ARIUM
RISK ARCHITECTURE

Example Application of The Risk Analysis Tool (RAT)

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Preface

This example application has been prepared by ARIUM Limited (short for Architects for Risk Identification Understanding and Management) 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.

Risk Analysis Tool (RAT)

1 Introduction

1.1 OVERVIEW OF THE TOOL FUNCTIONALITY.

Risk Analysis typically concentrates on what could go wrong by identifying hazards first and then putting in place checks to control the hazards. With the Risk Analysis Tool (RAT) you look at risk in terms of what you want to achieve rather than what you want to avoid. You build a dependency model which says what needs to go right at each level and the software helps show how it could go wrong. This provides a formal method of risk analysis and helps document the evaluation of risk and subsequent mitigations. For example, whilst "glass" cockpits brought many improvements over the previous "clockwork" cockpits, they also introduced new, largely unforeseen, risks such as a reduction in situational awareness.

1.2 INTRODUCTION TO THE EXAMPLE APPLICATION

A specific example of a RAT model to illustrate the principle of Dependency Modeling and the RAT display software is displayed in section 4 (Tool Output) of this report

2 Input Data

Dependency Modelling. Every day, in aviation and in life in general, we have to rely on many things over which we have no real control. For example, a safe car journey depends, at least in part, on the behaviour of other road users. The essence of risk is this dependency upon things beyond our control. The key to managing risk successfully lies in understanding how and why the uncontrollables matter to us and in finding ways of reducing our dependency on them. This is dependency modelling. A dependency model maps out the web of interrelations between your goals and sub goals and ultimately the uncontrollables which are called ***fortunes*** as shown in Figure 1.

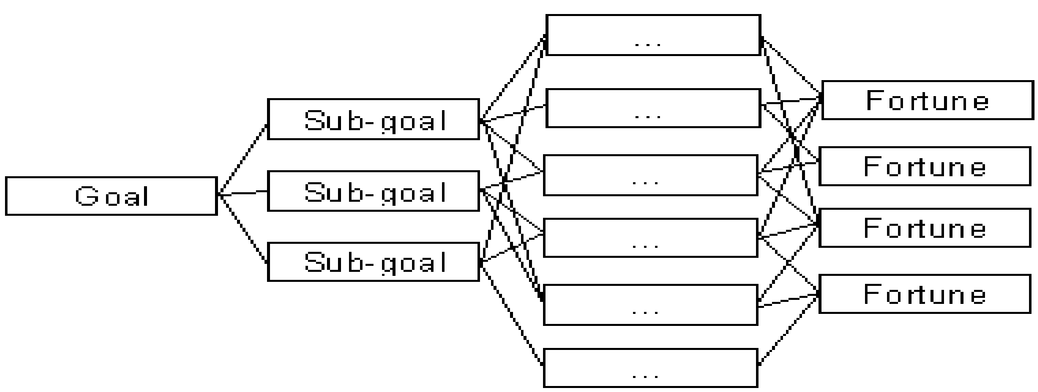


Figure 1 **Real World Complexity**

In the Risk Analysis Tool this web is more conveniently displayed as a tree of dependencies expanding outwards from the high level objective or goal to the fortunes at the leaves as shown in Figure 2.

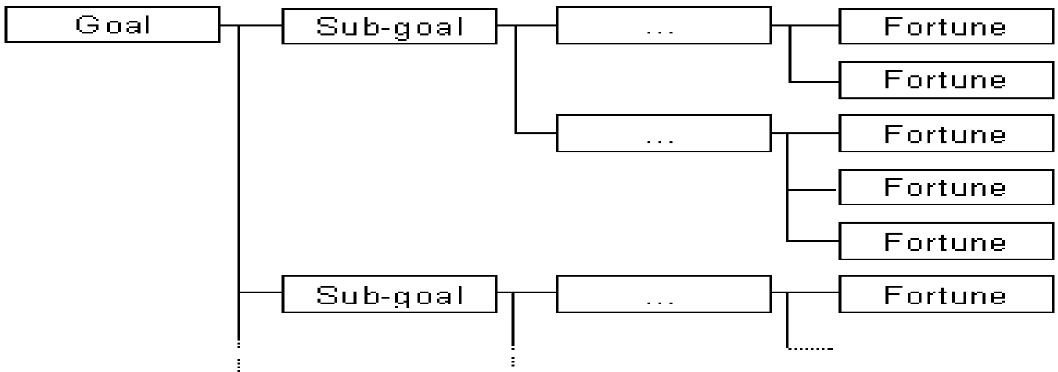
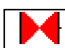
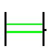


