

## 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.

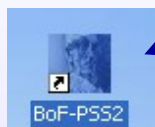
Therefore follow the steps of the example by repeating **only** the actions which are pointed with  thick arrows (from top to down)

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



# Start the simulator

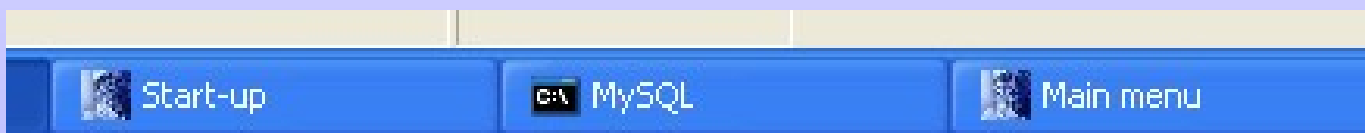
4



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

**Initial specifications**

Bank of Finland Payment and Settlement Simulator

Version: 0.9.6/2004-02-24  
Licensee: Bank of Finland  
Financial Markets

**Initial specifications**

☒ Create new project:  ☐ Modify old project:

**Databases**

The simulator will create a new input and output database for each project in the indicated default directory. The user can change directory and also specify an already existing input and output database when desired. However, there can only be one input and output database assigned to the same project at one time.

Input database:

Output database:

**Default directories**

The simulator will use indicated default directories for the different file types. Each project is assumed to have its own default directories. The user can change the defaults and also use common directories.

Default directory for input files:

Default directory for error list:

Default directory for output files:

Default directory for output reports:



# Main menu

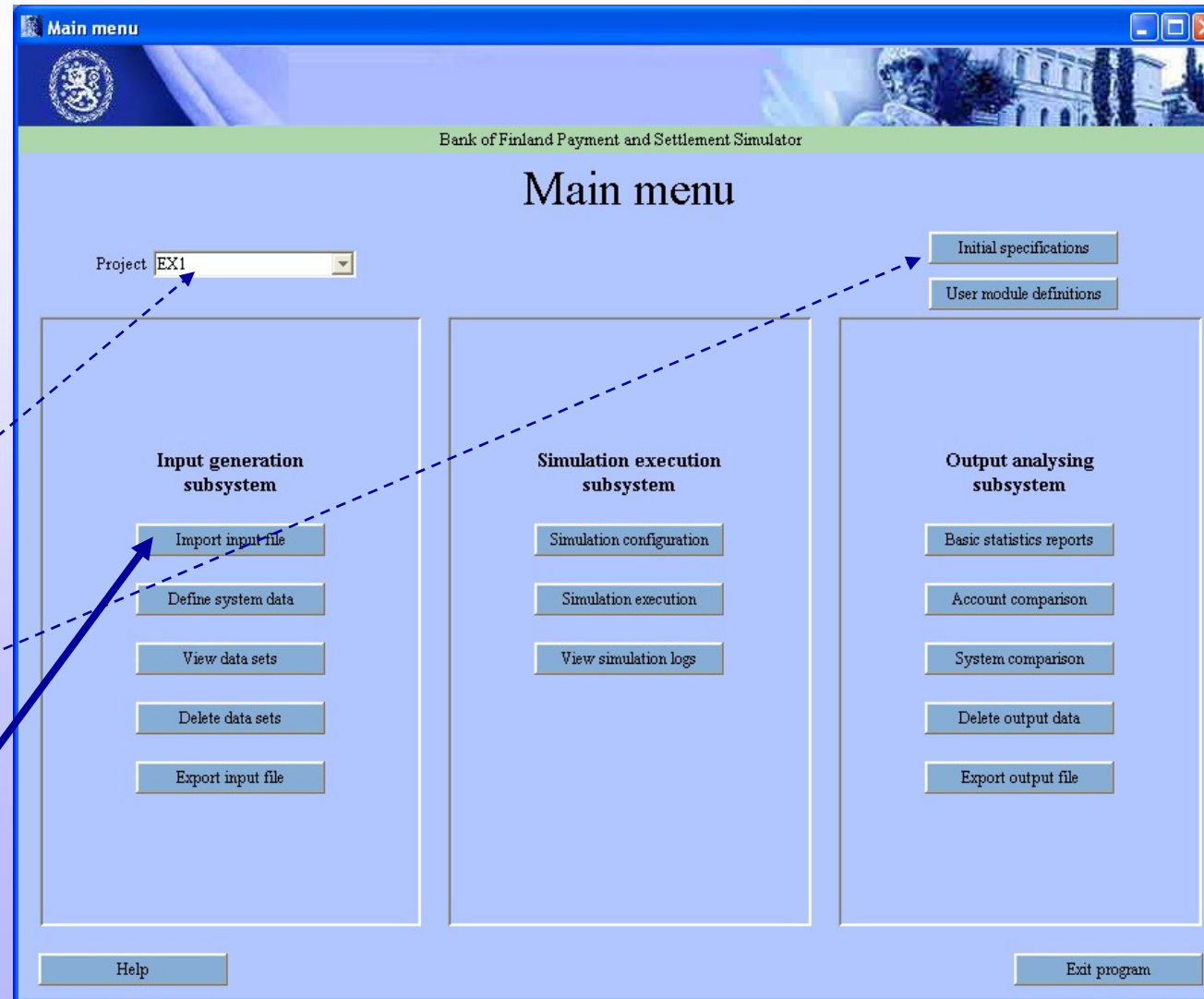
The main menu will open up whenever you start the simulator in the future.

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 importing data (click on the button).



There are four types of input files

- Participant data files
- Transaction data files
- Intraday credit data files
- Beginning-of-day balances files

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

The default folder for input files is INPUT in the corresponding project directory. In our project EX1 –case 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. See [www.bof.fi/sc/bof-pss](http://www.bof.fi/sc/bof-pss)

