1 Appendix

During preparations for the 2020 CPS Research Symposium the question was posed by an industry member if there was a plan to make the Sampling-Risk model (described in ***CPS Final Report - Hartnett***) available to industry and others, for example in the form of an app-type product. The intention would be to enable industry to perform their own analyses independently for the specific parameters of interest to them. This was not part of the initial project plan and was not incorporated into the timeline or budget. However, the opportunity arose to explore this idea in a proof-of-concept manner. *The specific task is to develop a first "proof of concept" of an application or tool for the industry to use to do analyses themselves. This will be developed in Analytica (the software used to develop the tool) to show possible functionality, and a summary appendix for the project report will describe the "proof-of- concept" tool.* There are two goals:

- to prove that the Analytica model can be adjusted to allow for a non-expert user to interact with the model and perform calculations—this will be achieved by developing a user interface that avoids the need to understand the underlying complexities of the mathematical calculations and software implementation
- to prove that the types of user interactions developed in Analytica can be brought to an app-type environment

This appendix summarises the findings.

1.1 User interface development

To enable user interaction with the Sampling-Risk model, we developed a user interface that provides the ability to conduct the types of analyses described in the ***Final Report***. To provide a useful tool to be used by industry (and others) the capabilities of the Sampling-Risk model were expanded, and user controls were developed for the interface. Specific expansions developed to explore the feasibility of transforming the Sampling-Risk model into a tool to be used by others were:

- ability to select any combination of the process steps to explore the role of the location of sampling,
- ability to select any combination of the pre-defined log reduction options to compare the impact in risk reduction from sampling ('No Reduction' is included as an option),
- providing the option to include a user-defined custom log reduction for a decrease step, and the option to include/exclude this custom input,
- ability to include or exclude pathogen growth, and to choose the temperature.

These expansions provide flexibility beyond a fixed list of inputs as used to demonstrate the relationships between sampling and risk presented in the ***Final Report***. These expansions demonstrate that the tool can be enhanced with additional flexibility that would allow industry to better reflect their particular circumstances in terms of how their processing situation may affect the pathogens present. The interface itself is shown in **Figure A1**. The interface was built to reflect an app-type process consisting of three sequential pages.

Page 1 is the front page with a basic introduction (that can be readily adjusted) and the initial inputs needed to define the specific sampling plan variables. Page 2 provides options to select the location(s) of sampling to be analysed and compared, the features of processing including the magnitude of a

reduction step (if included), and the choice to include pathogen growth in the calculations with the temperature for growth specified. Page 3 shows the results provided as a graph in the same layout as throughout the analyses in the ***Final Report***. Next and Back buttons were developed to provide navigation between the pages, and a Help button was developed to provide capacity for instructions, glossary, or other useful user support information.