Figure 2 **Reduced Complexity Using Dependency Model**

There are two sorts of dependency. **And**, where <u>all</u> the precursors must be in place to achieve the goal and **Or**, where any of the precursors would be sufficient. In a dependency model, **And** dependencies are points of weakness whereas **Or** dependencies are strengths. In creating this chain of dependencies step by step it becomes easier to see which areas need to be addresses in order to manage the risk or hazard. The RAT software also contains a mathematical engine which enables certain assumptions to be weighted with probabilities of failure using data extracted from safety incident management systems such as BASIS (British Airways Safety Incident System), AQD (Aviation Quality Database) or AVSiS. The probabilities are manually entered into the system and the mathematical model can then calculate and identify which parts of the model are the weaker links in the safety management chain.

3 Analytical Process and Output

The Risk Analysis Tool is an easy to use program written to run on Microsoft Windows. A model file consists of a number of sheets in a “workbook” like interface similar to Microsoft Excel. The Grid/Spreadsheet allows quick and easy manipulation of numerical and text data in a familiar format. The dependency map enables the manipulation of dependency relationships using drag and click whilst Graphs creates persuasive representations of the model’s data. A screenshot of the dependency map is shown below in Figure 3. The following symbols are used in the dependency map.

	An **And** dependency. In a positively phrased dependency model, **And** dependencies are points of weakness.
	An **Or** dependency. In a dependency model, such relationships represent points of strength, 'alternatives'.
	An element whose dependencies are not modelled any further can be an uncontrollable factor. These are shown with a thundercloud symbol.
	Other elements with no further dependencies are discretionary measures which may be introduced into an **Or** dependency to mitigate the effect of one or more uncontrollables.

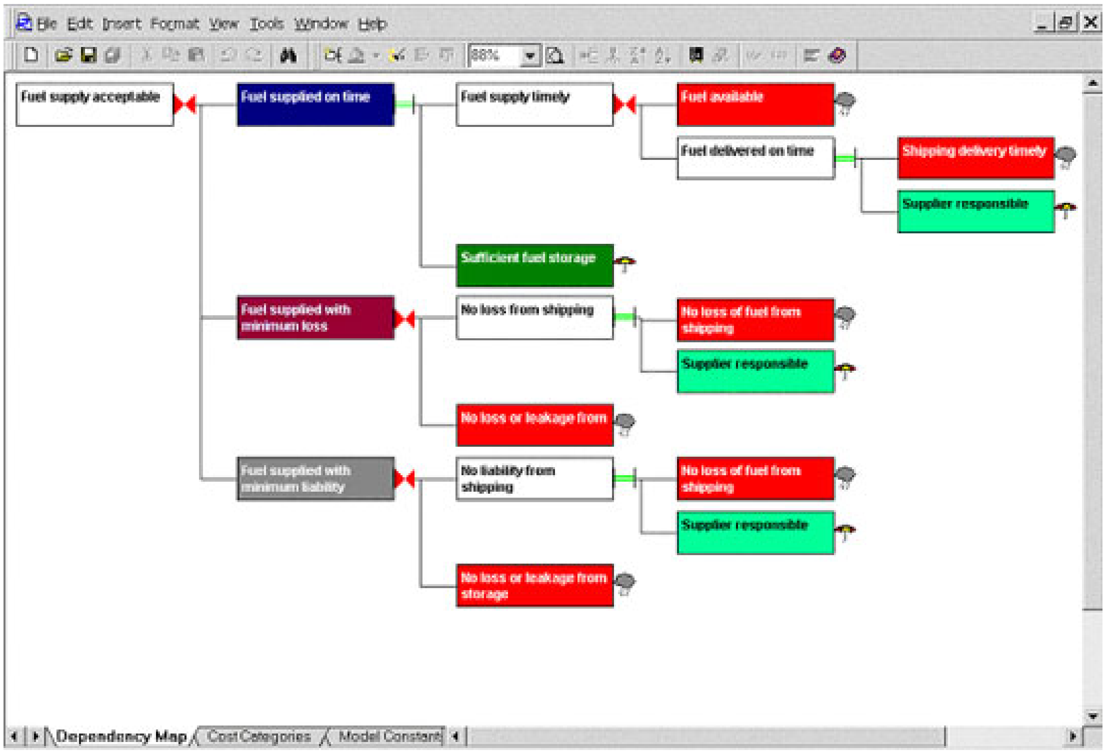


Figure 3 **Dependency Map**

The software is simple to install, configure and maintain, requiring a minimum of only 4 files and approximately 1MB of disk space. It will run on the recommended minimum specification computer for Microsoft Windows 95 and NT. Larger models benefit from more RAM. A typical 2004 PC specification can run large models in a few seconds.

