EFORWOOD
Sustainability Impact Assessment of the Forestry - Wood Chain

Project no. 518128

EFORWOOD

Tools for Sustainability Impact Assessment

Instrument: IP

Thematic Priority: 6.3 Global Change and Ecosystems

# Deliverable D1.2.5
# Database of case studies and EU-FWC and summary report of database development (update)

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| **Dissemination Level** | | |
| **PU** | Public | |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
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# Abstract

This document describes the process of the EFORWOOD database development, defines the database structure, describes the internet-based data collection tool and depictures the main statistics of collected data.

The EFORWOOD database was built by work package (WP) 1.2. It contains information describing forestry wood chains (FWC) provided by respective EFORWOOD modules and is further used by the ToSIA model (WP 1.4).

Currently there are two databases; one is structured according to the specification of "case study chains", the other one is structured according to the specification of "EU-FWC" (European forestry wood chain). The current databases are stored at project partner Institute of Forest Ecosystem Research, Ltd (IFER).

Both databases can be accessed using the EFORWOOD database client, the software tool developed to enter data, design FWCs and generate XML[1] as an input for ToSIA. Access to the EFORWOOD database is limited to approved users only.


# Executive Summary

The purpose of this document is to

i. summarize all the steps made in the process of the database development
ii. describe the actual database structure
iii. describe the actual status of the software solution for the data collection
iv. present the main statistics of the collected data for the case study chains and the EU-FWC chain

This deliverable extends D1.2.5 „Database of test chains and summary report of database development".

The EFORWOOD database contains information describing forestry wood chains (FWC) provided by respective EFORWOOD modules and is further used by the ToSIA model (WP 1.4). Work package (WP) 1.2 is responsible for the EFORWOOD database development and maintenance. The database serves as a data source to the ToSIA model. Data are collected by modules 2-5. Currently there are two databases; one is structured according to the specification of "case study chains", the other one is structured according to the specification of "EU-FWC" (European forestry wood chain). The current databases are stored at project partner Institute of Forest Ecosystem Research, Ltd (IFER).

The first version of the database structure was designed based on discussions between WP 1.2 and WP 1.4 in February 2006. The database was implemented as a relational database in an open source database system MySQL[2]. Due to continuous changes in the database structure it

[1] XML – eXtensible Markup Language is is a simple, very flexible text format used for data exchange in a form of structured text. For more information, please see http://www.w3.org/XML

[2] MySQL is open source database system. For more information please see www.mysql.com

was converted into MS Access[3] that is more suitable for adjusting the database structure. The whole database is available in XML format any time.

During the first data collection round the data was collected using MS Excel[4] sheets and manually entered into the database. Based on this experience it was decided to develop a software tool to enable internet based data collection. The tool is called EFORWOOD Database Client. It is based on the client-server technology and it enables multiple on-line acces to the actual database that is stored and maintained on a dedicated computer located in IFER. The EFOREWOOD Database Client also enables designing chains and generates XML as an input for ToSIA. Access to the EFORWOOD database is limited to approved users only.

The structure of EFORWOOD database reflects informational content and logical relationships as they are formulated by respective EFORWOOD modules.

The general FWC as defined by EFORWOOD is structured into four hierarchical levels. First level is a FWC itself. There are currently three case study chains. Second level breaks the chain into four separate modules. Every module consists of several stages, which are natural steps in a FWC flow. The last, most important and most detailed level, is represented by processes. Transformation of materials and energy takes place within a process. Linking individual processes will permit to follow the material flows along the chains. All processes are connected to each other via its input / output products.
EFORWOOD database describes both static and dynamic part of the FWC. The static part describes processes (main process attributes, input products of a process, output products of a process, indicators of a process). The dynamic part describes sequencing of processes in chains. Lookup lists are preferably used whenever a set of predefined values is known prior to entering data.