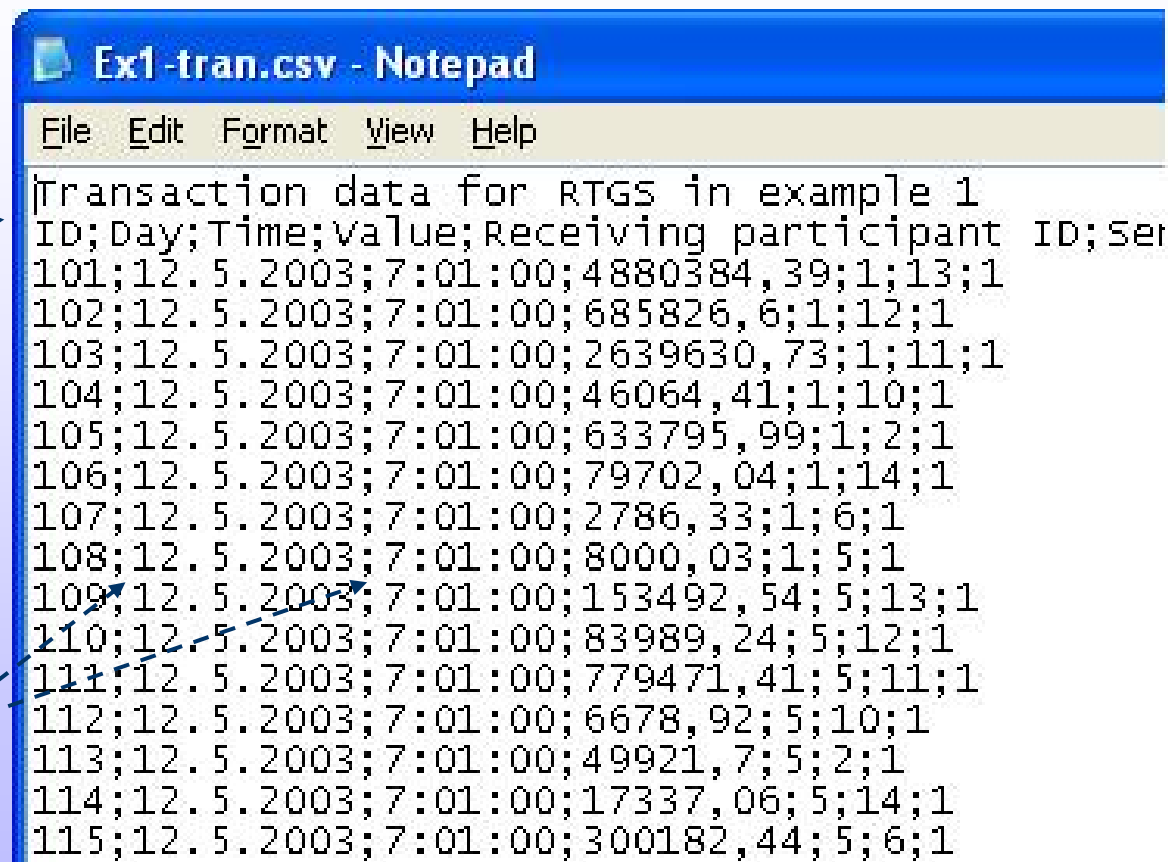
The “import input file” screen can now be used to import the data to input database of the simulator.



# Typical CSV-file

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

Data delimiter between each data field ( ; )



```

Ex1-tran.csv - Notepad
File Edit Format View Help
Transaction data for RTGS in example 1
ID;Day;Time;Value;Receiving participant ID;Ser
101;12.5.2003;7:01:00;4880384,39;1;13;1
102;12.5.2003;7:01:00;685826,6;1;12;1
103;12.5.2003;7:01:00;2639630,73;1;11;1
104;12.5.2003;7:01:00;46064,41;1;10;1
105;12.5.2003;7:01:00;633795,99;1;2;1
106;12.5.2003;7:01:00;79702,04;1;14;1
107;12.5.2003;7:01:00;2786,33;1;6;1
108;12.5.2003;7:01:00;8000,03;1;5;1
109;12.5.2003;7:01:00;153492,54;5;13;1
110;12.5.2003;7:01:00;83989,24;5;12;1
111;12.5.2003;7:01:00;779471,41;5;11;1
112;12.5.2003;7:01:00;6678,92;5;10;1
113;12.5.2003;7:01:00;49921,7;5;2;1
114;12.5.2003;7:01:00;17337,06;5;14;1
115;12.5.2003;7:01:00;300182,44;5;6;1
  
```

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





# Import participant data 1

9

Select PART table

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

Browse for input file

State system name  
i.e. the name to recognize  
the payment system  
(in this example EX1)

State data set ID,  
(i.e. EX1PART)

See explanation on  
next page

Bank of Finland Payment and Settlement Simulator

Import input file

Project: EX1

Database table: PART participant data

Data format defaults

Data separator: ; Date format: yyyymmdd

Decimal separator: , Time format: hhmmss

Input file: C:\BoF-PSS2\P\_EX1\INPUT\Ex1-part.csv Browse

System ID: EX1

Create new data set: EX1PART

Create new template: PART

Update old data set: [ ]

Use old template: [ ]

Insert in old data set: [ ]

Number of rows/records to skip at the beginning: 2

Number of rows/records to skip at the end: 0

Data table

Line column...	DB col	Man/Opt	Var. name	Descriptive name
1	3	M	P_PARTICID	Participant ID
2	4	O	P_ACCOUNTID	Account ID
3	5	O	P_FULLNAME	Full name
4	6	O	P_SHORTACR	Short acronym
5	7	O	P_ACCOUNTNAME	Account name
6	8	O	P_SETINSYS	Settles in system
7	9	O	P_SETONPAR	Settles on participant
8	10	O	P_SETONACC	Settles on account

Rows processed: [ ] Rows with errors: [ ]

Stop import Undo import Execute import View error report

Help Back to main menu Exit program

# 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

<b>Data set IDs</b>	CRVAL1	CRVAL2		CRVALn
<b>Data tables</b>	<div>ICCL table</div>	<div>ICCL table</div>	• • •	<div>ICCL table</div>

*Use a clear naming convention  
for different data sets*



# Import participant data 2

11

**Import input file**

Bank of Finland Payment and Settlement Simulator

Project : EX1

Database table:

Data format defaults  
Data separator:  Date format:   
Decimal separator:  Time format:

Input file:

☒ Create new data set:  ☒ Create new template:   
☐ Update old data set:   
☐ Insert in old data set:

Number of rows/records to skip at the beginning:  Number of rows/records to skip at the end:

Data table

File column...	DB col	Man/Opt	Var. name	Descriptive name
1	3	M	P_PARTICID	Participant ID
	4	O	P_ACCOUNTID	Account ID
2	5	O	P_FULLNAME	Full name
	6	O	P_SHORTACR	Short acronym
	7	O	P_ACCOUNTNAME	Account name
	8	O	P_SETINSYS	Settles in system
	9	O	P_SETONPAR	Settles on participant
	10	O	P_SETONACC	Settles on account

Rows processed:  Rows with errors:

Create a new template that corresponds to your input data

State the name of the new template (see also next slide)

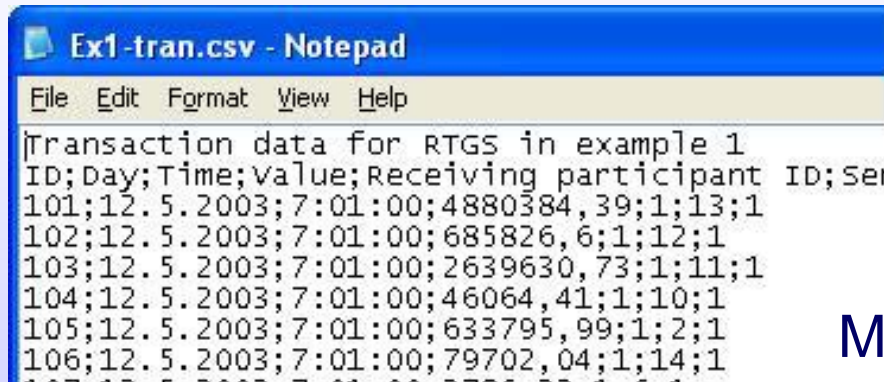
State how many lines to skip in the beginning

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



# Template to CSV-file relationship, Example for transaction data<sup>12</sup>

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



```
Ex1-tran.csv - Notepad
File Edit Format View Help
Transaction data for RTGS in example 1
ID;Day;Time;Value;Receiving participant ID;Ser
101;12.5.2003;7:01:00;4880384,39;1;13;1
102;12.5.2003;7:01:00;685826,6;1;12;1
103;12.5.2003;7:01:00;2639630,73;1;11;1
104;12.5.2003;7:01:00;46064,41;1;10;1
105;12.5.2003;7:01:00;633795,99;1;2;1
106;12.5.2003;7:01:00;79702,04;1;14;1
```

Two introductory  
explanation rows  
to be skipped

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

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

13

Import input file

Bank of Finland Payment and Settlement Simulator

Project: EX1

Database table:

Data format defaults

Data separator:  Date format:

Decimal separator:  Time format:

Input file:

System ID:

☐ Create new data set

☐ Update old data set

☐ Import old data set

EX1PART

Create new template:

Use old template:

Number of rows/records to skip at the beginning:

Information

Import data created and saved to database!

