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EUROCONTROL Guidance Material for Short Term Conflict Alert
Appendix C: Cost Framework for the Standardisation of STCA

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This document is a set of guidelines for users of the Cost Framework to assess the economic impact of the standardisation of Short Term Conflict Alert for individual ANSPs.		
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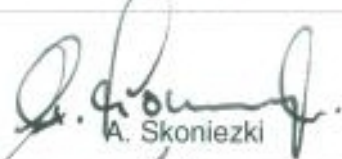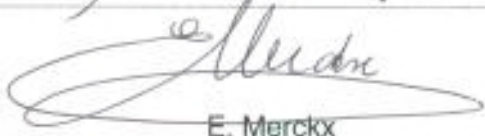
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CONTENTS

EXECUTIVE SUMMARY

This document is a set of guidelines for users of the Cost Framework to assess the economic impact of the standardisation of Short Term Conflict Alert for individual ANSPs. The cost framework calculates the potential financial implications for an Air Navigation Service Provider (ANSP) that is planning to implement STCA, in accordance with The European Convergence and Implementation Plan objective ATC02.2 (Implement ground based safety nets – Short Term Conflict Alert Level 2).

The Cost Framework is a model based on Microsoft Excel, and includes the option to use @RISK software to analyse project uncertainty to identify the economic risks associated with STCA implementation.

This document provides:

- Background information into the study.

- Detailed instructions for using the spreadsheet model.

- How to obtain the results of the calculations.

- How to view the results of the Cost Framework

1. INTRODUCTION

1.1 General

This document provides the guidelines for using the cost framework for the standardisation of Short Term Conflict Alert (STCA).

The cost framework calculates the potential financial implications for an Air Navigation Service Provider (ANSP) that is planning to implement STCA, in accordance with The European Convergence and Implementation Plan objective ATC02.2 (Implement ground based safety nets – Short Term Conflict Alert Level 2).

1.2 Objective of the Cost Framework

When assessing the economic implications of implementing STCA Level 2 it is important to ensure that ANSPs understand the costs of implementing STCA Level 2. This knowledge, along with the other guidelines and specifications produced by the SPIN Task Force, will help ensure that ANSPs implement an effective STCA in an efficient manner.

1.3 Structure of the document

The document has the following structure:

- Background information.

- How to use the Cost Framework.

- How to obtain the results.

- Viewing the results.

2. BACKGROUND INFORMATION

2.1 Introduction

This section provides some background information regarding the Cost Framework. The following sections describe the software required to run the Cost Framework, how the cost elements have been estimated, factors that are included and how they affect the costs of implementation and what the Cost Framework can tell an organisation implementing STCA Level 2.

2.2 Software requirements

The Cost Framework has been developed using Microsoft Excel, in conjunction with Palisade Decision Tools @RISK.

The functionality added through using @RISK helps to assess the financial risk when implementing STCA and identifies the cost elements that have the greatest impact on the overall cost. This is provided through a sensitivity analysis and uses tornado diagrams to present the project sensitivities.

We understand that this software is commercially available, however we have also assumed that many organisations may not have access to it. Therefore, the Cost Framework also works without @RISK, and hence without the added functionality that @RISK provides.

2.3 Cost estimates

Firstly, we identified a list of costs that would be incurred by an ANSP implementing STCA Level 2. These costs were grouped into the following categories:

- Project overheads.

- Research and development.

- Procurement.

- Implementation.

- Supplementary support.

- Hardware and system maintenance.

We estimated the costs for each of the elements within these categories, using expert judgement. These estimates were then validated by ANSPs, industry and the SPIN Task Force. The detailed list of costs and assumptions are included in the Economic Assessment of Standardised STCA [Ref 1].

2.4 Factors affecting cost of implementation

We have included the following factors when assessing the cost implications for STCA Level 2:

- The number of operational units with an ANSP that require STCA implementation.

- The number of ATCOs that require STCA Level 2 training.

- The number of technical support staff that require training.

- The current STCA technology at each unit, ie whether a unit has STCA in the ATM system, and;

  - How a unit without STCA plans to implement STCA Level 2. The two options are to upgrade their current ATM system or to implement a new ATM system that includes STCA.

