

Migration of a Flexible Reporting System from SAS 6.12 to SAS 9.1.3

- A project experience -

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ABSTRACT

This paper will discuss the execution of a project to migrate a flexible reporting application from version 6.12 of SAS® to version 9.1.3. The application is in use at a leading research facility for pre-clinical studies in The Netherlands called NOTOX B.V. The main function of the application is to provide a flexible reporting environment for pre-clinical toxicology and reproduction studies executed for a variety of sponsors in the pharmaceutical industry.

INTRODUCTION

This paper will describe a migration project from SAS 6.12 to SAS 9.1.3 undertaken at NOTOX B.V.

The paper broadly consists of three parts which will cover:

- NOTOX B.V. - the company, followed by a description of the 'old' applications;
- A walkthrough of the migration project;
- The migrated system including project metrics and lessons learned.

NOTOX B.V.

NOTOX B.V. was founded in 1983 to provide full safety and toxicology services for the pharmaceutical, chemical and agrochemical industry. The facility is in 's-Hertogenbosch, The Netherlands, and is located conveniently close to major airports and was extended in 2001 to employ now over 250 staff. Recently NOTOX B.V. was acquired by WIL Research Holding Company Inc. structured as a management buyout ensuring the continuity of management and quality while coupling together the science, service, and financial strength of highly regarded organizations. The partner of NOTOX in the U.S. is WIL Research Laboratories, LLC in Ashland, Ohio. NOTOX's expertise in genetic and in-vitro toxicology, eco-toxicology, environmental fate testing, metabolic screening and regulatory affairs complements WIL's worldwide leadership in developmental and reproductive toxicology and expertise in chronic, neuro, inhalation and intravenous toxicology and safety pharmacology.

For more information please visit www.notox.nl

OVERVIEW OF THE APPLICATIONS TO MIGRATE

FRS (SAS VERSION 6.12)

BACKGROUND

The FRS is a Flexible Reporting System created with SAS version 6.12.

The main function of the FRS is to provide a flexible reporting environment for pre-clinical toxicology and reproduction studies. The application has been created because the existing data entry system had insufficient reporting capabilities to satisfy client needs.

The application is created using SAS Base, SAS Macro, SAS/AF®, SAS/GRAPH® and SAS/STAT®.

THE APPLICATION

Access to the application is regulated via a logon procedure.

Once logged on the user can select the study type to report on (toxicology/acute toxicology/reproduction).

REPORT SELECTION SCREEN

When the study type is selected, the user has to specify the project number to report on.

If this is a valid project number, the available tables and graphs for this study type are shown.

From this screen the user can select the table(s) and/or graph(s) to be generated.

It also allows the user to set some general parameters such as page number to start with, the title of the report and the output type (word document or PDF document).

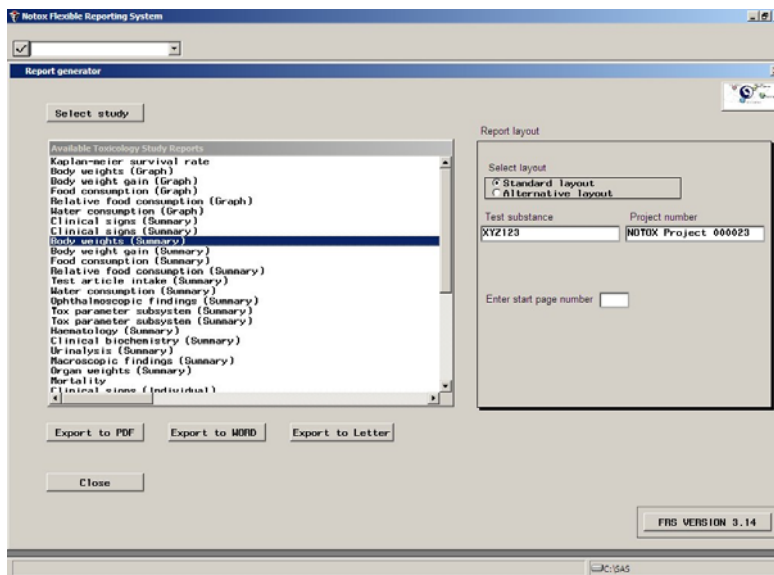


Fig. 1 Report selection screen

REPORT INFO SCREEN

For each table or graph selected a screen is displayed allowing the user to customise this particular table or graph.