File column...	DB col	Man/Opt	Var. name	
1	3	M	P_PARTICID	Participant ID
	4	O	P_ACCOUNTID	Account ID
2	5	O	P_FULLNAME	Full name
	6	O	P_SHORTACR	Short acronym
	7	O	P_ACCOUNTNAME	Account name
	8	O	P_SETINSYS	Settle in system
	9	O	P_SETONPAR	Settles on participant
	10	O	P_SETONACC	Settles on account

Rows processed:  Rows with errors:

Start the import by  
Clicking “Execute  
import” button

Clic “Ok” in popup  
Informing the ending  
of import

Check that all lines  
were imported  
Successfully  
(0 lines with error)

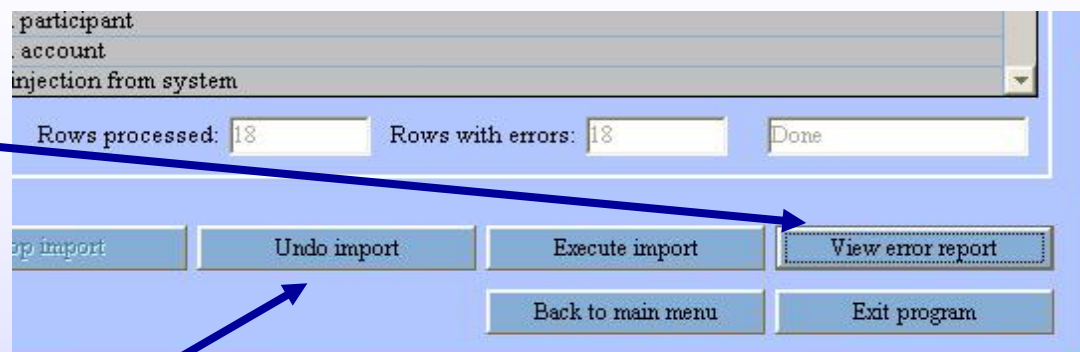
If there were errors  
see the next two  
slides



# Import error handling for participant data

14

If the import wasn't  
Successful you  
can view error report.  
See the next slide.



(It opens in Excel, which  
needs to be closed in order  
to get back to the simulator)

And undo the import.

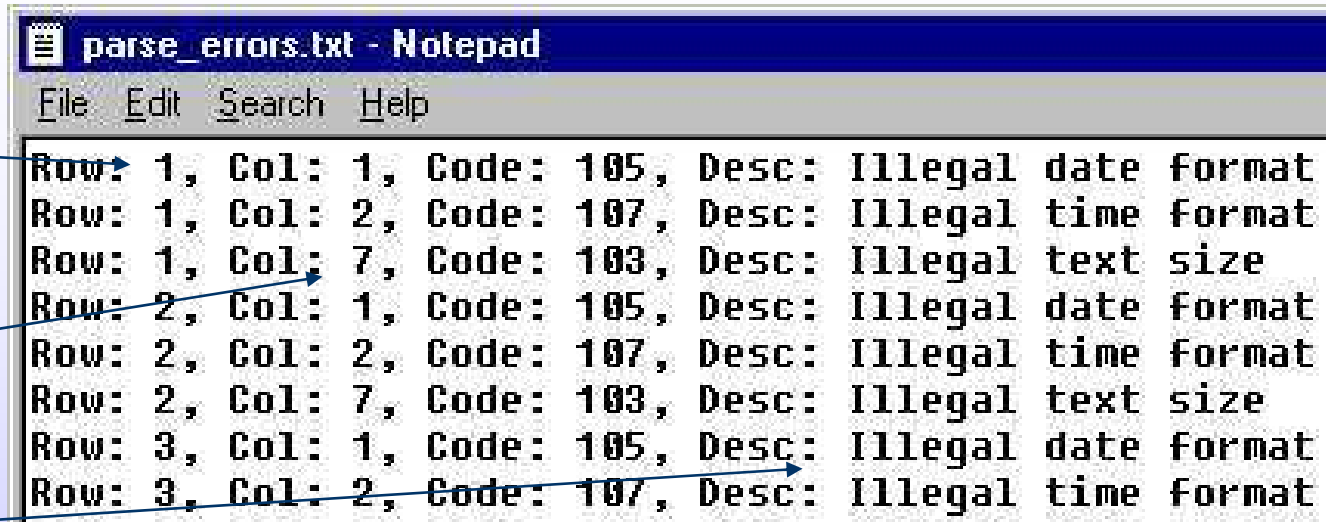
For opening the error reports outside the simulator look in  
to ERRORLIST folder in the projects directory (in this  
example C:\BoF-PSS2\P\_EX1\ERRORLIST)



Line in CSV-file  
with error

Column/field  
with error

Error type



	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)



# Import transaction data 1

16

Change the database table to TRAN for importing transactions

Check the date and time format. (in this example d-m-yyyy and hh:mm:ss) Data and decimal separators settings are remembered from previous import.

Choose the file to import

State data set ID

Type in the System ID precisely in the same form as before in participant data (case sensitive)

Bank of Finland Payment and Settlement Simulator

Import input file

Project: EX1

Database table: **TRAN Transaction data**

Data format defaults

Data separator: **,** Date format: **d-m-yyyy**

Decimal separator: **.** Time format: **hh:mm:ss**

Input file: **C:\BoF-PSS2\IP\_EX1\INPUT\Ex1-trans.csv** Browse

System ID: **EX1**

Create new data set: **EXITRAN**

Create new template: **TRAN**

Update old data set:

Use old template:

Number of rows/records to skip at the beginning: **0**

Number of rows/records to skip at the end: **0**

Data table

File column...	DB col	Man/Opt	Var. name	Descriptive name
1	3	M	T_TRANSAID	Transaction ID
2	4	M	T_INTRODATE	Introduction date
3	5	M	T_INTRTIME	Introduction time
4	6	M	T_TRANVALU	Transaction value
7	7	O	T_FRSYSTID	From system ID
6	8	M	T_FRPARTID	From participant ID
9	9	O	T_FRACCOID	From account ID
10	10	O	T_TOSYSTID	To system ID
5	11	M	T_TOPARTID	To participant ID
12	12	O	T_TOACCOID	To account ID

Rows processed: Rows with errors:

Stop import Undo import Execute import View error report

Help Back to main menu Exit program



# Import transaction data 2

17

Choose to create new template and state the name for it

Choose the number of lines to skip

Enter the numbers of columns where the required fields are located in the csv-file (for this recall the more detailed explanation on slide 11 )

Start the import by clicking "Execute import"

