

ASICBA Aviation Safety Improvement using Cost Benefit Analysis

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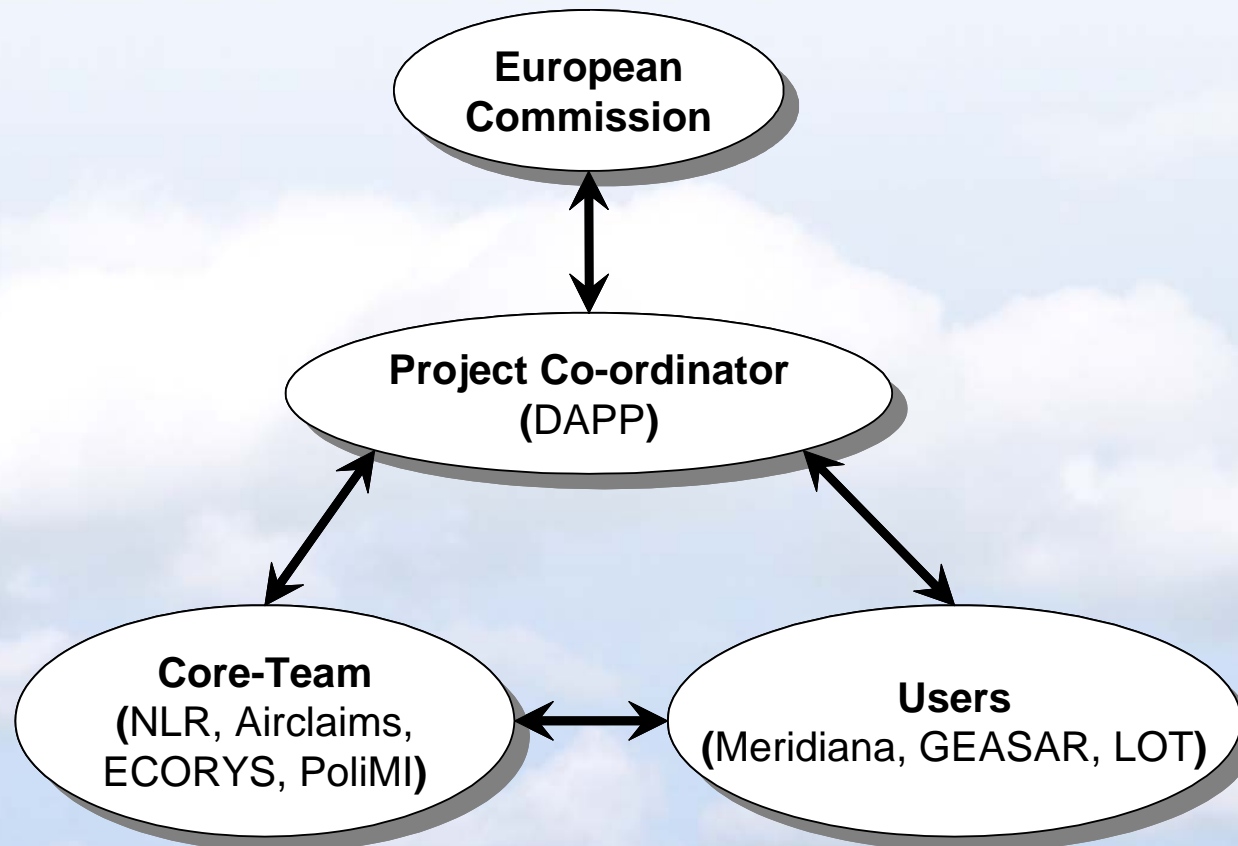
Content

- Introduction
- Project Consortium
- Project Overall Objective
- The new safety approach
- Project Structure
- General description of the approach
- Risk Model
- Cost model
- Cost-benefit analysis
- The Decision Support System
- Conclusion

Introduction

- Funded by European Commission via FP6
- Research organisations (3), Aviation information company (1), University (1), Airlines (2), Airport authority (1)
- Duration: 2 years, finalised by 15 January 2007
- Approach to assess the costs and benefits of safety measures
- Safety effects expressed in monetary terms