There are three case study chains in the case study database:

1. Baden-Württemberg General Structure Case Study
2. Scandinavian General Structure Case Study
3. Iberian General Structure Case Study

And there is the EU-FWC chain in the EU database. There are 392 processes defined within the three case study chains and set of 27 indicators. There are 2188 processes defined within the EU-FWC chain and set of 27 indicators.

This document does not deal with the data quality. There is a special deliverable D1.2.6 “Report on data quality” to provide quality assessment of the collected data.

[3] MS Access - relational database management system from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user interface and software development tools. For more information, please see www.microsoft.com

[4] MS Excel - spreadsheet application written and distributed by Microsoft for Microsoft Windows and Mac OS X. For more information, please see www.microsoft.com

# Content

# 1 Introduction

The purpose of this document is to

i. summarize all the steps made in the process of the database development
ii. describe the actual database structure
iii. describe the actual status of the software solution for the data collection
iv. present the main statistics of the collected data for the case study chains and the EU-FWC chain

This new deliverable resumes and extends deliverables D1.2.5 „Database of test chains and summary report of database development“.

The EFORWOOD database contains information describing forestry wood chains (FWC) provided by respective EFORWOOD modules and is further used by the ToSIA model (WP 1.4). Work package (WP) 1.2 is responsible for the EFORWOOD database development and maintenance. The database serves as a data source to the ToSIA model. Data are collected by modules 2-5.

Currently there are two databases; one is structured according to the specification of “case study chains”, the other one is structured according to the specification of “EU-FWC” (European forestry wood chain). The current databases are stored at project partner Institute of Forest Ecosystem Research, Ltd (IFER).

This document does not deal with the data quality. There will be a special deliverable D1.2.6 update “Report on data quality” to provide quality assessment of the collected data.

# 2 Database development

The first version of the database structure was designed based on discussions between WP 1.2 and WP 1.4 in February 2006. The database structure respected the specific requirements of ToSIA developers as defined in that early stage of the model development. At that moment the database was implemented as a relational database in an open source database system MySQL. Due to continuous changes in the database structure it was easier to use more user friendly tool than MySQL to design and manage the database. Therefore the database is designed by MS Access. The whole database is available in XML format any time.

During the first data collection round the data was collected using MS Excel sheets and manually entered into the database. Blank excel files were preformatted and sent to module leaders for further distribution within modules in the beginning of September 2006. A cover letter explaining the data needs was distributed together with the forms. Content of the database was not available to partners and the topology of the chain could not have been visualized. It was necessary to re-design the excel sheets each time the topology changed.

Based on the first collection round experience, it was decided to develop a software tool to enable internet based data collection, the EFORWOOD Database Client. The EFORWOOD Database Client is a tool designed to allow EFORWOOD partners to enter data into the common EFORWOOD database and to design chains.

Main advantages of the EFORWOOD Database Client are:

- Visualisation of the chain topology
- Possibility to design the chain topology
- The picture of the chain topology is linked directly to the database and it is also stored in the database
- Possibility to download content of the database

The current database is stored at IFER. It is accessible using a software tool developed at IFER and based on the client-server technology. EFORWOOD Application Server runs on dedicated computer located in IFER and accessible via the Internet. The server is connected to the actual EFORWOOD database. The database can be accesses using the EFORWOOD database client, the software tool developed to enter data, design FWCs and generate XML as an input for ToSIA. Access to the EFORWOOD database is limited to approved users only.

During the data collection for case studies, several changes to the database structure were made:

1. Conversion factors: In test chains, all conversion factors (Product unit to t, Product unit to ha, Product unit to m3, Product unit to EURO, Product unit to t of C) were linked to processes and its input and output products. Therefore one product could have more values defined for one conversion factor based on a process the product is used and based on the time validity. A change was made; all conversion factors except of "Product unit to EURO" are linked directly to products now. The possibility to define more values for one product and conversion factor based on time validity / scenario is still enabled.
2. Time validity / scenarios: In test chains, only indicator values were time / scenario specific. In case studies and the EU-FWC, all other process attributes and chain topology attributes are also time / scenario specific (input / output products shares, split ratios, M2/M3 specific attributes).
3. Logic of export / import buckets was implemented to cover international trade within the EU FWC.