Most of the options presented on the screen are derived from the available project data. A default selection is presented, allowing the user to customise when required.

Some typical options the user can select or change are:

- The title of the table or graph;
- The reporting period;
- The number of decimals;
- Whether to calculate statistics or not.

Report info screen

Body weights (Summary)

Report title
BODY WEIGHTS (GRAM) SUMMARY

Project data

1	RECEIVING ANIMALS		1	7
2	RANDOMIZE ANIMALS		1	7
3	DOSE WEIGHING FOOD		1	29
4	TO BE CONTINUED...		1	1

From To

Reporting units
☒ GRAMS
☐ KILOGRAMS

Decimal places
0

☒ Calculate statistics Statistical group 1

Appendix
APPENDIX 1

OK SKIP EXIT

☐ Add footnotes

Fig. 2 Report info screen

OUTPUT

Once all selected tables and graphs are processed, the results are exported to the selected output medium (word document or PDF document). This is stored on a pre-defined network area.

APPENDIX 1

NOTOX Project

TEST ARTICLE INTAKE (MG SUBSTANCE/KG BODY WEIGHT/DAY) SUMMARY
MALES

		GROUP 1 CONTROL	GROUP 2 600 PPM	GROUP 3 3000 PPM	GROUP 4 15000 PPM
TREATMENT	MEAN	0	72	378	2246
DAYS 1-8	ST.DEV	0.0	1.9	10.1	249.4
WEEKS 1-2	N (CAGE)	12	10	10	14
DAYS 8-15	MEAN	0	61	314	2037
WEEKS 2-3	ST.DEV	0.0	1.5	6.3	85.9
	N (CAGE)	12	10	10	7 x
DAYS 15-22	MEAN	0	56	293	1907
WEEKS 3-4	ST.DEV	0.0	1.5	13.2	99.3
	N (CAGE)	12	10	10	11 x
DAYS 22-29	MEAN	0	50	272	1586
WEEKS 4-5	ST.DEV	0.0	1.2	18.4	215.6
	N (CAGE)	12	10	10	3 x
DAYS 29-36	MEAN	0	49	261	1446
WEEKS 5-6	ST.DEV	0.0	1.4	8.6	---
	N (CAGE)	12	10	9 x	1 x
DAYS 36-43	MEAN	0	46	246	---
WEEKS 6-7	ST.DEV	0.0	1.4	9.0	---
	N (CAGE)	12	10	10	0 x
DAYS 43-50	MEAN	0	44	236	1624
WEEKS 7-8	ST.DEV	0.0	1.4	8.6	99.1
	N (CAGE)	12	10	10	14
DAYS 50-57	MEAN	0	41	220	1405

Fig. 3 PDF output

HDS (SAS VERSION 8.2)

BACKGROUND

The HDS is a Historical Data Reporting System created with SAS version 8.2.

The main function of the HDS is to provide a reporting environment which allows the user to create descriptive statistics on parameters across a number of similar historical projects.

Clients of NOTOX are requesting historical data more and more frequently to verify that values reported within a particular study are within a “normal” range. This can be achieved by comparing the values of a given study to the values of a range of similar studies. The procedure NOTOX originally had in place for such requests was too labour intensive to execute on a more frequent basis.

The application is created using SAS Base, SAS Macro, SAS/AF, SAS/GRAPH and SAS/STAT.

THE APPLICATION

Access to the application is regulated via a logon procedure.

Once logged on the user can select the study type to report on (toxicology/acute toxicology/reproduction).

PROJECT FILTER

When the study type is selected, the project filter screen is presented.

This screen helps the user with selecting similar projects by using the pre-defined options within this selection filter.

