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D3.3 - CYBER RISK MODELLING TOOL

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1 Introduction

1.1 Purpose and Scope

D3.3 is defined as a demonstrator in the WISER Description of Action. This demonstrator consists of three software tools that have been carefully selected by the consortium in order to serve a specific purpose in the WISER framework.

In addition to providing the software tools, we find it useful to document the deliverable in the form of a written report, which is this document. The purpose here is to do the following:

- Describe the role of the risk modelling tools in WISER.
- Give a brief overview of each tool, as well as licencing information.
- Provide links to detailed descriptions and instructions for each tool.
- Provide links to sites from which the tools can be downloaded.
- Explain the interaction between the tools and the overall WISER framework.

Each of the three tools is an editor supporting one of the modelling languages selected for WISER modelling. The languages are CORAS [2], DEXi [1], and R [3]. The characteristics of these languages, the criteria for selecting them, the guidelines for their use in the context of WISER, as well as the role of these languages in the overall WISER methodology, is described in D3.2. Here in D3.3 we focus only on the actual editors, and the way they are employed within the WISER framework.

The CORAS editor offered by WISER is developed by SINTEF. It extends a version of the CORAS tool developed independently of WISER, as further explained in Section 3. The DEXi editor and the R editor, on the other hand, are both developed outside of the WISER project without involvement of the consortium members.

As further explained in Section 6, the editors should be installed on the local machine of the person doing the modelling. The intention is not to distribute the editors as an integrated part of the WISER package; instead, we provide links to the relevant download sites. This ensures that the editors can be updated independently from the WISER package.

1.2 Relationship to other project outcomes

This deliverable is strongly related to D3.2: Cyber risk modelling languages and guidelines, preliminary version (and by extension, its final version D3.4 due in March 2017). D3.3 should therefore be read in conjunction with D3.2, which offers the motivation for selecting each of the modelling languages, as well as the guidelines for creating models.

In addition, D3.3 is related to the overall framework design documented in D2.3 by providing the details of which modelling tools have been selected for fulfilling the role of the risk modelling implied by the framework design.

1.3 Structure of the document

Having explained the purpose and scope of the document and its relationship to other project outcomes, we structure the rest of this document as follows: In Section 2, we explain the role of the risk modelling tools in WISER. The next three sections then present a brief overview of each of the three tools and provide links to detailed descriptions and instructions, as well as download sites and licence information. We then explain how the tools interact with the overall WISER framework in Section 6, before concluding in Section 7.

2 The role of the risk modelling tools in WISER

The role of the risk modelling tools in WISER is to provide the technical support needed for developing risk models and assessment algorithms. As explained in D3.2, in WISER we employ three different modelling languages, each serving a specific purpose. Hence, we also employ three different tools. Figure 1 shows how the modelling tools support different parts of the overall modelling method presented in D3.2.