# 3 Database structure

The structure of EFORWOOD database reflects informational content and logical relationships as they are formulated by respective EFORWOOD modules.

The general FWC as defined by EFORWOOD is structured into four hierarchical levels. First level is a FWC itself. There are currently three case study chains. Second level breaks the chain into four separate modules. Every module consists of several stages, which are natural steps in a FWC flow. The last, most important and most detailed level, is represented by processes. Transformation of energy and materials takes place within a process. Linking individual processes will permit to follow the flows along the chains. All processes are connected to each other via its input / output products. One link between two following processes is defined by output product of the source process and the input product of the target process.

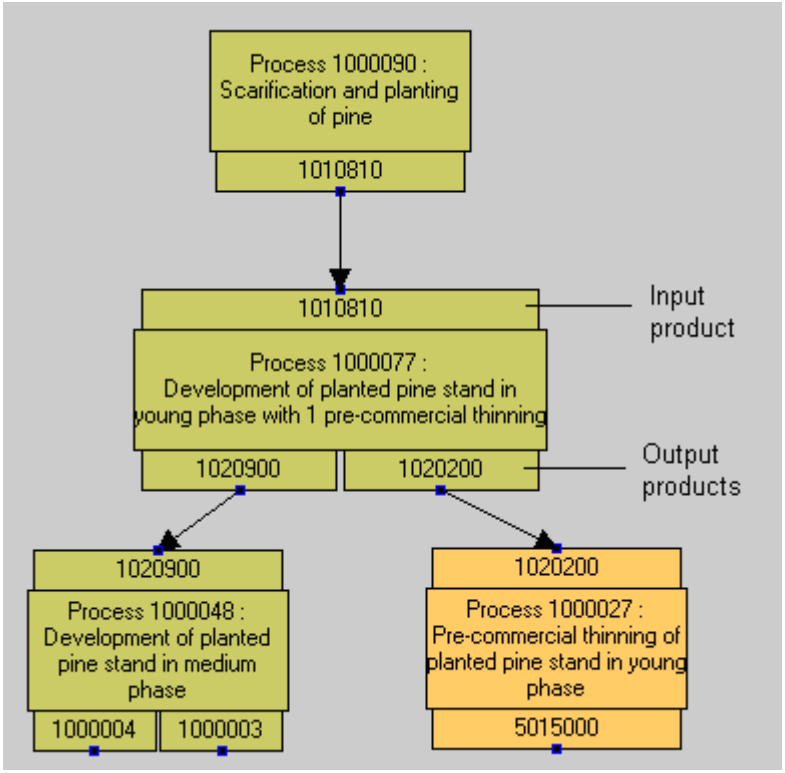

*Fig. 1. EFORWOOD database structure: FWC*

There can be several FWCs in one database. One FWC is then manually exported and imported via xml in order to be processed in ToSIA as a whole. All processes and products from all FWCs are available to be used in any of the FWCs in the database; this way available indicator values and conversion factors can be reused. The topology of each FWC is designed using the part of the database client called Chain editor.
Once a topology is created, data can be entered or imported. To describe a chain, following attributes are required:

1. Process attributes:
   - Name, description, assumptions, geo-information
   - Process unit
   - Input product shares, output product shares; it describes the shares of input / output products of the total carbon flow through the process)
   - Indicator values
   - Conversion factor to EURO
2. Conversion factors of products: Product unit to ha, product unit to m3, product unit to t, product unit to t of C
3. Link properties: Split ratios; it defines how the material flow is divided into several branches of the FWC

EFORWOOD database describes both static and dynamic part of the FWC.