Bank of Finland Payment and Settlement Simulator

Import input file

Project : EX1

Database table: TRAN Transaction data

Data format defaults

Data separator: ; Date format: d-m-yyyy

Decimal separator: , Time format: hh:mm:ss

Input file: C:\BoF-PSS2\F\_EX1\INPUT\Ex1-tran.csv Browse

System ID: EX1

Create new data set: EX1TRAN

Create new template: TRAN

Update old data set:

Use old template:

Insert in old data set:

Number of rows/records to skip at the beginning: 2

Number of rows/records to skip at the end: 0

Data table

File column...	DB col	Man/Opt	Var. name	Descriptive 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
	12	O	T_TOACCOID	To account ID

Rows processed: Rows with errors:

Stop import Cancel import Execute import View error report

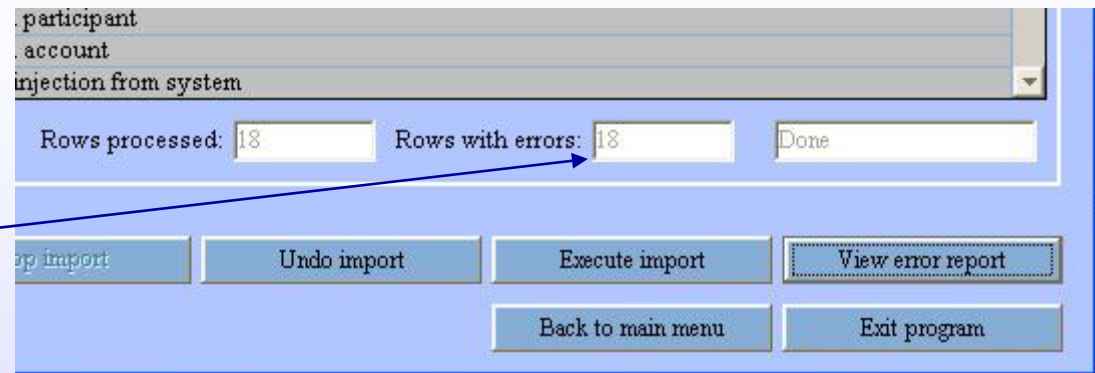
Help Back to main menu Exit program

# Import transaction data 3

18

**When import is finished  
check that it was successful  
(0 rows with errors)**

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



participant  
account  
injection from system

Rows processed: 18 Rows with errors: 18 Done

Import Undo import Execute import View error report

Back to main menu Exit program

**Basic solutions to error situations were listed on slide “Import error handling for participant data”. 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.**



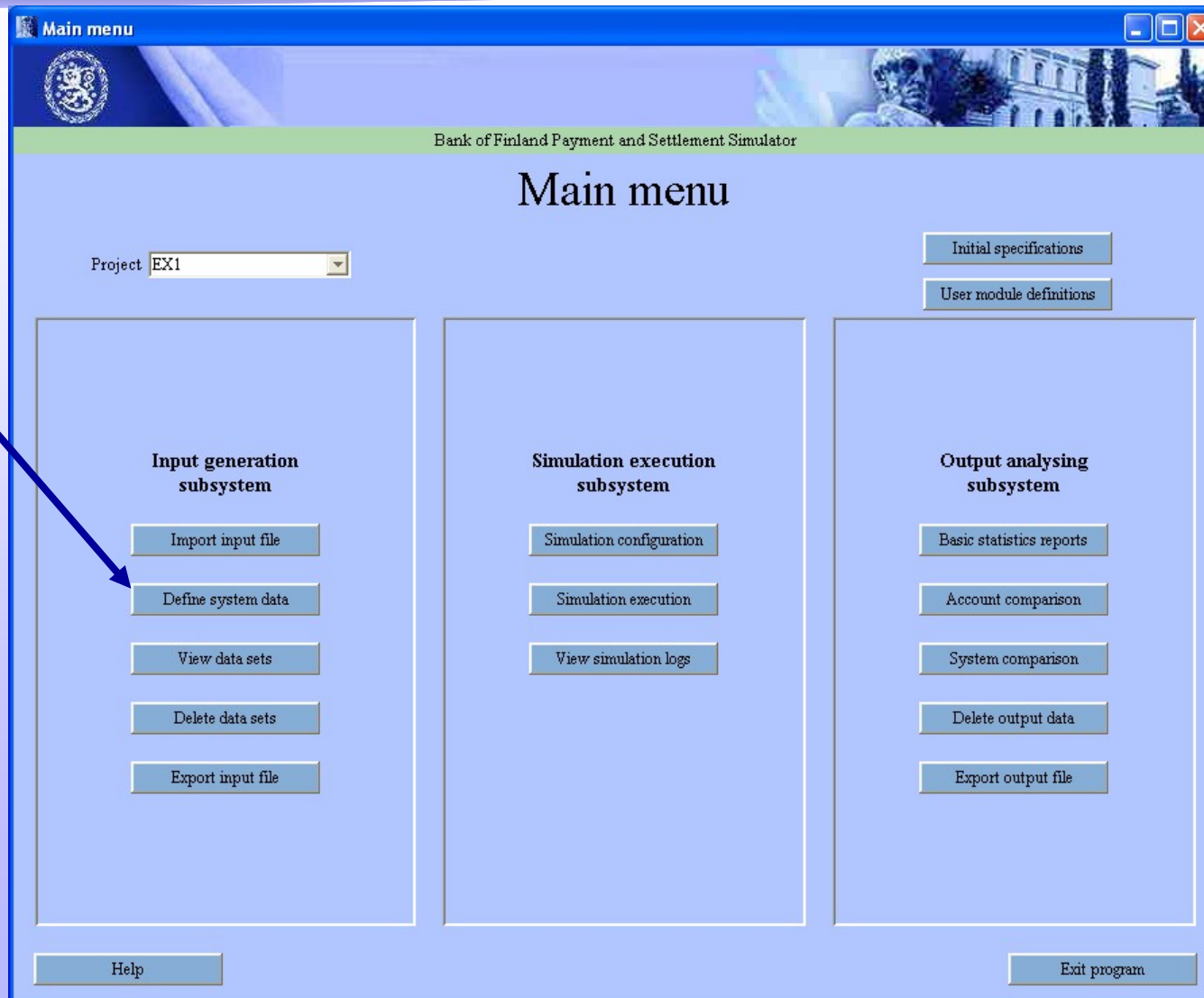


# Main menu

When all necessary data is successfully imported, return to main menu...

and proceed into system data definitions

There you can define the basic structure (RTGS, CNS, DNS), queue facilities, optimization features (splitting, partial netting...), opening hours and other functionalities for the system under study.



# System data definition 1

20

In system definition

Type the system ID again precisely in the same form as it was used when importing data. (case sensitive)

And give name for this system data set (see next slide)

Bank of Finland Payment and Settlement Simulator

### System control data specification/modification

Project : EX1

System ID:

☐ Modify old system data set ☐ Create new system data set  Copy from old system data set

System full name:  Opens (within 24h):  System description:   
System type:  Closes:   
System acronym:

**Transfer of balances**  
☐ Transfer balances to next day

**Intraday credit availability**  
☐ Credits according to limit table, or  
☐ No credits available, or  
☒ Credit available without limits

**Handling of unsettled transactions**  
☒ Transfer unsettled transactions to next day/settlement occasion or  
☐ Delete unsettled transactions or  
☐ Force end-of-day settlement of unsettled transactions

Potential algorithms: select one and add it to the attached algorithms by pressing the 'Add algorithm' button. ENT and END algorithms are mandatory.

