Step-by-Step Simulation example

Example 1 decimal comma version

Background information

This presentation describes step-by-step how a basic RTGS simulation is performed using the BoF-PSS2 simulator.

The main steps are
- Input data creation
- Simulation execution
- Analysis of results

This version uses decimal comma as decimal delimiter and semicolon as data delimiter, which is important to note in order to get the Excel interface to function properly.
(If you are using decimal points please change to the other version of the example).

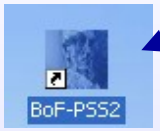
How to follow the example

Instructions in this example are mainly presented with screenshots from simulator. These will tell you what the simulator window looks like, when you have finished the necessary actions in that simulator window. Instructions for steps in one window can however be divided into several slides.

Therefore follow the steps of the example by repeating **only** the actions which are pointed with thick arrows. 

Thin arrows are used occasionally in explanations and require no action. 

Start the simulator



Double click on the simulator icon
or start the program from
the windows program menu.

Three windows will open up:
- Start-up window for simulator
- MySQL window for database interface
- Simulator user interface window

All three windows are necessary during simulations and will be closed automatically when you exit from the simulator.

Initial start up

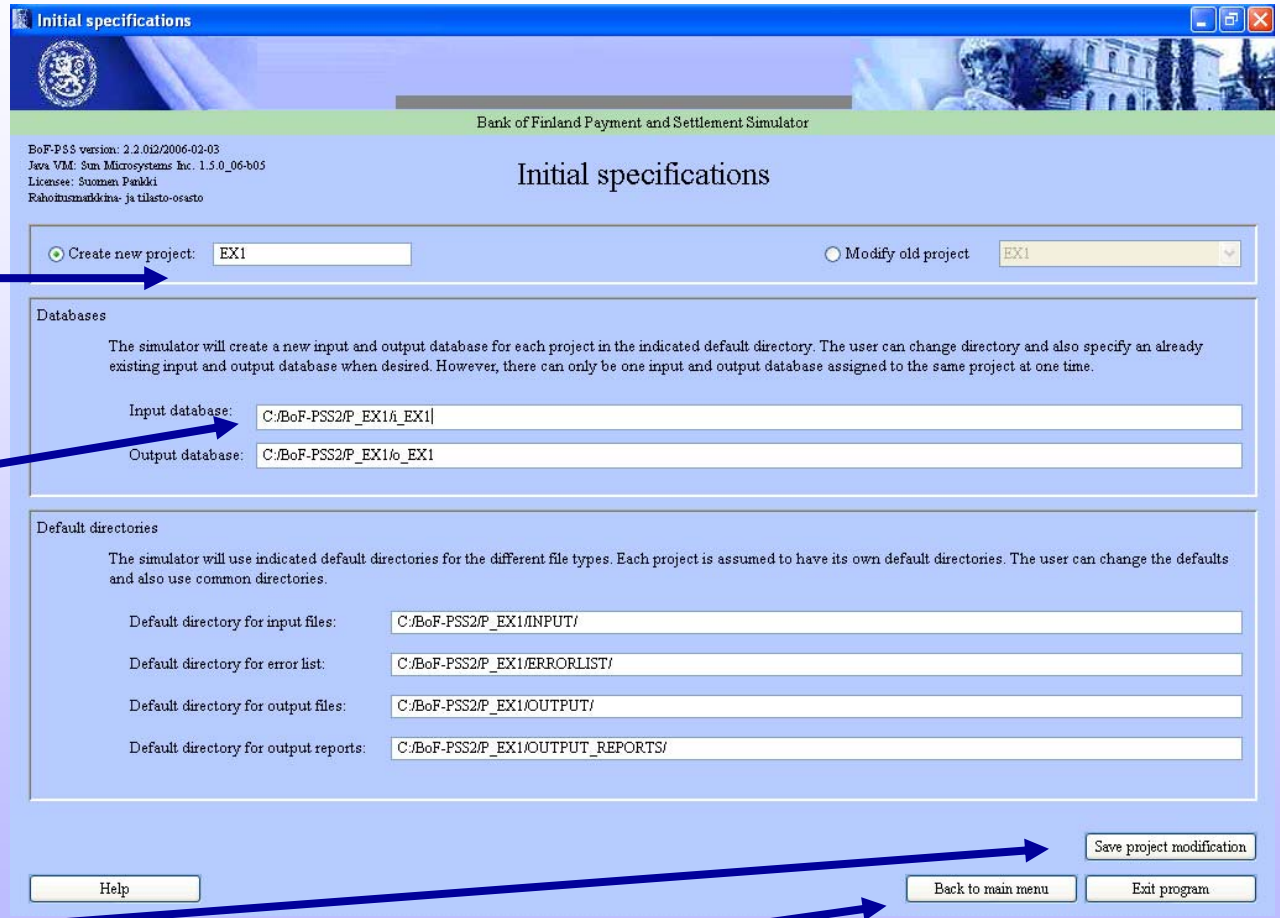
First time you run the simulator initial specifications open up.

-Specify a project name. Projects are used to separate simulation topics.

-Click on one of the fields and the default database and directory names emerge. (Stick to the defaults if no particular reason to change.)

-Save project

-Go to main menu



Main menu

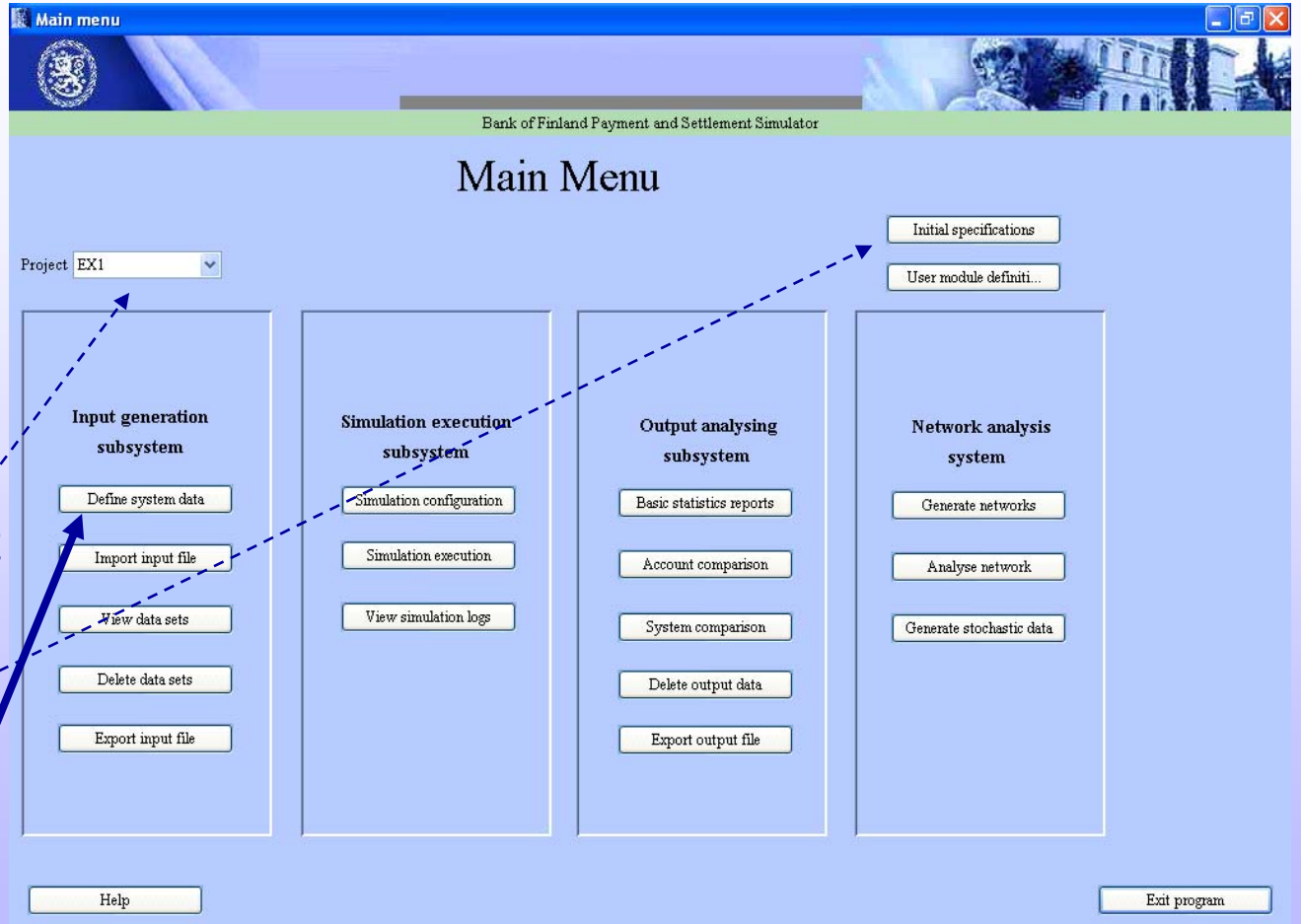
The main menu will open up whenever you start the simulator in the future.

It provides the window to the different functions of the simulator.

You can choose the project you are working with

and define new projects when necessary (see previous slide).

-Start by defining system data (click on the button).

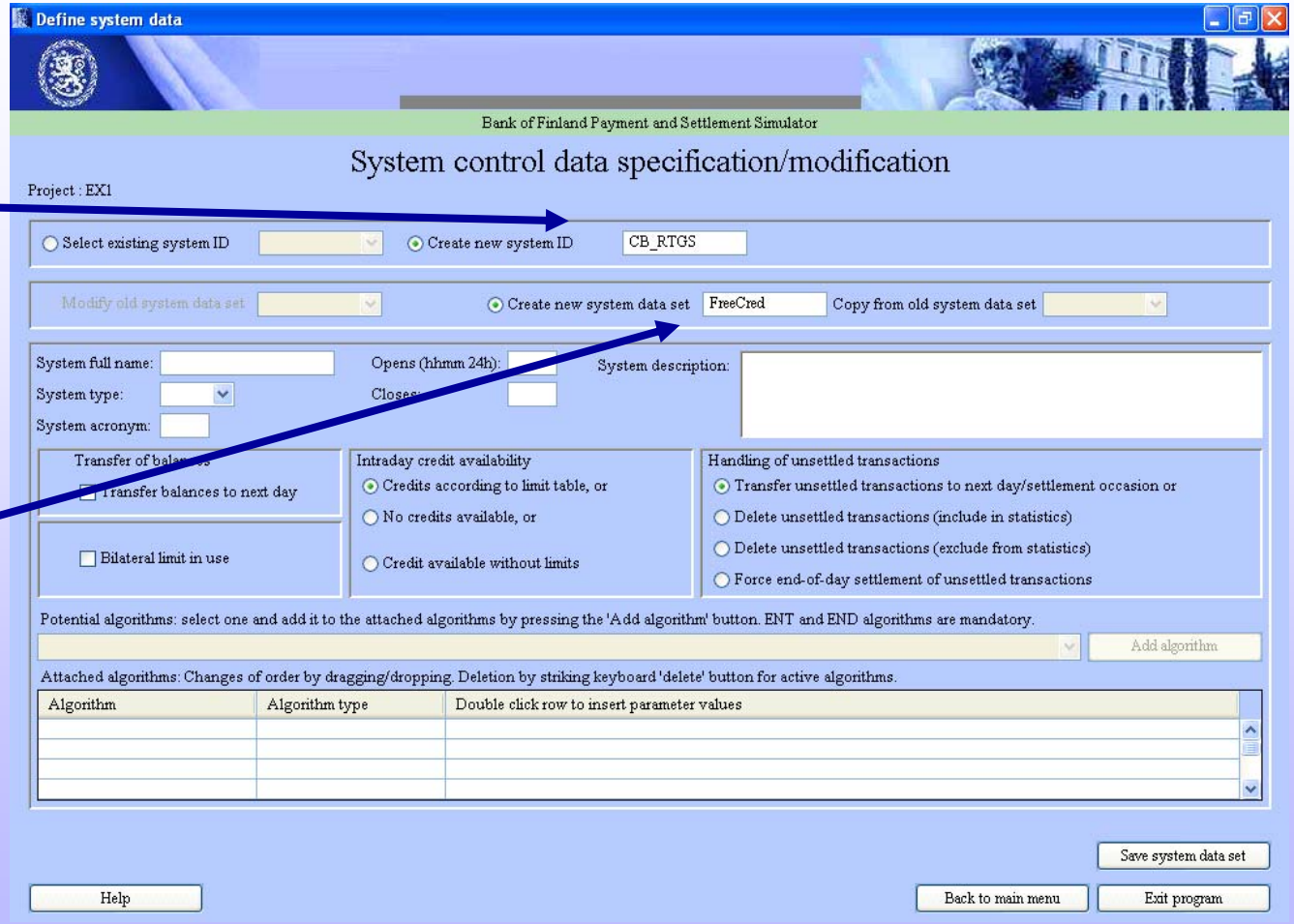


System data definition 1

In system data definition

-type the system ID CB_RTGS (best practice is to use real system name)

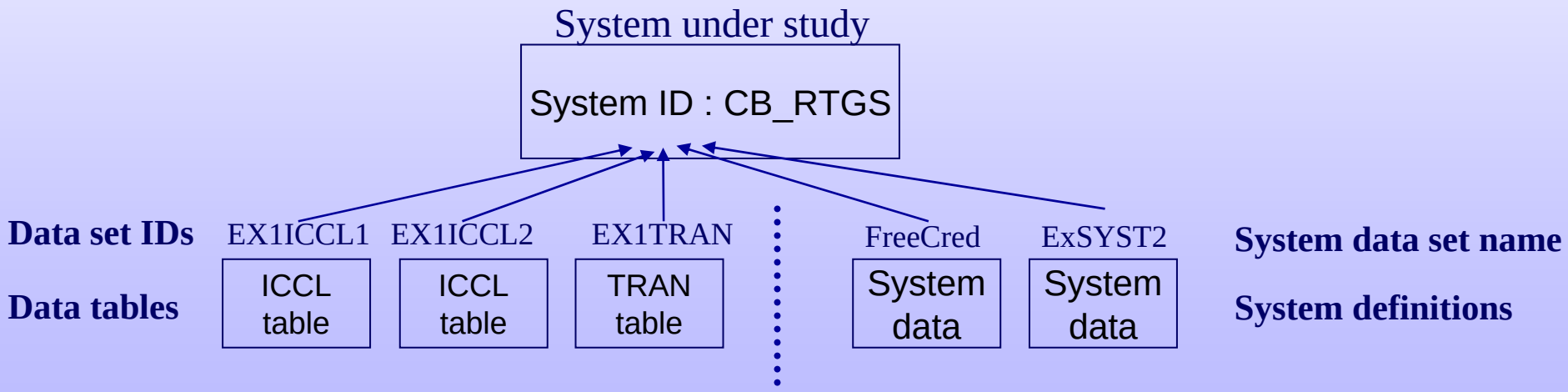
-and give name (FreeCred) for this system data set. (see next slide)



System ID & system data set name

System ID is the name for the real system under study. It is used to link together all different datasets belonging to one system.

Dataset IDs were used to allow storage of parallel data tables. Similarly system definitions are given a system dataset name to allow parallel system setups. These can easily be used to test i.e. different queuing methods or effects of including some optimization feature.



System IDs are needed because there can be several real systems in one project or one simulation e.g. parallel RTGS and DNS-systems.

