

Example Application of Microsoft Excel

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In Conjunction with:

GAIN Working Group B, Analytical Methods and Tools

September 2004



Preface

This example application has been prepared by Airbus in conjunction with the Global Aviation Information Network (GAIN) Working Group B (Analytical Methods and Tools) (WGB) as one of a number of such examples of the use of analytical methods and tools described in the “*Guide to Methods & Tools for Airline Flight Safety Analysis*”. The intent of these example applications is to illustrate how various tools can be applied within an airline flight safety department, and provide additional information on the use and features of the tool and the value of such analysis. GAIN WG B hopes that these example applications will help increase the awareness of available methods and tools and assist the airlines as they consider which tools to incorporate into their flight safety analysis activities.

Each example application of an analytical method or tool is posted on the GAIN website (www.GAINweb.org). Readers are encouraged to check the website periodically for a current list of example applications, as further examples will be added as they become available.

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Microsoft Excel

1 Introduction

1.1 OVERVIEW OF THE TOOL FUNCTIONALITY

Excel is a flexible tool which can be used for many purposes and in many different ways. A brief overview of the general functionality of the software is provided earlier in this Guide in Section 3.2. Since most readers will already be familiar with the general use and capabilities of the software, this will not be repeated here. However, some more advanced features, which readers may not have used before, are discussed in the example application below.

1.2 INTRODUCTION TO THE EXAMPLE APPLICATION

This example illustrates one potential use of Excel for safety analysis in an airline environment.

In a very small-scale flight operation it may be possible to perform the safety analysis using only paper reports and no formal analysis software, at least for some time. On the other hand, in a large operation, this is impractical and special-purpose data management and analysis tools become necessary. In between the two situations, a fairly simple approach using general-purpose software, like the one described here, may provide the transition from a manual system to a more advanced tool. The aim of this example is to show how some Excel functions can be used to make the data management and analysis task significantly more efficient and reliable than when done manually. Most organizations already have Excel (or a similar tool), which means that there is no extra cost in starting to use it more efficiently.

In the example, the airline has collected data on safety related events, and is inputting the data to an Excel table. We will follow, step-by-step, how Excel can be used at the different stages of the analysis process: data input, analysis, output, and application of the results. The example does not by any means try to be exhaustive in demonstrating Excel functions; the idea is to show some examples and to encourage the reader to discover more.

2 Input Data

It is assumed that the flight safety office receives the source reports (e.g. Air Safety Reports) on paper. The criteria for filing a report have been specified by the airline (and the aviation authority, as some of these reports may require Mandatory Occurrence Reporting to the authority). The responsibility of the flight safety office (and the Flight Safety Manager in particular) is to ensure that all reports are correctly processed, all concerns in them are addressed and all necessary corrective actions take place.

This requires two different analysis processes to be run in parallel: a case-by-case analysis to analyze all significant reports one by one, and another process to treat all the reports together for identifying any worrying patterns, e.g. problem airports.

In this example, the airline is collecting Air Safety Reports (ASRs), which all have a reference number in the format “nn/yy/ttt” where nn is a running number, yy is the year and ttt is the aircraft type. The reports come from different departments of the airline. The data need to be analyzed both case-by-case and with a longer-term cumulative perspective.

Example Applications of Analytical Tools for Airline Flight Safety

In order to provide a means to identify similar situation in the data, it is common practice to define a set of common keywords or descriptors. The keywords or descriptors can be very detailed items or rough categories, also depending on the quantity of the data and the chosen analysis method. They usually evolve in time, making it necessary to make updating them easy. In this example, the airline is using quite broad descriptors (like “crew meals quality” or “navigation database”) and also inputs the flight phases during which the event was caused and took effect. For case-by-case investigation and follow-up, the airline needs to assign a responsible person for each event (i.e. report) and track the status of the investigation and agreed actions.

Data input should be fast, easy and reliable. A typical tabular display of the ASR data is presented in Figure 1.