  - How a unit with STCA, whether it is fully operational or switched off due to ineffectiveness, plans to ensure the system meets the Level 2 requirements.

- Cost of effort per man day.

- The approximate complexity of the airspace.

- Uncertainty in the cost elements, which creates a range of costs for implementation.

These parameters are set by answering a series of questions at the start of the Cost Framework.

2.5 What is the output?

The output of the Cost Framework is a series of graphs and tables that are based on the estimated costs of implementing STCA, adapted according to the answers given to the initial questions.

The Cost Framework produces:

- A range of costs, from minimum to maximum for the cost of implementing STCA in all of the units specified in the answers to the questions.

- A range of costs per unit that will implement STCA, both in table and graph form.

- A breakdown of total costs (across all units) according to the category of costs, as defined in Section 2.3.

- A breakdown of each category of cost for each unit that will implement STCA.

3. HOW TO USE THE COST FRAMEWORK

3.1 Introduction

This section describes how to use the MS Excel spreadsheet, both with and without the support of the @RISK software. This section describes the key to

understanding the structure of the spreadsheet model, the list of questions to be answered and the additional options for tailoring the Cost Framework to local requirements.

3.2   Opening the Cost Framework file

Firstly, if using the @RISK software ensure that @RISK is opened prior to opening the Cost Framework. The MS Excel workbook can then be opened.

The program file (Cost Framework 2.0.xls) contains macros to analyse the selections made by the user. Therefore, on opening the spreadsheet, and if prompted, the user should enable macros in the workbook. If the security level is set to 'High' the macros will be disabled automatically and the security level within Excel will need to be reduced, possibly by a network administrator.

3.3   Spreadsheet key

The spreadsheet model has been developed in MS Excel and uses colour coding to help the user to identify where to input information in to worksheets and cells. The key is described in Table 3-1, below.

Colour	Cells / Worksheets	
Light Yellow	Both	These are the most important cells and worksheets. These are where the important information is input into the spreadsheet and are vital for the Cost Framework to function. Please follow the instructions on these worksheets carefully.
Light Green	Both	These are cells and worksheets that should be changed only if the user requires. These can be used to tailor the Cost Framework to local requirements or to change assumptions that do not fit a particular situation. Our recommendation is not to change these unless it is vital to do so.
Light Blue	Worksheets	This worksheet presents the results once the model has been run.
Grey	Worksheets	These worksheets provide the background calculations that are a vital part of the spreadsheet model. Our recommendation is not to change these.

Table 3-1: Spreadsheet key

3.4   Questions to be answered

The Cost Framework relies on a number of inputs from the user to calculate the range of costs for STCA Level 2 implementation. Some questions require

an exact answer from a number of options. An incorrect entry may result in the Cost Framework failing. Therefore, the utmost care should be taken to ensure the answers to the questions are compatible with the Cost Framework. There are dropdown lists to help ensure that the correct inputs are made.

The questions are separated in to a number of sections, each of these are described below.

Section 1 – Basic ANSP information

The first section requests basic information about the ANSP. These questions are shown in Table 3-2, below.

Section 1 – Basic ANSP information		
Question	**Possible answers**	**How the answer is used**
Are you using the full @Risk program in conjunction with this model? If so please, load it now.	Yes or No (contained in a dropdown list)	This sets up the model to use @RISK or to only use MS Excel.
ANSP Name	Any	This places the ANSP name in relevant cells, labelled by [ANSP_Name] in the model.
How many Units is [ANSP Name] responsible for?	Any numeric figure from 1-8 contained in a dropdown list)	This activates the cells that require data for each of the units of the ANSP.

Table 3-2: Section 1 - Basic ANSP information questions

A screen shot of Section 1 is shown in Figure 3-1, below.

Section 1 - ANSP Basic Information	
Are you using the full @Risk program in conjunction with this Workbook?	[Yes/No]
ANSP Name	[ANSP Name]
How many Units is [ANSP Name] responsible for?	[Number of Units]

Figure 3-1: Screenshot of Section 1

Section 2 – Unit specific information

Section 2 requests information that is specific to each unit that will be implementing STCA Level 2. These questions are shown in Table 3-3, below.