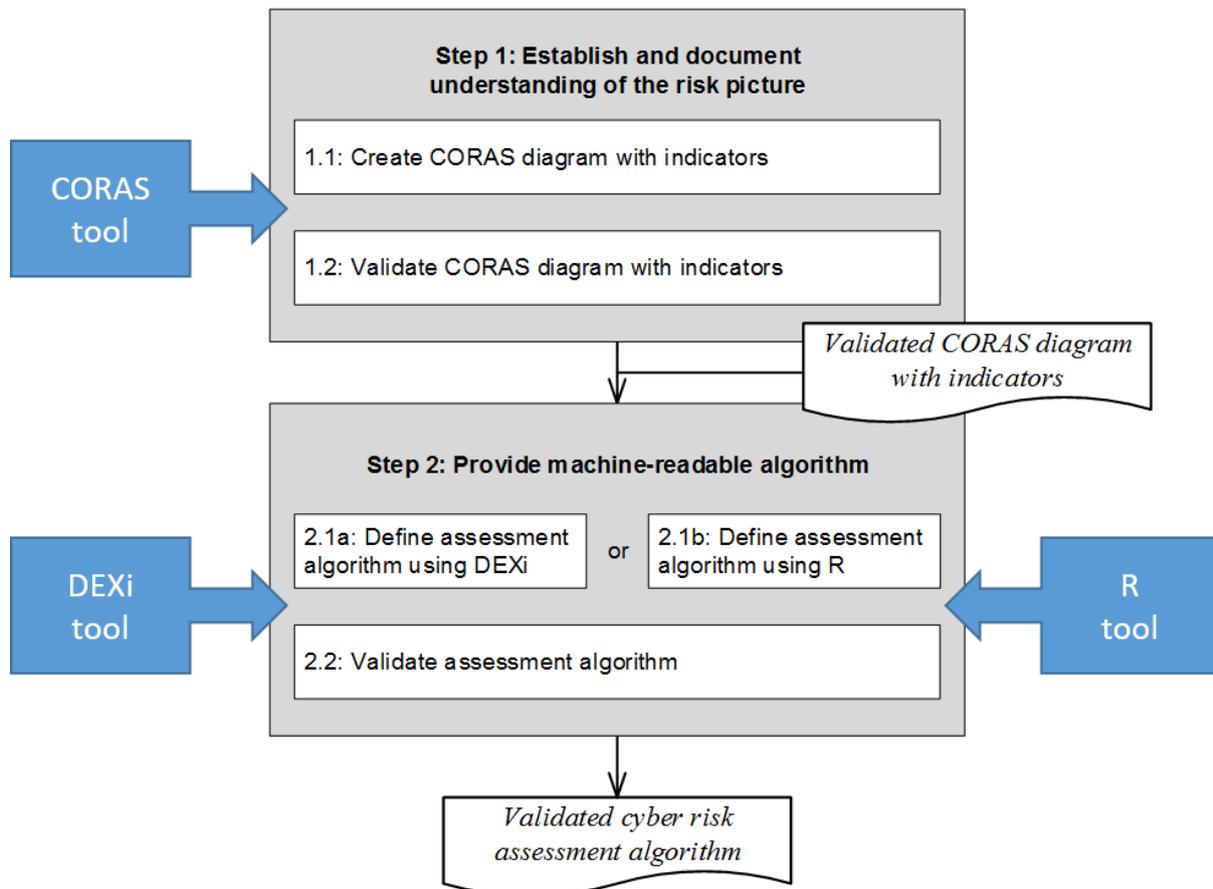


Figure 1 The role of the risk modelling tools

The CORAS tool supports the creation of CORAS diagrams in Step 1. CORAS diagrams are used to document and convey an understanding of how risks may materialize among human actors. CORAS models are not meant to be executed by the Risk Assessment Engine or any other part of the WISER framework. Hence, the sole purpose of the CORAS tool is to provide the editor functionality allowing users to draw and view CORAS diagrams with relevant indicators attached. Recall that indicator values represent up-to-date information collected from the business configuration, vulnerability testing, network layer monitoring and application layer monitoring that serve as input for the Risk Assessment Engine. This is further explained in D2.3 (in particular sections 5.2 and 6.2), D5.1 (in particular Section 3) and D3.1 (in particular Section 6). We present the CORAS tool in Section 3.

The DEXi tool supports qualitative modelling in Step 2. Unlike CORAS models, DEXi models are meant to be executed. More specifically, they are executed by the Risk Assessment Engine during runtime in order to obtain up-to-date risk level assessments based on the latest indicator values. Being able to execute a model during development and validation is therefore highly useful. The DEXi tool offers functionality for model execution, as well as editor functionality for creating and viewing DEXi models. We present the DEXi tool in Section 4.

The **R** tool supports quantitative modelling in Step 2. As is the case for DEXi models, **R** models will be executed during runtime.

3 The CORAS tool

3.1 Overview of the tool

Figure 2 shows a screen shot of the CORAS tool with the WISER extension for indicators¹. The middle part shows the pane where the diagrams are drawn. In this particular diagram, there are two indicators: one network layer indicator (yellow) and one test result indicator (green). On the left-hand side is the palette, from where the user can drag and drop model elements. On the upper right-hand side is an outline of the complete diagram, which is useful for large models, while on the lower right-hand side shows a list of all diagrams in the model.