System data definition 2

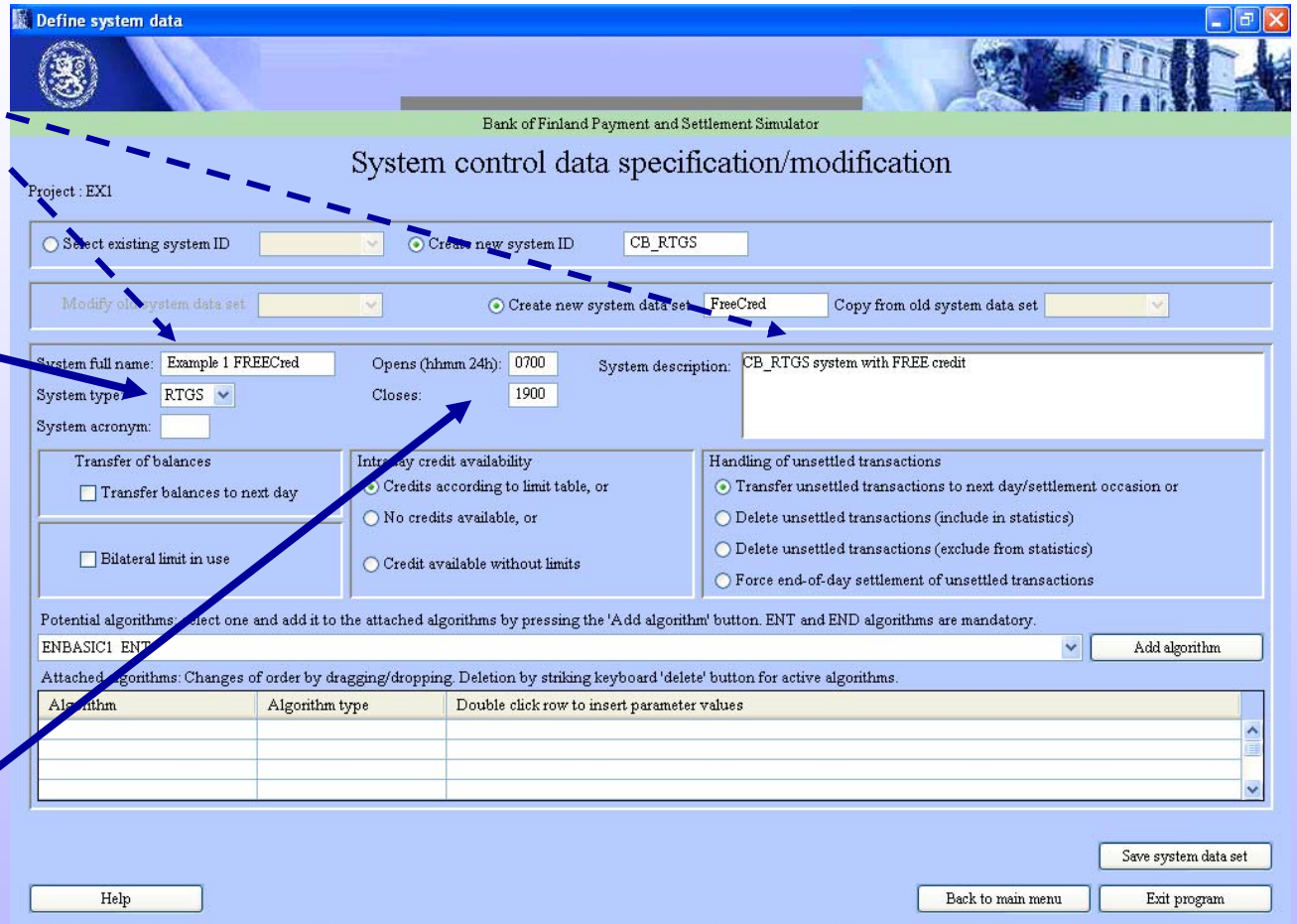
-System full name and description are optional. (use these for notes)

-Choose system type (RTGS)

System types available:

- RTGS (real time gross settlement)
- CNS (continuous net settlement)
- DNS (deferred net settlement)

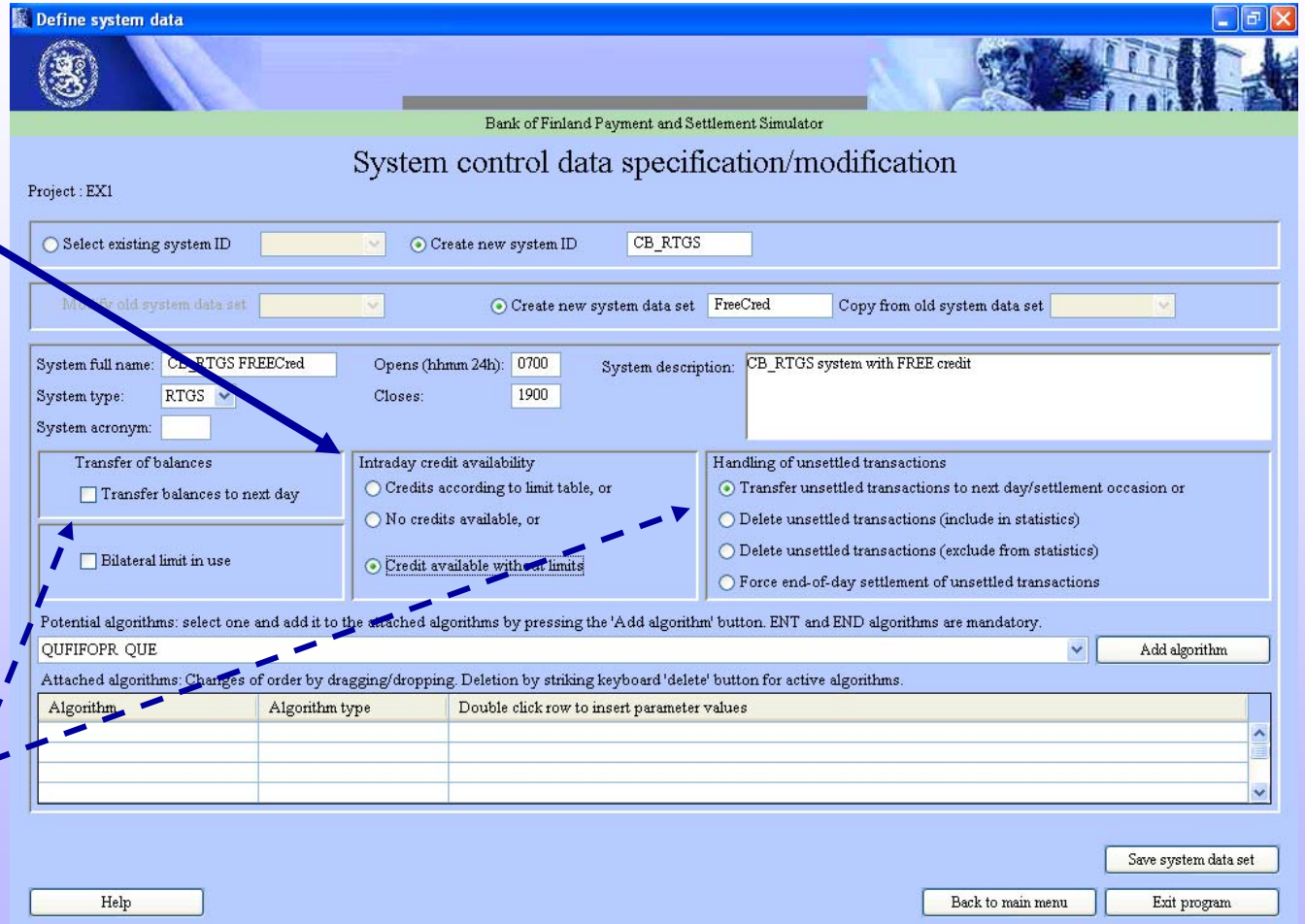
-Set the opening hours (in this example 0700 – 1900).



System data definition 3

-In this FreeCred system dataset, choose *credit available without limits* to allow free intraday credit.

-Transferring of balances and options for handling unsettled transactions at the end on day can be defined. These are currently irrelevant since EX1 data has only one day



System data definition 4

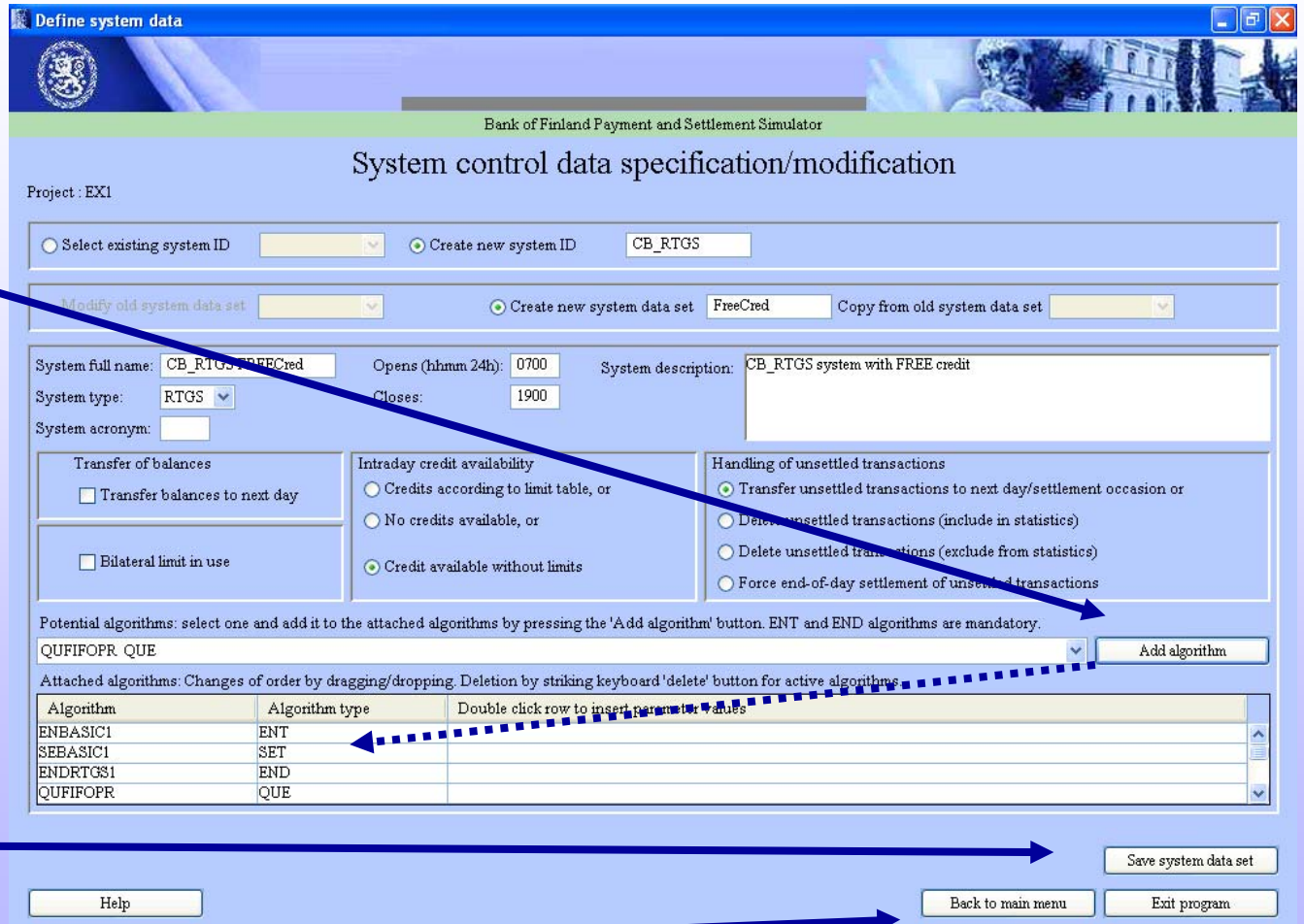
-Add following algorithms to system by selecting them one by one in drop down list an clicking "add algorithm".

- ENBASIC1
- SEBASIC1
- ENDRTGS1
- QUFIFOPR

(see also next slides)

After these steps system definition can be saved.

Return to Main menu



Algorithms

- **Algorithms are used to define the processing conventions for each system. There are several algorithm types** (with three letter names e.g. QUE) **and often more than one actual algorithm within each type to choose from** (e.g. QUFIFOPR and QUBYPAFI**).**
- **One simulated system can not include two algorithms of same type.**
- **Three types are mandatory (SUB, ENT & END) others are optional.**

Types can be classified in main- and sub-algorithms (see next 2 slides)

Main algorithms

- **ENT** (entry) algorithm is first processing phase for a transaction. Transactions are generally transferred to bookings when liquidity is available or queued/discarded if there is a lack of liquidity.
- **SET** (settlement) algorithm processes queued transactions, e.g. invoking gridlock- resolution algorithms. Is needed always if there is a queue in system structure
- **END** (end-of-day) algorithm clears up end-of-day situations
- **SUB** (submission) algorithm determines what happens next in the simulation, i.e. it chooses the next transaction or system event to be processed. SUB algorithm is selected in the simulation configuration (slide 32).

Sub-algorithms

These can be invoked by ENT, SET and END algorithms

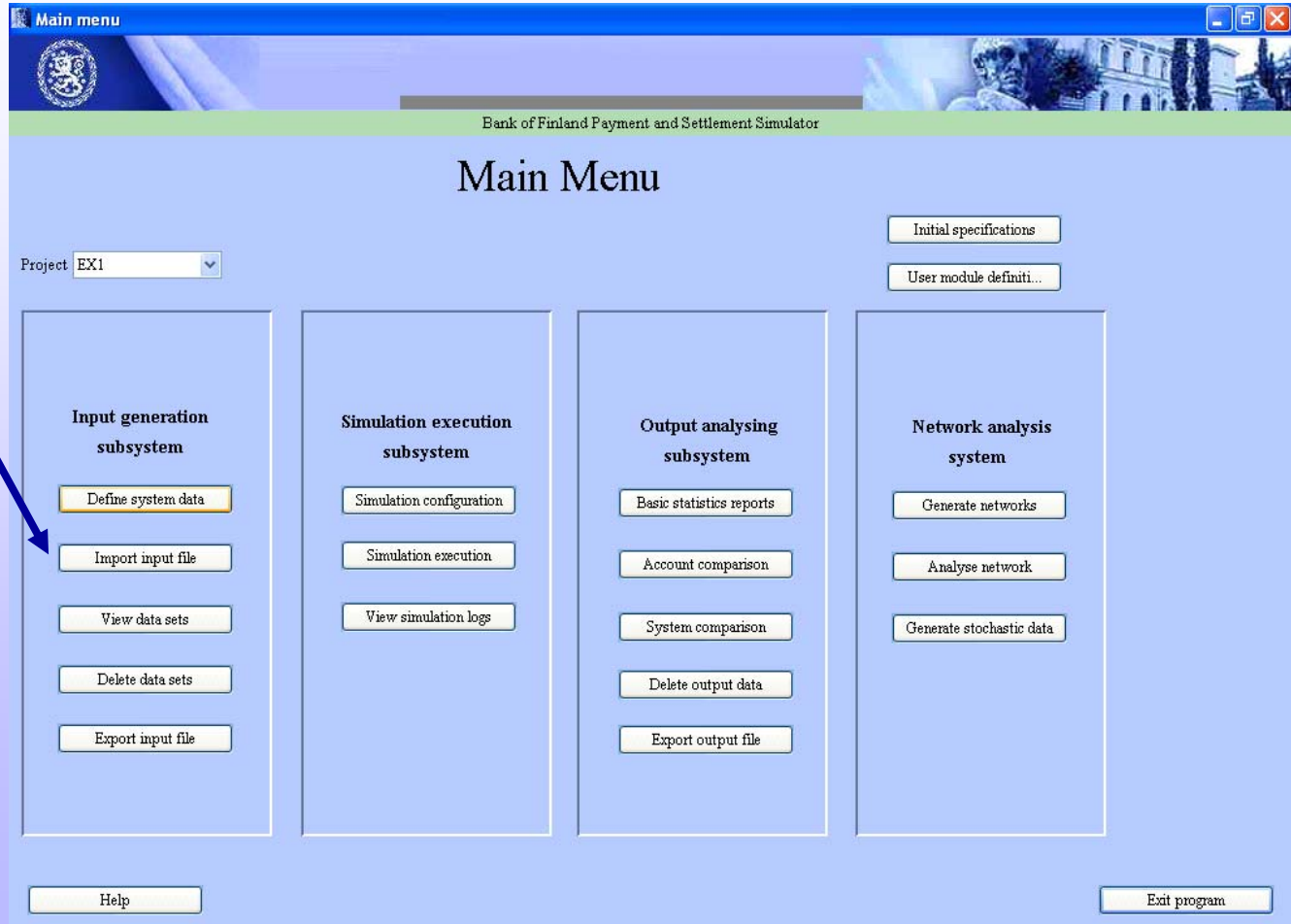
- **QUE** (queue release) algorithms release individual transactions from waiting queues in a defined order
- **SPL** (splitting) algorithms split large transactions into small, easy-to-process transactions
- **INJ** (injection) algorithms transfer liquidity from/to accounts to/from other systems
- **BOS** (bilateral offsetting) nets queued transactions between two counterparties in a given order
- **PNS** (partial net settlement) algorithms seek multilateral payment batches that can be netted
- **MNS** (multilateral net settlement) Multilateral netting of “all or nothing” transactions in queues.