ASR	Month	Ref	Year	Fleet	Source	Descriptor name	Descriptors	Flight Phase (cause)	Flight Phase (effect)	Responsible	Target Date	Status
18/01/321	7-Jul	18	01	321	MainHub	Pas_1	Passengers - safety awareness	Parked	MULTIPLE	T. Shibahashi	18-Dec-02	Pending action
19/01/321	7-Jul	18	01	321	MainHub	Mis_6	Heavy checks - integrity	Parked	MULTIPLE	A. Muir	01-Oct-02	Closed
29/01/320	7-Jul	29	01	320	TechDiv	Aircraft_5	Electrical system	Descent/approach	Descent/approach	Safety Review Board	12-Nov-02	Pending action
29/01/320	7-Jul	29	01	320	TechDiv	Aircraft_5	Electrical system	Descent/approach	Descent/approach	G. Gibbs	15-Mar-03	Monitor
30/01/320	7-Jul	30	01	320	TechDiv	Mis_2	Line maintenance	Parked	Taxi	P. Mitra	16-Apr-03	Monitor
30/01/320	7-Jul	30	01	320	TechDiv	Mis_3	Tech log entries addressed	Parked	Taxi	G. Gibbs	16-Apr-03	Pending action
40/01/330	7-Jul	40	01	330	MainHub	Aircraft_5	Electrical system	Parked	Descent/approach	T. Shibahashi	12-Nov-02	Pending action
42/01/330	7-Jul	42	01	330	MainHub	Mis_2	Line maintenance	Parked	Go-ground	P. Mitra	01-Oct-02	Pending action
43/01/330	7-Jul	43	01	330	MainHub	Traffic_4	ATC-aircraft communication	Cruise	Landing	A. Perrin	16-Apr-03	Closed
46/01/330	7-Jul	46	01	330	MainHub	FlightOps_1	Disturbances - sensitive flight phases	Takeoff/climb	MULTIPLE	T. Shibahashi	15-Mar-03	Monitor
47/01/330	7-Jul	47	01	330	MainHub	Mis_6	ATC-aircraft communication	Cruise	Cruise	T. Shibahashi	12-Nov-02	Closed
47/01/330	7-Jul	47	01	330	MainHub	Mis_6	Heavy checks - integrity	Cruise	Cruise	A. Perrin	12-Nov-02	Closed
49/01/330	7-Jul	49	01	330	MainHub	Traffic_2	ATC - clearances	Descent/approach	Descent/approach	G. Gibbs	01-Oct-02	Pending action
57/01/320	7-Jul	57	01	320	MainHub	Aircraft_5	Electrical system	Cruise	Cruise	J. Ping	15-Mar-03	Closed
57/01/320	7-Jul	57	01	320	MainHub	FlightOps_1	Disturbances - sensitive flight phases	Cruise	Cruise	T. Shibahashi	12-Nov-02	Closed
63/01/320	7-Jul	63	01	320	MainHub	Mis_1	Completion of mx tasks	Parked	MULTIPLE	P. Mitra	18-Dec-02	Monitor
63/01/320	7-Jul	63	01	320	MainHub	Mis_2	Line maintenance	Parked	MULTIPLE	P. Mitra	15-Mar-03	Monitor
64/01/320	7-Jul	64	01	320	MainHub	Ground_2	Refuelling - fuel leak	Parked	Parked	J. Ping	01-Oct-02	Pending action
24/01/321	8_Avg	24	01	321	MainHub	Loading_1	Load sheet	Parked	Takeoff/climb	G. Gibbs	18-Dec-02	Closed
26/01/321	8_Avg	26	01	321	MainHub	Traffic_2	ATC - clearances	Descent/approach	Descent/approach	J. Ping	18-Dec-02	Closed
52/01/330	8_Avg	52	01	330	MainHub	Mis_3	Tech log entries addressed	Parked	MULTIPLE	T. Shibahashi	18-Dec-02	Monitor
55/01/330	8_Avg	55	01	330	MainHub	Ground_1	Runway engineer - ground staff	Parked	Parked	A. Perrin	12-Nov-02	Pending action
68/01/320	8_Avg	68	01	320	MainHub	FlightOps_5	Flap speed limits	Descent/approach	Descent/approach	P. Mitra	01-Oct-02	Pending action
16/01/332	9_Sep	16	01	332	Regional	Loading_3	Dangerous goods handling	Parked	Parked	P. Mitra	15-Mar-03	Monitor
28/01/321	9_Sep	28	01	321	MainHub	Aircraft_2	Crew awareness of aircraft systems condition	Parked	MULTIPLE	P. Mitra	18-Dec-02	Closed
59/01/330	9_Sep	59	01	330	MainHub	FlightOps_4	Flight envelope	Descent/approach	Descent/approach	J. Ping	01-Oct-02	Monitor
61/01/330	9_Sep	61	01	330	MainHub	Pas_2	Passengers - smoking in lavatory	Takeoff/climb	MULTIPLE	T. Shibahashi	12-Nov-02	Monitor
63/01/330	9_Sep	63	01	330	MainHub	FlightOps_1	Disturbances - sensitive flight phases	Descent/approach	MULTIPLE	T. Shibahashi	15-Mar-03	Monitor
64/01/330	9_Sep	64	01	330	MainHub	FlightOps_1	Disturbances - sensitive flight phases	Descent/approach	MULTIPLE	T. Shibahashi	01-Oct-02	Monitor
73/01/320	9_Sep	73	01	320	MainHub	Pas_2	Passengers - smoking in lavatory	Cruise	MULTIPLE	J. Ping	16-Apr-03	Closed
75/01/320	9_Sep	75	01	320	MainHub	Ground_3	Doors opened despite nav lights	Parked	Parked	T. Shibahashi	18-Dec-02	Closed
78/01/320	9_Sep	78	01	320	MainHub	Loading_1	Load sheet	Parked	MULTIPLE	T. Shibahashi	18-Dec-02	Monitor
78/01/320	9_Sep	78	01	320	MainHub	Loading_3	Dangerous goods handling	Parked	MULTIPLE	A. Perrin	18-Dec-02	Closed
104/01/320	9_Sep	104	01	320	Regional	Pas_1	Passengers - safety awareness	Parked	MULTIPLE	P. Mitra	16-Apr-03	Closed
107/01/320	9_Sep	107	01	320	Regional	Loading_4	Load - properly fixed	Parked	MULTIPLE	P. Mitra	15-Mar-03	Pending action
107/01/320	9_Sep	107	01	320	Regional	Loading_4	Load - properly fixed	Parked	MULTIPLE	J. Ping	12-Nov-02	Closed