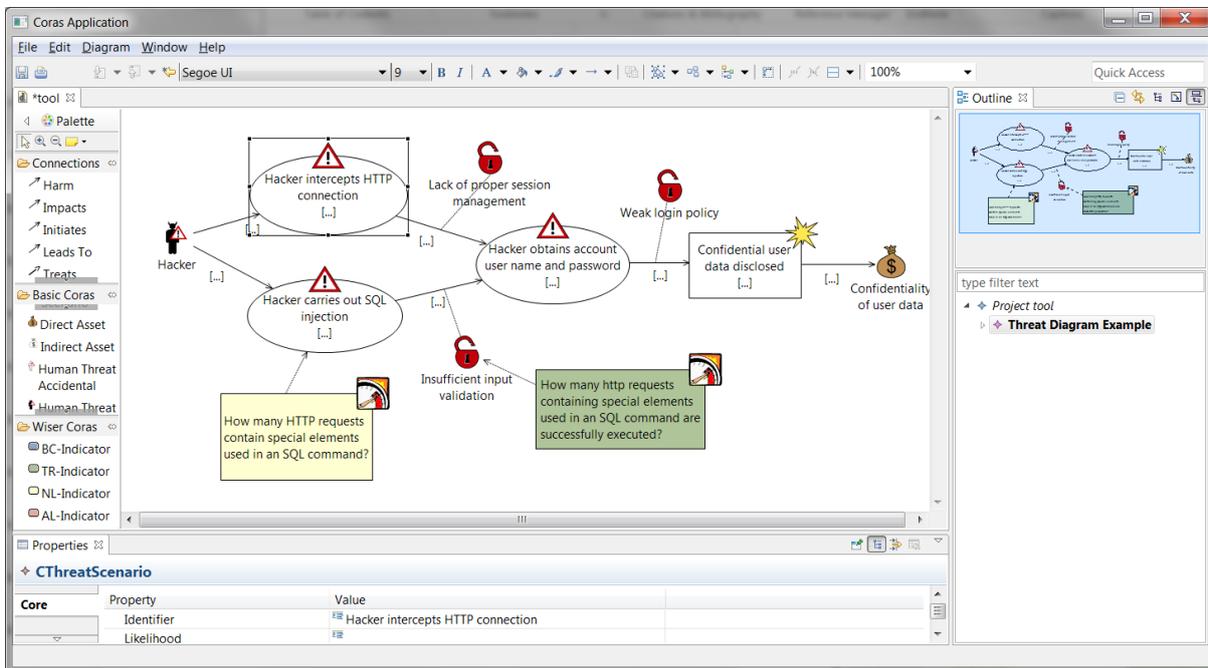


Figure 2 Screen shot of the CORAS tool

3.2 Downloads and instructions

- The general CORAS tool (without special support for indicators) can be freely downloaded from <http://coras.sourceforge.net/downloads.html> (accessed 22/5-2016). The extended version will be made available from the WISER web page <http://www.cyberwiser.eu/> by the end of June 2016.
- Instructions for the CORAS tool can be found at http://coras.sourceforge.net/coras_tool.html (accessed 22/5-2016).
- A list of CORAS-related publications can be found at http://coras.sourceforge.net/online_documentation.html (accessed 22/5-2016). The most

¹ Notice that in D3.1 and D3.2, the indicators look slightly different. The reason is that a temporary solution for drawing them was used, since the indicator support had not yet been implemented in the CORAS tool when the diagrams were developed.

extensive source, covering the full CORAS method and language as well as the tool is the CORAS book [2].

3.3 Licence

As shown by Figure 3, the CORAS tool is made available under the terms of the Eclipse Public Licence v1.0.

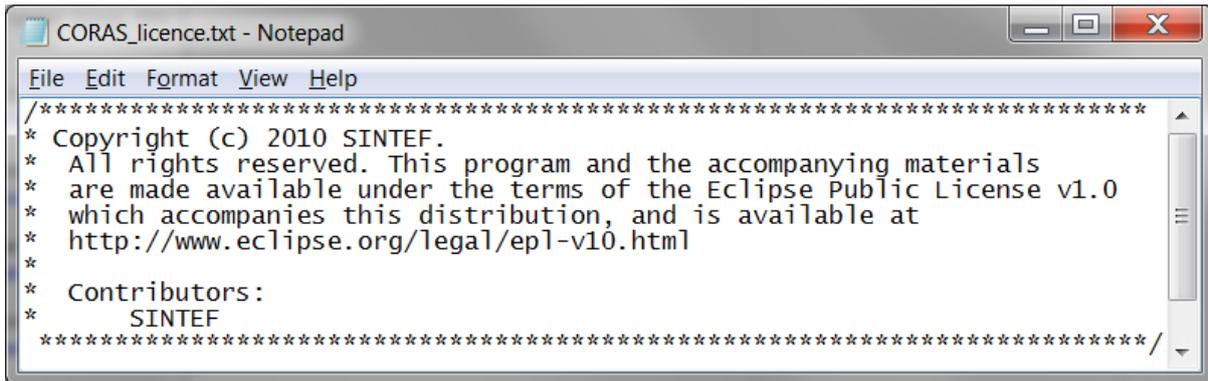


Figure 3 CORAS licence information

4 The DEXi tool

4.1 Overview of the tool

Figure 4 shows a screen shot of the DEXi tool with the Model tab selected. This part of the tool is used for creating a model. The model structure is defined in pane on the left-hand side, while further descriptions of nodes, scales and utility functions are defined on the right-hand side.

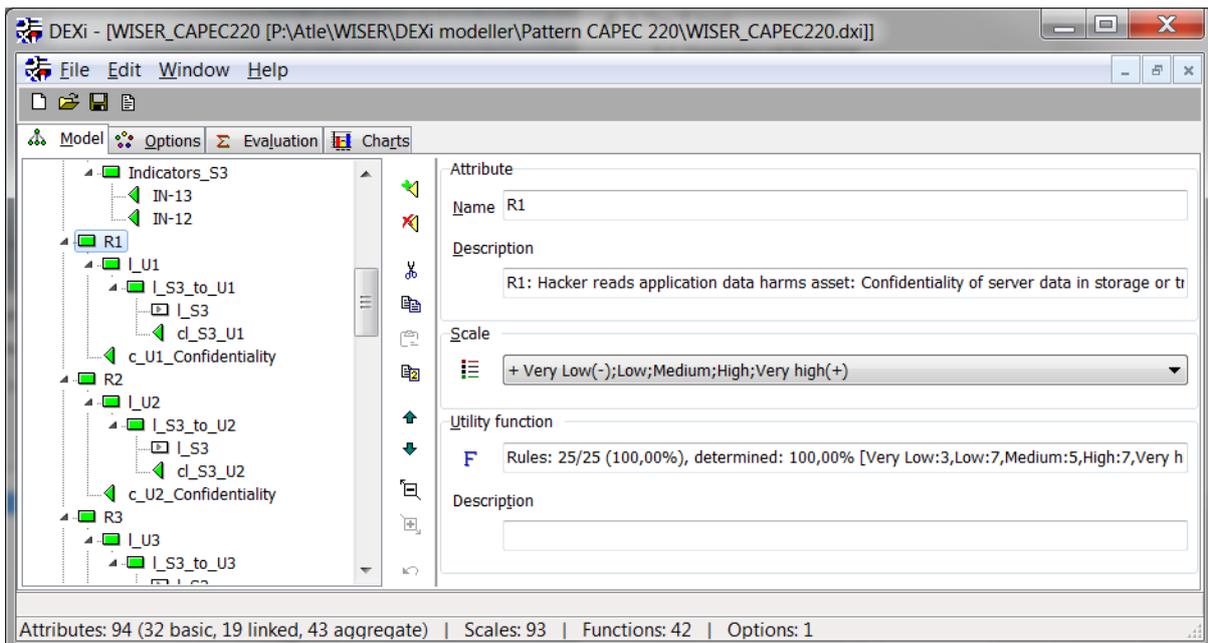


Figure 4 Screen shot of the DEXi tool (Model tab selected)

Figure 5 shows a screen shot of the DEXi tool with the Options tab selected. This part of the tool allows the user to define sets of values (called options) for all the leaf nodes, in other words to define possible input sets for the assessment algorithm.