Project Consortium



Project Overall Objective

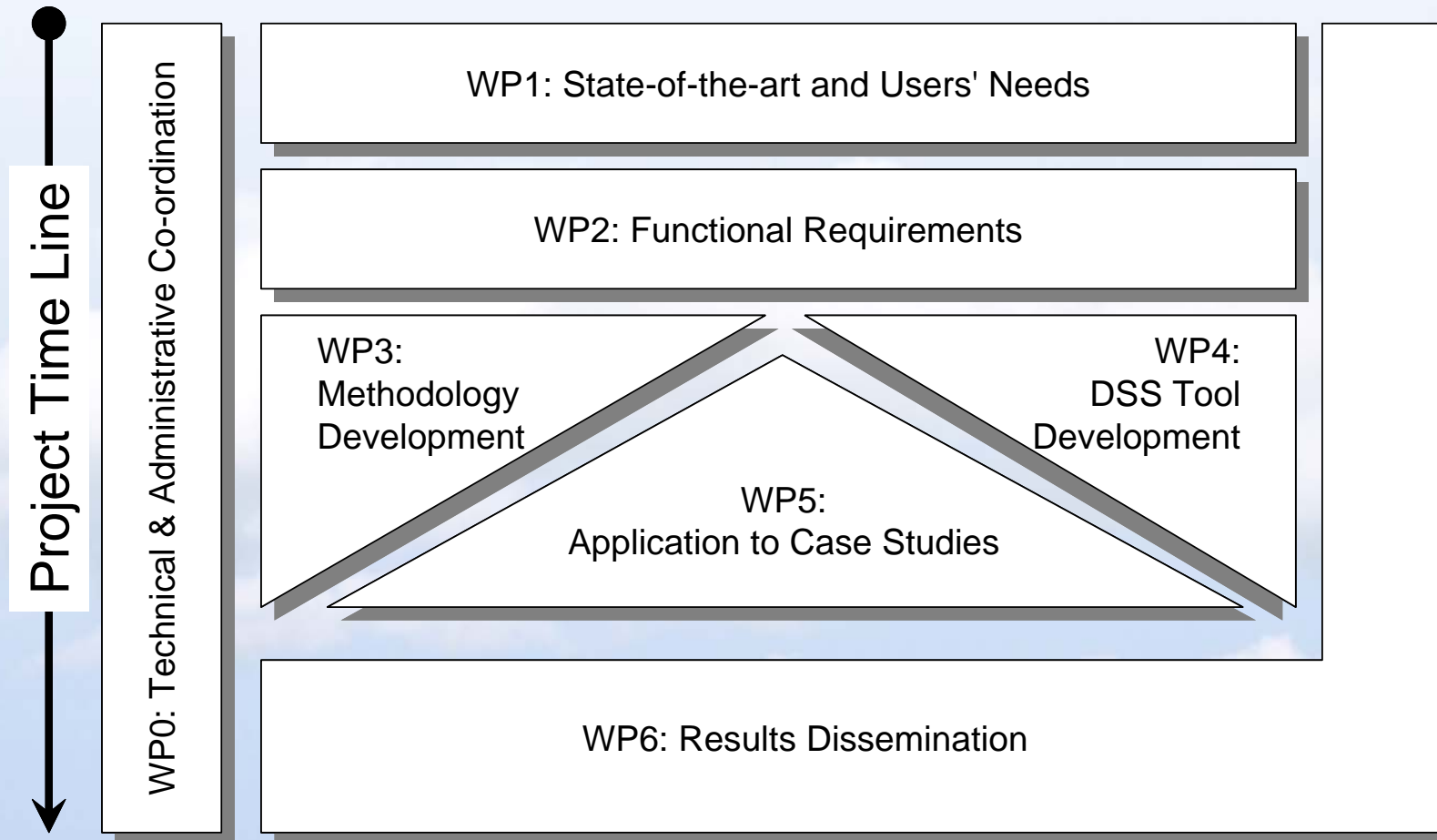
This project aims at the *improvement of aviation safety* through a new approach that will allow *aviation stakeholders to assess the effects of technical, managerial and political decisions at the safety level, together with the associated costs and benefits.*

The new Safety approach

The **new Safety Approach** will consist of a methodology that will be implemented into a **Decision Support System** (a sort of electronic handbook) providing a step-by-step procedure that will support the user throughout the different phases necessary for assessing the cost effectiveness of safety measures.

The **Decision Support System** will incorporate a data pool for the estimation of costs, benefits and risk reduction related to the implementation of specific safety measures.

