Chapter 9
E-CAT User Interface Tool

This chapter introduces the design of the E-CAT user interface tool. The tool is based on Excel with Visual Basic for Applications (VBA). Three different economic consequence options are developed for each type of threat, including a point estimate (Option 1), interval estimate (Option 2) and uncertainty distribution (Option 3). Step-by-step instructions are presented in the User's Guide in Appendix A.

The conceptual framework of the E-CAT user interface tool is illustrated in Fig. 9.1. The analytical function of E-CAT is structured in four layers. The master user interface is designed in layer 1, which functions as the gate for various options. The different user options are designed in layer 2, which functions as the major platform for both data input and output visualization. User input information is translated from contextual format into numerical format and is then calculated based on the corresponding reduced-form coefficients stored in layer 4. User Option 3 differs from Option 1 and 2 in that an additional step for Latin-hypercube sampling (LHS) procedure is added in layer 3 to present the output uncertainty in various forms of probability distribution.

One of the fundamental objectives of E-CAT user interface development is to achieve a user-friendly design. This requires the following considerations:

1. To make the interface page as concise as possible, but to maintain its functionalities as comprehensive as possible
2. To have the internal modeling mechanism operating as smoothly as possible with minimum computational source consumption
3. To make the interface tool as compatible as possible so that users with little knowledge of software installation can operate it
4. To make the functionalities as clear as possible in providing instruction to guide operation.

The designs of the various functional pages of E-CAT are introduced as follows. The master user interface page, as illustrated in Fig. 9.2, is designed for the user to specify the types of threat and option of output estimation. The current version of E-CAT is able to conduct economic consequence analysis for the following types

A. Rose et al., *Economic Consequence Analysis of Disasters*, Integrated Disaster Risk Management, DOI 10.1007/978-981-10-2567-9_9

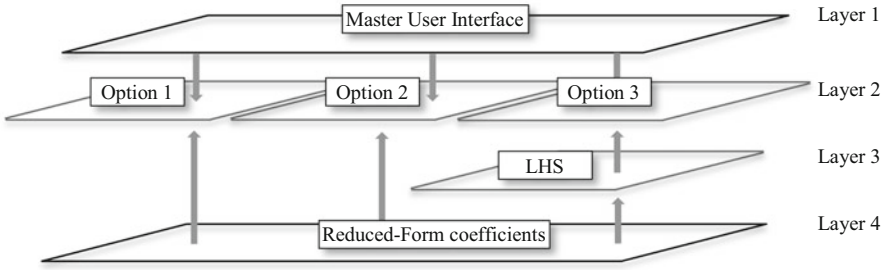

Fig. 9.1 E-CAT user interface tool structure design

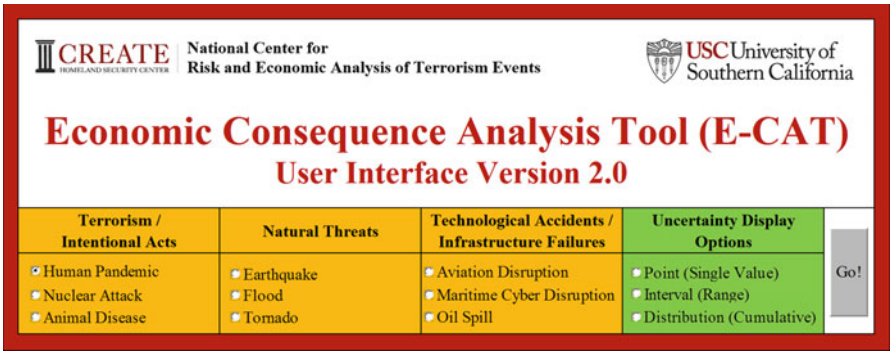

Fig. 9.2 E-CAT user interface for threat type and option selection

of threats: human pandemic, nuclear attack, animal disease, earthquake, flood, aviation system disruption, maritime cyber disruption and an oil spill. Three output estimation options are provided for each one. The Tool is designed to be user-friendly. For instance, when a user specifies the type of threat as "human pandemic" and the output option type as "point estimate", a point estimate page as illustrated in Fig. 9.3 is presented automatically. After the consequence analysis, the user can return to the main menu to select another threat or a different estimation option by clicking the "Main Menu" button on the top right of each option page. All results can be printed automatically by clicking the "Print Results" button. In addition, a "Reset Default" button is designed for the user to reset all the settings to default values.