Precise definitions for algorithms can be found in simulator manuals.

Main menu

When system definition is successfully done, return to main menu…

and proceed with importing data.



Input files and directories 1

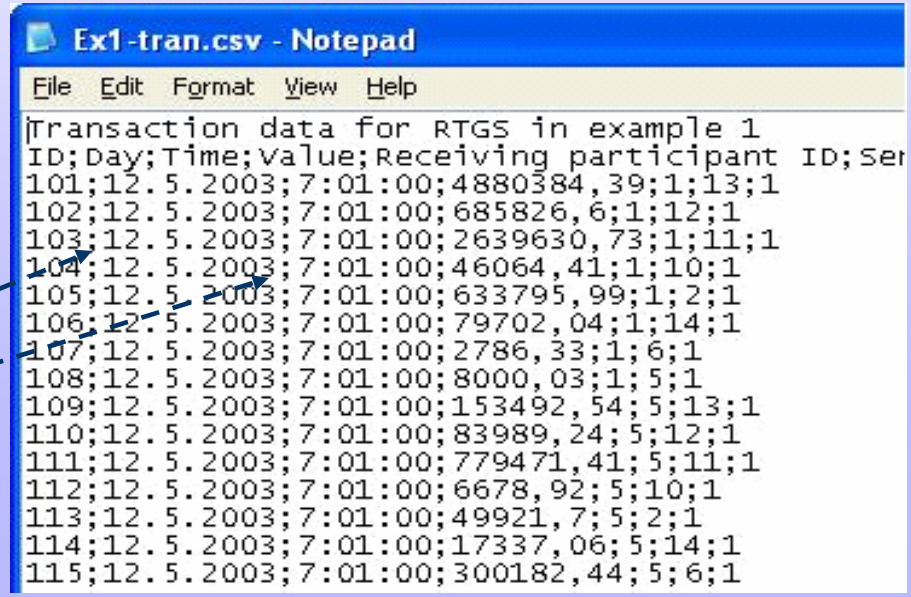
There are five types of input files
- Participant data files
- Transaction data files
- Intraday credit data files
- Beginning-of-day balances files
- Bilateral credit limit data

CSV-files can be easily created with Excel, Access, MySQL etc. The 'true' content can be easily checked with Notepad.

All input files are comma-separate-value files (CSV-files).

Title lines are helpful for labelling data fields and data set. They can be skipped in import.

Data delimiter between each data field.



Input files and directories 2

- **The default folder for input files is INPUT in the corresponding project directory. In this project EX1 it is C:/BoF-PSS2/P_EX1/INPUT**

- **Please copy the input files Ex1-part.csv and Ex1-tran.csv from the directory c:/BoF-PSS2/EXAMPLES/DECIMAL_COMMA to the example default input directory C:/BoF-PSS2/P_EX1/INPUT. Example material can also be found on the web pages of the simulator (*www.bof.fi/sc/bof-pss*).**

- **The "import input file" screen can now be used to import the data to input database of the simulator.**

Import participant data 1

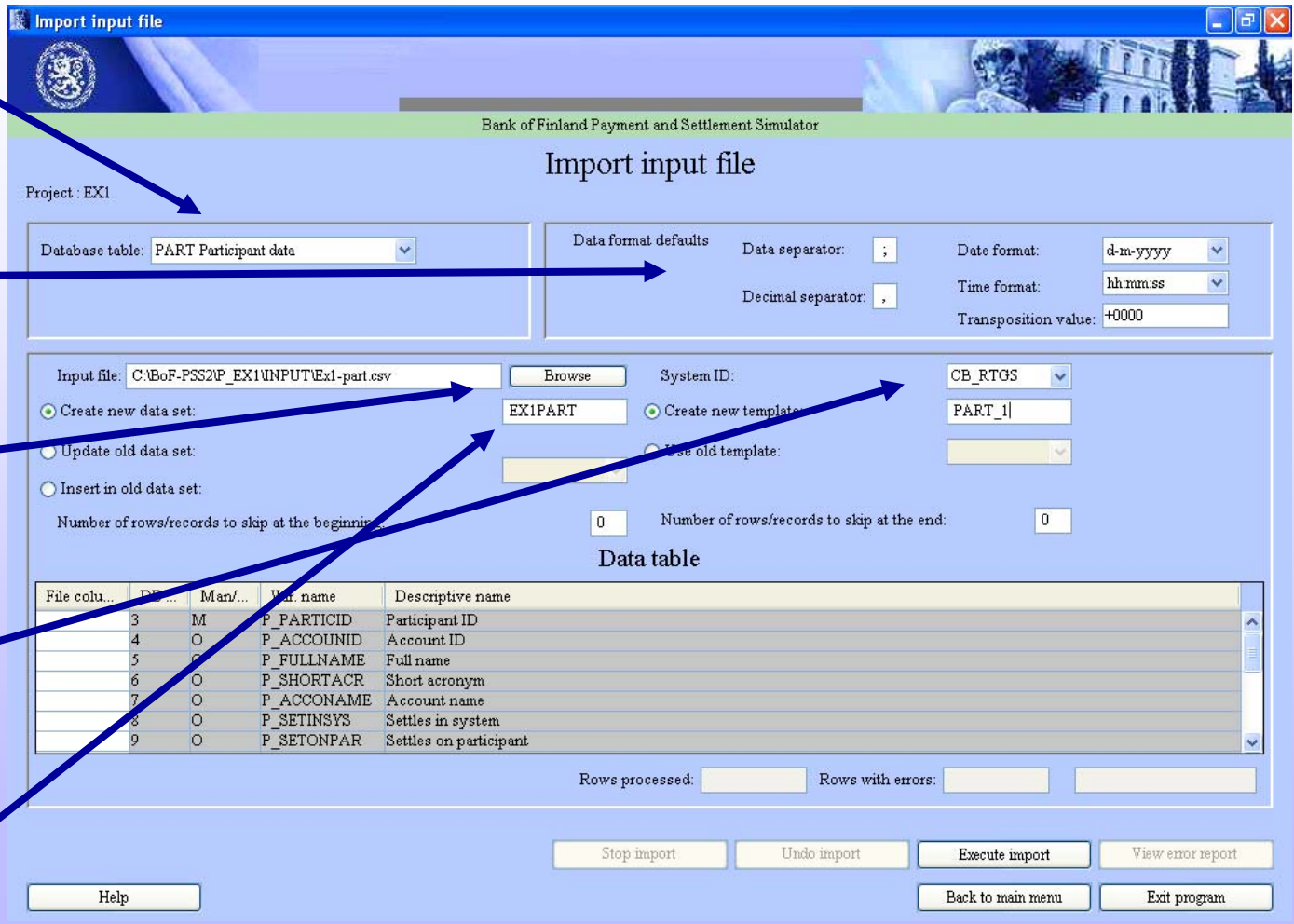
-Select PART table

-Check that data and decimal separator are correct (; and ,)

-Browse for input file

-Select system ID from Drop down list

-State data set ID, (i.e. EX1PART) See explanation on next slide



Data sets

- Data set IDs allow storage of parallel data tables in database
- Simulations may use different data sets for varying the input data, e.g. more or less intraday credit, normal or exceptional transaction flows

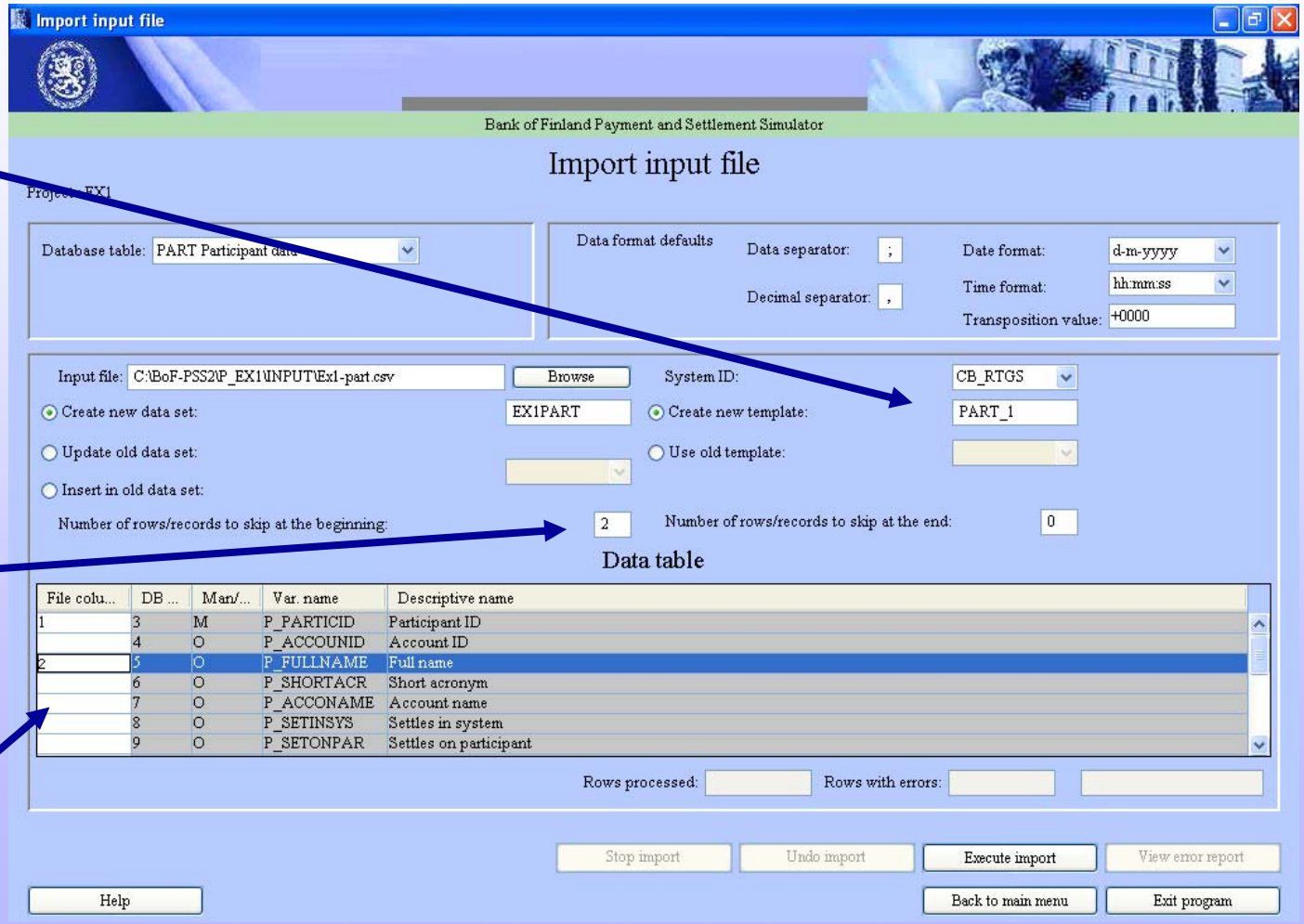
Use a clear naming convention for different data sets

Import participant data 2

-Create a new template that corresponds to your input data. State the name of the new template (see also next slide)

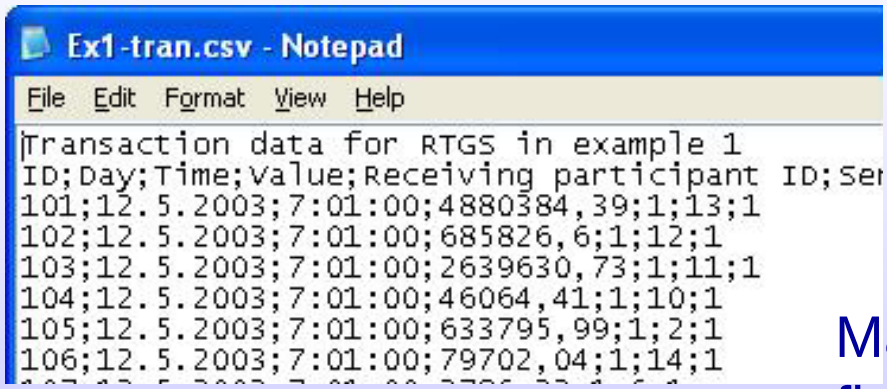
-State how many title lines to skip in the beginning

-State the columns in the CSV file which correspond to database fields



Template to CSV-file relationship, Example for transaction data

Templates are used to convert csv-files to simulator database. Created templates are saved and can be used later for new imports.



Two introductory explanation rows to be skipped

Mandatory (M) and optional (O) fields to import are marked here

datafile

Simulator input screen

File column...	DB col	Man/Opt	Var name	
1	3	M	T_TRANSAID	Transaction ID
2	4	M	T_INTRDATE	Introduction date
3	5	M	T_INTRTIME	Introduction time
4	6	M	T_TRANVALU	Transaction value
	7	O	T_FRSYSTID	From system ID
6	8	M	T_FRPARTID	From participant ID
	9	O	T_FRACCOID	From account ID
	10	O	T_TOSYSTID	To system ID
5	11	M	T_TOPARTID	To participant ID

File column in input template tells the data order in the input CSV-file

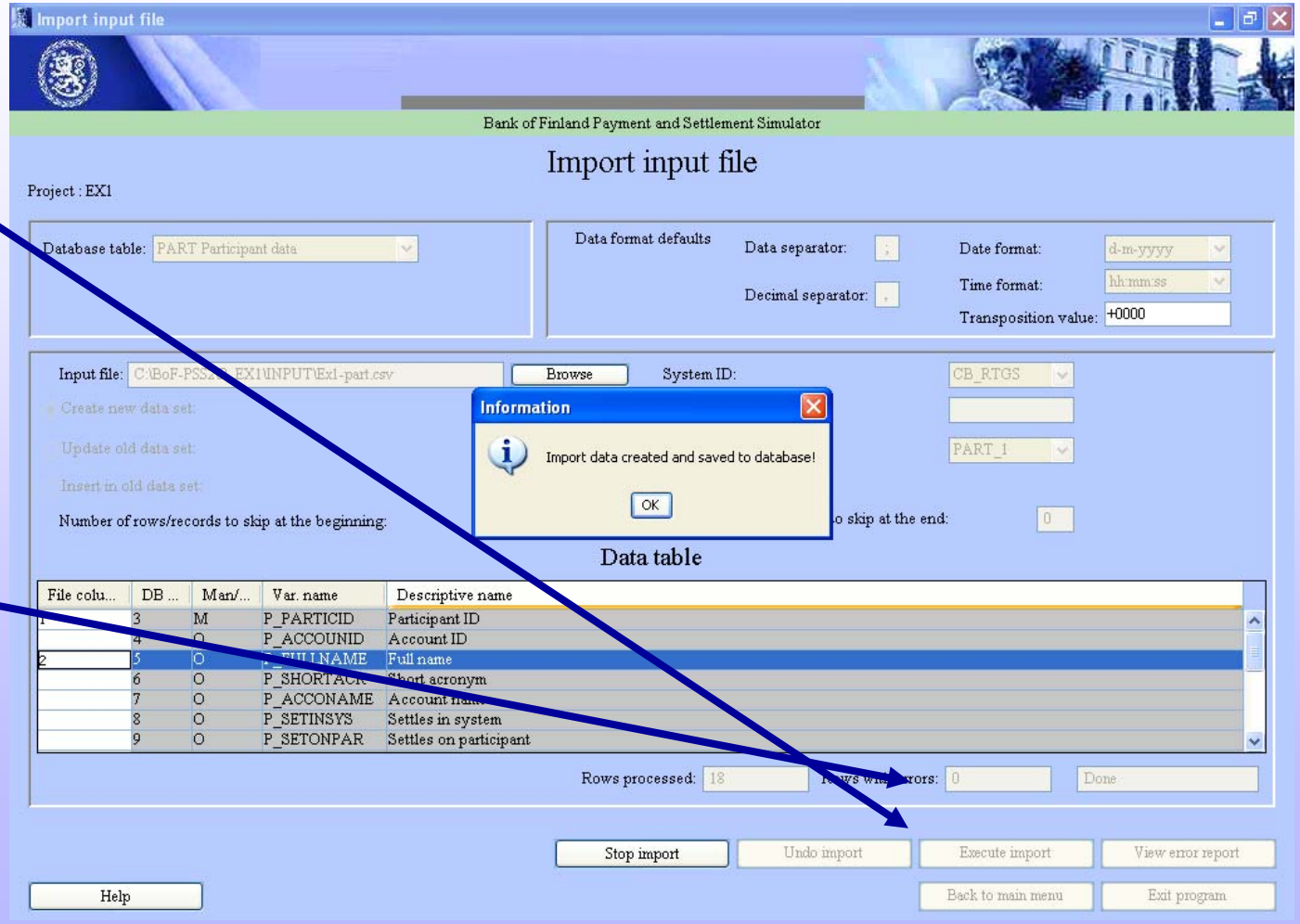
Import participant data 3

-Start the import by clicking “Execute import” button.