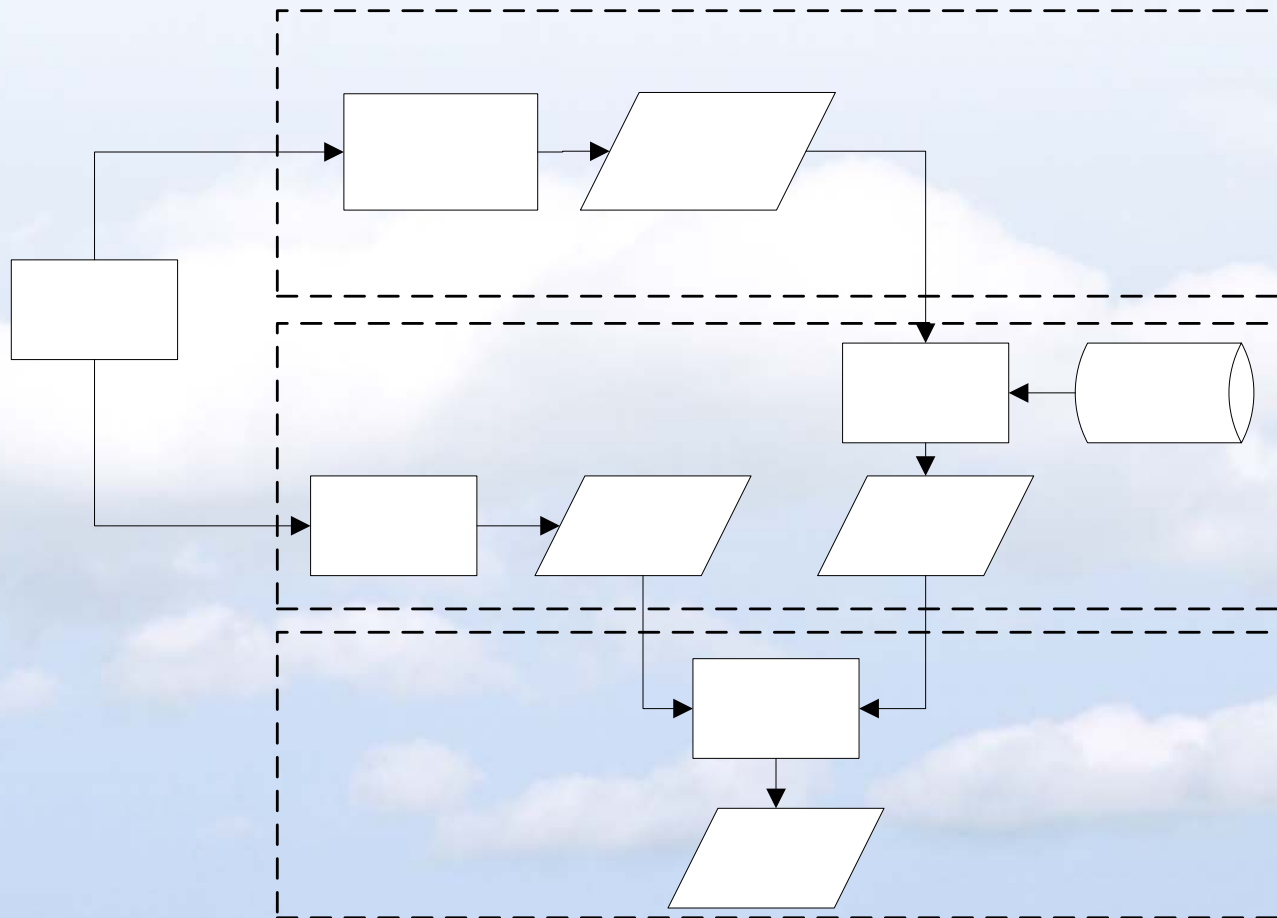
Project structure



Why is there a need for this?

- Cost-benefit analysis applied in some subsectors in aviation
- Cost benefit analysis of safety measures is relatively new in aviation
- Opportunity for balanced trade-off between safety improvement and investment
- Comparisons between different safety measures possible