The point estimate results (Fig. 9.3) allow the user to calculate economic consequences of a selected threat type in terms of GDP and employment losses based on a single magnitude input variable with combinations of other user input variables, such as "time of day", "duration", "resilience", "location", and etc. The user input area is highlighted in yellow, whereas grey boxes are not applicable for the specified threat type. For instance, in the case of Option 1 for the human pandemic scenario, the user is provided with five selection options in terms of magnitude, duration, behavioral-avoidance, behavioral-aversion and resilience-recapture. The magnitude variable requires an input of numerical value within the given range as suggested, whereas other variables provide various options of

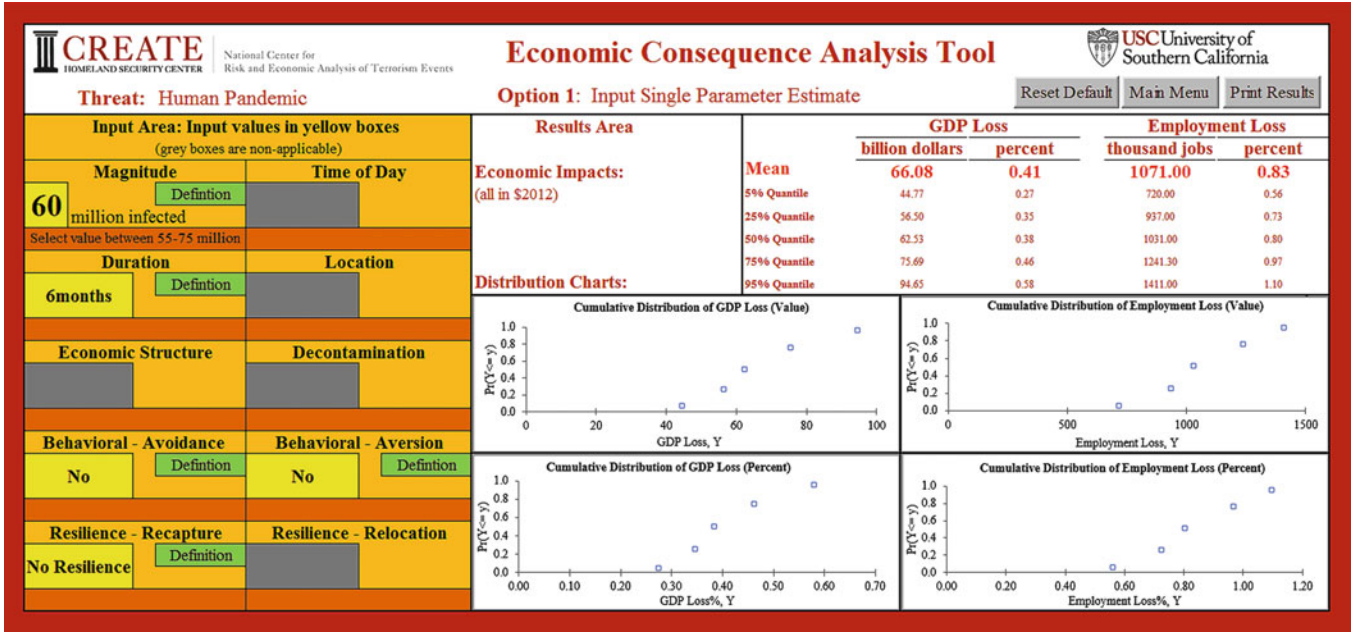

Fig. 9.3 E-CAT user interface option 1 (Human pandemic)

categorical selection from a drop-down list. For instance, the "time of day" variable allows the user to choose either a daytime or a nighttime option. The "duration" variable allows the user to choose either a 6-month period or a 9-month period. The "resilience" variable provides the user with three options: no resilience, lower-bound resilience and upper-bound resilience, whereas the two variables denoting behavioral effects only provide a "Yes or No" option for the user. Any change of an input variable would lead to an immediate update of results presented in the white color area. Outputs are presented in both numerical terms and cumulative distribution graphs. The numerical outputs of the mean estimates and estimates at various quantile levels are presented in both level change and percent change, respectively.