-Click “Ok” in popup informing the ending of import.

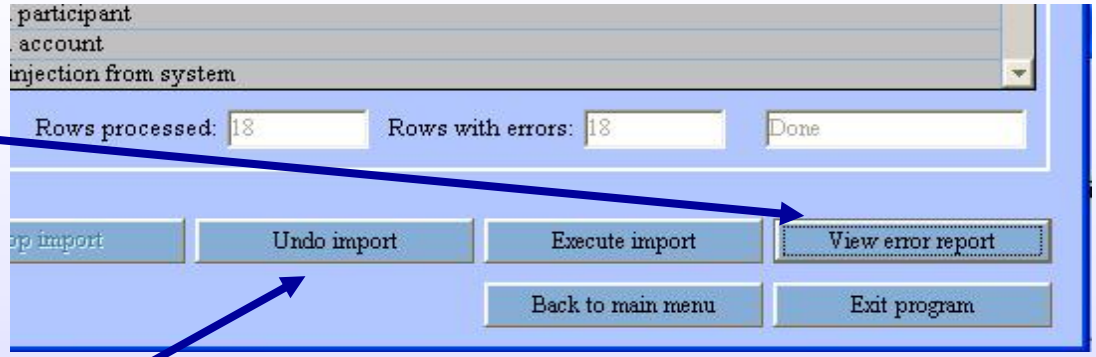
-Check that all lines were imported successfully (0 lines with error).

-If there were errors see the next two Slides.



Import error handling for participant data

If the import wasn't successful you can view error report. See the next slide.
(It opens in Excel. After studying the report close Excel to return to BoF-PSS2.**)**



And undo the import.

For opening the error reports outside the simulator look in to ERRORLIST folder in the projects directory (in this example C:\BoF-PSS2\P_EX1\ERRORLIST).

Import input error list

Line in CSV-file with error

Column/field with error

Error type

parse_errors.txt - Notepad

File Edit Search Help

```
Row: 1, Col: 1, Code: 105, Desc: Illegal date format
Row: 1, Col: 2, Code: 107, Desc: Illegal time format
Row: 1, Col: 7, Code: 103, Desc: Illegal text size
Row: 2, Col: 1, Code: 105, Desc: Illegal date format
Row: 2, Col: 2, Code: 107, Desc: Illegal time format
Row: 2, Col: 7, Code: 103, Desc: Illegal text size
Row: 3, Col: 1, Code: 105, Desc: Illegal date format
Row: 3, Col: 2, Code: 107, Desc: Illegal time format
```

Some possible problems now:

•Incorrect data or decimal separator (look at the slide “Import participant data 1”)

•Incorrect number of lines to skip in the beginning of csv-file (same as above)

Common problems with real data (not present in these examples):

•The csv-file can contain empty rows (usually) at the end of the file. Open the csv-file in notepad to check if there are rows like ,,,,, at the end of file.

•Or the data in cvs-file just isn’t looking like what was expected, check the template and data file (use notepad again).

When repeating the import after making corrections, choose “use old template”. Changes in template are saved automatically when the template is used.

Import transaction data 1

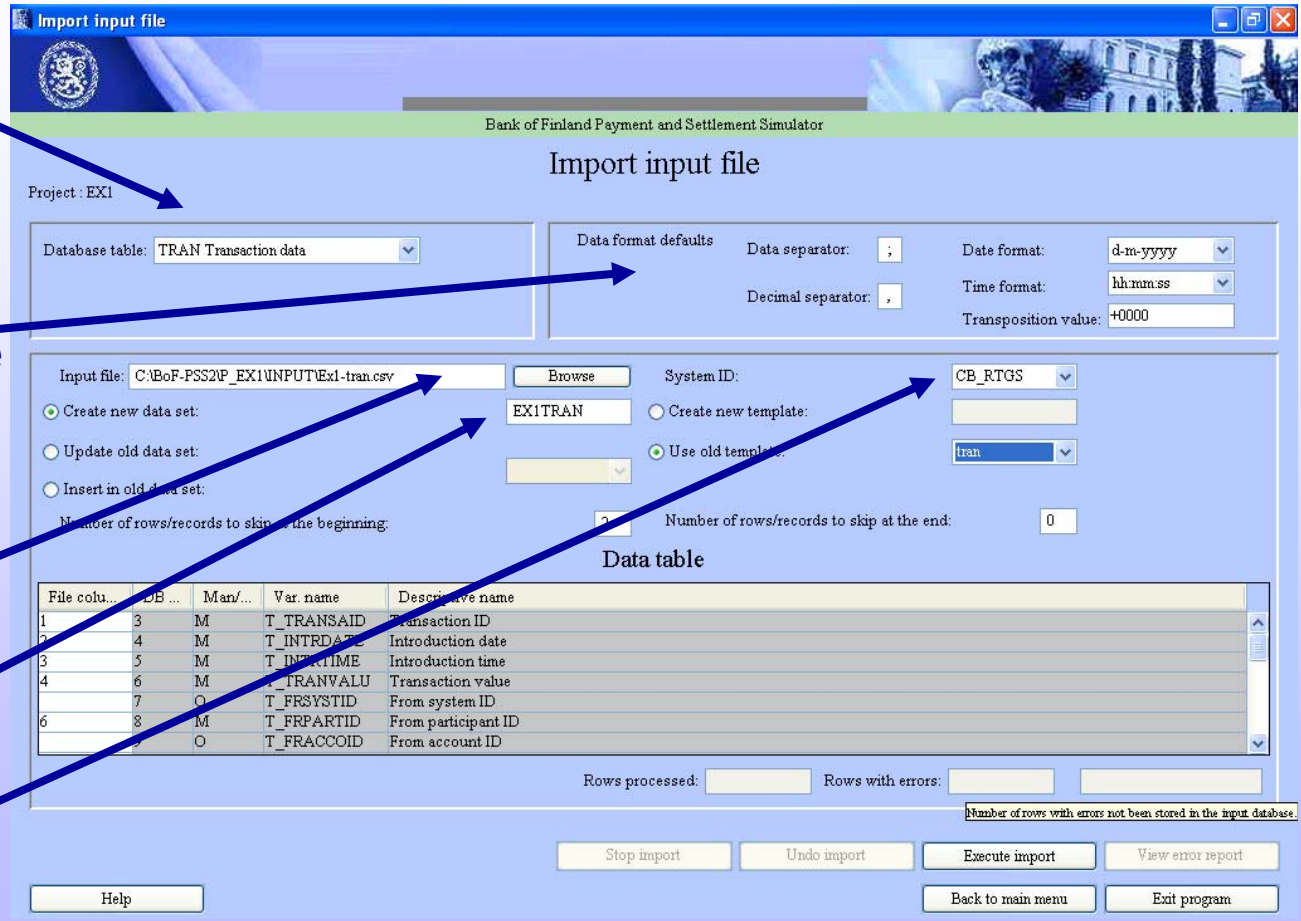
-Change the database table to TRAN for importing transactions.

-Check data and decimal separator and that date and time format match the contents of CSV-file (in this example d-m-yyyy and hh:mm:ss)**.**

Choose the file to import.

State data set ID.

Select the System ID from the drop down list.

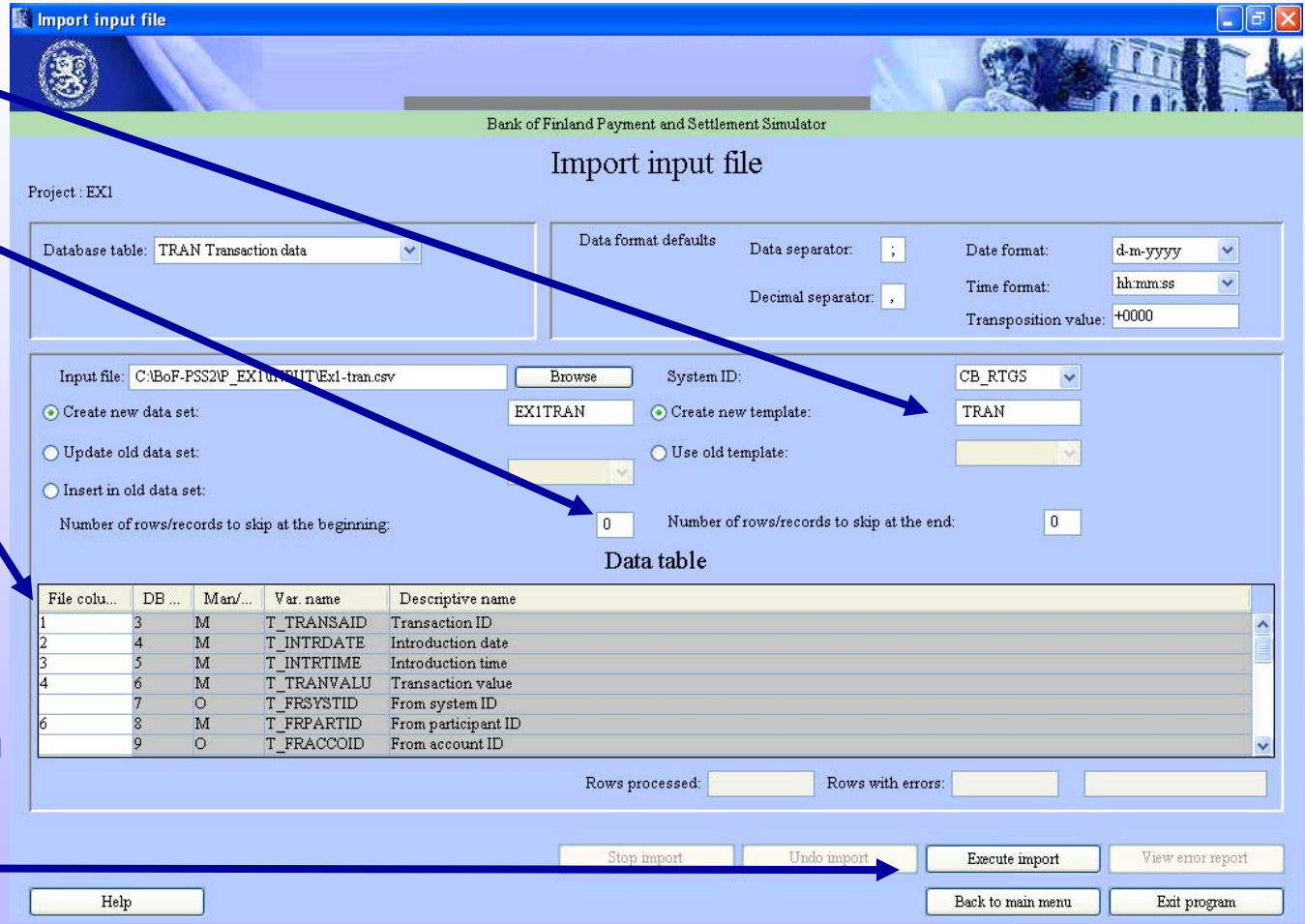


Import transaction data 2

-Choose to create new template and state the name for it.
-Choose the number of title lines to skip.

Enter the numbers of columns where the required fields are located in the csv-file (To participant, column 5 is not shown in the screenshot. Recall the more detailed explanation on slide 21).

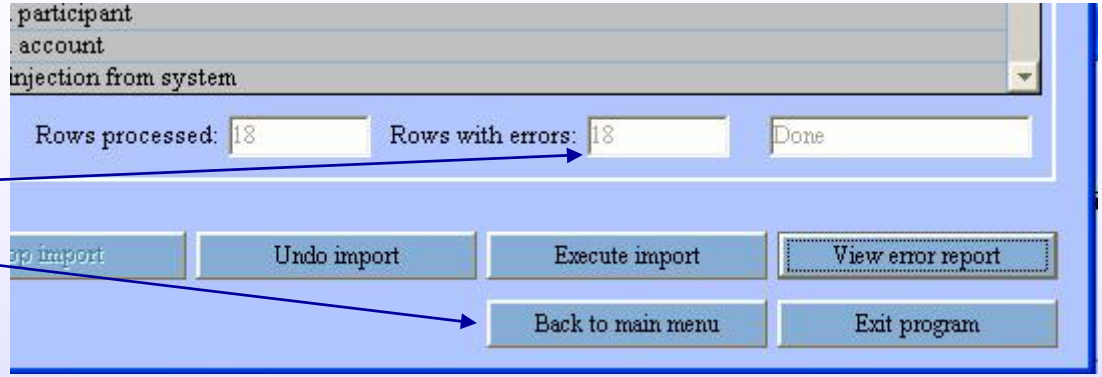
Start the import by clicking "Execute import" and then click "Ok" in pup.



Import transaction data 3

-When import is finished check that it was successful (0 rows with errors) and go back to main menu.

-If there were errors you can view the error report and undo the import.

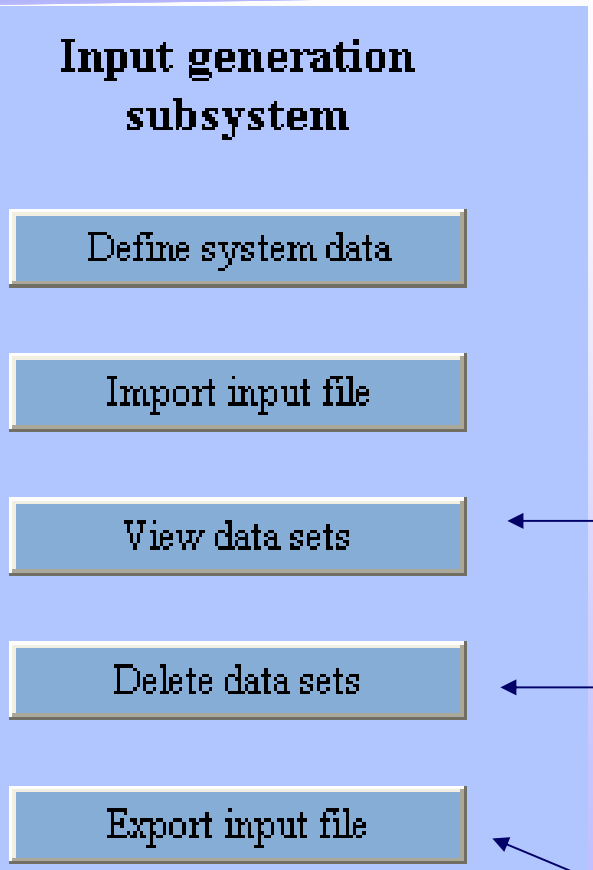


Basic solutions to error situations were listed on slide “Import input error list” (slide 24). New things to check here are for instance:

• Date and time format in simulator. Dash (-) in date format and colon (:) in time format can represent any separator mark in date or time data of csv file.
• Check the template and data file again to see that the data is situated and presented as you expected (open the csv file in notepad)

When repeating the import after making corrections choose “use old template”. Changes in template are saved automatically when the template is used.