- The static part describes processes:
  - main process attributes (table *Processes, ProcessValues*)
  - input products of a process (table *InputProducts, InputProductValues, ConvFactorsValuesIn*)
  - output products of a process (tables *OutputProducts, OutputProductValues, ConvFactorsValuesOut*)
  - indicators of a process (tables *IndicatorValues, IndicatorValueAttributes*)
- The dynamic part describes sequencing of processes in chains (table *ChainTopology, ChainTopologyValues*).

The tables with a “Value” in their names store time specific attributes of their “parent” tables (e.g. table called ProcessValues stores time specific attributes of the table called Processes).

Lookup lists are preferably used whenever a set of predefined values is known prior to entering data. The main advantages of using lookup lists are fast data editing, database consistency (only predefined values may be entered) and possibility to predefine the conditionality of lookup lists. From technical point of view, lookup list is a table that consists of two columns: ID and description. The ID is a unique code entered into the database and the description is a verbal explanation of the ID’s meaning. This description replaces the ID in the EFORWOOD Database Client. Lookup lists table names in the EFORWOOD database stats with the letter *x* to be easily recognised.
The database structure is open to be further adapted and developed in line with the development of data needs and data availability. The principle of using lookup lists enables authorized users to change the database structure using the EFORWOOD database client; such changes do not require further changes in the client or in the export to XML functionality. Other changes in the database structure require changes in the database client as well as in the XML.
Using the lookup lists, it is possible to change:

- List of indicators
- List of modules
- List of stages
- List of data source categories
- List of representativeness categories
- List of indicator units
- List of reporting units
- List availability types