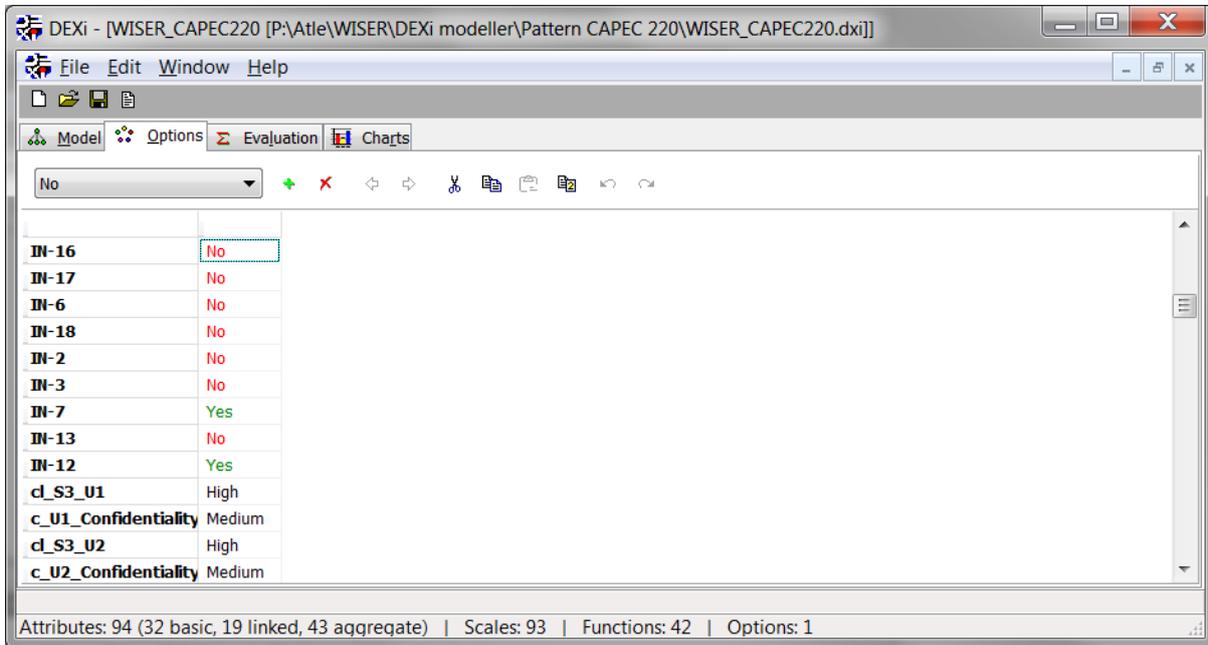


Figure 5 Screen shot of the DEXi tool (Options tab selected)

Figure 6 shows a screen shot of the DEXi tool with the Evaluation tab selected. This is the part that is used to see the results of executing a model. Values for the leaf nodes will be assigned according to the option selected in the Options tab. However, the user can override these by selecting different values from the defined scale for individual leaf nodes. The tool shows how values propagate to the root node, which is highly useful for developing and validating a DEXi assessment algorithm.