Section 2 – Unit specific information		
Question	**Possible answers**	**How the answer is used**
Please enter the names of the units	A text string with the unit name, eg Geneva, for each of the units.	This data is used to tailor the model to ensure the outputs are clearly labelled with the unit names.
Please enter the number of ATCOs in operations at [Unit Name 1]	A numerical figure, eg 420, which is the number of Air Traffic Controllers in operations at each of the units.	This data is used to adjust the training cost for each unit.
Please enter the number of technical staff requiring STCA training at [Unit Name 1]	A numerical figure, eg 15, which is the number of Technical Staff that require training at each of the units.	This data is used to adjust the training cost for each unit.

Table 3-3: Section 2 – Unit specific information requests

A screenshot of the Section 2 questions is shown in Figure 3-2, below.

Figure 3-2: Screenshot of Section 2 questions

Section 3 – Current system details

Section 3 requests details regarding the current STCA technology at each of the units. There are four options to choose from for each unit. These are:

1) The current ATM system at the unit **does not** include STCA. STCA will be included in an upgrade of the whole system.

2) The current ATM system at the unit **does not** include STCA. An STCA upgrade will be completed on the current system.

3) The current ATM system at the unit **does** include STCA, however the STCA is not in full operational use throughout all sectors and/or does not comply with Level 1 or Level 2 specifications.

4) The current ATM system at the unit **does** include STCA, is compliant with Level 1 Specifications and is therefore technically compliant with Level 2 Specifications.

Section 3 requires the user to place an 'x' into the box with the description that is the closest description to the current STCA implementation at each of the units. This is completed using the dropdown lists. Please ensure that each column only has one implementation description selected.

It is understood that a number of ANSPs may have units with varying maturity in terms of STCA implementation. Therefore, the user can define each of the units individually depending on the current technology implemented at the unit.

A screenshot of Section 3 is shown in Figure 3-3, below.

Section 3 - Current system details

Please place an x in next to the description that best describes the STCA implementation or proposed STCA implementation at each Unit.

	[Unit Name 1]	
1) The current ATM system at the centre does not include STCA. STCA will be included in an upgrade of the whole system.		
2) The current ATM system at the centre does not include STCA. An STCA upgrade will be completed on the current system.		
3) The current ATM system at the centre does include STCA, however the STCA is not in full operational use throughout all sectors and/or does not comply with Level 1 or Level 2		
4) The current ATM system at the centre does include STCA, is compliant with Level 1 Specifications and is therefore technically		

Figure 3-3: Screenshot of Section 3 questions

There are additional boxes provided for users entering information for more than two units.

Section 4 – Project risks

Section 4 requests information regarding the uncertainties that the user expects when implementing STCA Level 2. These figures are set to a figure of 10% above the mean figures (project overrun) and 10% below (project under budget). These can be changed by inputting a percentage into the relevant cells.

A screenshot of Section 4 is shown in Figure 3-4, below.

Section 4 - Project risks	Min below estimated cost	Max above estimated cost
1) All costs contain a degree of uncertainty. This assessment assumes that all costs can vary up to 10% above the estimated costs and also 10% below the estimated costs. If you wish to change this figure please do so in the boxes provided.	10%	10%

Figure 3-4: Screenshot of Section 4 questions

Section 5 – Estimated complexity factor

The Cost Framework applies a weighting to cost elements that are likely to be affected by the complexity of the airspace of the unit. Section 5 requests the user to choose one of the five complexity descriptions that most closely matches the complexity of the airspace for each unit. This is done using the dropdown lists.

The options for the description of complexity are:

1) Simple airspace - eg the TWR of a remote airport.

2) Simple/Moderate airspace – eg ACC outside of Core Area.

3) Moderately complex airspace –eg ACC/APP outside of Core Area.

4) Complex airspace - eg Typical Core Area ACC.

5) Extremely complex airspace - eg APP for a major European airport.

A screenshot for Section 5 is shown in Figure 3-5, below.

Section 5 - Airspace Complexity

1) Please estimate the complexity of the airspace for each unit the STCA will be implemented into.