Input generation subsystem



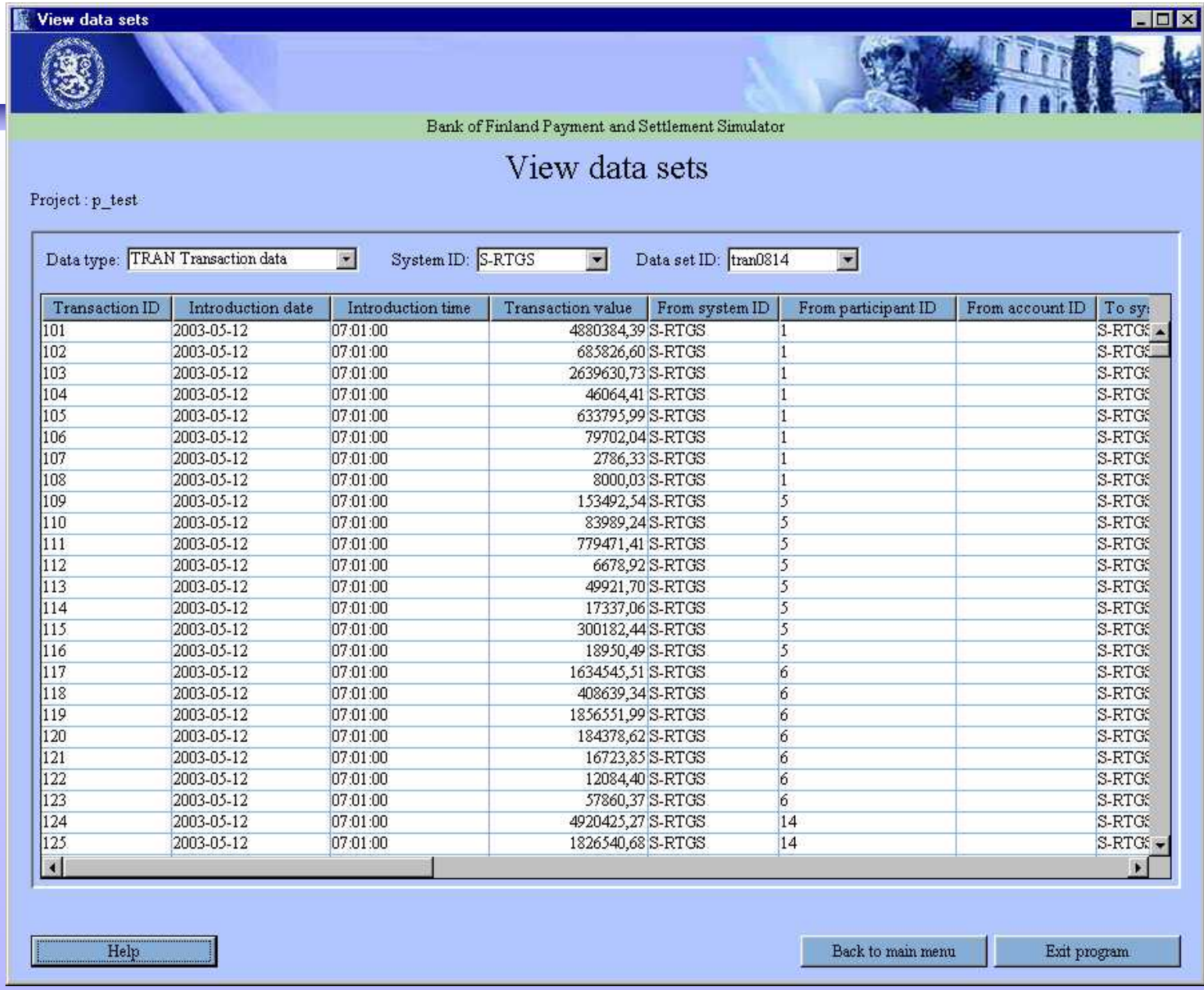
Three last buttons in import subsystem can be used to handle already imported datasets.

View data in input database (see next slide)

Delete data from input database (second next slide)

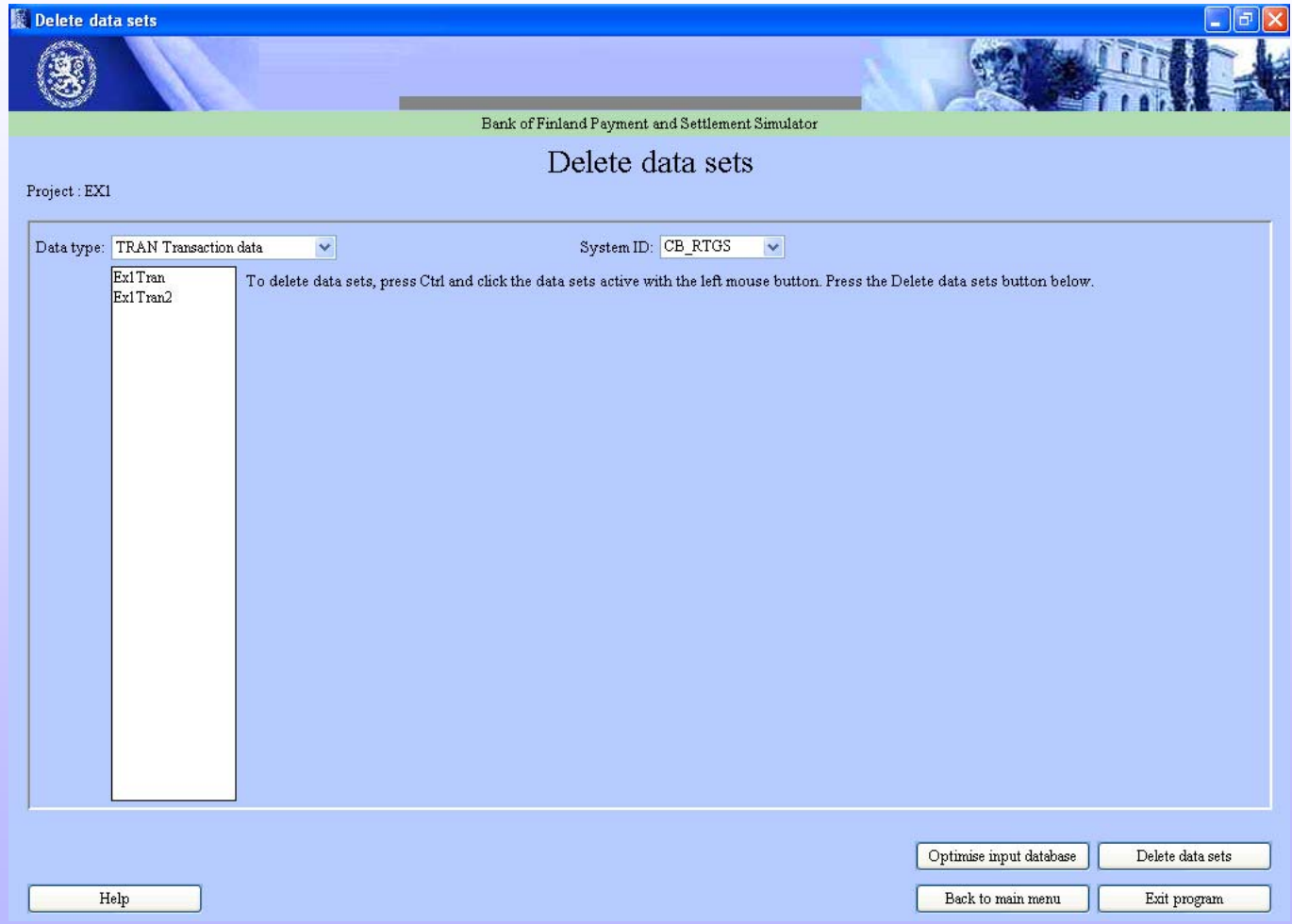
Export data from the input database, e.g. for editing purposes

View data set window is useful for checking moderate size data tables.



Delete data sets window provides view of available data sets.

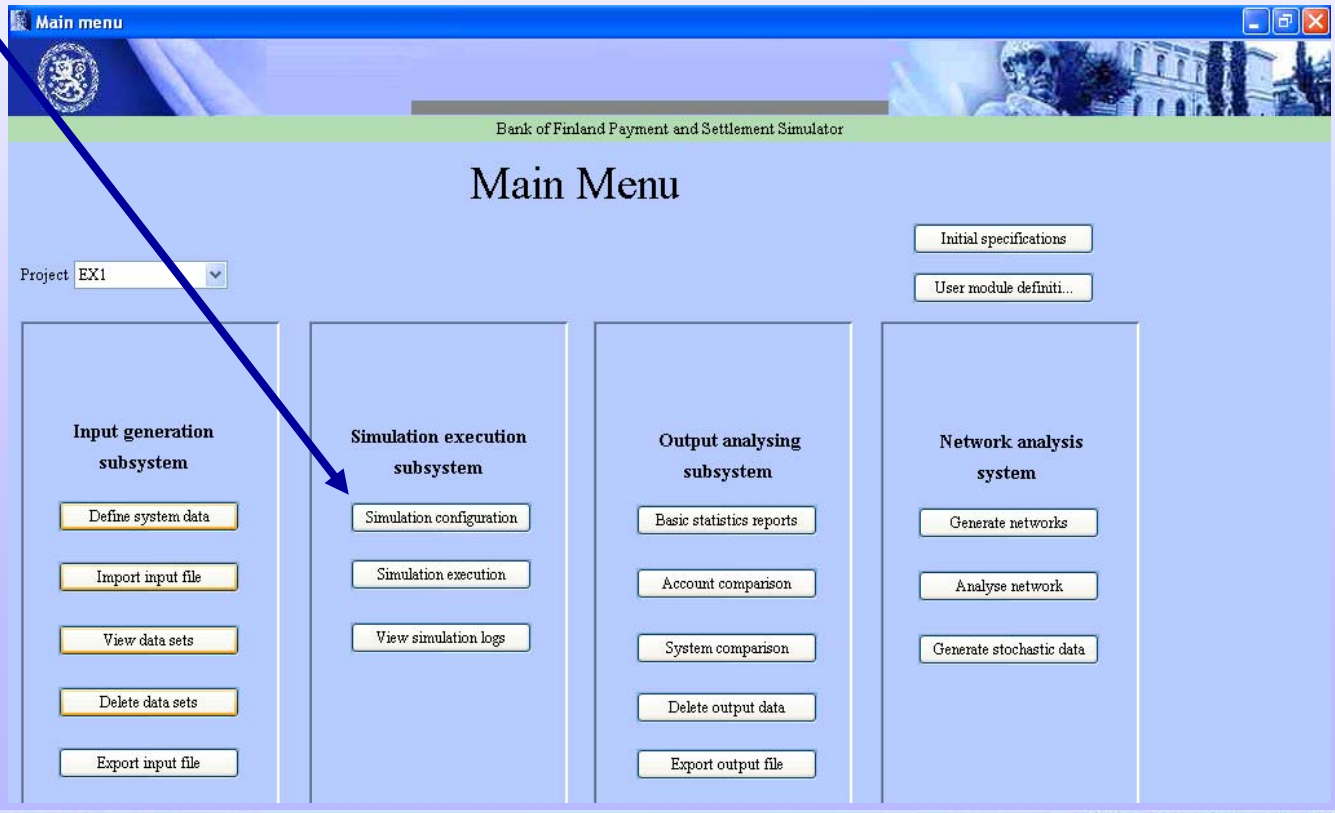
Erroneous or unnecessary data sets can be Deleted.



Main menu

Now the first main phase *input data creation* is cleared.

Move to simulation execution by selecting *simulation configuration* in main menu.



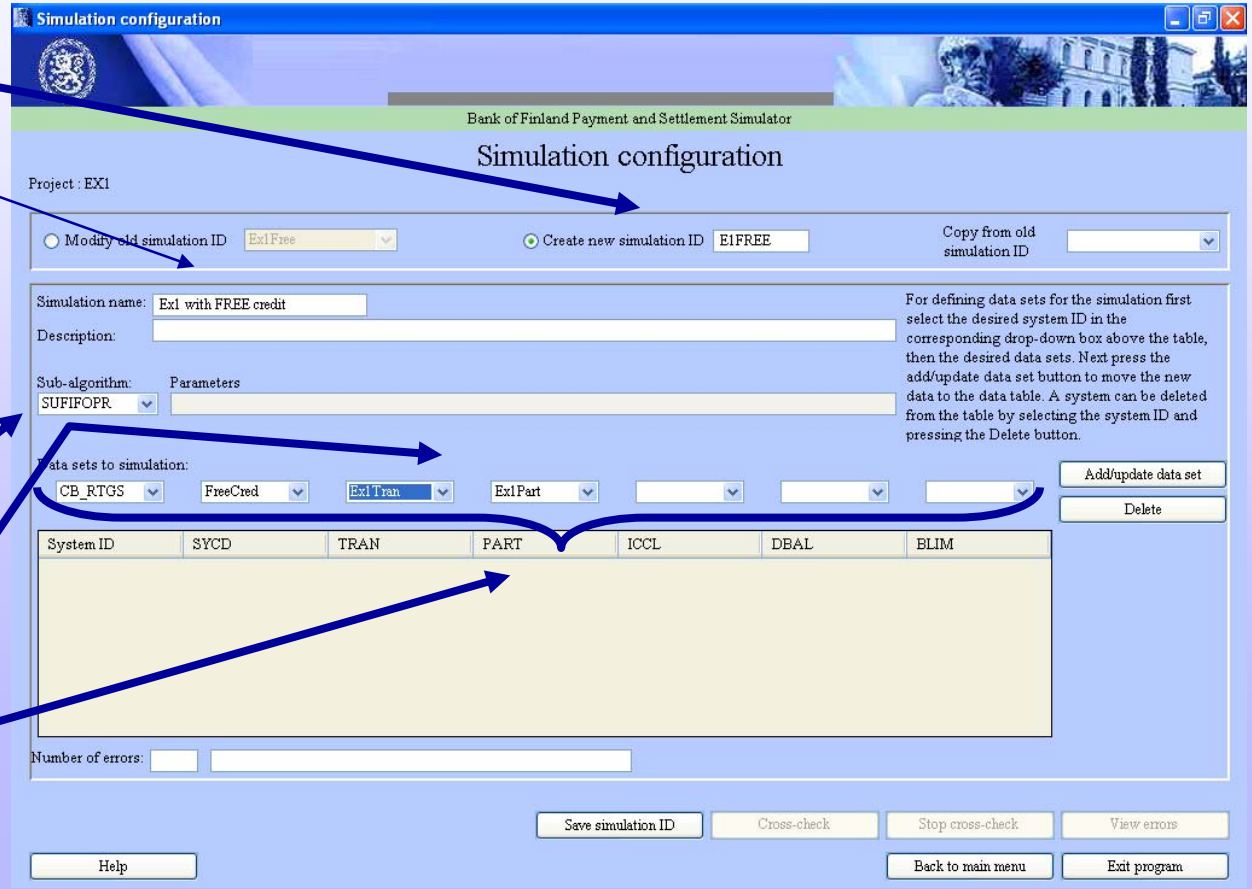
Simulation configuration 1

In simulation configuration window simulations are built by selecting the desired combination of imported data sets.

Start by typing simulation ID.
Simulation name and description are optional.
Again **use good naming convention** which describes the configured simulation.