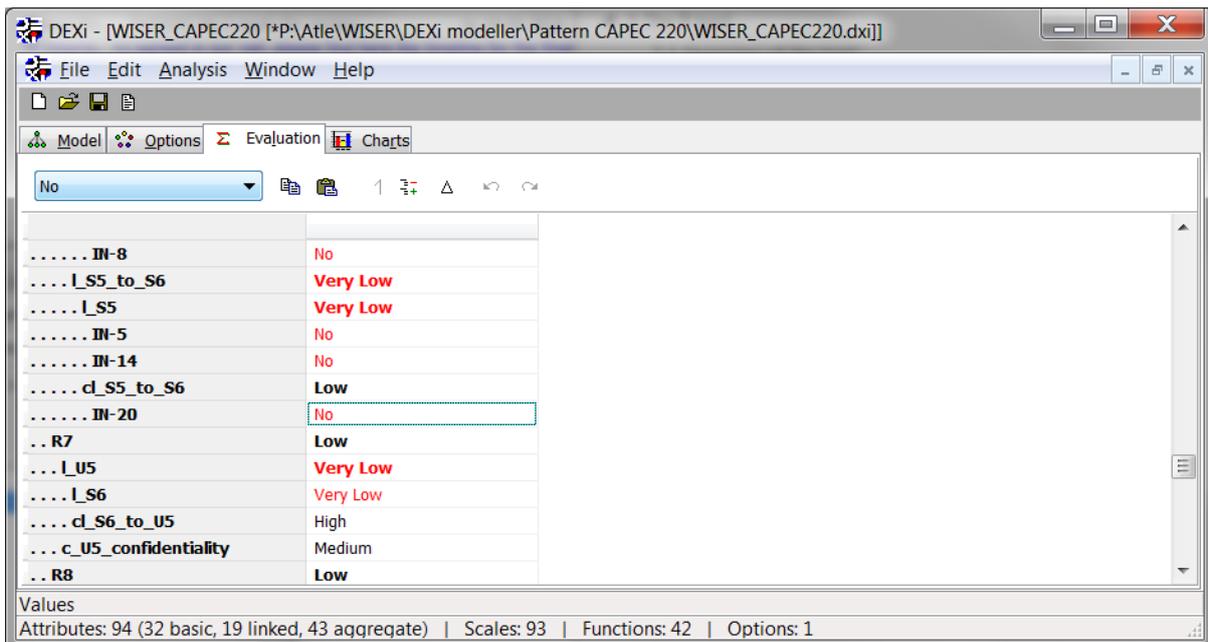


Figure 6 Screen shot of the DEXi tool (Evaluation tab selected)

4.2 Downloads and instructions

- The DEXi tool can be freely downloaded from <http://kt.ijs.si/MarkoBohanec/dexi.html> (accessed 22/5-2016).
- The DEXi user manual [1] can be freely downloaded from <http://kt.ijs.si/MarkoBohanec/DEXi/html/DEXiDoc.htm>. The site also provides links to a number of other publications related to the use of DEXi for a wide range of purposes.

4.3 Licence

DEXi 5.00 grants a "freeware" licence for all types of applications, including commercial, as explained by <http://kt.ijs.si/MarkoBohanec/DEXi/html/DEXiNew500.htm> (accessed 26/5-2016). See also Figure 7, which shows the licence information presented by v5.01 of the DEXi tool.

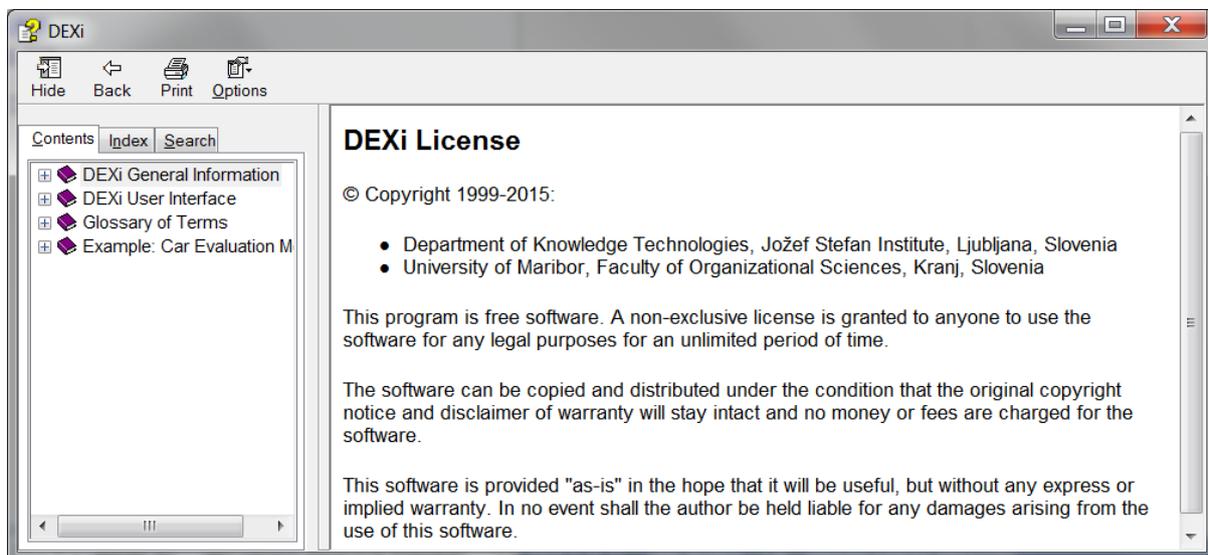
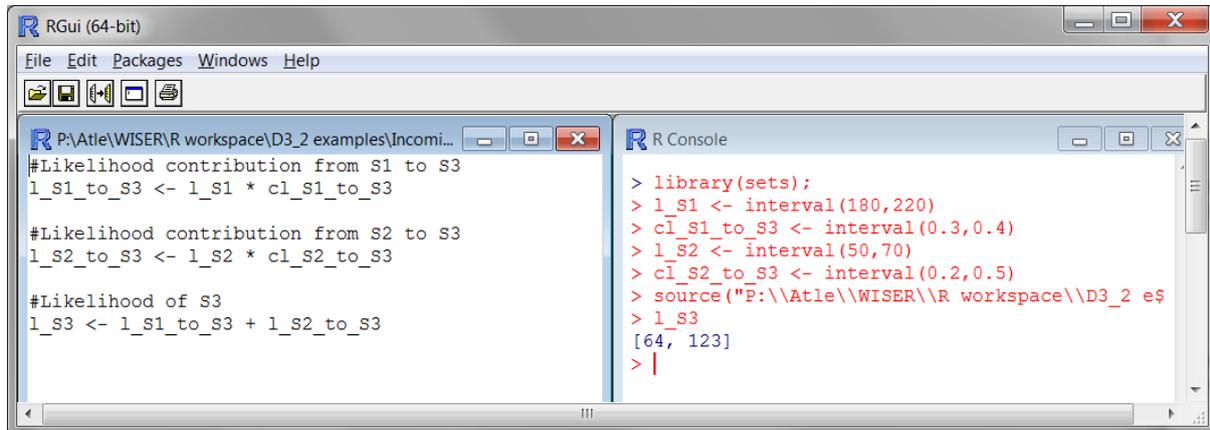