As shown in Fig. 9.3, without considering behavioral effects and resilience, in a human pandemic scenario where 60 million people are infected during a 6-month period, the mean GDP loss is $66.08 billion dollars, which is around a 0.405 % decline in the U.S. national GDP, with a mean employment loss is 1071 thousand jobs, which is equivalent to a 0.834 % reduction in jobs nationally. Behavioral effects in terms of avoidance and aversion, and resilience in terms of production recapture could have substantially altered the bottom-line. For instance, the mean estimate of GDP loss is amplified significantly to $79.88 billions of dollars if the behavioral-avoidance option is switched on in this case. However, if lower-bound resilience-recapture is selected, the mean estimate of GDP loss then reduces to $55.33 billion dollars. If an upper-bound resilience-recapture is selected, the mean estimate of GDP loss then reduces to $35.76 billion dollars.

Option 2 of the E-CAT user interface provides interval estimates (Fig. 9.4), which allows the user to calculate economic consequences of a selected threat in terms of GDP and employment losses based on the given range of magnitude, together with other user input variables. The key difference between Option 1 and 2 is that the latter option allows the user to specify both lower- and an upper-bound values of magnitude, with the capability to interact with other user input variables. Economic consequences are updated automatically in the output area once an input specification is changed. The interface design of Option 2 is the same as Option 1. The user input area is highlighted in the yellow boxes, whereas grey boxes are not applicable for the specified threat type. In the case of Option 2 for the human pandemic scenario, the user is provided with input options in terms of magnitude, duration, behavioral-avoidance, behavioral-aversion and resilience-recapture. After all inputs are specified, the results are presented in the white color area, which includes both numerical values and cumulative distribution charts for both GDP loss and employment loss, by value and percent, respectively.

The uncertainty distribution estimate as illustrated in Fig. 9.5 provides the user with an option to calculate GDP and employment losses based on a triangular distribution of the magnitude inputs, with interactions from other user input variables. In this option, the user is able to specify the magnitude values in terms of lower, middle and upper bounds. In addition, the user could also specify attributes, such as duration, behavioral-avoidance, behavioral-aversion and resilience-recapture. Numerical estimates of GDP and employment losses are displayed automatically in the output area. In addition, the cumulative frequency distribution charts and the relative frequency distribution charts of the mean estimates of GDP and employment losses are updated automatically.