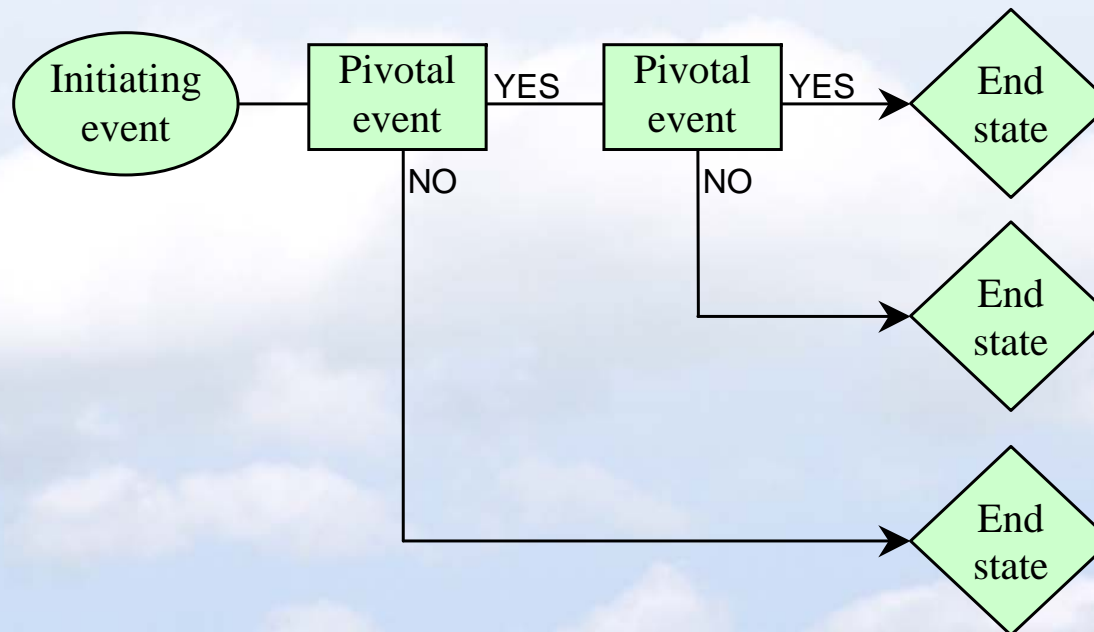
General description of the approach



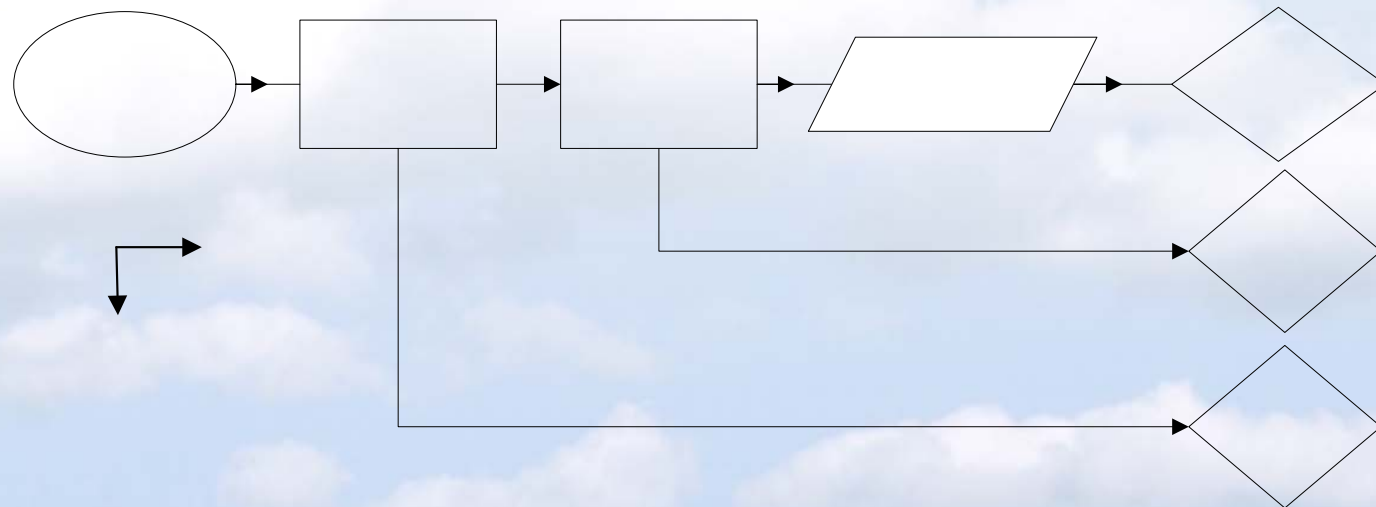
Risk model

- Scenario based
- Use of Event Sequence Diagrams (ESD)
 - Initiating event
 - Pivotal event
 - End State
- ESD: possible ways in which the effects of an initiating disturbance are handled by the aviation system
- 35 ESDs based on generic accident scenarios; extension of conventional risk techniques, i.e. fault trees and Bayesian Belief Networks
- Impact for each end state is noted as an impact vector