	Estimated complexity factor
[Unit Name 1]	[1 - 5]
	[1 - 5]
	[1 - 5]
	[1 - 5]
	[1 - 5]
	[1 - 5]
	[1 - 5]
	[1 - 5]

Figure 3-5: Screenshot of Section 5 questions

Section 6 – Effort costs

The Cost Framework takes into account the cost of a man day of effort, and this section requests this information. This figure inputted should be an estimate of the average cost of a man day for the team that will be responsible for implementing STCA Level 2. The default figure is set at €500.

A screenshot of Section 6 is shown in Figure 3-6, below.

Section 6 - Effort costs

Please enter the cost of one man day of effort in Euros, e.g 500.	[man_day_rate]

Figure 3-6: Screenshot of Section 6 question

Following the completion of all six sections the model is ready to calculate the costs of STCA Level implementation at each of the individual units.

4.   OBTAINING THE RESULTS

4.1   Introduction

The process to view the results of the Cost Framework depends on whether the @RISK program is being used. The instructions within the model change depending on whether the user selects 'Yes' or 'No' in Section 1 for using @RISK, however more detailed instructions are provided in the following sections to ensure that the model works correctly.
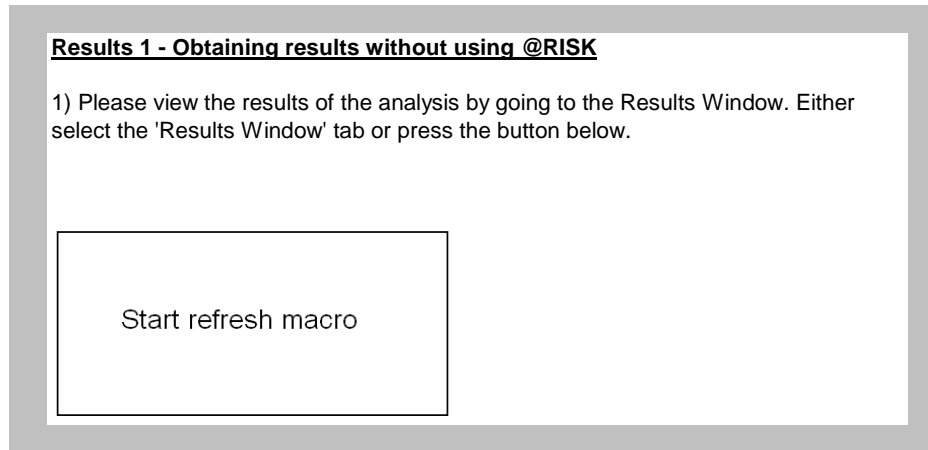
4.2   Obtaining the results without @RISK

Sections 1 – 6 must be completed in full prior to answering the questions in the results section.

Results 1 – Obtaining results without using @RISK

This section follows on from Section 6, described above. To calculate the costs and to view the results the user clicks on a button called 'Start refresh macro'.

A screenshot of the Results 1 section is shown in Figure 4-1, below.

Results 1 - Obtaining results without using @RISK

1) Please view the results of the analysis by going to the Results Window. Either select the 'Results Window' tab or press the button below.

Start refresh macro

Figure 4-1: Screenshot of Results 1 section, without using @RISK

This macro refreshes a number of pivot tables within the model and activates the 'Results Window' worksheet, where all of the tables and graphs are displayed.

Results 1 – Obtaining the results when using @RISK

This section follows on from Section 6, as described above, when @RISK is being used to add functionality to the Cost Framework. The procedure is more complicated than when not using @RISK.

The Cost Framework model instructs the user to start the @RISK simulation by selecting the 'Start Simulation' button from the @RISK toolbar. This runs the @RISK file and starts the simulation.

When prompted to delete a worksheet after the @RISK program has run the user must select 'Yes'.

The user will then be taken to the @RISK results summary window. However, before going any further the user must return to the 'Inputs' worksheet and run the macro to refresh the pivot tables. This is done by clicking on the 'Start refresh macro' button in the Results 1 section.

A screenshot of the Results 1 section is shown in Figure 4-2, below.