Fig. 4 Project filter

From this screen the exclusion screen can be called, which allows the user to exclude parameters or even entire projects from the available projects, to prevent biased information to be used in the system.

The excluded parameters and projects are stored in an exclusion table which is made available to all users.

REPORT SELECTION SCREEN

When a selection of projects has been made in the project filter screen the report selection screen is shown.

From this screen the user can select the tables to be generated.

It also allows the user to set some general parameters such as the page number to start with, the title of the report and the output type (word document or PDF document).

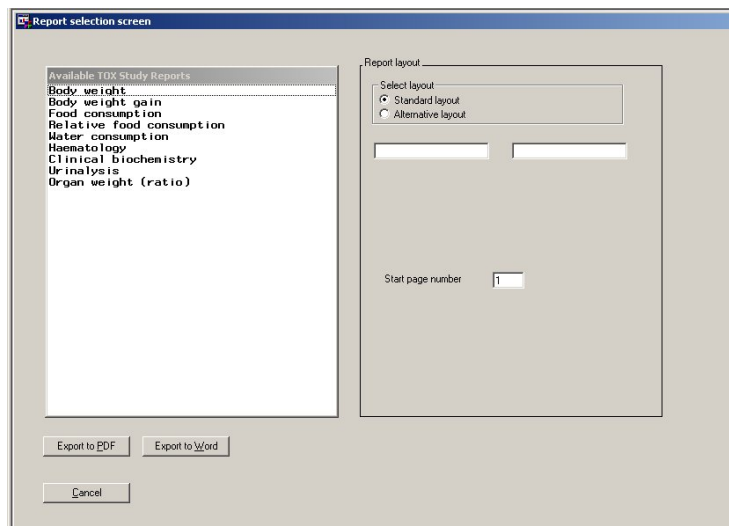


Fig. 5 Report selection screen

REPORT INFO SCREEN

For each table selected a screen is displayed containing the options available to the user to customise this table.

Typical options are the parameters to report on, the groups to report on, the descriptive statistics to present, the number of decimals, etc.

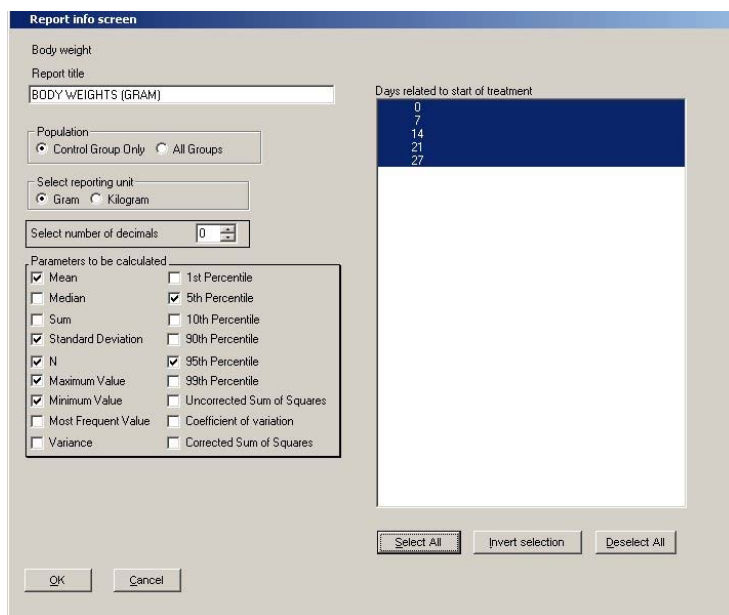


Fig. 6 Report info screen

OUTPUT

Once all selected tables are processed, the results are exported to the selected output medium (word document or PDF document). This is stored on a pre-defined network area.