Figure 1 Air Safety Report Data Table Showing a Drop-down Menu

The data table shown in Figure 1 has been created using the following Excel features:

- Drop-down menus ensure fast and reliable entry for columns “month”, “source”, “descriptors”, “flight phase”, “responsible” and “status”. In screenshot 1, the user is filling in the “flight phase” cell by picking “descent/approach” from the drop-down menu.
- The “descriptor name” is filled automatically by Excel based on the entry in the respective “descriptors” column (using the VLOOKUP command and the lists on a separate worksheet).

Example Applications of Analytical Tools for Airline Flight Safety

The database should contain all the information in such a format that the database can also be used for effective long-term analysis. One of the requirements is sorting the database in different ways. Sorting by aircraft type, event date or year would be difficult because the relevant information is embedded in the reference and not initially in its own column. To solve this, the reference number is automatically split into three respective columns. For example, the top row for these three columns contains the following formulas for extracting the correct parts of the reference number:

- =VALUE(LEFT(A3,FIND("/",A3)-1))
- =MID(A3,FIND("/",A3)+1,2)
- =RIGHT(A3,3)

All the options for the drop-down menus are specified on a separate worksheet which makes updating them easy (see Figure 2). The drop-down menus have been created using the command DATA/VALIDATION/ALLOW LIST and the lists have been defined on the separate worksheet using the INSERT/NAME/DEFINE command.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Q	R	S	T
	Descriptors	B-name	Flight Phases	Flight Phases	Source	Month	Responsible	Status											
1	Controlling aircraft on ground	Aircraft_1	Parked	On ramp with flight crew on board until pushback or engine start	MainHub	1_Jan	A. Perrin	Open											
2	Crew awareness of aircraft systems condition	Aircraft_2	Taxi	On-ground operation of the airplane from pushback or commencement of moving to holding point, including engine start; and from runway limit to terminal gate or engine stop	Hub2	2_Feb	G. Gibbs	Pending action											
3	Speed indications	Aircraft_3	Takeoff/climb	From entering the runway until the first cruising altitude is achieved	Regional	3_Mar	T. Shihabashi	Monitor											
4	False warnings - lav smoke	Aircraft_4	Cruise	From top of climb to top of descent (includes en route climb or descent)	TechDiv	4_Apr	J. Ping	Closed											
5	Electrical system	Aircraft_5	Descent/approach	From top of descent to threshold or go-around		5_May	P. Mitra												
6	Disturbances - sensitive flight phases	FlightOps_1	Go-around	From go around attitude to final approach fix		6_Jun	A. Muir												
7	Crew meals quality	FlightOps_2	Landing	From threshold to runway limit exit		7_Jul	Safety Review Board												
8	Navigation DB	FlightOps_3	MULTIPLE	Report concerns several flight phases		8_Aug	Board of Directors												
9	Flight envelope	FlightOps_4	UNKNOWN	Flight phase unknown		9_Sep													
10	Flap speed limits	FlightOps_5				10_Oct													
11	Running engines - ground staff	Ground_1				11_Nov													
12	Refuelling - fuel leak	Ground_2				12_Dec													
13	Doors opened despite nav lights	Ground_3																	
14	Load sheet	Loading_1																	
15	Cargo - foreign objects	Loading_2																	
16	Dangerous goods handling	Loading_3																	
17	Load - properly fixed	Loading_4																	
18	Completion of mt tasks	Mt_1																	
19	Line maintenance	Mt_2																	
20	Tech log entries addressed	Mt_3																	
21	Deferred defects - timeliness	Mt_4																	
22	Cockpit crew environment	Mt_5																	
23	Heavy checks - integrity	Mt_6																	
24	Passengers - safety awareness	Pass_1																	