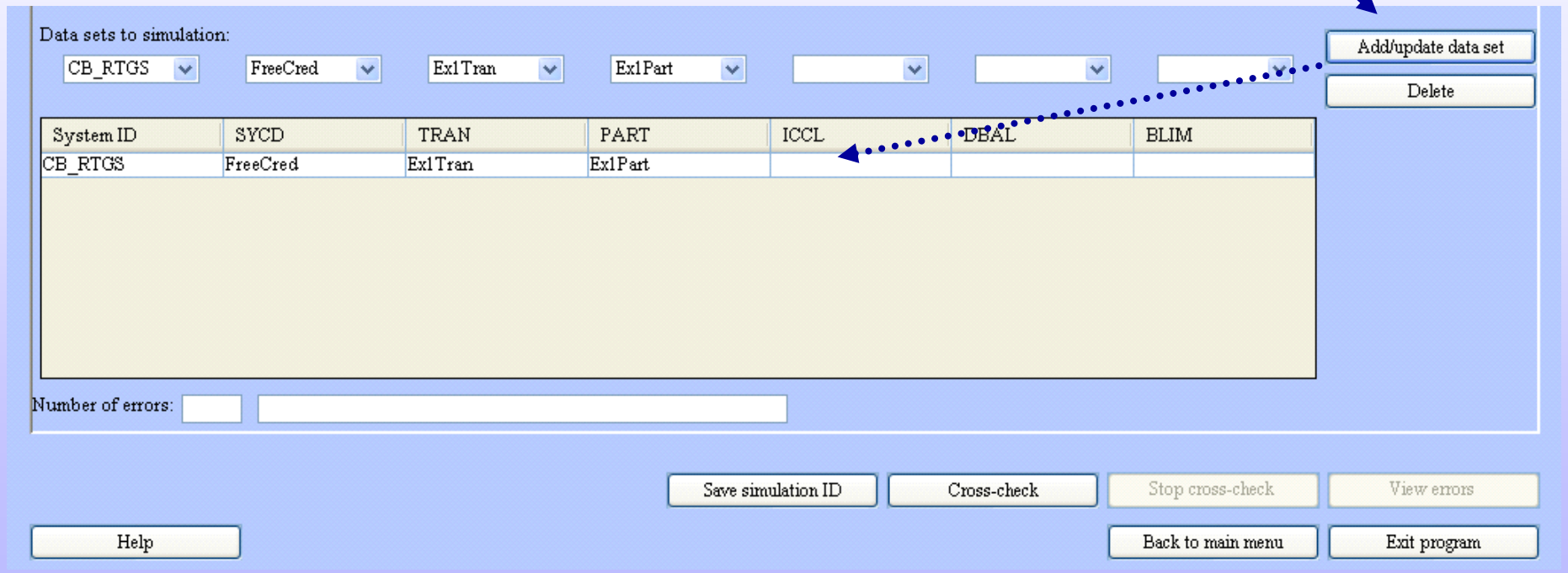
Select SUFIFOPR sub-algorithm.

Select which datasets are included in this simulation.



Simulation configuration 2

After selecting all necessary datasets from drop down menus, add them to simulation.

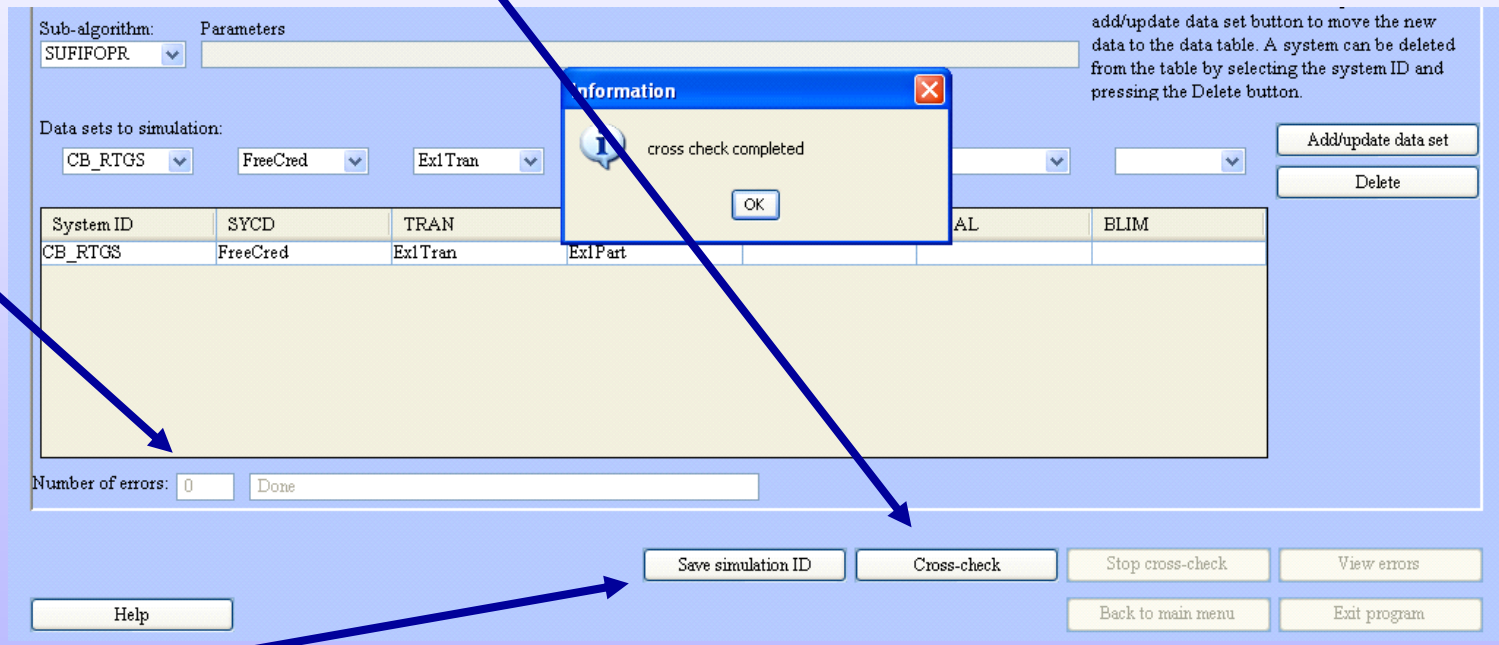


Simulation configuration 3

The integrity of configured simulation data must be checked. This is done by executing Cross-check.

-When cross-check is completed, make sure there were no errors (otherwise see the next slide).

-And save the created simulation ID.

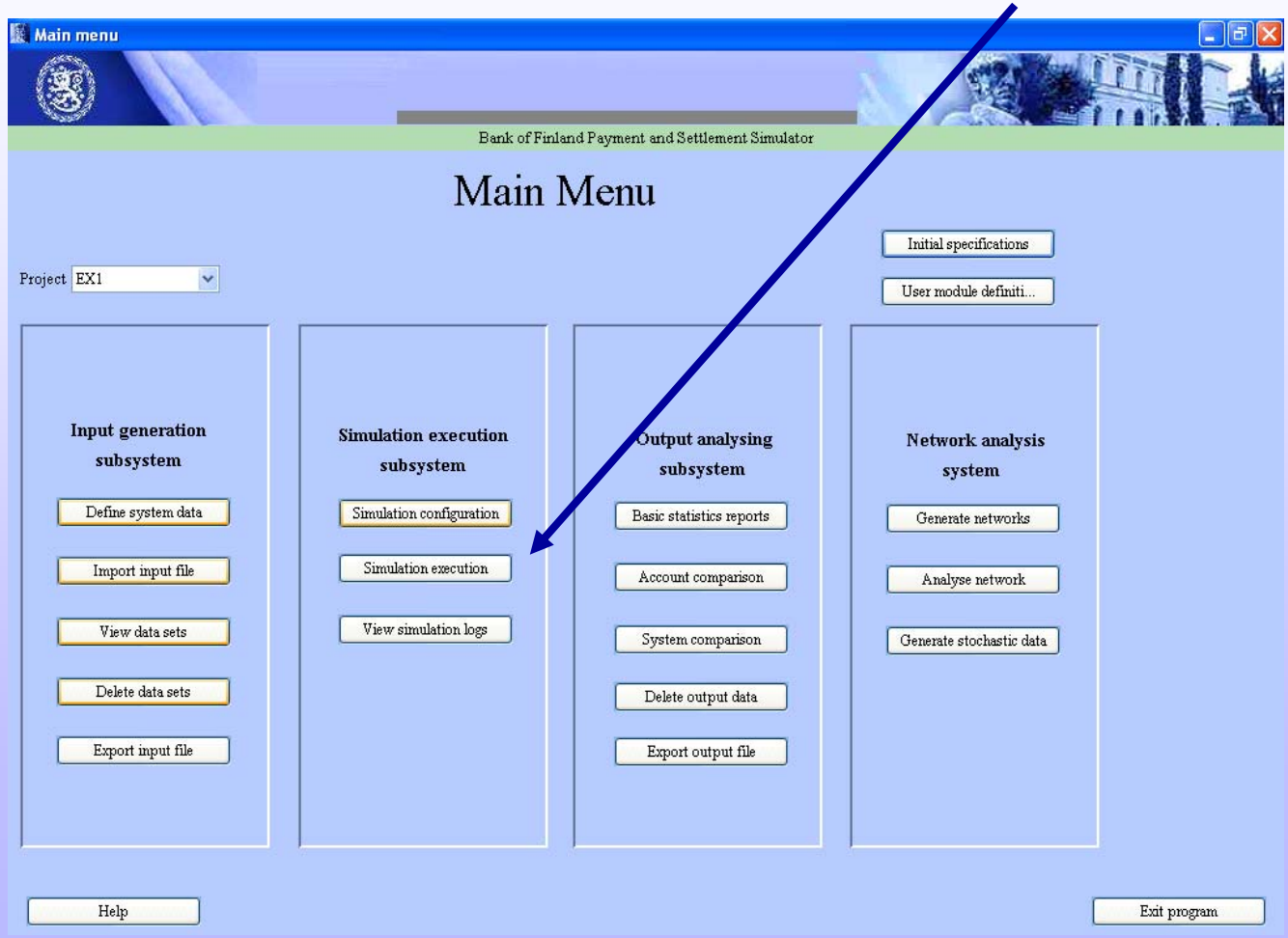


Cross-checking for data coherency

- Simulation configuration implies definition of which systems will run and with which data sets
- Cross-checking implies checking for data coherency e.g. that
  - all participants/accounts mentioned in transactions are available.
  - all systems are available as demanded by inter-system transactions
  - Systems are open when transactions are entering (same for intraday credit limit changes and beginning of day balances)
- Import functions have only checked the correctness of data values, but no cross-table checks have been made
- Incoherent data (sets) will not execute
- Cross-check will give error reports similar to import errors if there are problems

Simulation execution

Return to main menu and select simulation execution

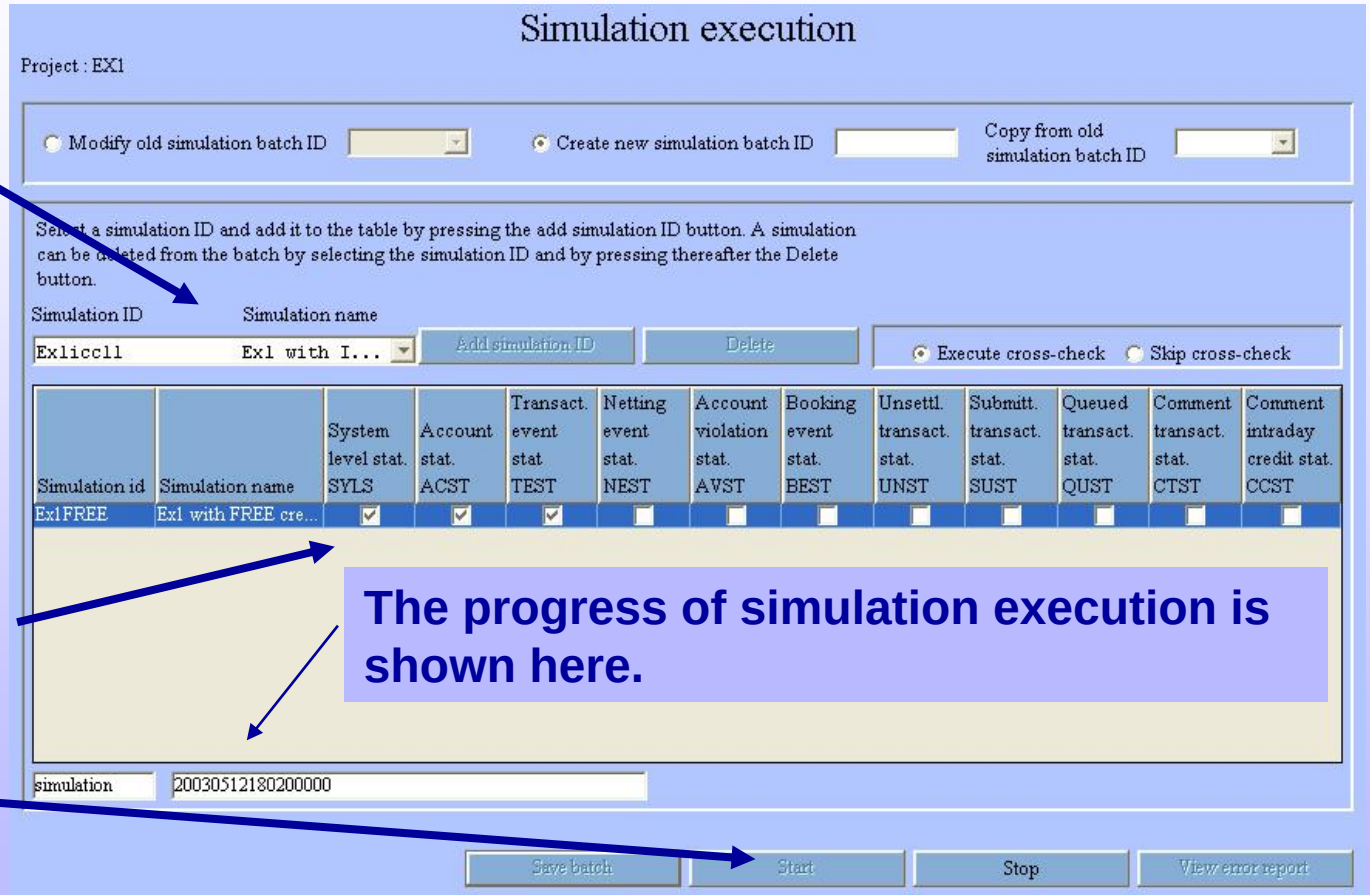


Simulation execution 1

-Select the simulation you want to execute and click Add simulation.
(Several simulations can be included in one batch run)

Define which output database are saved
(Basic set: SYLS, ACST & TEST)

Start the simulation

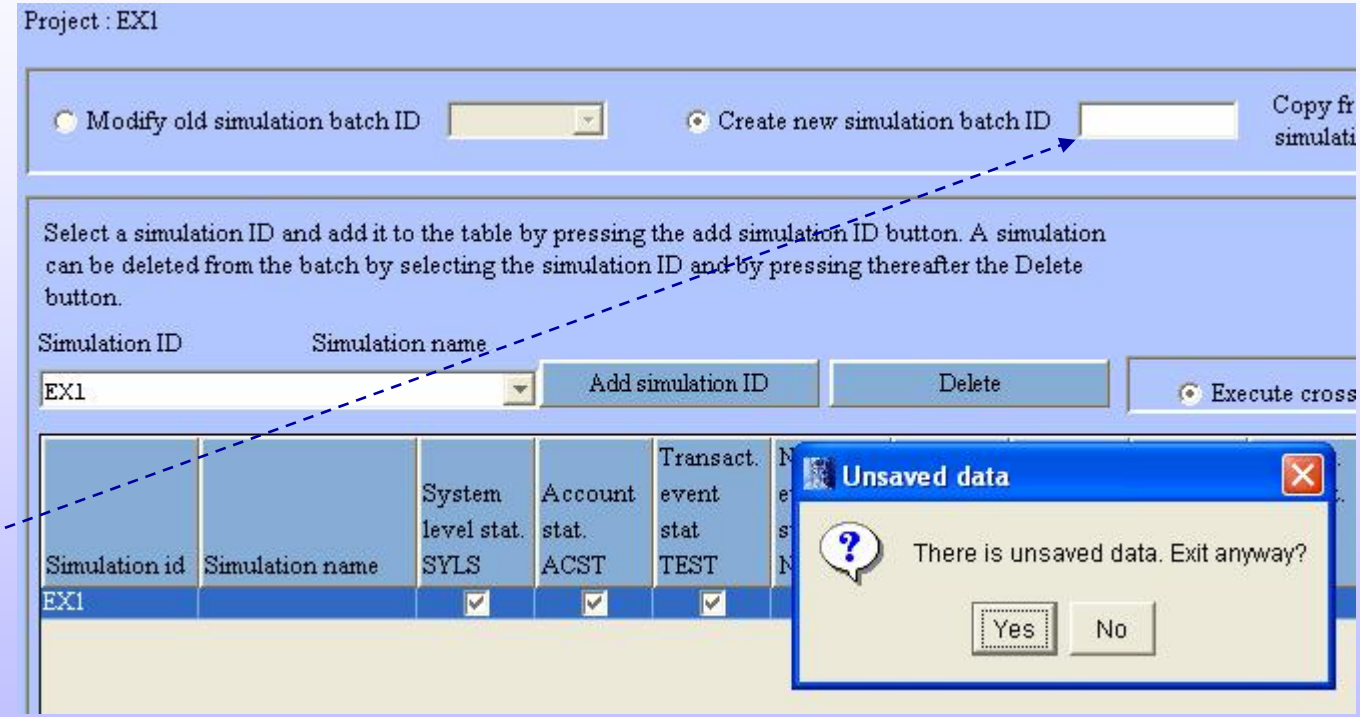


Simulation execution 2

After simulation is successfully executed, return to main menu.