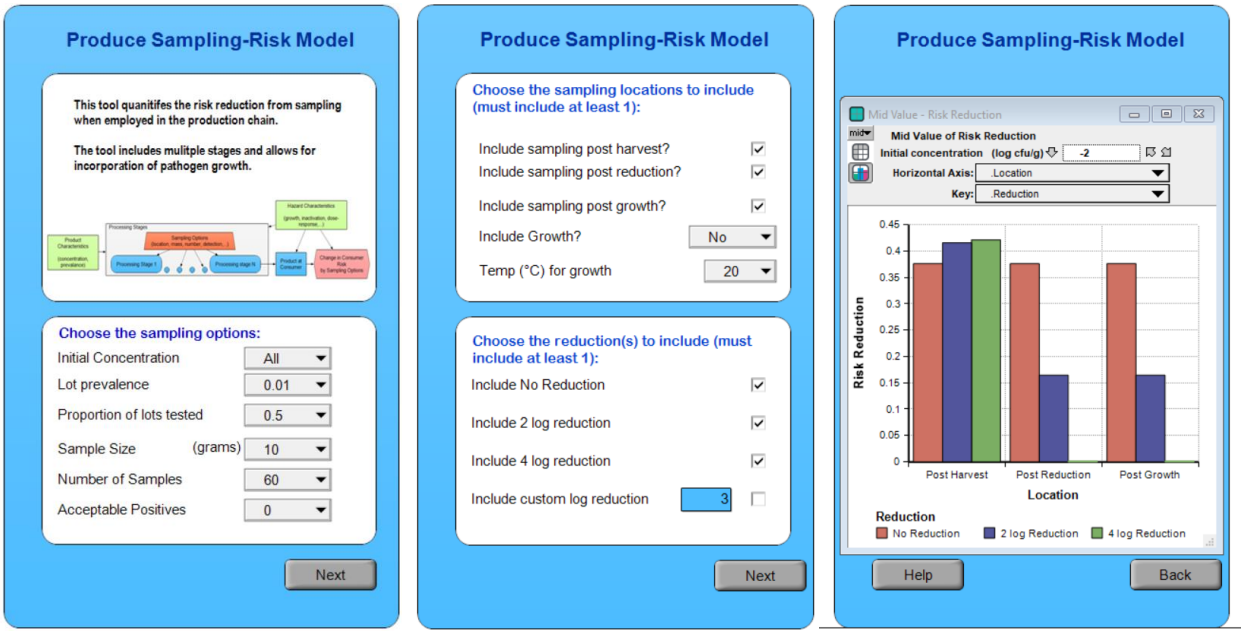
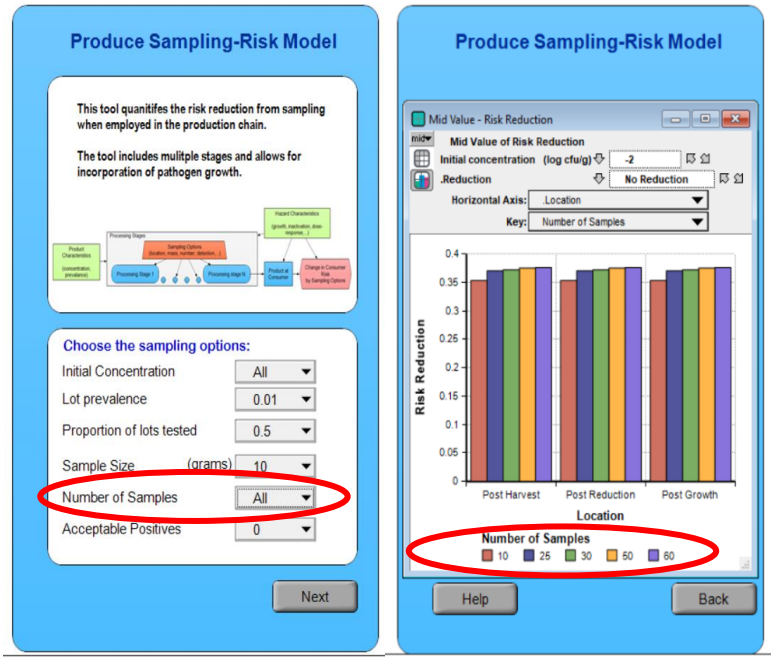


Figure A1: Screenshots of the three pages of the user interface for the Sampling-Risk tool within the Analytica software.



In the example in **Figure A2** (left), the user input for the number of samples has been adjusted to "All" which means that all of the options in the dropdown box are calculated in parallel. This change is then reflected in the results graph with different coloured bars for each number of samples run through the calculation.

Figure A2: Illustration of the capacity to make alternative selections on the user interface.