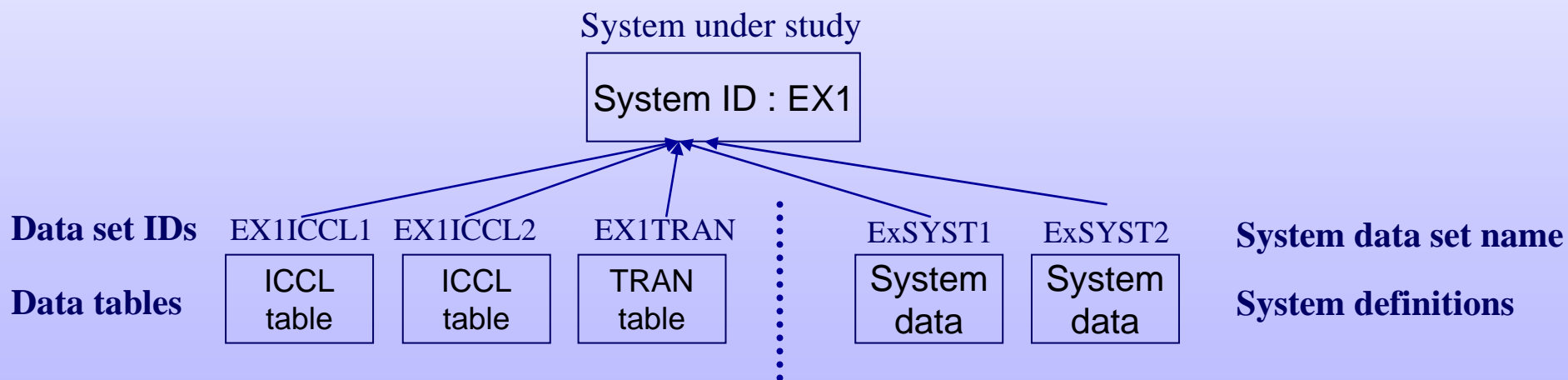
Attached algorithms: Changes of order by dragging/dropping. Deletion by striking keyboard 'delete' button for active algorithms.

Algorithm	Algorithm type	Double click row to insert parameter values
ENBASIC1	ENT	
SEBASIC1	SET	
ENDRTGS1	END	
QUFIFOPR	QUE	

# 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 ID:s 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 ID:s 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

22

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) and
- DNS (deferred net settlement)

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

Define system data

Bank of Finland Payment and Settlement Simulator

Project: EX1

System ID: EX1

☐ Modify old system data set ☒ Create new system data set Ex1FREE Copy from old system data set Ex1SYST

System full name: Example 1 FREEcredit Opens (hhmm 24h): 0700 System description: Example 1 system with FREE intraday credit

System type: RTGS Closes: 1900

System acronym:

Transfer of balances  
☐ Transfer balances to next day

Intraday credit availability  
☐ Credits according to limit table, or  
☐ No credits available, or  
☒ Credit available without limits

Handling of unsettled transactions  
☒ Transfer unsettled transactions to next day/settlement occasion or  
☐ Delete unsettled transactions or  
☐ Force end-of-day settlement of unsettled transactions

Potential algorithms: select one and add it to the attached algorithms by pressing the 'Add algorithm' button. ENT and END algorithms are mandatory.

ENBASIC1 ENT Add algorithm

Attached algorithms: Changes of order by dragging/dropping. Deletion by striking keyboard 'delete' button for active algorithms.

Algorithm	Algorithm type	Double click row to insert parameter values
ENBASIC1	ENT	
SEBASIC1	SET	
ENDRTGS1	END	
QUIFOPR	QUE	

Help

Save system data set

Back to main menu

Exit program

# System data definition 3

23

-Choose (in this example) *credit available without limits* in to allow free intraday credit.

Intraday credit-settings always affect all participants and accounts in one simulated system

-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

Define system data

Bank of Finland Payment and Settlement Simulator

System control data specification/modification

Project : EX1

System ID: EX1

☐ Modify old system data set ☐ Create new system data set EX1FREE Copy from old system data set EX1SYST

System full name: Example 1 FREEcredit Opens (hhmm 24h): 0700 System description: Example 1 system with FREE intraday credit

System type: RTGS Closes: 1900

System acronym:

Transfer of balances

☐ Transfer balances to next day

Intraday credit availability

☐ Credits according to limit table, or

☐ No credits available, or

☒ Credit available without limits

Handling of unsettled transactions

☒ Transfer unsettled transactions to next day/settlement occasion or

☐ Delete unsettled transactions or

☐ Force end-of-day settlement of unsettled transactions

Potential algorithms: select one and add it to the attached algorithms by pressing the 'Add algorithm' button. ENT and END algorithms are mandatory.

ENBASIC1 ENT Add algorithm

Attached algorithms: Changes of order by dragging/dropping. Deletion by striking keyboard 'delete' button for active algorithms.

Algorithm	Algorithm type	Double click row to insert parameter values
ENBASIC1	ENT	
SEBASIC1	SET	
ENDRTGS1	END	
QUFIPOPR	QUE	

Save system data set

Help

Back to main menu

Exit program



# System data definition 4

24

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

ENBASIC1  
SEBASIC1  
ENDRTGS1  
QUFIFOPR

(see also next slides)

After these steps system definition can be saved.

Return to Main menu

Define system data

Bank of Finland Payment and Settlement Simulator

System control data specification/modification

Project: EX1

System ID: EX1

☐ Modify old system data set ☐ Create new system data set EX1SYST ☐ Copy from old system data set

System full name: Example 1 System Opens (hhmm 24h): 0700 System description: Simple system definition for Example 1

System type: RTGS Closes: 1900

System acronym:

Transfer of balances  
☐ Transfer balances to next day

Intraday credit availability  
☒ Credits according to limit table, or  
☐ No credits available, or  
☐ Credit available without limits

Handling of unsettled transactions  
☒ Transfer unsettled transactions to next day/settlement occasion or  
☐ Delete unsettled transactions or  
☐ Force end-of-day settlement of unsettled transactions

Potential algorithms: select one and add it to the attached algorithms by pressing the 'Add algorithm' button. ENT and END algorithms are mandatory.

QUFIFOPR QUE

Attached algorithms: Changes of order by dragging/dropping. Deletion by striking keyboard 'delete' button for active algorithms.