HISTORICAL DATA BODY WEIGHTS (GRAM) MALES							
DAYS	MEAN	STD.DEV.	N	MIN	MAX	P5	P95
0	164	5.9	5	156	170	156.0	170.0
7	201	8.9	5	189	211	189.0	211.0
14	241	7.7	5	232	250	232.0	250.0
21	268	7.4	5	260	275	260.0	275.0
27	289	10.1	5	279	301	279.0	301.0
BODY WEIGHTS (GRAM) FEMALES							
DAYS	MEAN	STD.DEV.	N	MIN	MAX	P5	P95
0	134	6.1	5	127	141	127.0	141.0
7	151	6.3	5	145	158	145.0	158.0
14	168	6.5	5	159	175	159.0	175.0
21	183	6.8	5	174	190	174.0	190.0
27	192	7.0	5	184	203	184.0	203.0

Fig. 7 PDF output

THE DATA

The data that is used within both the FRS and the HDS applications is extracted from an Oracle database in which the detailed study data is collected. The ETL (Extract, Transform, Load) process is performed via a so called import/transform procedure. During the execution of this procedure a SAS program extracts the data from the Oracle database, the data is transformed into a structure optimised for reporting and finally loaded into the SAS data structure.

THE FRS AND HDS WITHIN NOTOX

The FRS is considered a business critical application. The application is used to produce the tables and graphs for the final study reports, a key deliverable to the sponsors of NOTOX.

Because of this a support agreement between NOTOX and OCS is in place.

The HDS is a supporting application which uses the same source of data as the FRS. The HDS generates reports containing descriptive statistics using data of similar projects. These descriptive statistics assist with the interpretation of the findings of a particular study.

THE MIGRATION PROJECT

BUSINESS DRIVERS

The main business drivers for the migration project were:

- The SAS version 6.12 sunset
The most important business driver for the migration project was the announcement by the SAS Institute to discontinue support for version 6.12 in the near future. It was decided that a business critical application should run in a supported environment.
- The number of users
Because the migration project had become inevitable, NOTOX could benefit from moving from PC based SAS to server based SAS. NOTOX is a healthy, growing organisation and consequently the number of users has increased to a point where it becomes more attractive to move to server based SAS. This will decrease both licensing and maintenance costs.
- To capitalise on the benefits of new technologies
Migrating would allow NOTOX to implement new technologies making the application more efficient, improve the look and feel and make it easier to maintain.

PROJECT GOALS

The following project goals were defined:

- Migrate the FRS and HDS to a SAS 9.1.3 environment
The main project goal is to migrate the FRS and HDS applications from version 6.12 to version 9.1.3 of the SAS system.
- Integrate both applications into one system and incorporate a third module to facilitate support
To have one system incorporating three subsystems is more efficient in terms of validation, support and maintenance.
- Move from running the SAS System on desktops to run the SAS System on a server
As the number of users is growing it has become more efficient to have the SAS System server based.

PROJECT APPROACH

The project was executed in stages using a waterfall methodology. The approach is set out below.

SCOPING STUDY

First a scoping study was conducted to get a good overview the entire project.

The following tasks were undertaken during the scoping study:

- Confirm project goals;
- Define project deliverables;
- Investigate migration and technology options;
- Perform a quick scan to determine the areas of the applications that need specific attention;
- Create a first cut estimate on effort and duration;
- Develop a detailed project plan.

PROJECT DEFINITION

With the help of the scoping study document OCS Consulting and NOTOX selected the options which were deemed best fit. The options selected were:

- Migrate the user interface from SAS/AF to a Windows based user interface to be developed using Delphi.
Because the move from PC based SAS to Server based SAS did not allow the use of SAS/AF as before, Delphi was selected to create the user interface.
- Use SAS Integration Technologies to communicate with SAS on the server.
SAS Integration Technologies was selected as the middleware to communicate between SAS and the user interface.

Having made the above selection, the project definition document could now describe exactly which areas of the FRS and the HDS will be affected and what the impact is. The document further contains a detailed project plan and detailed estimates on effort and duration.

APPLICATION DESIGN

As this project is a migration project, the original applications with corresponding documentation already existed. Therefore it was decided to create an application design document which combined both functional and technical specifications. The document is split up into two sections; one section details the programs on the SAS server and the other section describes the user interface.