Event Sequence Diagram



Example of an ESD



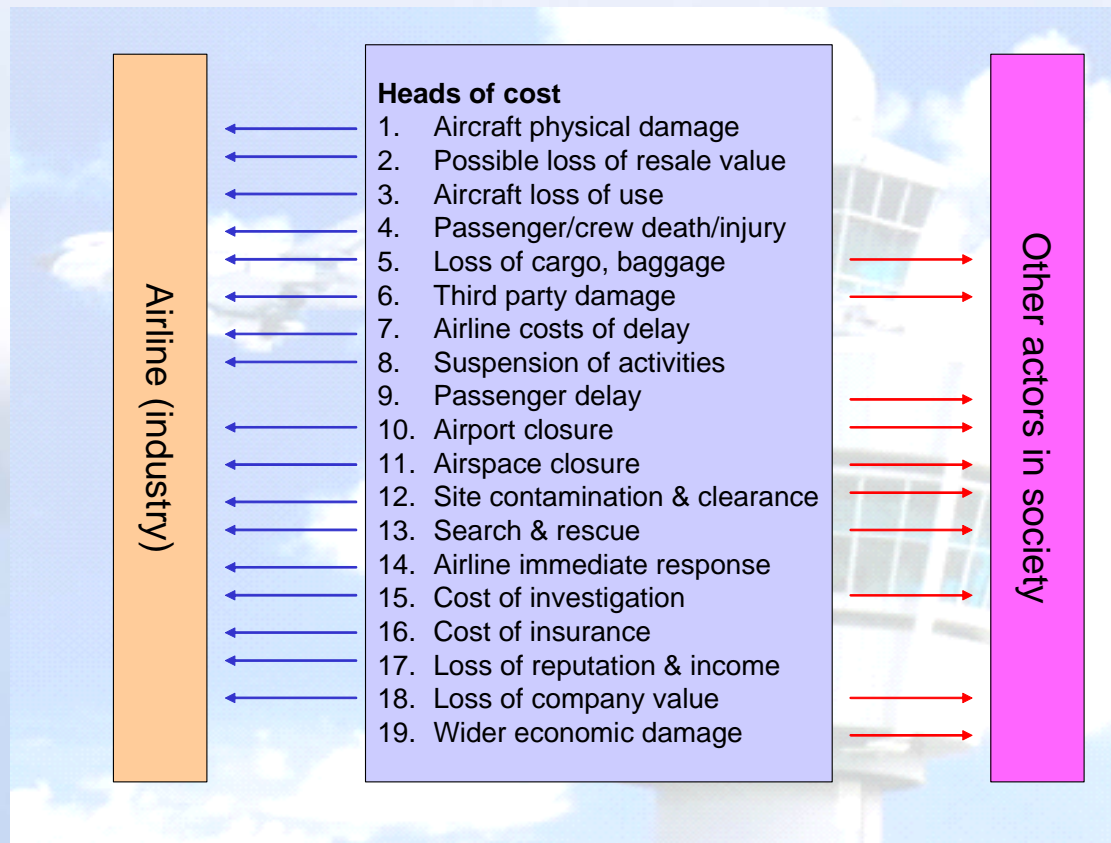
Impact vectors and severity levels

	Direct			Indirect		
	Aircraft	Occupants	Operation aircraft involved	Other airlines	Airport	3rd party
4	>75% damage (beyond economical repair)	80% killed	>4hrs delay (Flight aborted)	Many flights cancelled	Closed for 5 days	Fatalities and damage
3	50% damage	30 % killed	2 hrs < delay < 4 hrs	Many delays	Closed for 2 days	Few injuries and damage
2	15% damage	Some Injuries only	30min < delay < 2hour	Less than many delays	Runway closed for 2 days	Substantial material damage only
1	1% damage	Few injuries	15min < delay < 30min	Little delays	Runway closed for 12 hours	Minor material damage only
0	No Impact	No impact	No Impact (less than 15min delay)	No Impact	No Impact	No Impact

Cost model

- Costs resulting from an accident are a key notion
- 24 Heads of cost identified
- Distinction to stakeholders
 - Airline
 - Passengers
 - Airport operator
 - (Safety) Authority
 - Third party / society
 - Other airlines
 - Insurers
 - Aircraft manufacturers