Algorithm	Algorithm type	Double click row to insert parameter values
ENBASIC1	ENT	
SEBASIC1	SET	
ENDRTGS1	END	
QUFIFOPR	QUE	

- **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

- **SUB** (submission) algorithm determines when a transaction is submitted for processing, i.e. chooses next transaction to be processed. SUB algorithm is **not** selected in the system definition.
- **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



These can be invoked by ENT, SET and END algorithms

- **QUE** (queue release) algorithms release 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** (complete multilateral settlement) netting of all transactions in queues

*Precise definitions for algorithms can be found in simulator manuals*





Input generation  
subsystem

Import input file

Define system data

View data sets

Delete data sets

Export input file

**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

**View data sets**

Bank of Finland Payment and Settlement Simulator

Project: p\_test

Data type: **TRAN Transaction data** System ID: **S-RTGS** Data set ID: **tran0814**

Transaction ID	Introduction date	Introduction time	Transaction value	From system ID	From participant ID	From account ID	To system ID
101	2003-05-12	07:01:00	4880384,39	S-RTGS	1		S-RTGS
102	2003-05-12	07:01:00	685826,60	S-RTGS	1		S-RTGS
103	2003-05-12	07:01:00	2639630,73	S-RTGS	1		S-RTGS
104	2003-05-12	07:01:00	46064,41	S-RTGS	1		S-RTGS
105	2003-05-12	07:01:00	633795,99	S-RTGS	1		S-RTGS
106	2003-05-12	07:01:00	79702,04	S-RTGS	1		S-RTGS
107	2003-05-12	07:01:00	2786,33	S-RTGS	1		S-RTGS
108	2003-05-12	07:01:00	8000,03	S-RTGS	1		S-RTGS
109	2003-05-12	07:01:00	153492,54	S-RTGS	5		S-RTGS
110	2003-05-12	07:01:00	83989,24	S-RTGS	5		S-RTGS
111	2003-05-12	07:01:00	779471,41	S-RTGS	5		S-RTGS
112	2003-05-12	07:01:00	6678,92	S-RTGS	5		S-RTGS
113	2003-05-12	07:01:00	49921,70	S-RTGS	5		S-RTGS
114	2003-05-12	07:01:00	17337,06	S-RTGS	5		S-RTGS
115	2003-05-12	07:01:00	300182,44	S-RTGS	5		S-RTGS
116	2003-05-12	07:01:00	18950,49	S-RTGS	5		S-RTGS
117	2003-05-12	07:01:00	1634545,51	S-RTGS	6		S-RTGS
118	2003-05-12	07:01:00	408639,34	S-RTGS	6		S-RTGS
119	2003-05-12	07:01:00	1856551,99	S-RTGS	6		S-RTGS
120	2003-05-12	07:01:00	184378,62	S-RTGS	6		S-RTGS
121	2003-05-12	07:01:00	16723,85	S-RTGS	6		S-RTGS
122	2003-05-12	07:01:00	12084,40	S-RTGS	6		S-RTGS
123	2003-05-12	07:01:00	57860,37	S-RTGS	6		S-RTGS
124	2003-05-12	07:01:00	4920425,27	S-RTGS	14		S-RTGS
125	2003-05-12	07:01:00	1826540,68	S-RTGS	14		S-RTGS

Help Back to main menu Exit program

Delete data sets  
window  
provides view  
of available  
data sets

Erroneous or  
unnecessary  
data sets can be  
deleted

Bank of Finland Payment and Settlement Simulator

## Delete data sets

Project: p\_test

Data type: **TRAN Transaction data** System ID: **2P**

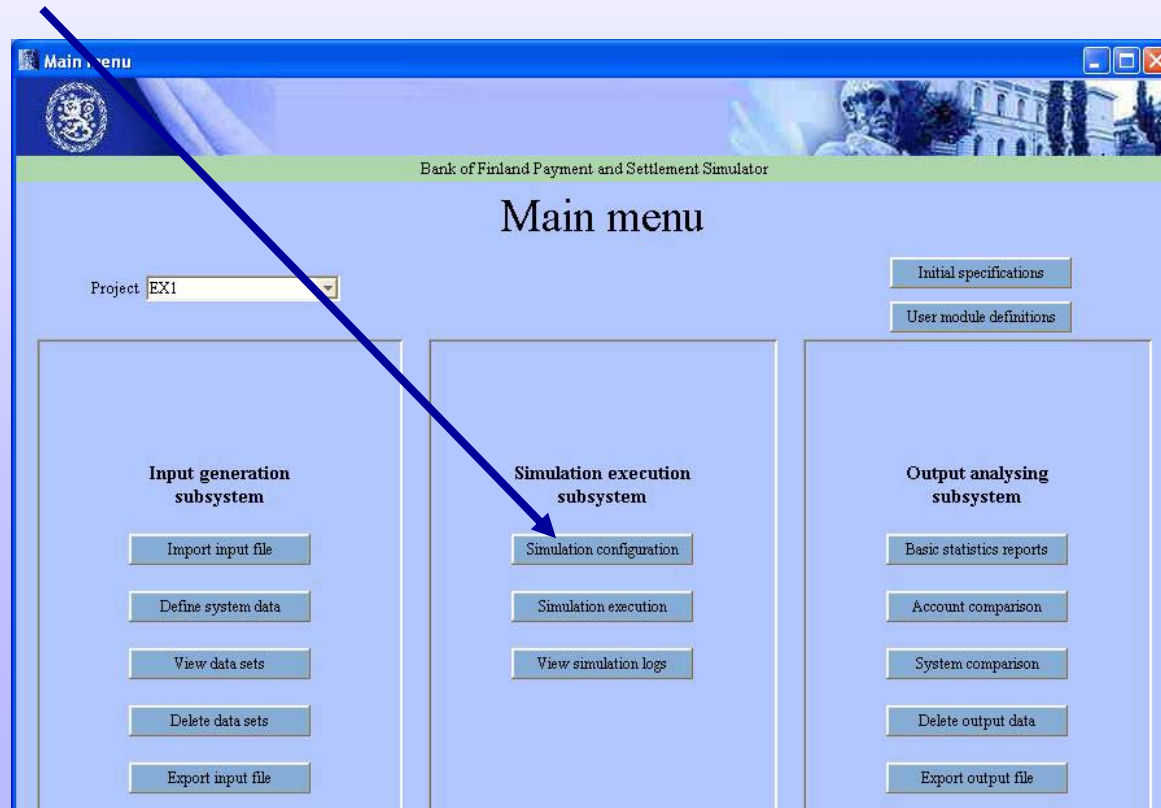
- 2Ptran2
- 2tran
- tran3

To delete data sets, press Ctrl and click the data sets active with the left mouse button. Press the Delete data sets button below.

Help Delete data sets Back to main menu Exit program

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

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





# Simulation configuration 1

32

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 which datasets are  
included in this simulation.

If you have several options  
available in System ID or  
you can't find some dataset  
you imported see the next  
slide.