Figure 7 DEXi licence information

5 The R tool

5.1 Overview of the tool

Figure 8 shows a screen shot of the R tool used to define R scripts.



```
File Edit Packages Windows Help
P:\Atle\WISER\R workspace\D3_2 examples\Incomi... R Console
#Likelihood contribution from S1 to S3
l_s1_to_S3 <- l_s1 * c1_s1_to_S3

#Likelihood contribution from S2 to S3
l_s2_to_S3 <- l_s2 * c1_s2_to_S3

#Likelihood of S3
l_s3 <- l_s1_to_S3 + l_s2_to_S3

> library(sets);
> l_s1 <- interval(180,220)
> c1_s1_to_S3 <- interval(0.3,0.4)
> l_s2 <- interval(50,70)
> c1_s2_to_S3 <- interval(0.2,0.5)
> source("P:\\Atle\\WISER\\R workspace\\D3_2 e$
> l_s3
[64, 123]
> |
```

Figure 8 Screen shot of the R tool

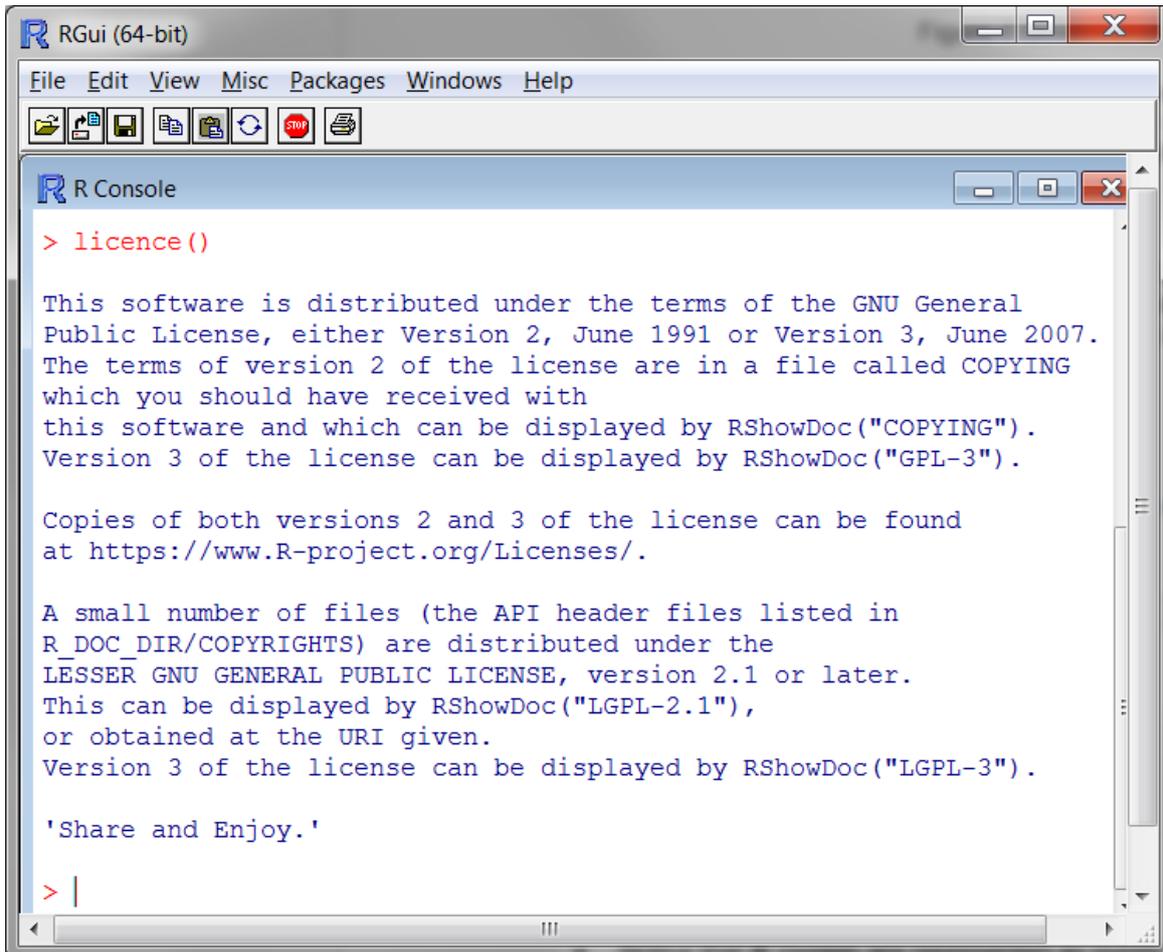
The left-hand part of the figure shows a script pane where the script statements are written. The right-hand side shows the R console. This allows the user to execute/evaluate R statements and scripts interactively, which is very useful for developing and validating scripts.