Figure 2 Definition of Lists for the Drop-down Menus on a Separate Worksheet

Additional features can be added to help data entry and spotting errors. In the example table, the same event may be entered several times to allow specifying different descriptors to the same event. To help visualize when the same report is repeated on two consecutive rows, the reference number on the second line will turn gray. Similarly, to help managing the data, target dates which have been passed turn violet and all closed items turn green. These features have been created with the CONDITIONAL FORMATTING function.

3 Analytical Process

The example table supports both case-by-case and long-term analysis.

3.1 CASE-BY-CASE ANALYSIS

The case-by-case analysis is in practice a technical investigation with several contributing experts from different parts of the airline, coordinated by a nominated responsible person. The process is straightforward but may take some time, and the challenge for the Flight Safety Manager is to monitor the progress.

The data table supports this process through the last three columns. These allow the user to specify who is in charge of the analysis (investigation), what is the agreed target date for closing, and what is the status of the investigation today. The user can either scan through the main table to check the status of specific reports, or use a dedicated monitoring table on a separate worksheet to get an overall picture of investigations (see Figure 3).

FOLLOW-UP OF ACTIONS PER RESPONSIBLE						
Count of Month	Status					
Responsible	Closed	Monitor	Open	Pending action	Grand Total	
A. Muir	2				2	
A. Perrin	8		1	1	10	
Board of Directors	1		1		2	
G. Gibbs	9		5	7	21	
J. Ping	18		7	2	27	
P. Mitra	16		10	7	33	
Safety Review Board	1			1	2	
T. Shibahashi	8		10	1	4	23
Grand Total	63		34	1	22	120
To see related reports, double-click on numbers						

Figure 3 A Pivot-table for Monitoring Progress on Case-by-case Analyses

The table has been created using the PIVOT TABLE command, and it has the advantage that clicking on any cell in the table will automatically create a new worksheet listing the events in question. For example, clicking on the cell “pending action” of “T.Shibahashi” containing the number “4” would create a worksheet listing the 4 reports pending action, for which T.Shibahashi is responsible (see Figure 4). This function is available for all pivot tables created with Excel.

Example Applications of Analytical Tools for Airline Flight Safety

ASR	Month	Ref	Year	Fleet	Source	Descriptor name	SP category	SP impact	Descriptors	Flight Phase (cause)	Flight Phase (effect)	Responsible	Target Date	Status
189014321	7_Jul	18_01	321	MainHub	Pax_1	Pax	Disqualifying	Passengers - safety awareness	Parked	MULTIPLE	T. Shibahashi	18/12/02	Pending action	
344014320	10_Oct	94_01	320	MainHub	FlightOps_1	FlightOps	Disqualifying	Disturbances - sensitive flight phases	Descent/approach	Descent/approach	T. Shibahashi	12/11/02	Pending action	
477014320	10_Oct	47_01	320	TechDiv	Traffic_6	Traffic	Disqualifying	ATC communication - technical issue	Taxi	Cruise	T. Shibahashi	16/04/03	Pending action	
140014330	7_Jul	40_01	330	MainHub	Aircraft_5	Aircraft	Disqualifying	Electrical system	Parked	MULTIPLE	T. Shibahashi	12/11/02	Pending action	

Figure 4 Drill-down to One Cell in the Action Monitoring Table

3.2 LONG-TERM ANALYSIS

Classically, the long-term analysis involves the flight safety manager directly. He/she has to use different sorting and visualization techniques to try to identify similarities between events, or other interesting matters in the safety data. This is hardly possible in a paper-based system. Usually this analysis is based on keywords or other descriptors, which is also the case in our example.