Simulation configuration

Project: EX1

☐ Modify old simulation ID  ☐ Create new simulation ID  Copy from old simulation ID

Simulation name:

Description:

Sub-algorithm:

Data sets to simulation:

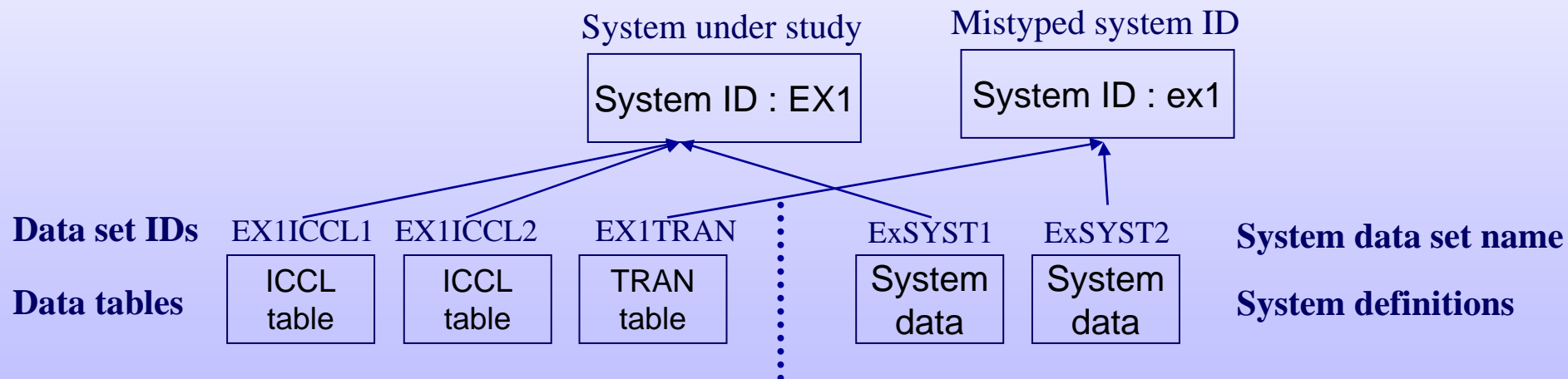
System ID	System data set	Transaction data set	Participant data set	Credit limit data set	Balance data set

Number of errors:

For defining data sets for the simulation first select the desired system ID in the corresponding drop-down box above the table, then the desired data sets. Next press the add/update data set button to move the new data to the data table. A system can be deleted from the table by selecting the system ID and pressing the Delete button.



Problems in configuration described in previous slide may be caused by mistyping the System ID while importing some datasets. In the example below two data sets have System ID is with lowercase letters. Only datasets with exactly identical ID can be included under same system in one simulation.



**This problem is solved by re-importing the data sets and stating the System ID correctly.**

(deleting the incorrect data sets before re-importing is recommended)



# Simulation configuration 2

34

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

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

Data sets to simulation:

EX1 Ex1FREE EX1TRAN EX1PART

System ID	System data set	Transaction data set	Participant data set	Credit limit data set	Balance data set
EX1	Ex1FREE	EX1TRAN	EX1PART		

Information

cross check completed

OK

Number of errors: 0 Done

Save simulation ID Cross-check Stop cross-check View errors

Help Back to main menu Exit program

Add/update data set Delete

# 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 eg 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 1

## Return to main menu and select simulation execution

Batch run info can be saved for re-use (optional)

Select the simulation you want to execute and click Add simulation.

(Several simulations can be included in one batch run)

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

Start the simulation

**Simulation execution**

Project : EX1

☐ Modify old simulation batch ID 
☒ Create new simulation batch ID 
 Copy from old simulation batch ID

Select a simulation ID and add it to the table by pressing the add simulation ID button. A simulation can be deleted from the batch by selecting the simulation ID and by pressing thereafter the Delete button.

Simulation ID  Simulation name

☒ Execute cross-check
 ☐ Skip cross-check

Simulation id	Simulation name	System level stat. SYLS	Account stat. ACST	Transact. event stat. TEST	Netting event stat. NEST	Account violation stat. AVST	Booking event stat. BEST	Unsettled transact. stat. UNST	Submitted transact. stat. SUST	Queued transact. stat. QUST	Comment transact. stat. CTST	Comment intraday credit stat. CCST
Ex1FREE	Ex1 with FREE cre...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

simulation

The progress of simulation execution is shown as the current time in simulation or as the name of the output table written





After simulation is successfully executed, return to main menu.

You will be asked about unsaved data. (batch run information) Select to exit anyway.

Project : EX1

☐ Modify old simulation batch ID  ☒ Create new simulation batch ID  [Copy fr  
simulati](#)

Select a simulation ID and add it to the table by pressing the add simulation ID button. A simulation can be deleted from the batch by selecting the simulation ID and by pressing thereafter the Delete button.

Simulation ID  Simulation name    ☒ Execute cross

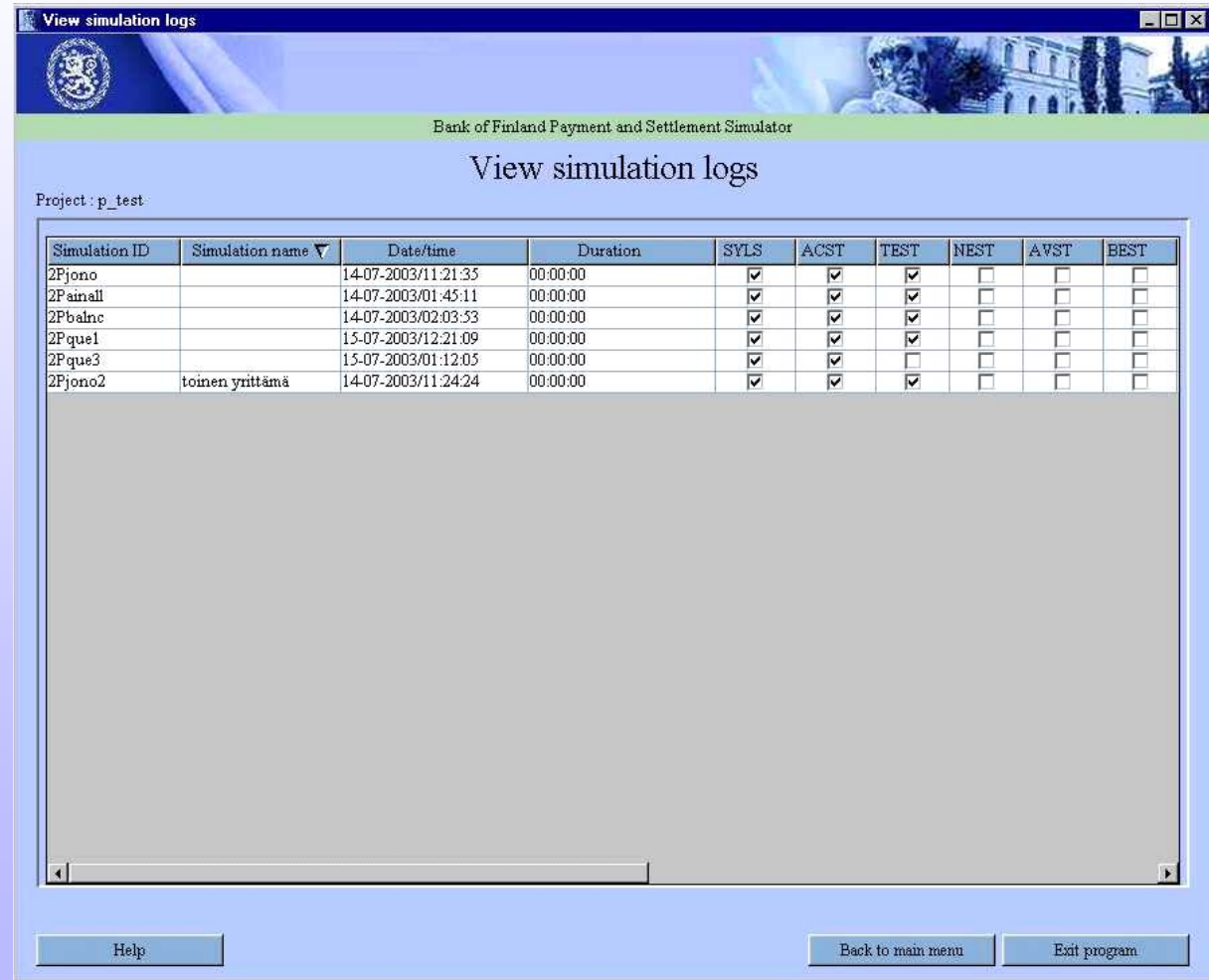
Simulation id	Simulation name	System level stat.	Account stat.	Transact. event stat.	N
EX1		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

**Unsaved data**  
There is unsaved data. Exit anyway?

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.