Costs resulting from an accident



Example Aircraft related costs

Severity level	Heads of costs		
	Physical damage	Loss of resale value	Loss of use
4	€32 m	€0	€0
3	€16 m	€4.8 m	€3 m
2	€5 m	€2.4 m	€1.5 m
1	€0.3 m	€1.3 m	€0.4 m
0	€0	€0	€0

CBA computation

- Safety value
- Investment costs
- Operational costs
- Operational benefits (if any)
- Trade off
 - Airline / airport
 - Society
- Internal rate of return / net present value

The DSS requirements

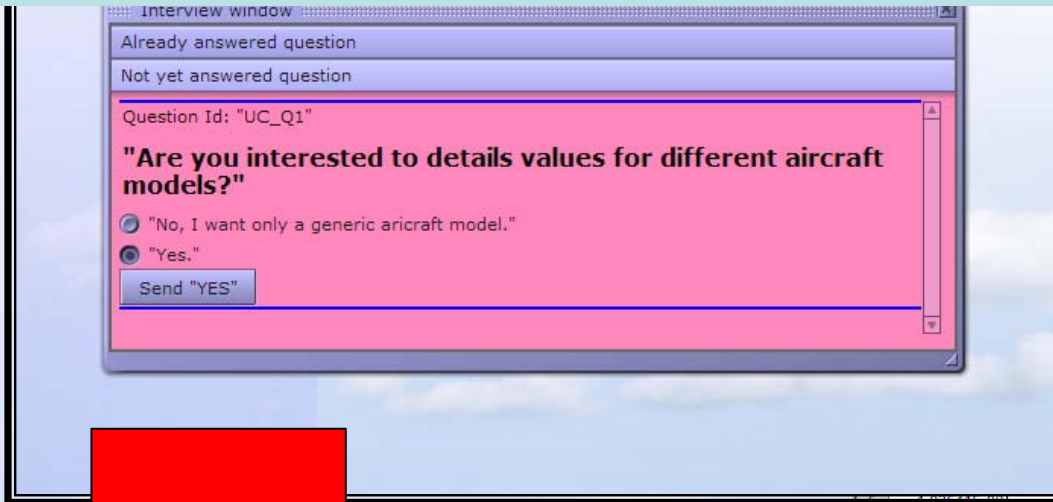
- Must be usable by a **generic stakeholder user**, not an expert in risk analysis
- Must be a *WEB* tool, accessible by a standard **internet browser**
- Applies the CBA methodology **to user specific data**, while **user's data remain private**
- Returns the **results** of the CBA **together the formulas** used to perform the calculations

What the DSS does

- Performs an **interview phase**, asking the user about **conditions and objectives**, in order to **select pertinent ESDs** and default values of events probability from the general model
- Asks the user to **customize parameters** in order to match correct probability for events and correct values for costs
- Asks the user to quantify values involved into **safety measure effects**
- Sends to the user an MS **Excel report** that contains all data inserted, perform calculations and presents final result

How the DSS looks

From the Web User Interface



						END STATES			EXPOSITION
T	U	V	W	X	Y	Z			
AMB	YES-CFTAMB	NO-CFTAMB	AGOR	ASOR	FCN	Exposition			
0.45	0.000129933	0.000158807	0.000142199	0.000158807	0.000129	11.25			
0.3	3.41329E-09	7.96435E-09	3.88565E-09	7.96435E-09	7.9E-09	24			
0.2	2.07082E-09	8.28328E-09	2.49172E-09	8.28328E-09	1.0775E-08	7.5			
0.4	6.59977E-05	9.89965E-05	7.30069E-05	9.89965E-05	0.00025801	11.25			
0.28	2.65478E-09	8.82659E-09	3.04841E-09	8.82659E-09	9.875E-09	24			
0.2	2.89915E-09	1.15966E-08	3.48841E-09	1.15966E-08	6.465E-09	7.5			
0.45	0.000128812	0.000157437	0.000143569	0.000157437	0.000129	26.25			

Trough a Server-Side Expert System over the General Model

to the Final CBA Report



Conclusion

- CBA is a useful tool for understanding gains and losses of safety investments
- CBA should be one of the inputs in decision making process
- Safety benefits often disregarded in CBA
- ASICBA method offers opportunity to include safety benefits in CBA
- Method has been applied to case studies from users in the industry