. The main concept in the approach is that safety effects can be expressed in monetary terms, and thus they can be compared with the associated costs of safety measures. The model developed in ASICBA has been set-up as an integrated model and consists of three main building blocks: the risk model, the cost model and the cost-benefit trade-off.

First, the risk reduction of the safety measure is assessed. Then the output feeds into a cost module that contains a database of accident costs translating the risk reduction into a decrease in accident costs. This can be considered the safety value (benefit) of the safety measure. Other impacts of the safety measure concerning the costs of the measure itself and other benefits are also assessed. All costs and benefits are then combined in a CBA computation.

**Risk model** - In order to assess the impact of certain measures on the level of safety, a scenario, based on a risk model, has been developed. The architecture of the model extends conventional risk analysis techniques (fault trees and event trees) by introducing a hybrid causal model of event sequence diagrams, fault trees and influence diagrams. Event Sequence Diagrams (ESDs) are used to define the scenario within which various causal factors would be seen as a hazard. In the model, 35 ESDs have been identified, representing the more common and more significant generic accident scenarios such as controlled flight into terrain or mid-air collision. Initially the building blocks of the scenarios are kept broad and generic to cover many similar situations. The possible causes and contributing factors of these events are not directly of interest at the scenario level. They are added by means of fault trees and influence diagrams. For each ESD, probabilities for all events in the ESD have been derived. The effect of a safety measure on the accident probability is determined by estimating the effect of the measure on the likelihood of occurrence of the initiating events and the pivot events.

**Cost model** - The ESDs of the risk model terminate in various End States, which describe the consequences of the possible different outcomes of the event scenario. To link risk model to cost model, the “impact” of each End State is determined. The impact indicates the magnitude of the consequences on all actors involved or affected by an event.

To assess the costs arising from these events, for each of six groups of actors, the relevant heads of cost have been identified from a total of 24 possible areas of cost. Each group may be associated with one or more heads of cost. Next, for each severity level for such a group, the costs are determined. Finally, the estimated costs are allocated to stakeholders. Not all accident costs are borne by the same stakeholder. In order to assess the viability of a safety measure for one particular stakeholder only those costs that are relevant to him have to be taken into account.

**CBA Computation** - The risk model provides an accident likelihood and severity (Impact Vector), both before and after the application of the safety measure. For each “Impact Vector”, the associated accident costs are calculated. By multiplying the difference in likelihood before and after the application of the safety measure with the associated accident costs, the effect of the safety measure is expressed in monetary terms. This can be considered the safety value of the measure, and is a benefit in the CBA calculation. The safety value is combined with the other required inputs for the CBA calculation. These other inputs are not predetermined in the model, but need to be provided by the user. With these inputs, the final CBA calculation can be made. In the CBA the tradeoff between the costs on the one hand and the benefits of the measure on the other hand is made over a given time frame. The outcome is expressed in terms of the internal rate of return or the benefit to cost ratio.

**Decision Support System** - A Decision Support System (DSS) has been developed to assist users in applying the ASICBA methodology. It supports them in assessing the effects of their safety related technical, managerial and political decisions with the associated costs and benefits.
It supports decisions such as whether or not to introduce a safety measure, by helping stakeholders to agree priorities for investment in safety, based on the most beneficial outcome.

The DSS has been designed to respond to the needs of all aviation stakeholders while also having the flexibility to enable individual stakeholders to apply it in their situations, perhaps more limited or specific. The DSS tool is in the form of an Electronic Handbook, which incorporates a data pool of default values to assist in the estimation of costs, benefits and risk reduction arising from the implementation of specific safety measures. The system needs to be easily useable by people who may not be ‘computer expert’. Therefore, it has a simple interface, which guides the user, as required, through the various steps of conducting the analysis and includes a simple ‘question and answer’ section to help narrow the number of available choices. As a result, the user will normally only see the details of the model, that are relevant to the specific case under study.

Using the risk database and the cost database the DSS provides the estimation of costs and benefits related to the safety measure under investigation. After specifying all required input, the DSS provides the user with a Microsoft Excel® report that contains the results, either positive or negative, of the CBA together with all supporting data (either default or specified by the user) and formulas used to calculate the final results.

Summary of the interview phase

Although the DSS includes a database of suggested default values for risks and event costs, the user can replace these with figures which are considered to be more relevant to the actual situation under consideration.

Examples of DSS final report

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