The descriptors can be used in combination with the basic event data (month, phase of flight, a/c type) to create useful tables and charts for making the analysis. First approach is to create a table where issues are ranked based on number of reports per descriptor, sorting the list from the highest count to the lowest. Another way is to follow the number of events per descriptor each month, visualizing a monthly trend.

Figure 5 shows a chart constructed by combining the information about the descriptor category and the flight phase. Excel offers many options for visualizing the data this way and the options to use depend on the exact needs of the analyst.

Example Applications of Analytical Tools for Airline Flight Safety

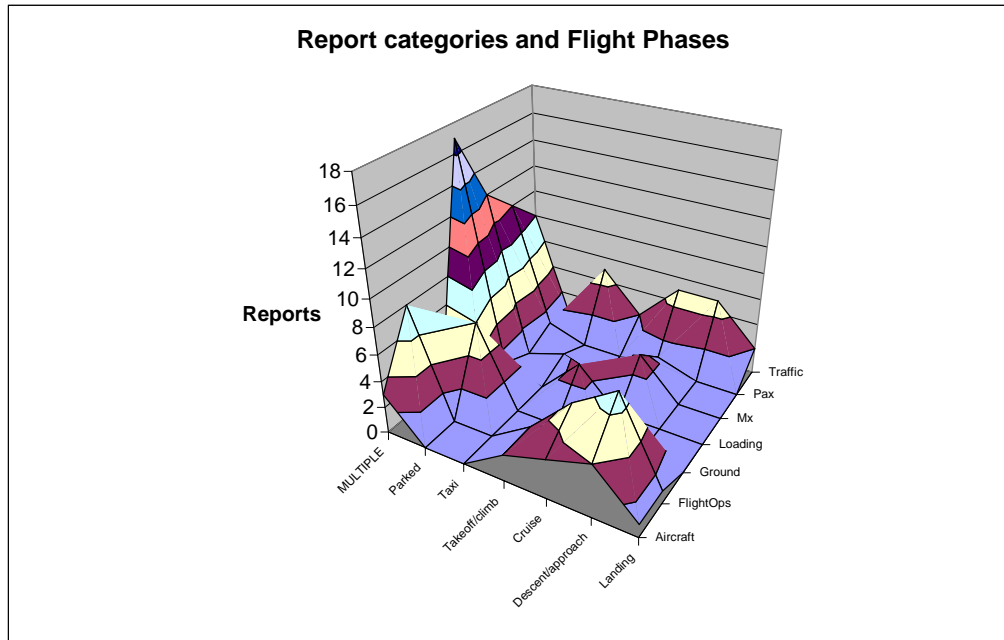


Figure 5 Analysis by Combining Different Data Fields

Data can also be analyzed simply by studying the main data table with the help of the DATA/FILTER/AUTO FILTER command. This function allows the user to specify a filtering criterion for each column and show only rows (events) which fulfill all filtering criteria. An important difference between analysis using the auto-filter and using the pivot tables is that the auto-filtering is a one-time action leaving no trace for later consulting (unless manually carried out each time) whereas the pivot table is a permanent source, and can be specified to update itself automatically each time the file is opened.

4 Tool Output

The tool can be considered to have two kinds of outputs. The most valuable output are the different tables and chart which can be used for analyzing the data. The second kind of output are the charts and tables which are used in safety reporting and communication.

All these outputs can be specified using all the versatile graphical functions of Excel; for example bar charts, pie charts, 3D charts and graphs. It is also possible to automate the creation of regular safety reports/communications to a high degree, by creating the analytical elements with Excel pivot tables and then inserting them to a ready template using a specific Excel MACRO. This only leaves the analyst the task of commenting the results. In fact, Excel is so flexible, that many people use it for presenting results from other safety tools.

Typically, a safety communication would include a set of standard charts and tables (usually showing some parameters as a function of the time period). These would then be commented by the analyst. Occasionally some issue could be highlighted with the help of additional charts, graphs or tables. It may be necessary to create several different (standard) safety communication reports addressing the different needs: management, operational units, and aviation authorities.

5 Application of the Analysis Results

The analysis results often point to some actions which are considered necessary for maintaining an acceptable safety level. The timely implementation and effectiveness of the measures can then be followed using the same database: the former through the “status” column, or the latter by ensuring that similar events do not re-occur at an unacceptable frequency.