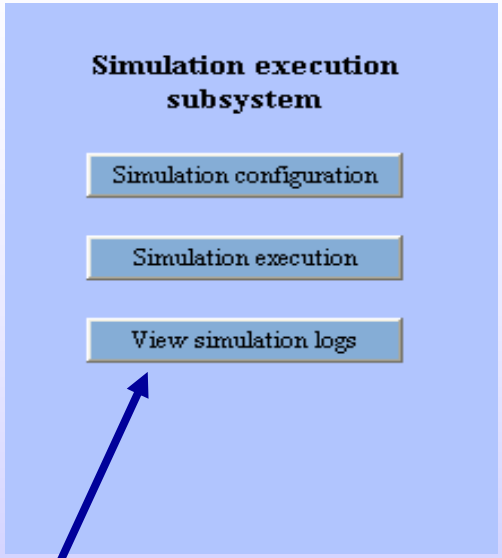
You will be asked about unsaved data. (batch run information).

With Batch ID it is possible to save the created setup (which simulations to run and which output tables to save for each simulation).

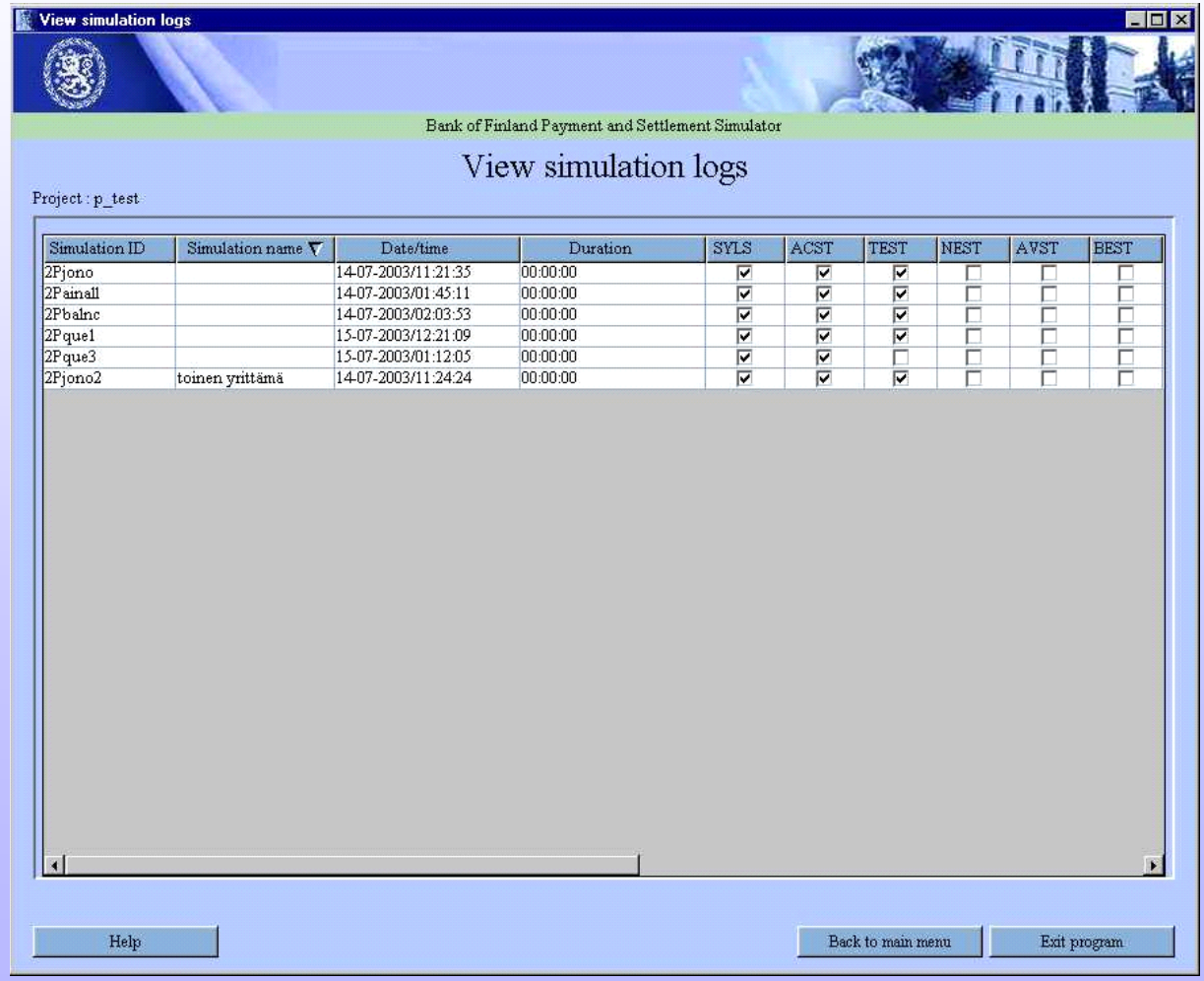


For this tiny example such is not worthwhile. Select to exit anyway.

Simulation execution 3

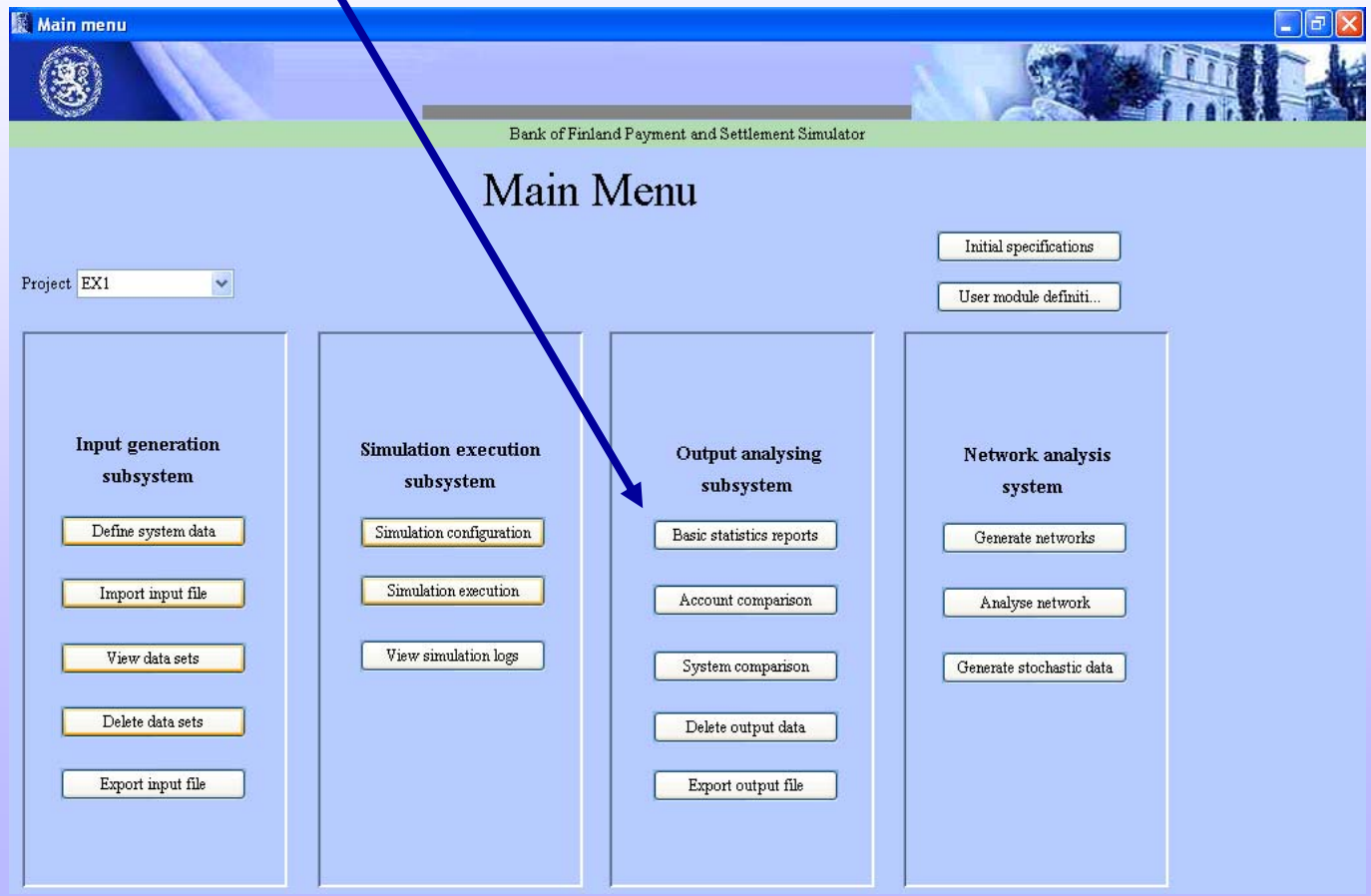


View simulation logs **button in Main menu can be used to examine previous simulations and available output data tables.**

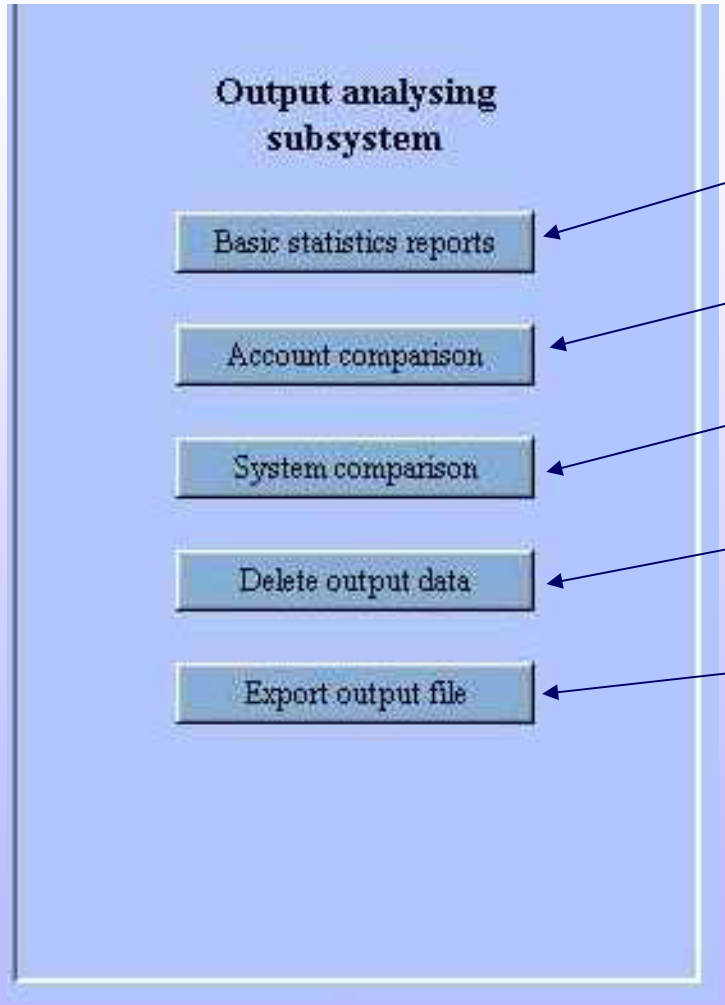


Output analysing subsystem

Reports can be created after successful execution of a simulation



The output analysing subsystem provides basic output reports and export facilities



Basic statistics report

Account level comparisons of simulations

System level comparisons of simulations

Deleting unnecessary output data

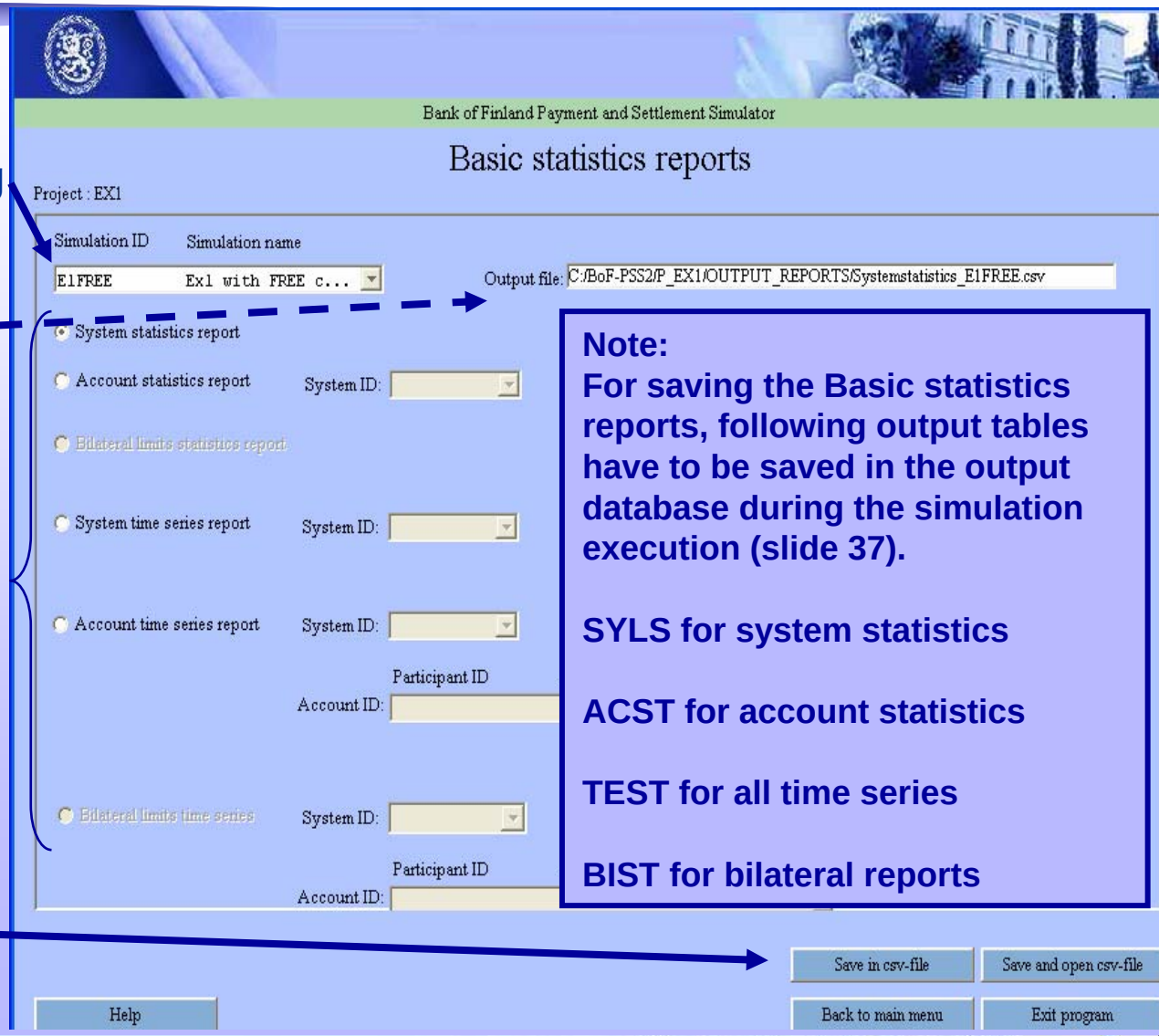
Exporting output files for further analyses (all data from output database to CSV files)

Ready made reports: basic statistics

Simple reports can be exported from *Basic statistics reports* window after choosing the executed simulation. Path and name of the output file can be edited here.