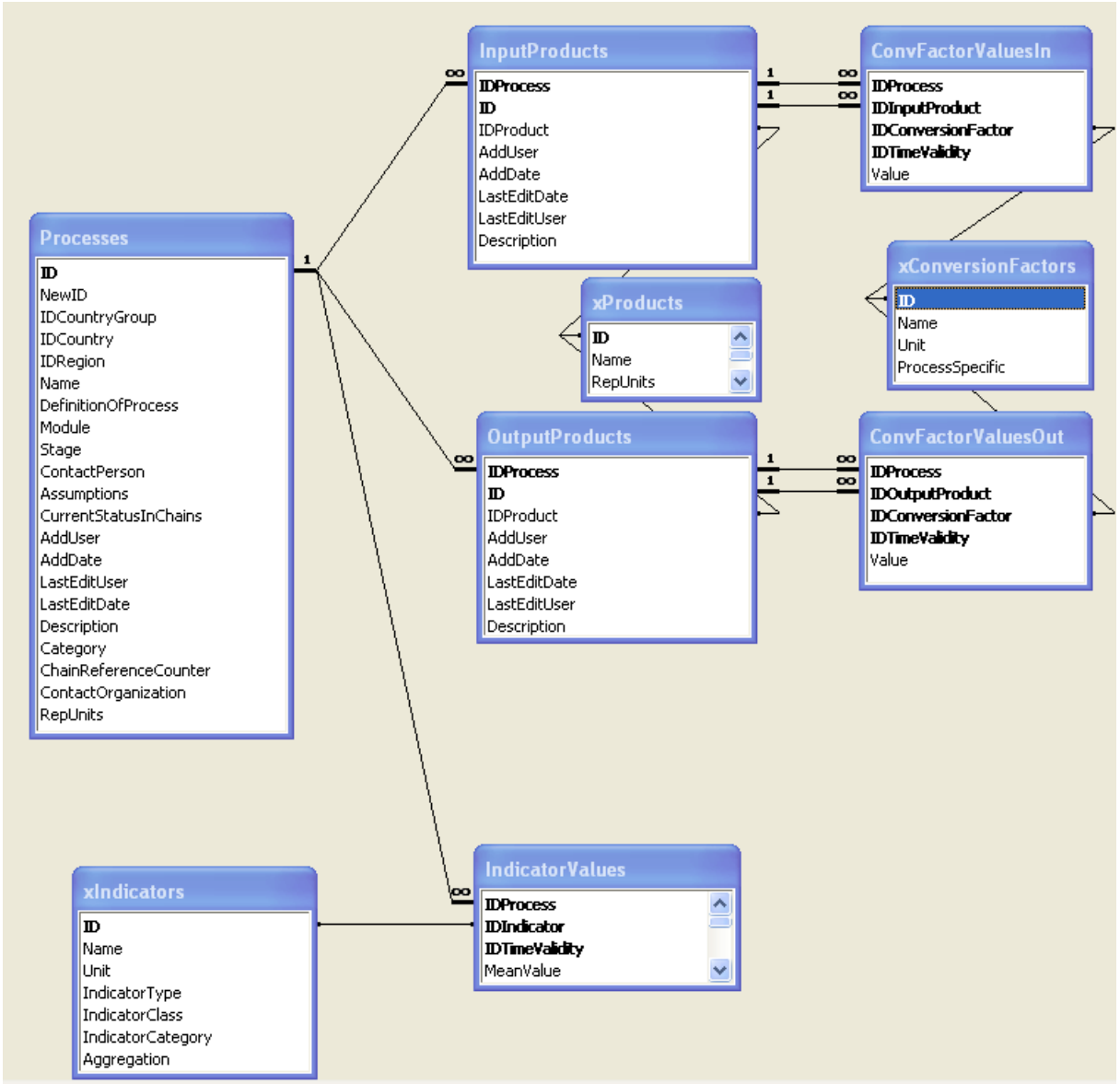


*Fig. 2. EFORWOOD database structure – static part*

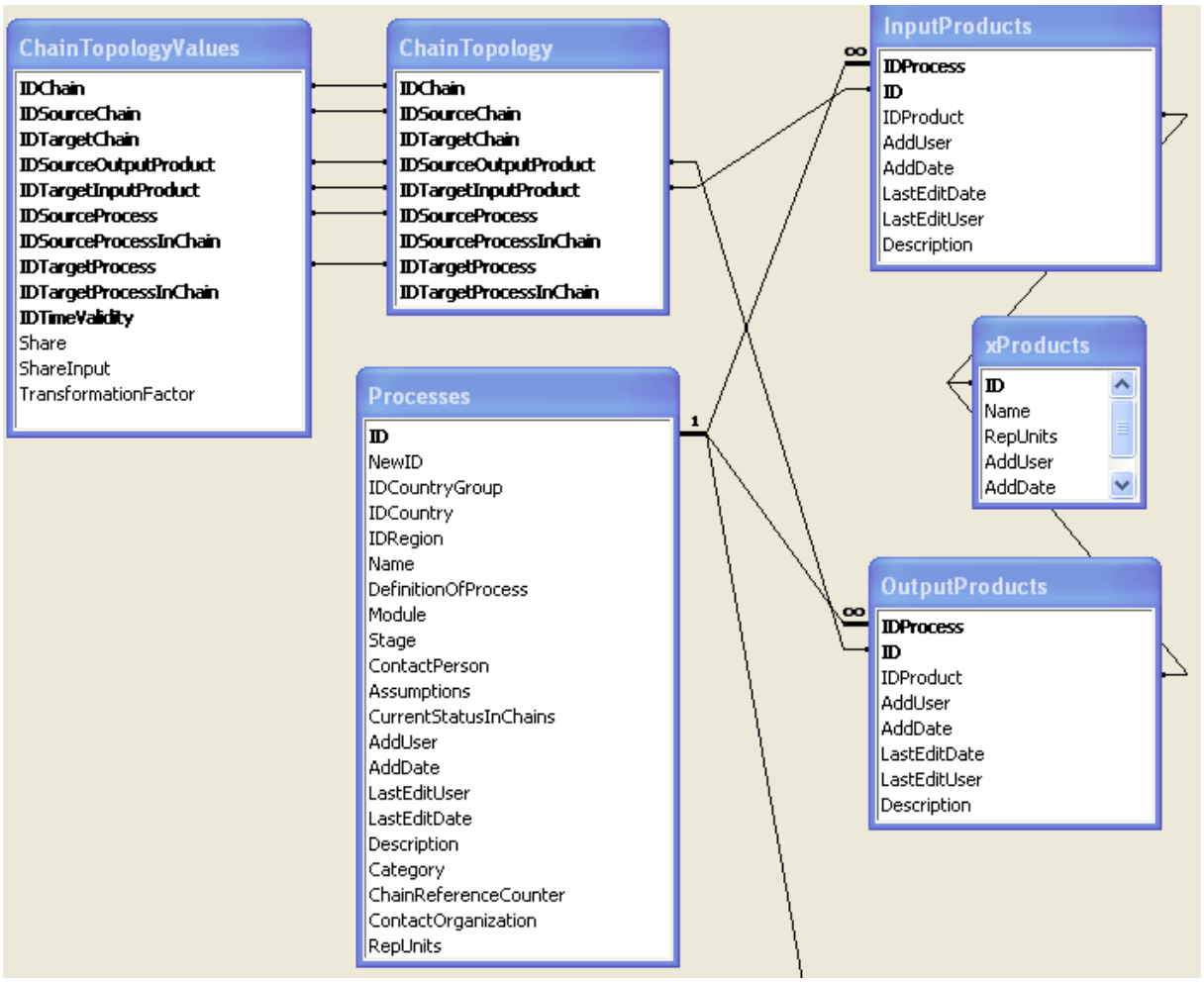


*Fig. 3. EFORWOOD database structure – dynamic part*

Several queries were predefined to enable creating overviews and checking the values:

- overview_Processes.sql: lists all processes used in the selected chain / module
- overview_InputProducts.sql: lists input products of selected processes
- overview_OutputProducts.sql: lists output products of selected processes
- overview_Indicators.sql: lists indicator values for selected processes
- overview_ConversionFactors_InputProducts.sql: lists conversion factors for selected processes and products
- overview_ConversionFactors_OutputProducts.sql: lists conversion factors for selected processes and products
- check_InputProductsShares.sql: checks if the sum of input product shares equals 1
- check_OutputProductShares.sql: checks if the sum of output product shares equals 1
- lListOfLinks.sql: lists existing links
- lLinks_ManyToOne_final.sql/ lLinks_OneToMany_final.sql: checks sums of ManyToOne / OneToMany ratios

# 4 Technology description

To make the process of data collection and database building as effective as possible and to provide partners with instant access to the database, it was decided to make the EFORWOOD database accessible using client-server technology. To implement this solution, two new software applications in addition to an existing EFORWOOD database were developed. These applications are the EFORWOOD Application Server (in the following referred to as Server) and the EFORWOOD Database Client (in the following referred to as Client). So now the data collection system consists of three parts:

- EFORWOOD database:
  The storage for all EFORWOOD data. It is built as relational database currently using Microsoft Access. To ensure data safety the database is backed up every day and contains a table with the history of all changes to the database.

- EFORWOOD Application Server:
  This application runs on a dedicated computer located in IFER and is accessible via the Internet. The server is connected to the actual EFORWOOD database. It handles multiple simultaneous connections of Client applications and serves as interface to the database providing the data over the network. Other important functions of the server include:
  - managing the user permissions for each user allowing to access/change just the portion of data for which the user has authorization
  - export contents of the database in XML format for ToSIA
  - simple messaging (the operator can send messages to the Clients connected to the Server)

- EFORWOOD Database Client:
  This software tool is necessary for each partner who wants to access the EFORWOOD database. It can be downloaded from the EFORWOOD internet portal. When started, this software connects to the Server via the Internet and authorizes using username and password provided to each user. The Client allows the user to access contents of the database using hierarchically organized forms and overview tables. The client also contains the chain editor which enables the users to design chains visually using graphical representation of processes and their interconnections. The authorized users can also use the Client to obtain the complete content of the database in XML format (used as ToSIA input).
  A standard installation routine was prepared to install the client on a computer, including registration of all necessary dependencies and creating of shortcuts.