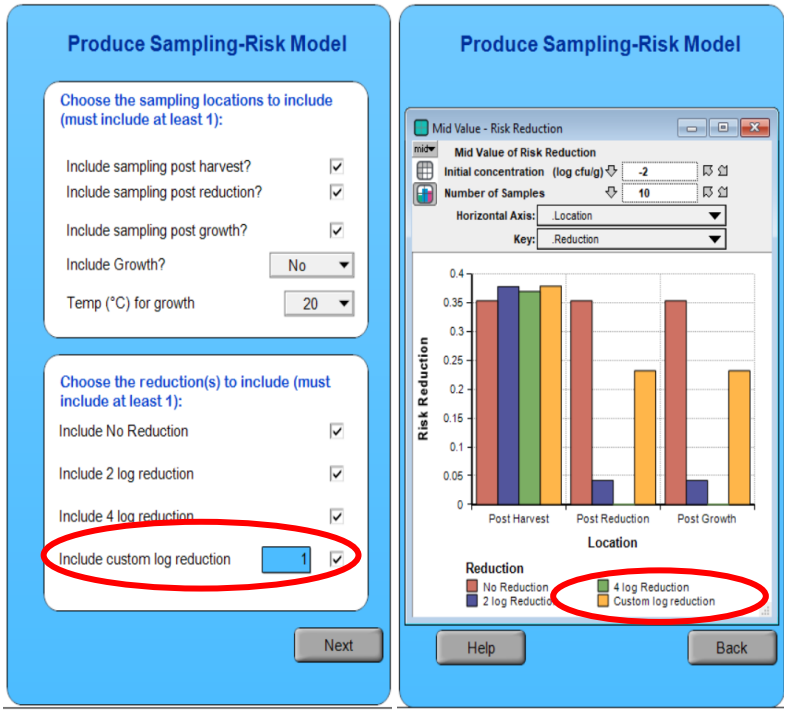


Figure A3: Illustration of the custom log reduction feature.

In the example in **Figure A3** (left), the custom log reduction feature is demonstrated. A log reduction of 1 is added to the analysis (the magnitude is entered by the user). This calculation is conducted in parallel with the other selected reductions, and the result is added to the graph (yellow bar).

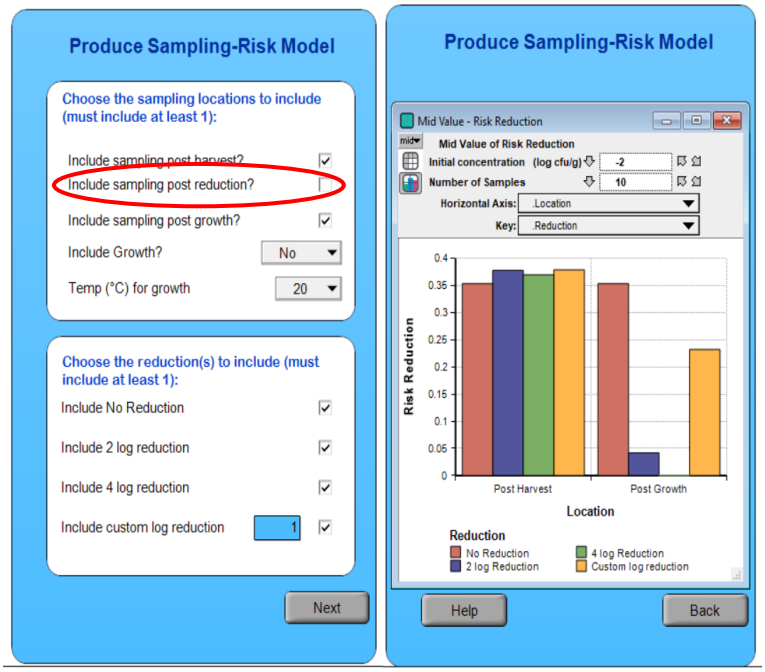


Figure A4: Illustration of the capacity to select which sampling locations are included in the analysis.

In the example in **Figure A4** (left), the ability to select which location(s) to assess (and compare) is shown. In the example the sampling post reduction step is removed from the analysis by unchecking the box. With this action, Post Reduction values are not shown in the results. This example also shows the inclusion of the custom log reduction, illustrating that multiple customisations can be selected at the same time.

1.2 Proving the tool with user interaction can be developed in a more app-focussed environment

The proof-of-concept user interface described in Section 1.1 was contained within the original modelling software Analytica and developed to demonstrate that a user could achieve meaningful interaction with the tool and be able to perform similar calculations as described in the ***Final Report*** without the need to make adjustments to the model itself.

To further prove out the idea of a user-focused app, we need to determine if the types of relationships we are able to determine within Analytica can also be described in a platform designed for app development. This was not immediately clear, as Analytica has a very powerful capacity for handling the multidimensional data that the Sampling-Risk model generates (as a result of considering multiple scenarios in parallel). This capacity allows users to explore many relationships at the same time (for example, Figure A4 examines both the relationship with sampling location and log reduction in the same single graphic). This power is the reasoning behind selection of Analytica as the modelling tool of choice for the Sampling-Risk model. However, it would not be the first choice for app development (nor is it intended to be by design). We therefore explored if the types of relationships being generated could be provided to the user in a similar manner using platforms intended for app-type products. To do this we utilised R, which has both modelling capacity and a specific developer environment Shiny that focusses on development of user interfaces for statistical tools to be used by others.

The available time and budget did not allow a re-implementation of the Sampling-Risk model within R, so to test the analysis capacity summary results data was extracted from the Analytica file and used as the basis for exploration. This is sufficient to meet the needs of the task.