Results 1 - Obtaining results the when using @RISK

1) Please run the @Risk simulation by selecting 'Start Simulation' in the @Risk tool bar.
2) When requested whether to delete the sheet, ensure that you select 'yes', and ensure you return directly to this worksheet
3) Please run the 'start refresh macro' by clicking on the button below

Start refresh macro

Figure 4-2: Screenshot of Results 1 section, when using @RISK

This macro refreshes a number of pivot tables within the model and activates the 'Results Window' worksheet, where all of the tables and graphs are displayed. The additional @RISK tornado graphs can be view by accessing the 'Tornado Graphs' worksheet.

Results 2 – Resetting the spreadsheet

The user can also reset the spreadsheet at any time during the process. This enables the user to restart the data entry process. This is done by clicking on the 'Reset the spreadsheet' macro, which is in the Results 2 section.

A screenshot of the Results 2 section is shown in Figure 4-3, below.

Results 2 - Resetting the spreadsheet

1) Reset the spreadsheet by clicking on the button below.

Reset spreadsheet

Figure 4-3: Screenshot of Results 2 section

# 5. VIEWING THE RESULTS

5.1 Introduction

The detail of the results available to the user depends on whether @RISK is used to add functionality to the Cost Framework. This section describes how the results are displayed without @RISK and then describes the added results that are achieved when using @RISK.

5.2 Viewing the results without @RISK

The results of the Cost Framework are displayed in the 'Results Window' spreadsheet. This worksheet is activated after the 'Start refresh macro' has run.

The first table and graph of results is the total cost per unit, which is defined as a range (min, mean and max). The figures are displayed in thousands of Euros. An illustrative graph is shown in Figure 5-1, below, for an ANSP with eight units with varying STCA implementations, varying numbers of staff and varying airspace complexities.

	Min	Mean	Max
Unit 1	829890	957333	1091823
Unit 2	1009935	1173500	1347335
Unit 3	873149	998517	1129555
Unit 4	25200	28667	32267
Unit 5	1079348	1240861	1410692
Unit 6	1321155	1545500	1785355
Unit 7	1134360	1321000	1519760
Unit 8	12600	14333	16133
Total Cost	€ 6,285,636	€ 7,279,711	€ 8,332,920
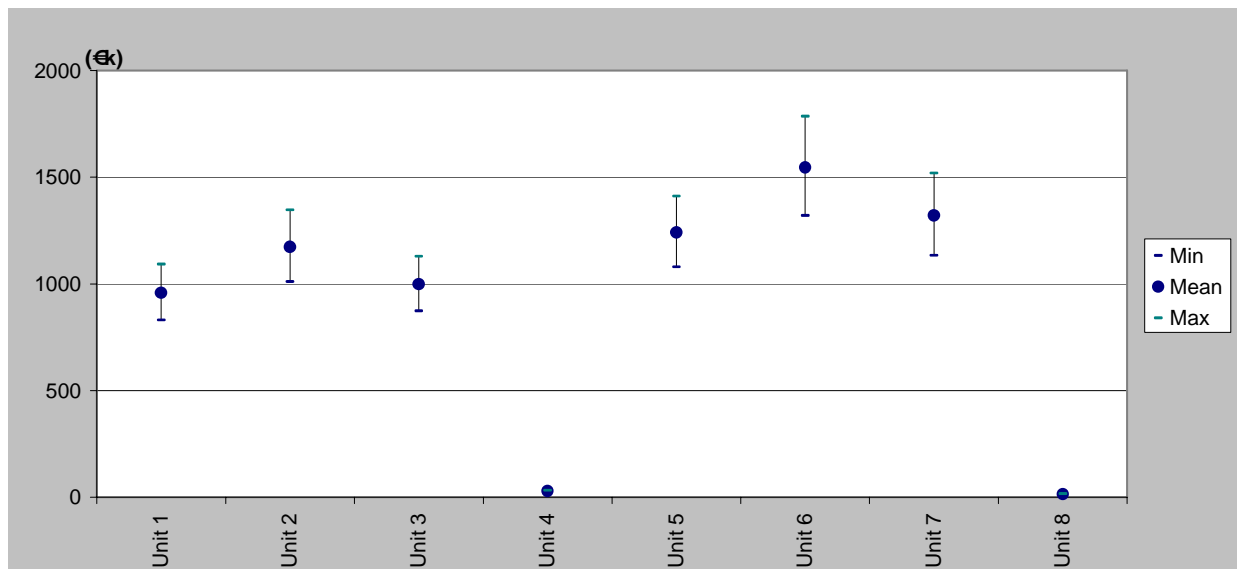
Figure 5-1: Illustrative table and graph of total costs per unit

