

## HANDIRISK: DEVELOPMENT OF AN EXPERT SYSTEM FOR IMPORT RISK ANALYSIS

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*Cet article présente le développement et l'application de HandiRISK, un programme informatique pour l'analyse quantitative et qualitative du risque. HandiRISK pourrait aider de nombreux pays dans la production économique d'analyses de risque transparentes, reproductibles et valides sur le plan méthodologique, et dont les facilités d'analyse de sensibilité et de scénario permettraient la réalisation de stratégies de gestion du risque plus efficaces. Il est également souhaitable que HandiRISK puisse assurer l'absence d'approches divergentes et incompatibles avec les règles commerciales internationales pouvant provoquer un conflit avec l'Organisation Mondiale du Commerce. HandiRISK est actuellement développé en parallèle avec une revue internationale d'analyse de risque. Les modèles génériques employés dans HandiRISK sont issus de cette revue et ont été discutés par un personnel technique et vétérinaire. HandiRISK a été conçu sous forme de modules dont les premiers prototypes ont été appliqués sur du matériel génétique. Le système pourra être étendu ultérieurement et les modèles pourront inclure d'autres produits animaux, animaux vivants, vaccins et données biologiques. Un prototype fonctionnel complet sera démontré lors de cette présentation.*

### INTRODUCTION

With the signing of the Uruguay round of the General Agreement on Trade and Tariffs (GATT) and the formation of the World Trade Organisation (WTO), the only remaining legitimate non-tariff trade barrier to the movement of animals and animal products is the application of the Sanitary and Phytosanitary (SPS) Measures. Within Article 5 of this agreement it is stated that "Members shall ensure that their SPS Measures are based upon an assessment, as appropriate to the circumstances, of the risks to human, animal or plant health ...". In support of this, a booklet produced by the WTO Secretariat and titled *Understanding the World Trade Organisation Agreement on Sanitary and Phytosanitary Measures* states that "... (WTO member) Countries must establish SPS Measures on the basis of an appropriate assessment of the actual risks involved." and that "... the SPS agreement encourages the wider use of systematic risk assessment among all WTO member countries and for all relevant products.". While this philosophy represents a healthy shift toward trade decisions based on risk assessment rather than risk avoidance, there are notable constraints to its practical application. The foremost of these is the difficulty encountered by many countries in regard to the availability of either monetary resources or persons with the specific skills that are needed to conduct valid risk assessments (particularly where these are of a quantitative nature). A second significant concern is the current lack of sufficient guidelines or international standards and, once again, the problem is more serious for those contemplating quantitative analyses.

Quantitative risk assessment has recently received a great deal of attention in the animal health field and, where the nature of the commodity and availability of data make it a feasible proposition, is strongly encouraged as a structured, transparent and objective means of investigating and communicating the residual risk associated with disease protection strategies. Advances in the accessibility of Monte Carlo simulation have led to the advent of stochastic quantitative models in which both natural variation and inherent uncertainty may be represented. These simulation tools or add-ins may also be used to conduct sensitivity analyses (such that the importance of a particular stage in an import procedure may be assessed) and to generate graphical and tabular outputs that greatly enhance an analyst's ability to communicate both the size of import risks and their behaviour.

### THE HANDIRISK PROJECT

#### **Objectives**

The principal objective of this project is to construct an expert-system-based application (HandiRISK) that will overcome the logistic problems facing importing countries by providing a rapid and efficient means of conducting technically valid quantitative and qualitative risk assessments. HandiRISK assessments will be completely transparent and it is hoped that the models on which they are based may be adopted by the major trading organisations as international standards.

HandiRISK is being designed as a stand-alone program which will walk the user sequentially through a risk assessment. The assessments generated by HandiRISK may be either quantitative or qualitative, and may be based on flexible generic models from the program's knowledge base or on models constructed by the user from a set of tools within the program. Generic models will be derived from a review of quantitative risk assessments and will have been reviewed and critiqued by an international panel of referees.

#### **Interface**

The first stage of any HandiRISK analysis will involve characterising the assessment with regard to the exporting country or region, the purpose of the import and the animal species and commodity. Once these have

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been formalised, the user may utilise a link to the OIE database program HandiSTATUS in order to generate a list of potential disease-causing agents. A separate assessment will be conducted for each agent, and each may be quantitative or qualitative.