The programs on the SAS server

This section describing the programs on the SAS server mainly consists of high level specifications as most programs only needed to be migrated using base SAS. The SAS programs interacting with the new user interface needed to be created and were therefore described in full detail.

The user interface

This section describes all types of screen elements used in the application and how to handle these elements and their events. The screen elements are controlled by SAS through an information dataset containing the settings and values of each screen element. This allows control from within SAS on the values presented and the ability to hide or disable certain screen elements.

Further to that it contains detailed flow diagrams of the application screens and their events. For each screen an example image of the screen to be created is displayed; the accompanying SAS information dataset to be expected and the events the screen has to be able to handle are provided as well.

APPLICATION DEVELOPMENT

The development work was split up into 4 main tasks which were executed parallel:

- Construction of the communication module to communicate between SAS and the user interface;
- Development of the user interface;
- Creation of the SAS programs controlling the user interface;
- Migration of the SAS programs required by the system.

APPLICATION TEST

To test the migrated system a number of test scenarios were executed on the migrated FRS system and on the original FRS and HDS application. The results were subsequently compared.

VALIDATION

The validation of the migrated FRS system is split up into 3 areas:

- Installation Qualification (IQ);
When the FRS system was delivered to NOTOX an IQ was performed as specified in the FRS system installation guide. This IQ covered the installation of the SAS system, the import/transform procedure, the FRS system on the SAS server and the FRS system on the client PC.
An IQ report stating that the installation was successful has been delivered to NOTOX.
- Operation Qualification (OQ);
After the delivery was completed NOTOX performed an operation qualification procedure verifying that the FRS system is functioning as specified.
- Performance Qualification (PQ).
When the OQ completed successfully a performance qualification was executed verifying that the system is functioning properly in a real life situation.

For the PQ the following scope was set:

- The transformed SAS datasets must be identical to the SAS datasets used by the previous version of the FRS and HDS for the project numbers used in the validation.
- The user interface must have equivalent or improved functionality compared to the previous version of the system.
- The user interface must offer the same or better information compared to the previous version of the system.
- The reports must be identical to the reports created by the previous version of the system or should differ from the previous version as expected due to approved change.

TECHNOLOGY

The FRS system is a multi-user, client/server reporting application.

This application uses a Windows based user interface to communicate with SAS on the server. The user interface is developed using Delphi.

The user interface uses a communication module created by OCS Consulting which allows the user interface to interact with the SAS system using SAS Integration Technologies as middleware. The communication module was developed in such a way that it can be switched to communicate with SAS on the server or SAS on the local machine, allowing off-site development.

The user interface itself consists of an executable and a .ini file which can reside on an application server. This means that only Integration Technologies needs to be installed on the client PC.

The image below presents a schematic overview of the FRS system.