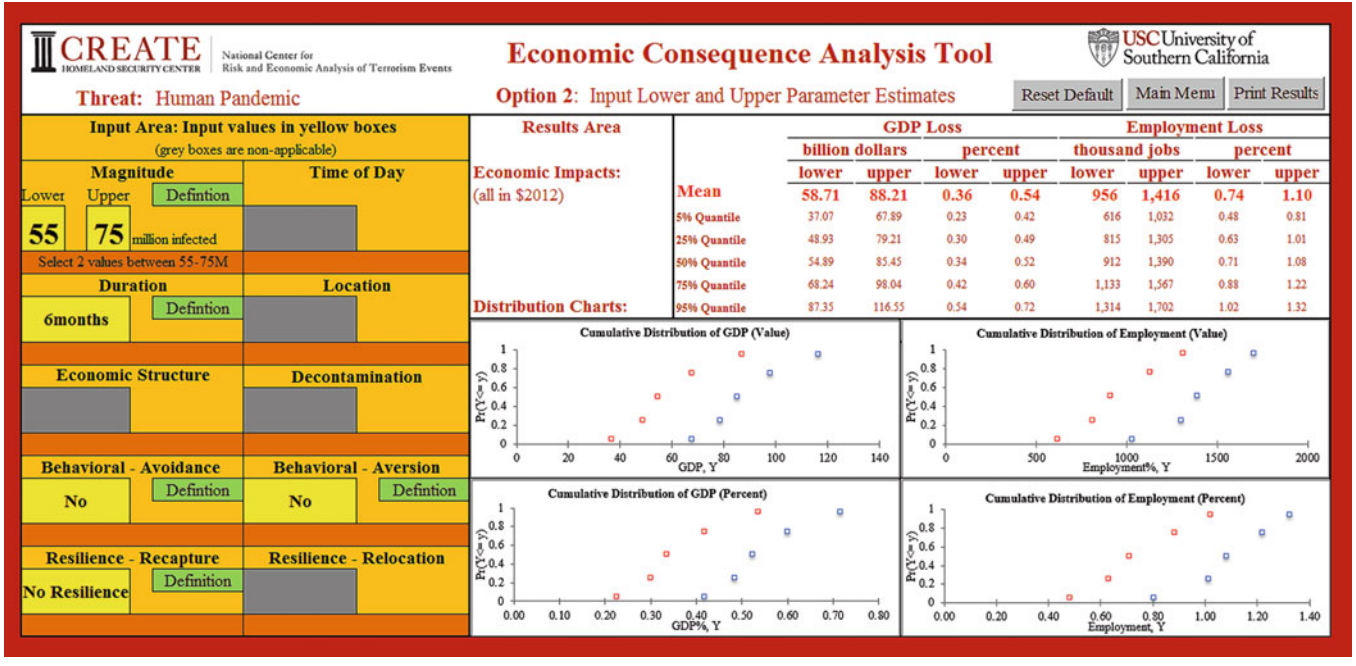

Fig. 9.4 E-CAT user interface option 2 (Human pandemic)

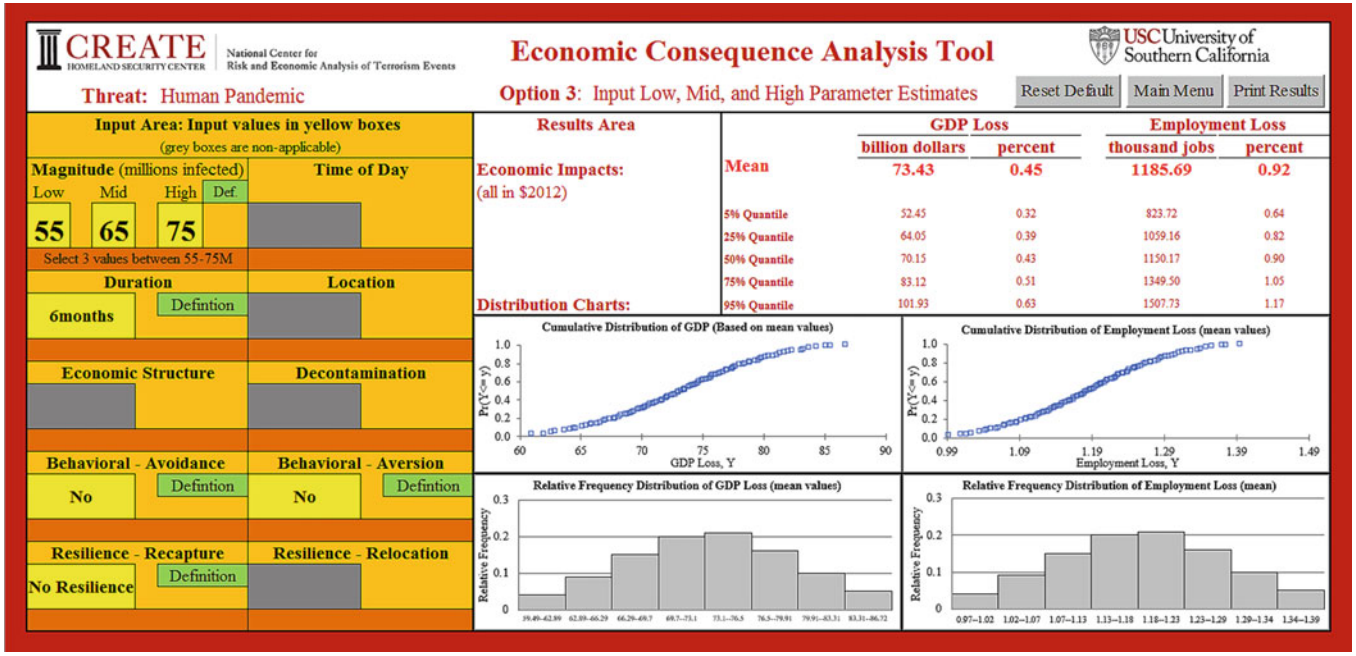

Fig. 9.5 E-CAT user interface option 3 (Human pandemic)