Figure 5-1 shows the total costs for each of the units and displays a range of values that results from the uncertainties of the calculations entered by the user in Section 4 of the 'Inputs' spreadsheet. It shows that the two units with an effective STCA in place (Units 4 and 8) only incur minor costs to implement STCA Level 2. It also shows that Unit 6 is likely to incur the highest costs. Therefore, attention should be paid to these units incurring the highest costs as they, invariably, also have the greatest uncertainty in costs and hence potential for overrun of budget.

The second table and graph displays the costs that the ANSP will incur in each category of cost, as defined in Section 2.3 of this document. An illustrative table and graph is shown in Figure 5-2, below.

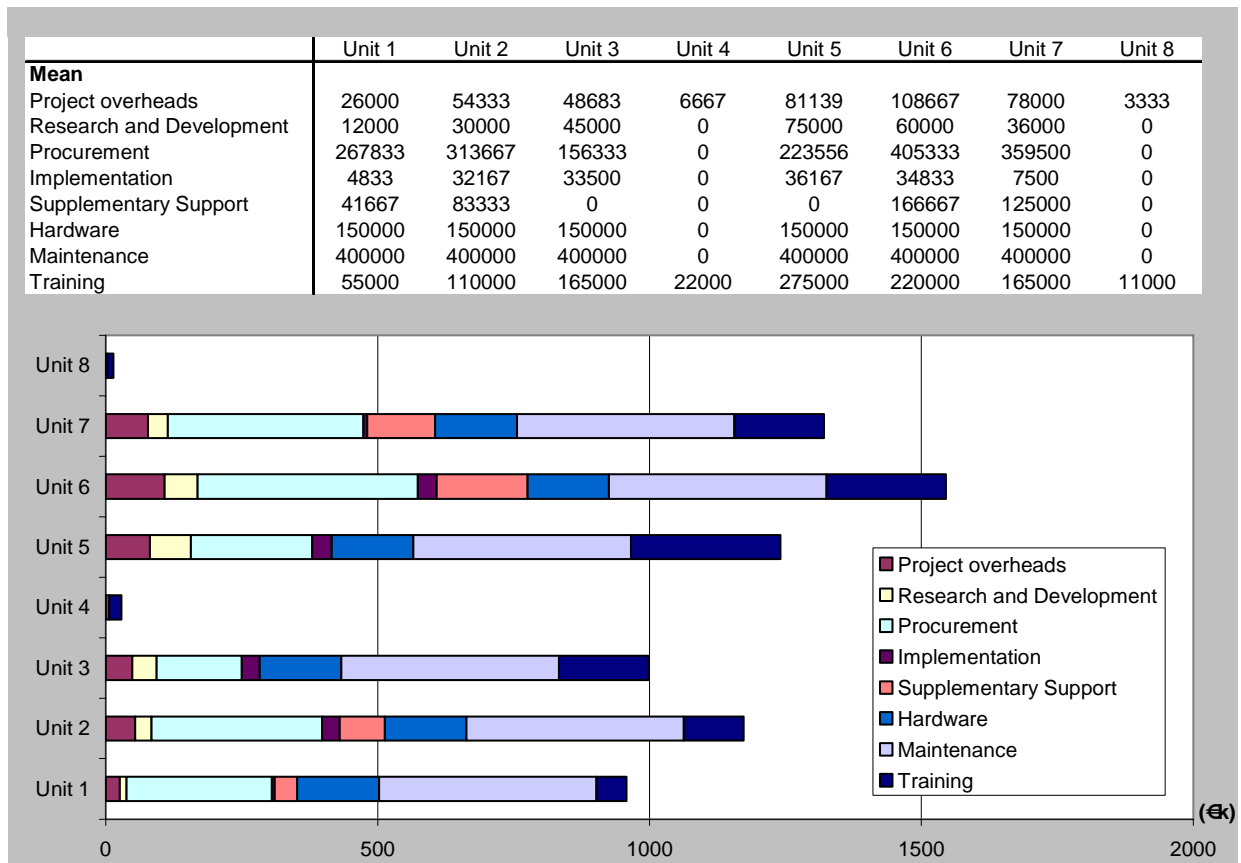|	Min	Mean	Max
Project overheads	366140	406822	447504
Research and Development	232200	258000	283800
Procurement	1553600	1726222	1898844
Implementation	134100	149000	163900
Supplementary Support	375000	416667	458333
Hardware	810000	900000	990000
Maintenance	2160000	2400000	2640000
Training	920700	1023000	1125300
Total Cost	€ 6,551,740	€ 7,279,711	€ 8,007,682
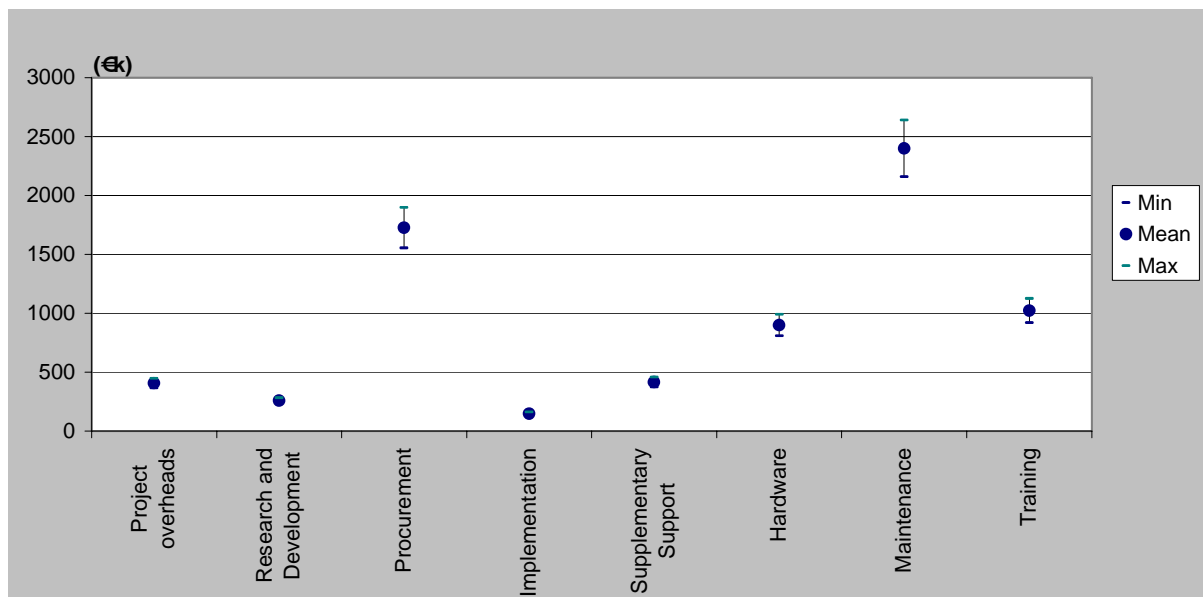
Figure 5-2: Illustrative table and graph of cost categories for ANSP