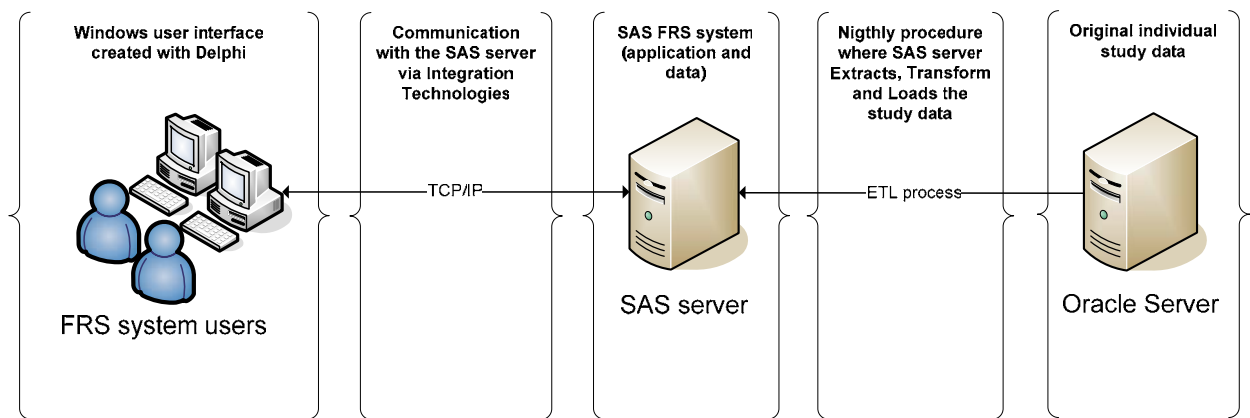


Fig. 8 Schematic overview of the FRS system

THE FRS SYSTEM VERSION 4.0

As described in the project goals the new FRS system is a system incorporating the FRS and the HDS as a subsystem. All subsystems can run simultaneously providing the user with a uniform environment.

FRS

The FRS is now a subsystem of the FRS system. The following images show the same screens that were presented in the description of the FRS (SAS 6.12)

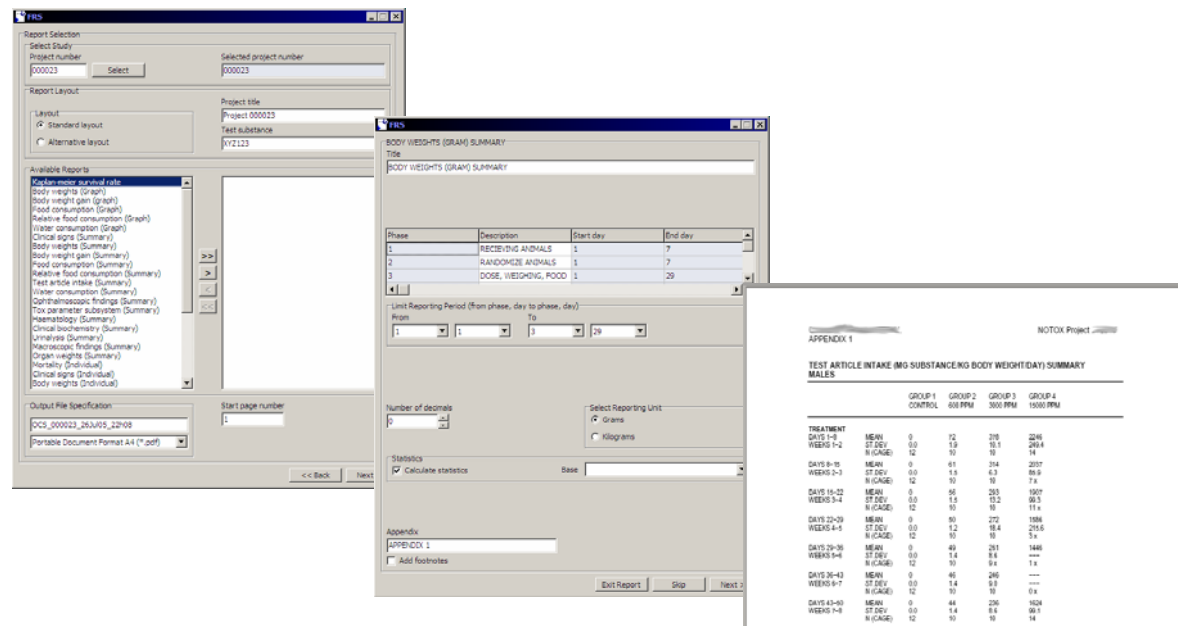


Fig. 9 The migrated FRS

HDS

The HDS is now a subsystem of the FRS system. The following images show the same screens that were presented in the description of the HDS (SAS 8.2)