4 Tool Output

The information in this section is an example of a RAT model to illustrate the principle of Dependency Modeling and the RAT display software.

The objective or goal we wish to achieve is “Aircraft does not land gear up”; this depends upon both “Gear is selected down” AND “Gear system works correctly”. The red double triangle symbol represents the AND relationship. Continuing the model: “Gear is selected down” depends upon either “pilot remembers to select gear down, OR “Pilot is prompted to select gear down”. The green parallel line symbol represents the OR relationship.

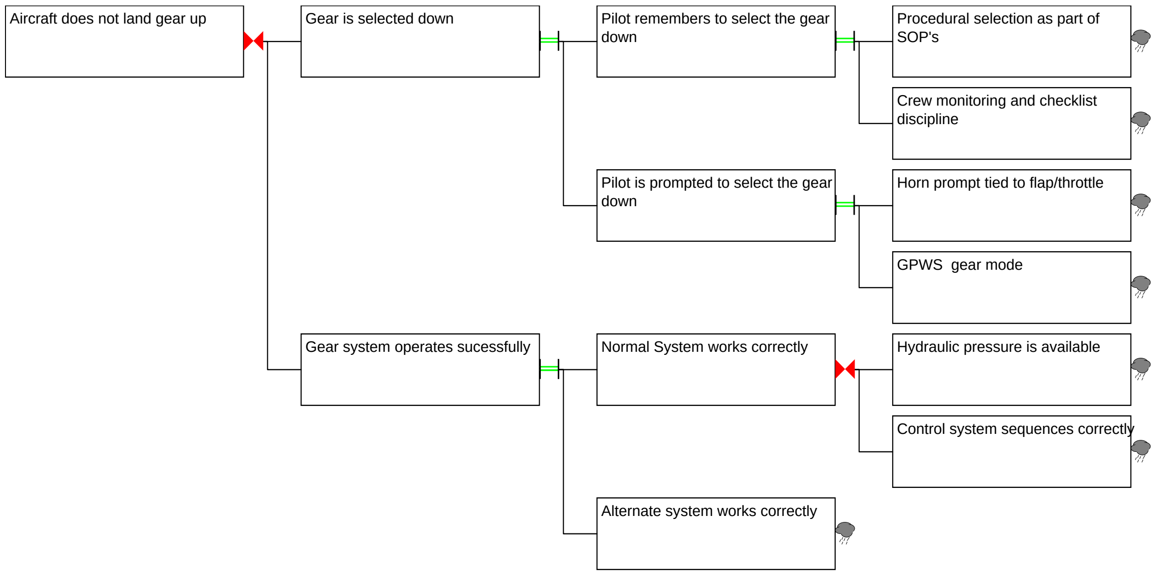


Figure 4 **Dependency Model – Landing Gear**

If failure rates of the individual risk elements on the right of the model are inserted (e.g. Hydraulic pressure to lower the gear may not be available once per 500,000 flights i.e. a failure rate of 2×10^{-6}), the RAT software will calculate the risk that the overall objective will fail. It will also indicate where efforts to improve the overall risk will be most effective.

5 Application of the Analysis Results

RAT is available for use by anybody who wishes to do so. However, in practice it is best utilized by an experienced person trained and practiced in its use. This person can act as a facilitator and communicate with the people who hold the knowledge and expertise in the particular field that is being assessed. Captain John Savage acts in this capacity for British Airways Flight Operations who have produced almost two hundred RAT models on a wide variety of subjects, including:

- Security: the effects of fitting an armoured door to the Flight Deck
- B737: the consequences of increasing the recommended maneuvering speeds to accommodate possible rudder malfunction.
- Fire: the possible effects of reduced/withdrawn fire cover at en-route alternate airfields such as North Atlantic ETOPS alternates.
- LAHSO: the risks involved in Land and Hold Short Operations in North America.

Most models are produced to improve flight safety and therefore a strict cost benefit analysis is not appropriate. However some models *are* produced to evaluate the relative safety of proposed new procedures as compared to current procedures. For example a change to the procedure for approaching stands at one of the London Terminals is expected to save US$ ½ million per year whilst maintaining or improving the relative safety. Yet other models have been used to persuade other bodies such as the UK Civil Aviation Authority (the regulator), the BAA (the airport authority), BALPA (the pilots' association) and other departments within British Airways, of the merits of proposed changes to the British Airways operation.