5.2 Downloads and instructions

- The Comprehensive R Archive Network (CRAN) at <https://cran.r-project.org/mirrors.html> (accessed 20/5-2016) provides an extensive list of mirror sites from which the R tool can be freely downloaded. Versions for Linux, Mac OS X and Windows are offered.
- Notice that R models are represented as purely textual scripts. This means that any text editor can be used to create scripts, although not all editors support execution of R statements.
- R manuals can be freely downloaded from <https://cran.r-project.org/manuals.html> (accessed 20/5-2016). In particular, a very useful introduction to R [3] can be found there. Other forms of documentation, such as online FAQs, can be found under the 'Documentation' heading on <https://www.r-project.org/> (accessed 20/5-2016).

5.3 Licence

As further detailed by Figure 9, the R tool is distributed under the terms of the GNU General Public License. The Figure is a screen shot of the console of R version 3.2.3 (2015-12-10).



```
RGui (64-bit)
File Edit View Misc Packages Windows Help
R Console
> licence()

This software is distributed under the terms of the GNU General
Public License, either Version 2, June 1991 or Version 3, June 2007.
The terms of version 2 of the license are in a file called COPYING
which you should have received with
this software and which can be displayed by RShowDoc("COPYING").
Version 3 of the license can be displayed by RShowDoc("GPL-3").

Copies of both versions 2 and 3 of the license can be found
at https://www.R-project.org/Licenses/.

A small number of files (the API header files listed in
R_DOC_DIR/COPYRIGHTS) are distributed under the
LESSER GNU GENERAL PUBLIC LICENSE, version 2.1 or later.
This can be displayed by RShowDoc("LGPL-2.1"),
or obtained at the URI given.
Version 3 of the license can be displayed by RShowDoc("LGPL-3").

'Share and Enjoy.'

> |
```

Figure 9 R licence information

6 Interaction with the rest of the WISER framework

In order for the risk models to be available for the rest of the WISER framework, in particular the Risk Assessment Engine, the models need to be stored in the Data Warehouse. The Data Warehouse stores all risk models for the clients. Figure 10 illustrates the transfer of risk models between the local machine of the modeller, the Data Warehouse, and the Risk Assessment Engine. The Risk Assessment Engine retrieves the assessment algorithms to be executed (i.e. the DEXi and R models) from the Data Warehouse. Notice that CORAS models are never transferred to the Risk Assessment Engine, as they are not meant to be executed.

The leftmost box represents the local machine of the person developing or tailoring (or simply viewing) a model. This is done using the CORAS, DEXi or R tool installed on her local machine.

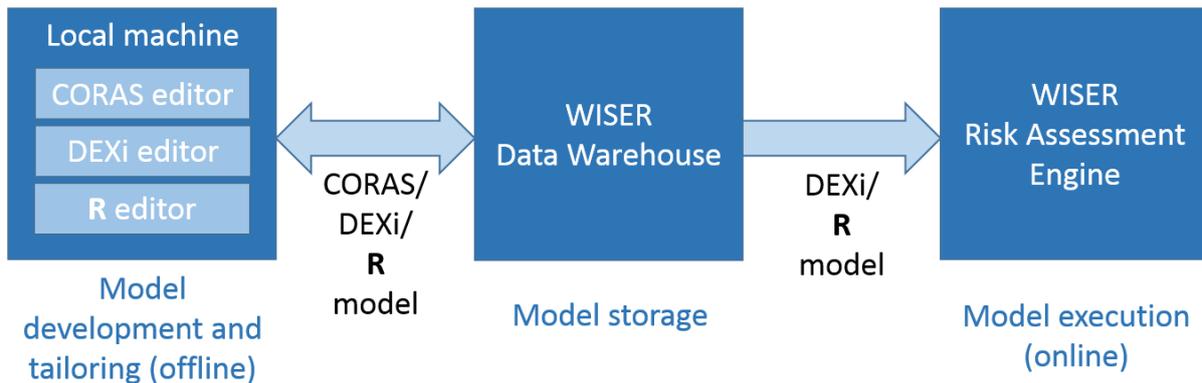


Figure 10 Transfer of models in the WISER framework

The Dashboard will have a separate Modelling section that provides a user interface for i) uploading a model from the local machine of the user to the Data Warehouse, ii) downloading a risk model from the Data Warehouse to her local machine, and iii) removing a model from the Data Warehouse. These actions are represented by the two-way arrow between the local machine and the Data Warehouse in Figure 10. The Dashboard itself is not shown in Figure 10, since in this context it serves only as a user interface to the Data Warehouse.

For all three tools described above, a model is represented by file of the appropriate type, denoted by a corresponding file extension, as shown in Table 1.

Tool	File name format
CORAS	modelname.coras_project
DEXi	modelname.dxi
R	modelname.r

Table 1 File extension for risk models

Each of the three tools provides a standard user interface for opening and saving files in a directory structure via the commands/buttons *Open/Save/Save as*. This basic functionality is the same for the three tools, and also similar to the way these tasks are done in, for example, well-known Office programs like Word, Excel and Power Point.

When making changes to a model, the person doing the modelling (the modeller) needs to download the model from the Data Warehouse to her local machine, make the changes to the model, and upload the model to the Data Warehouse. Figure 11 shows the process for doing this. The process is the same whether we refer to a CORAS model, a DEXi model or an R model.