These include i.e. simple system or account level statistics (see next slide) and time series with defined time interval.

After choosing the desired report, you can save it or save & open with Excel (close excel to return to simulator).



Example 1 results

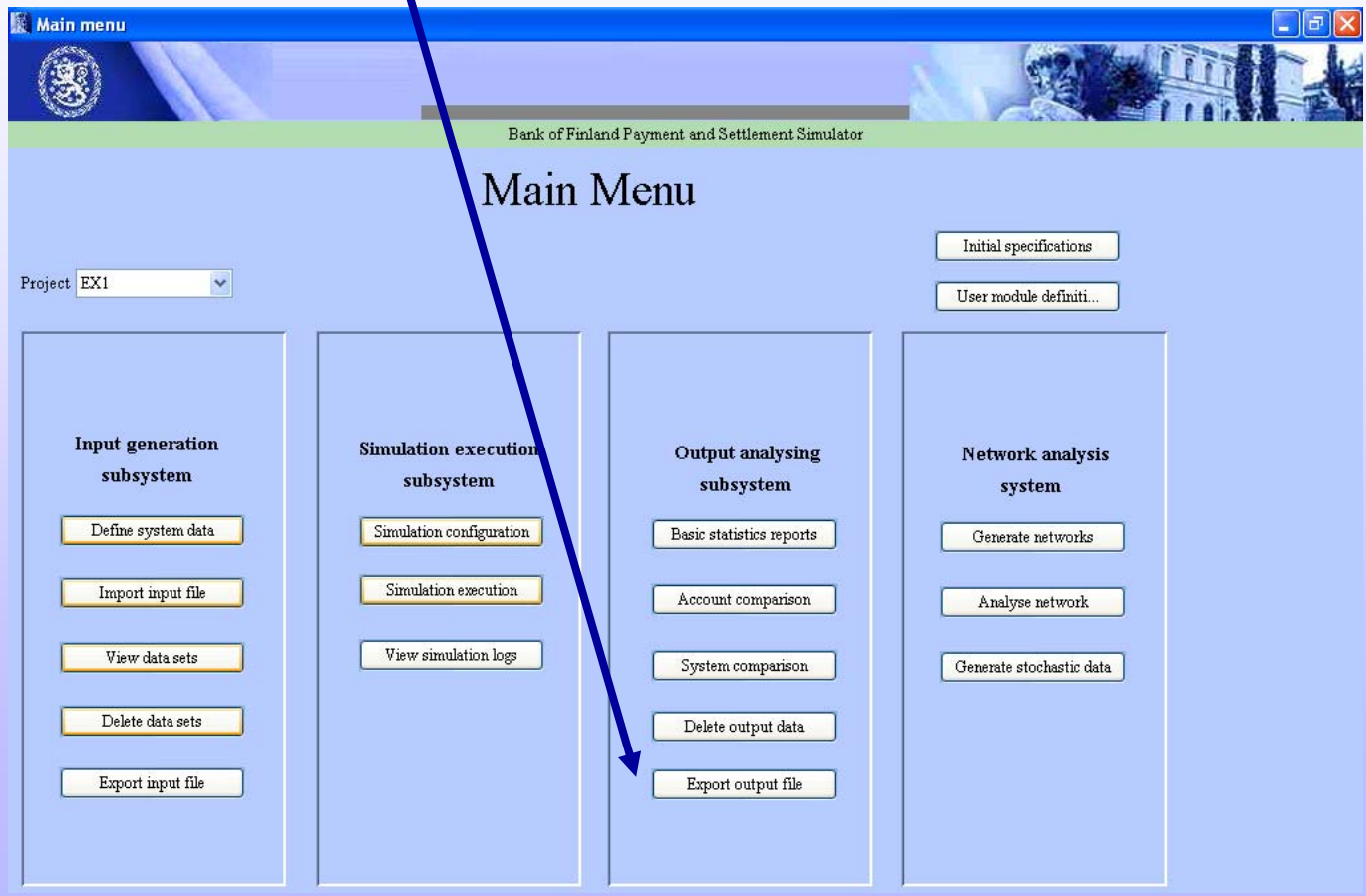
Correct results for example simulations are distributed with the example material. These are listed in the example description text file.

For example file Ex1_ Accountstatistics_free_dp.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Account statistics													
2														
3	Simul. ID:	ex1_free	Simul. date:	5-25-2004										
4	Simul. nan	Example1_	Simul. time:	11:48:02										
5	System:	SMALL												
6														
7	Date	Participant	Account	Bod	Eod	Ave	Min	Max	Average cr	Value settl	Value unse	Number se	Number unsettl	
8	12.5.2003	1		0	-9920125.53	-1.55E+07	-6.25E+07	8976191	4.10E+07	7.56E+07	0	52	0	
9	12.5.2003	10		0	201801.95	-8117389.29	-1.24E+07	1204704	1.14E+07	1.51E+07	0	16	0	
10	12.5.2003	11		0	-2.57E+08	-9.76E+07	-4.16E+08	3.59E+08	2.17E+08	1.68E+09	0	115	0	
11	12.5.2003	12		0	2.04E+08	3.56E+08	-6.79E+07	7.77E+08	6.78E+07	9.51E+08	0	71	0	
12	12.5.2003	13		0	-2.31E+08	1.45E+07	-2.31E+08	2.00E+08	1.34E+08	9.94E+08	0	89	0	
13	12.5.2003	14		0	2.32E+08	2.16E+08	-113762.95	4.98E+08	113605	3.18E+08	0	63	0	
14	12.5.2003	15		0	-237.21	-150.32	-237.21	0	150.32	237.21	0	2	0	
15	12.5.2003	16		0	-3.09E+07	-9.72E+07	-1.28E+08	0	1.28E+08	2.09E+08	0	60	0	
16	12.5.2003	17		0	0.03	-1.74E+07	-9.55E+07	1.28E+08	6.29E+07	2.75E+08	0	9	0	
17	12.5.2003	18		0	0	-1.74E+07	-1.21E+08	0	9.04E+07	1.21E+08	0	26	0	
18	12.5.2003	2		0	-8257211.55	-2.45E+07	-4.63E+07	4.27E+07	3.52E+07	1.04E+08	0	47	0	
19	12.5.2003	3		0	231.61	-2.24E+07	-9.85E+07	231.61	4.58E+07	1.44E+08	0	102	0	
20	12.5.2003	4		0	140	91.97	0	140	0	0	0	0	0	
21	12.5.2003	5		0	-5.47E+07	2.54E+07	-5.47E+07	1.24E+08	1.68E+07	2.02E+08	0	25	0	
22	12.5.2003	6		0	1.56E+08	1.29E+08	-3.15E+07	2.15E+08	2.63E+07	9.81E+07	0	31	0	
23	12.5.2003	7		0	0	0	0	0	0	0	0	0	0	
24	12.5.2003	8		0	3.90E+08	6.11E+07	0	3.90E+08	0	0	0	0	0	
25	12.5.2003	9		0	-3.90E+08	-5.02E+08	-1.46E+09	0	1.06E+09	2.58E+09	0	70	0	
26														

Exporting output data

With Export output file tool detailed data can be exported to CSV files.



Exporting output data 1

- Data from tables which were saved in the simulation execution can be exported. In this example SYLS, ACST and TEST were saved.
- Similar templates as in data import are used
- Data can be analysed in any program i.e. Excel

Available output databases:
(exact definitions of data fields are found in Descriptions of databases and files -manual)

SIMULATION, SYSTEM AND ACOCUNT LEVEL

SYLS, system level statistics

ACST, account level statistics

BIST, bilateral statistics

TRANSACTIONS LEVEL

TEST, Transaction event statistics,

NEST, Netting event statistics,

AVST, account violation statistics

BEST, booking event statistics,

UNST, unsettled transactions statistics

SUST, submitted transactions statistics

QUST, queued transactions statistics

CTST, comment transactions statistics

CCST, comment intraday credit statistics

QURE, queuing reason statistics

Exporting output data 2

Specify/change data formats

-Choose simulation and output table.

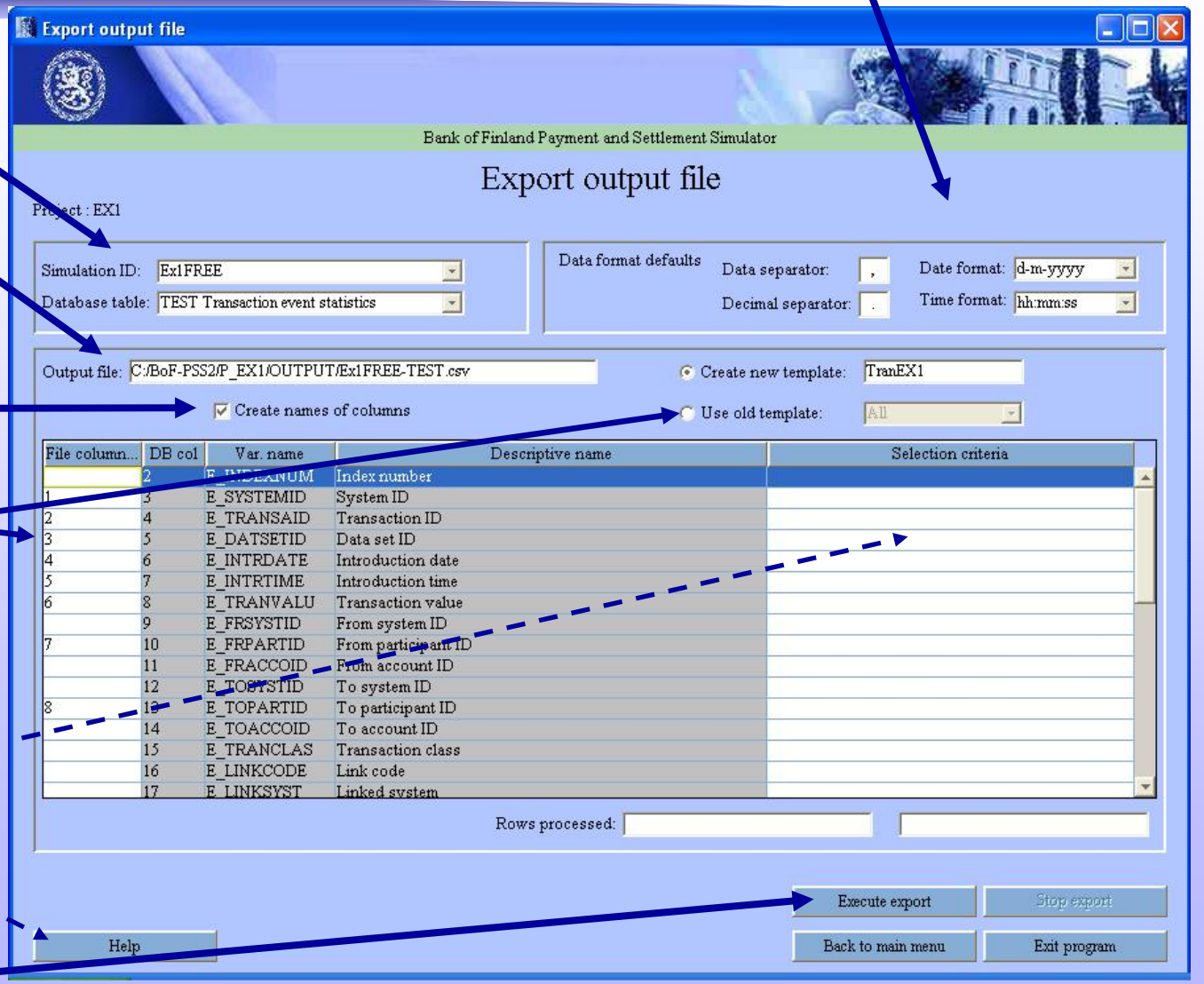
-Name for output file.

-Enable column names if necessary.

-Choose or define output template (i.e. which lines will be Included in the export).

-Export criteria can be useful for large data sets (see help topic 5.9 for Selection criteria).

-Execute export (next slide).



Example of output export CSV-file opened with Excel

Microsoft Excel - Test1

File Edit View Insert Format Tools Data Window Help

Arial 10 B I U 100%

A1 = FIRSTSMA

	A	B	C	D	E	F	G	H	K	L	M	N
1	FIRSTSMA	FIRST SMALL										
2	System ID	Transactio	Data set ID	Introductio	Introductio	Transaction val	From p	To p:	Settlement time	Settlement	Sending account's balance	
3	RTGS-A	100	TRAN1	12.5.2003	22:10:00	4880384,39	13	1	22:10:00	1	-4880384,39	
4	RTGS-A	101	TRAN1	12.5.2003	22:10:00	685826,6	12	1	22:10:00	1	-685826,6	
5	RTGS-A	102	TRAN1	12.5.2003	22:10:00	2639630,73	11	1	22:10:00	1	-2639630,73	
6	RTGS-A	103	TRAN1	12.5.2003	22:10:00	46064,41	10	1	22:10:00	1	-46064,41	
7	RTGS-A	104	TRAN1	12.5.2003	22:10:00	633795,99	2	1	22:10:00	1	-633795,99	
8	RTGS-A	105	TRAN1	12.5.2003	22:10:00	79702,04	14	1	22:10:00	1	-79702,04	
9	RTGS-A	106	TRAN1	12.5.2003	22:10:00	2786,33	6	1	22:10:00	1	-2786,33	
10	RTGS-A	107	TRAN1	12.5.2003	22:10:00	8000,03	5	1	22:10:00	1	-8000,03	
11	RTGS-A	108	TRAN1	12.5.2003	22:10:00	153492,54	13	5	22:10:00	1	-5033876,93	
12	RTGS-A	109	TRAN1	12.5.2003	22:10:00	83989,24	12	5	22:10:00	1	-769815,84	
13	RTGS-A	110	TRAN1	12.5.2003	22:10:00	779471,41	11	5	22:10:00	1	-3419102,14	
14	RTGS-A	111	TRAN1	12.5.2003	22:10:00	6678,92	10	5	22:10:00	1	-52743,33	
15	RTGS-A	112	TRAN1	12.5.2003	22:10:00	49921,7	2	5	22:10:00	1	-683717,69	
16	RTGS-A	113	TRAN1	12.5.2003	22:10:00	17337,06	14	5	22:10:00	1	-97039,1	
17	RTGS-A	114	TRAN1	12.5.2003	22:10:00	300182,44	6	5	22:10:00	1	-302968,77	
18	RTGS-A	115	TRAN1	12.5.2003	22:10:00	18950,49	1	5	22:10:00	1	8957240,03	
19	RTGS-A	116	TRAN1	12.5.2003	22:10:00	1634545,51	13	6	22:10:00	1	-6668422,44	

All data fields and rows of a given data table recognised by the simulation ID can be exported

That's it!

What next?

- You can run the same simulation with intraday credit limits. For this you need to import additional data and create a new system setup (see Ex1-description.txt).
- Having several simulations run in one project, you can test account & system comparison reports

There are also three other examples provided with different systems structures (correct answers are also included):

- Example 2 with two systems, a main RTGS and a continuous net settlement system in interaction.
- Example 3 with two systems, a main RTGS and a deferred net settlement system, in interaction.
- Example 4 with RTGS based securities settlement system with Delivery Versus Payment -functionality.