A user interface was developed using R-Shiny that can be shown in a browser, as shown in Figure A5. The interface includes responsive design and therefore automatically re-sizes to the screen. The tool is responsive to changes in input selections by the user, enabling options to be explored rapidly. This is illustrated in Figure A6, which shows the ability to change the sampling locations that are included in the analysis.

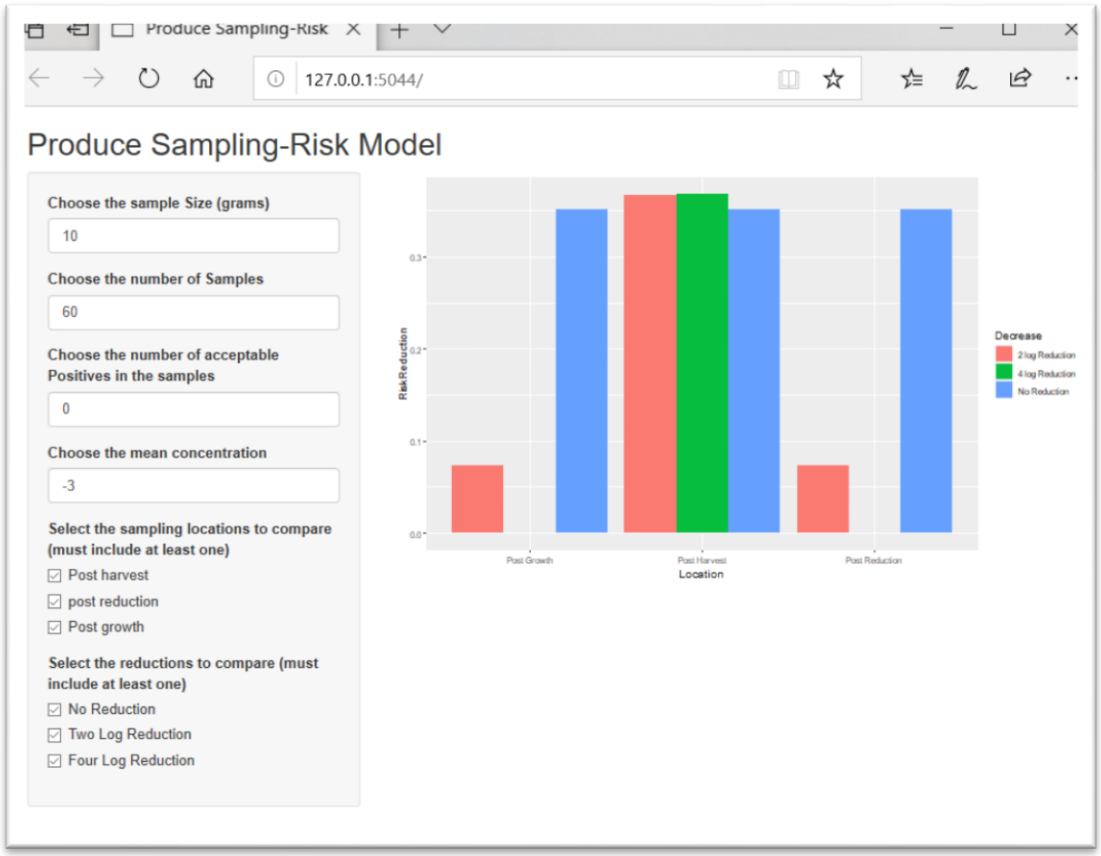


Figure A5: Screenshot of the tool interface as displayed on a browser. As selections are made, the results presented in the graph are updated. See, for example, Figure A6. (Note that at this time, sample size, number of samples, and number of acceptable positives is for display only; all other inputs are 'live' and will adjust the graph when different selections are made).