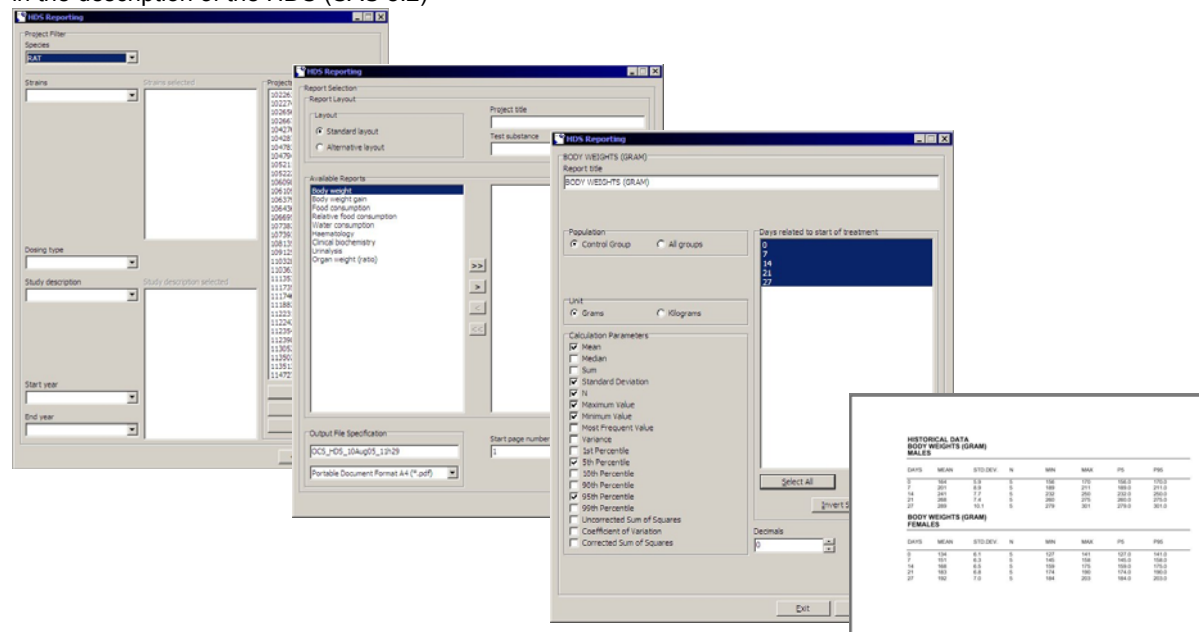


Fig. 10 The migrated HDS

THE MESSAGE SYSTEM

As mentioned before the FRS is a business critical system, therefore NOTOX has a support agreement in place with OCS Consulting. In the previous version of the FRS the user had the option to report a message about the FRS, which would be received by the OCS Consulting helpdesk.

In the new system the message system is incorporated.

This system allows the users to report messages about the FRS or the HDS subsystem.

When a message is created it is automatically e-mailed to the OCS helpdesk where it will be processed.

This system also contains a message overview which allows the users to view the messages reported and their status, or when required the audit trail of a message can be reviewed.

The figure shows two screenshots of the message system interface. The left screenshot is the 'Message Report' dialog box, which contains fields for System (FRS or HDS), Study Type (Acute toxicology, Toxicology, or Reproduction), Project, Report, Description, and Priority. The right screenshot is the 'Message Overview' dialog box, which displays a list of messages and their status, with filters for Message Status and Message Reported Period.

Fig. 11 The message system

PROJECT METRICS

To illustrate the size of this project the following metrics are presented below:

Actual project effort excluding validation	Approx. 100 days
Team size	5 people
Effort by Skill set:	
Documentation	15 days
SAS Knowledge	40 days
Delphi Knowledge	30 days
Integration Technology Knowledge	5 days
Project Management	10 days
Total number of user interface screens:	
FRS	7
HDS	7
Message system	4
Total number of SAS programs for the user interface:	
SAS programs	31
SAS macros	63
Total number of SAS programs that were migrated:	
SAS programs	126
SAS macros	15

LESSONS LEARNED

Every project brings new insights; these are some of our experiences:

- Migrating from version 6.12 to version 9.1.3 of SAS thereby skipping version 8 does not present specific additional difficulties.
- Creating a windows based user interface which communicates with SAS is not only very controllable, but is also very fast in comparison to, for example a browser based application.
- When communicating via Integration Technologies it is possible to maintain a SAS Work environment during the entire session allowing the use of work -datasets, -macros, -formats, etc.

TIP

We found it useful to create a proof of concept environment to build experience with PC development environments communicating with Integration Technologies.

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