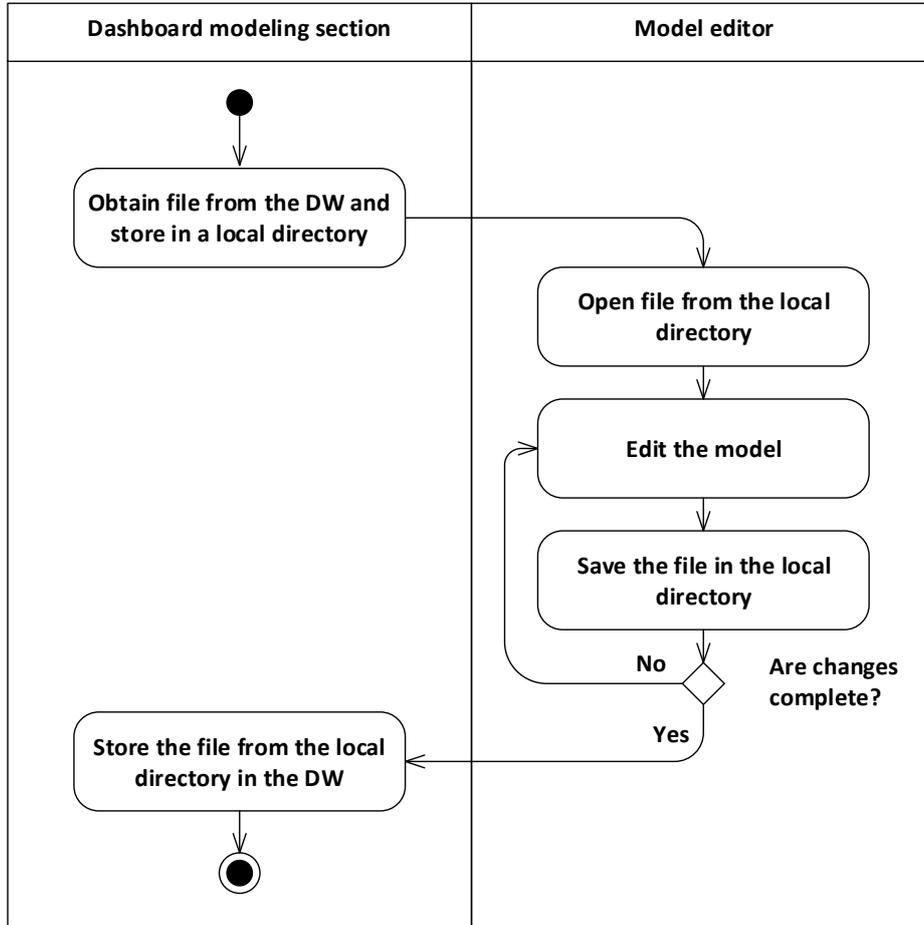


Figure 11 Exchanging model files with the Data Warehouse (DW).

The modeller performs all activities. The left-hand swim lane shows activities performed using the modelling section of the WISER Dashboard, while the right-hand swim lane shows activities performed using the modelling tool corresponding to the model type in question. When creating a new model, the process is the same as in Figure 11, except that the modeller starts by creating a new file using the modelling tool, rather than by fetching an existing model from the Data Warehouse.

A huge advantage of this approach is that each of the modelling editors can be maintained and updated independently from the rest of the WISER framework, as long as the file format of the models remain unchanged. For example, if a new version of the DEXi editor becomes available, a modeller can install this without worrying about whether it is consistent with the WISER framework. This is particularly important for the DEXi and R editors, as these are developed outside of the WISER project.

7 Conclusions

In this report, which is best understood in conjunction with the presentation of cyber-risk modelling languages and guidelines in D3.2, we have presented the three modelling tools that support the modelling languages selected for WISER, i.e. CORAS, DEXi and R. For each of them, we have given a brief overview of the tool and provided links to web sites where detailed descriptions and instructions can be found, as well as download sites. All tools can be freely downloaded. They are also well supported by suitable user documentation.

All the three modelling tools offer functionality for editing and viewing models. In addition, the DEXi tool and the **R** tool, which are used to create executable models (algorithms) to be run by the Risk Assessment Engine, offer functionality for interactive execution of models and/or model fragments. This is highly useful for development and validation of such models.

We have also explained the role of the risk modelling tools in the WISER risk modelling method, and the way the tools interact with the rest of the technical WISER framework. The coupling between the tools and the rest of the framework is loose, in the sense that there is no direct technical links between the editors and the framework. The interaction is done by exchanging models between the Data Warehouse and the local machine of the modeller via the Dashboard user interface. This approach ensures that each risk modelling tool can be updated independently from the rest of the WISER framework. Conversely, the WISER framework can be updated and rolled out independently from the modelling tools.

8 References

- [1] M. Bohanec: DEXi: Program for Multi-Attribute Decision Making. User's Manual, version 5.00. IJS DP-11897, 2015.
- [2] M. S. Lund, B. Solhaug and K. Stølen: Model-Driven Risk Analysis. The CORAS Approach. Springer, 2011.
- [3] W. N. Veneables, D.M. Smith and the **R** Core Team: An Introduction to **R**, v. 3.2.2, 2015.