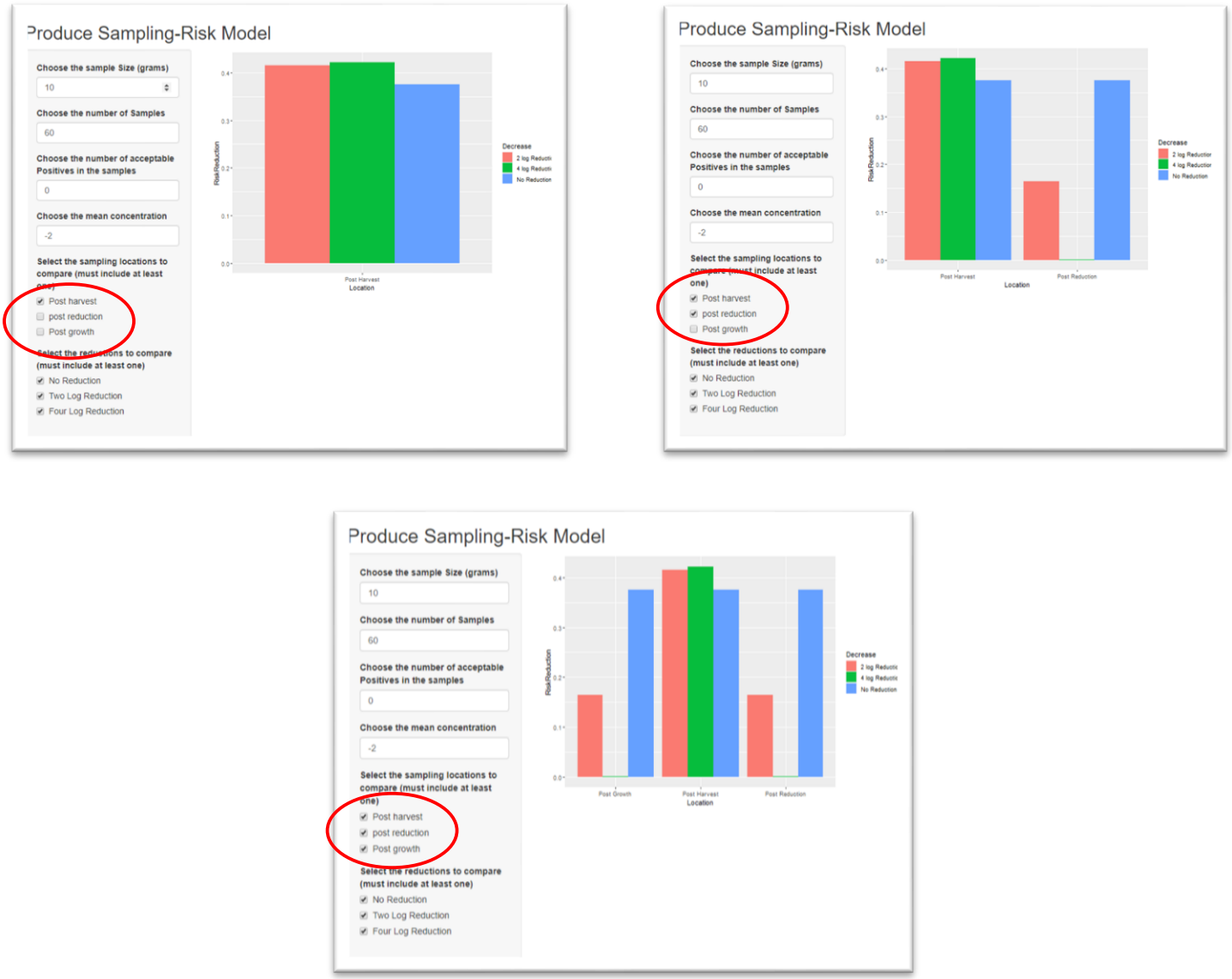


Figure A6: Illustration of the capacity to select which sampling locations are included in the analysis.

1.3 Key findings

An early proof-of-concept interface has been developed that demonstrates the feasibility of further expansion of the Sampling-Risk model to an app-type product that enables industry to independently explore the relationship between sampling and consumer risk.

1.4 Next steps

It has been demonstrated that an app-type tool is feasible and could be a reasonable next step for this work. A key choice would be the exact platform, with the following requirements:

- the core mathematical functionality of the Sampling-Risk model must be reproducible in the environment selected,
- provides compatibility with a range of platforms likely to be used by industry (iOS, Windows, Android etc.),
- ideally provides future sustainability of the tool (for example, it should not be reliant upon software that may become obsolete in the next 2 or 5 years).

The overall process would require sufficient time/budget to allow for implementation of the model within the app environment in addition to the coding of the interface itself. Ideally, a consultation process would be undertaken to establish if there are additional features/capabilities that would be useful to industry to ensure the final product would be useful in risk management activities. A pilot-test process should also be undertaken to ensure stability and usability of the system.