Figure 5-2 shows the total costs for each of the cost categories and displays a range of values that results from the uncertainties of the calculations entered by the user in Section 4 of the 'Inputs' spreadsheet. From this illustrative analysis the user can identify the most costly aspects of upgrading their systems to comply with STCA Level 2 specifications. For example, this illustrative analysis shows that the procurement of the systems and the 10 year maintenance contracts are the most costly items.

The third table and graph combine the two previous analyses to show, for each unit, how the costs are distributed between the different cost categories. An illustrative table and graph is shown in Figure 5-3, below.

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
Mean								
Project overheads	26000	54333	48683	6667	81139	108667	78000	3333
Research and Development	12000	30000	45000	0	75000	60000	36000	0
Procurement	267833	313667	156333	0	223556	405333	359500	0
Implementation	4833	32167	33500	0	36167	34833	7500	0
Supplementary Support	41667	83333	0	0	0	166667	125000	0
Hardware	150000	150000	150000	0	150000	150000	150000	0
Maintenance	400000	400000	400000	0	400000	400000	400000	0
Training	55000	110000	165000	22000	275000	220000	165000	11000

**Figure 5-3: Illustrative table and graph for unit costs per category**

Figure 5-3 shows the breakdown of the costs per unit into the individual cost categories. The figures are based on the average costs for the units.