The third button in execution subsystem (*view simulation logs*) can be used to examine previous simulations and available output data tables



View simulation logs

Bank of Finland Payment and Settlement Simulator

View simulation logs

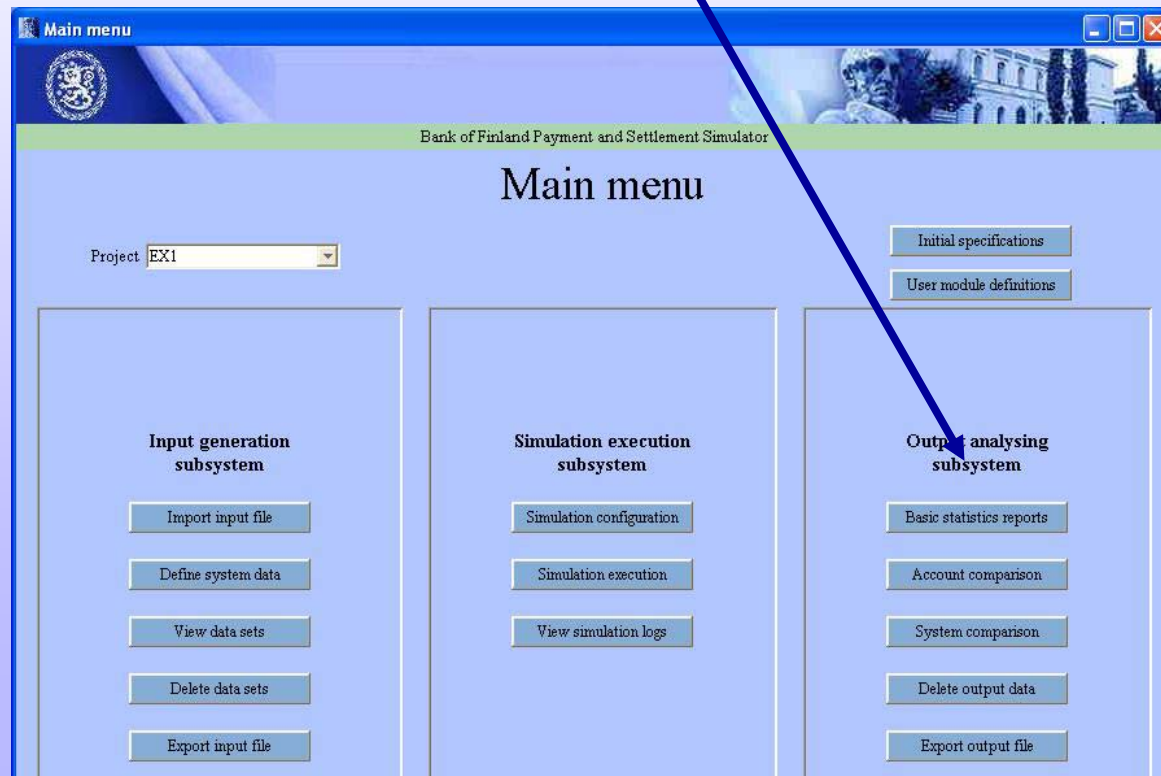
Project: p\_test

Simulation ID	Simulation name ▼	Date/time	Duration	SYLS	ACST	TEST	NEST	AVST	BEST
2Fjono		14-07-2003/11:21:35	00:00:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2Fainall		14-07-2003/01:45:11	00:00:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2Fbainc		14-07-2003/02:03:53	00:00:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2Fque1		15-07-2003/12:21:09	00:00:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2Fque3		15-07-2003/01:12:05	00:00:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2Fjono2	toinen yrittämä	14-07-2003/11:24:24	00:00:00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Help Back to main menu Exit program



Reports can be created after successful execution of a simulation



## The output analysing subsystem provides basic output reports and export facilities

### Output analysing subsystem

Basic statistics reports

Account comparison

System comparison

Delete output data

Export output file

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

41

Simple reports can be exported (Output file name) from *Basic statistics reports* window after choosing the executed simulation

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)

Basic statistics reports

Project : EX1

Simulation ID	Simulation name
Ex1FREE	Ex1 with FREE cr...

Output file: C:/BoF-PSS2/P\_EX1/OUTPUT\_REPORTS/Systemstatistics\_Ex1FREE.csv

Choose one of the report options

- ☒ System statistics report
- ☐ Account statistics report System ID:
- ☐ System time series report System ID:
- ☐ Account time series report System ID:

Participant ID:   
Account ID:

Help

Save in csv-file Save and open csv-file  
Back to main menu Exit program

Note:

Saving of certain output tables in simulation configuration (see slide 36) is required to enable basic statistic reports.

SYLS for system statistics

ACST for account statistics

TEST for all time series



# 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. name:	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 unse	Number unse
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														



With *Export output file* tool detailed data can be exported to csv files. (Exported tables must be selected in simulation Execution window. Now 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

BARI, simulation batch run data

SIRI, simulation run data

SYLS, system level statistics

ACST, account level 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





# Exporting output data 2

Specify/change data formats

44

Choose simulation  
Choose output table

Name for output file

Enable column names  
if necessary

Choose or define  
output template

Export criteria can be  
useful for large data sets  
(see help topic 5.8 for  
Selection criteria)

Export file (next slide)

Bank of Finland Payment and Settlement Simulator

Export output file

Project: EX1

Simulation ID: Ex1FREE

Database table: TEST Transaction event statistics

Data format defaults

Data separator: ,

Date format: d-m-yyyy

Decimal separator: .

Time format: hh:mm:ss

Output file: C:/BoF-PSS2/P\_EX1/OUTPUT/Ex1FREE-TEST.csv

☒ Create names of columns

☒ Create new template: TranEX1

☐ Use old template: All

File column...	DB col	Var. name	Descriptive name	Selection criteria
2	E_INDEXNUM	Index number		
1	E_SYSTEMID	System ID		
2	E_TRANSID	Transaction ID		
3	E_DATSETID	Data set ID		
4	E_INTRDATE	Introduction date		
5	E_INTRTIME	Introduction time		
6	E_TRANVALU	Transaction value		
7	E_FRSYSTID	From system ID		
7	E_FRPARTID	From participant ID		
11	E_FRACCOID	From account ID		
12	E_TOSYSTID	To system ID		
13	E_TOPARTID	To participant ID		
14	E_TOACCOID	To account ID		
15	E_TRANCLAS	Transaction class		
16	E_LINKCODE	Link code		
17	E_LINKSYST	Linked system		

Rows processed:

Execute export Stop export

Back to main menu Exit program

Help



## 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

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*



## What next?

- You can run the same simulation with intraday credit limits. For this new data set(s) need to be imported. (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.