If a *quantitative generic* assessment is requested, the user will be prompted through an interactive series of windows to supply relevant data or distributions and to specify or choose from a range of risk management strategies (eg testing protocols). Once a quantitative model has been completed, the user will be given the opportunity to request a sensitivity analysis and to enter the appropriate simulation characteristics. The model may then be stored or run. Where the user opts for a *qualitative generic* assessment, HandiRISK will again generate a series of windows relating to the stages in the particular importation except that, in contrast to quantitative approach, he or she will only be required to select appropriate risk-management strategies. Once completed the qualitative model may be stored or viewed as an interactive decision tree or influence diagram (see below).

While the validity of the flexible generic models incorporated into HandiRISK will be internationally recognised, it is expected that some users may wish to construct their own, or consider variations on those generated by the program. To meet this end, a series of 'tools' will be incorporated into HandiRISK to enable users with limited mathematical experience to assemble technically correct models and incorporate advanced features such as the bibliographic referencing for data. Where the user elects to construct their own *quantitative* assessments, he or she will be prompted through a theoretically infinite series of design windows, each of which will contain fields to identify the relevant stage in the import and any probabilities associated with it. The user will also be given the opportunity to specify whether each window represents a fixed stage in the assessment or a *decision* to opt for a particular risk management strategy (for example quarantine). Where the latter is indicated, the user will then be asked to specify alternative strategies and to save these into empty models. By constructing an assessment in this fashion, the user will be able to rapidly generate a large number of models and, therefore, efficiently examine the efficacy of a range of risk management strategies.

### **Outputs**

Outputs generated by HandiRISK are designed to facilitate risk communication and provide a transparent base for policy negotiation. Graphical outputs include probability and cumulative density functions, tornado graphs and interactive decision trees and influence diagrams. Each of these are valuable as a means of intuitively conveying the results of a risk assessment and enabling decision makers to act with the maximum possible information. The most fundamental tabular output will be a comprehensive report which lists all inputs, outputs and algorithms implicit to the model constructed. This report is designed to facilitate the WTO condition of transparency and, while exhaustive and therefore quite bulky, may be used as a reference in policy negotiation. The second tabular output generated by HandiRISK is a summary report, which simply lists the models examined in an analysis and, where quantitative, gives summary statistics for each. The summary report will have a sortable format and, as such, large numbers of alternative models may be re-arranged in order to determine those that provide adequate protection.

*Development:* HandiRISK is being developed iteratively through a sequence of prototypes. The first of these, a hard-coded non-operational model, was demonstrated in Switzerland in 1996 at a meeting of animal health risk analysts. The second and current prototype is based on modifications suggested both by this audience and an international body of technical referees. The second prototype, while restricted by a knowledge base containing only models for genetic material, is a fully functional expert system which will serve to demonstrate the functionality intended in future models and provide a means by which various aspects of architectural design and implementation may be explored. This prototype will contain fully functional data entry and output features and will use either a purpose-built simulation tool or a link to a commercial package to conduct assessments. The prototype will not contain features for either qualitative or user-defined assessments as these are considered refinements best added to a successfully implemented design base. This prototype will be available for demonstration during ISVEE 1997 by arrangement with the first author. It is hoped that comments gathered during this conference and through a panel of referees may be incorporated into the first 'complete' prototype of HandiRISK. This is scheduled for circulation and appraisal in mid 1998.

### **CONCLUSIONS**

With recent changes in the structure and philosophy governing international trade in animals and animal products risk assessment, and particularly quantitative risk assessment, has become an important addition to veterinary epidemiology. In many countries, however, constraints produced by a lack of both resources and sufficient international guidelines have meant that risk assessments for importations are seldom feasible. HandiRISK is a flexible expert system-based software application designed to circumvent these difficulties. HandiRISK will produce both quantitative and qualitative assessments based either on extensively refereed and internationally recognised standards, or on models specified by the user. The outputs of HandiRISK are designed to facilitate risk-communication and to satisfy WTO requirements for transparency. HandiRISK is being developed iteratively as a series of prototypes, the second of which is available for demonstration by appointment with the first author.