5.3 Viewing the results with @RISK

When using @RISK, the analyses described above are also available but take into the account the @RISK simulation.

There are additional analyses available when using @RISK. These are the in the form of tornado graphs that assess the impact of the individual cost items to the cost for each unit. These tornado charts help the user to focus on how sensitive the total costs are to the individual cost items.

An example of the tornado graphs generated by @RISK is shown in Figure 5-4, below.

Regression Sensitivity for Unit 1 Total Cost/G6
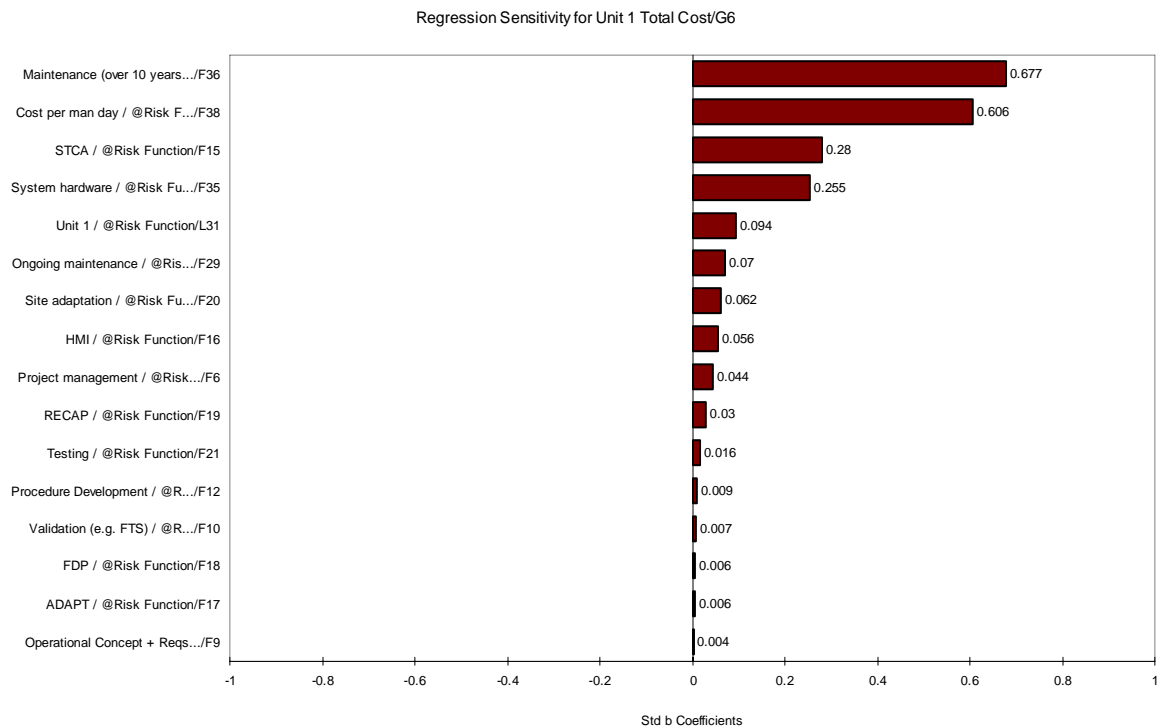
Figure 5-4: Example of @RISK tornado graph

Figure 5-4 shows that the cost for this illustrative unit is most sensitive to the cost of the maintenance contract and the cost of a day of effort. In this illustrative example a one standard deviation increase in the cost of maintenance will result in a 0.677 standard deviation increase in the total cost, whilst a one standard deviation increase in the cost of effort will result in a 0.606 standard deviation in the total cost.

6.   SUMMARY

The graphs and tables presented in this section provide an estimate of the cost that an ANSP will incur when implementing STCA Level 2.

The Cost Framework has been developed to be easy to use and informative, whilst allowing the flexibility for ANSPs to adapt it to fit local requirements.

7.   REFERENCES

1   An economic assessment of standardised STCA, Helios Technology Limited, October 2006.

END OF DOCUMENT