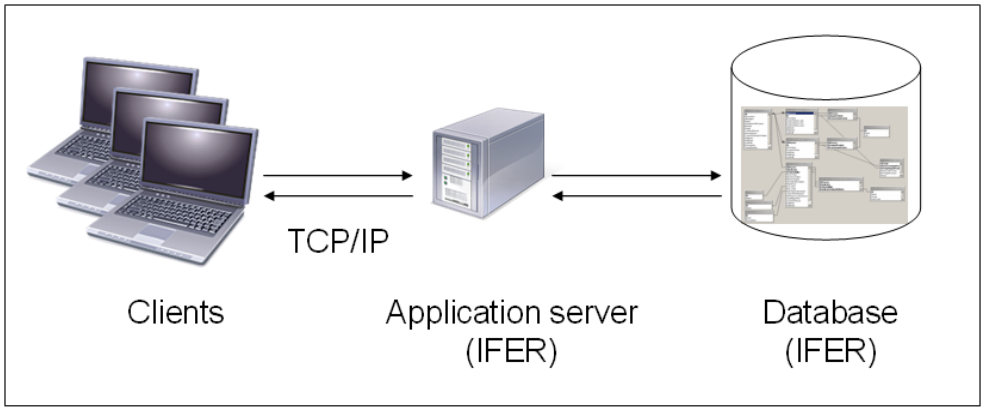


*Fig.4. Client server technology*

The EFORWOOD Database Client itself consists of two parts:

- Data editor (to enter data about processes: products and indicators)

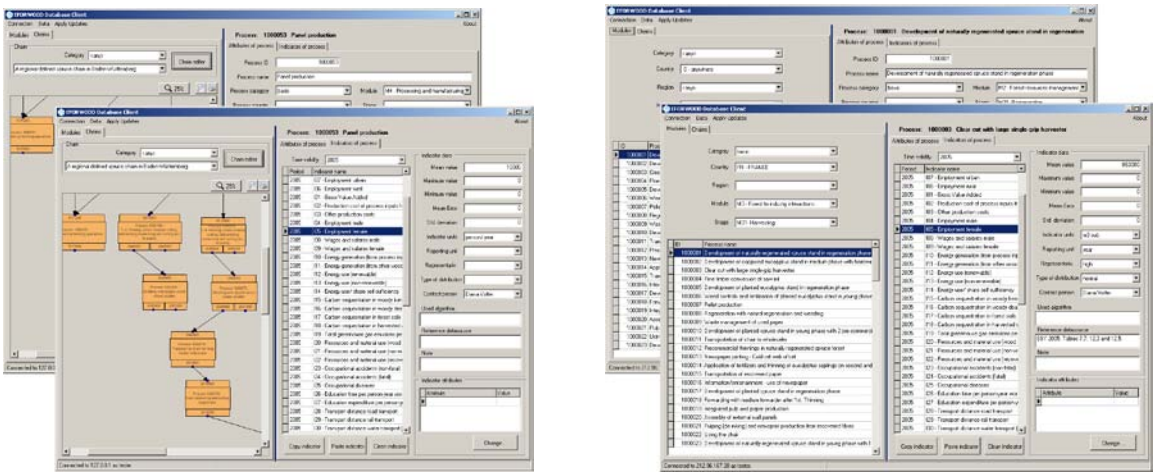

*Fig.5. EFORWOOD Database Client: Data editor*

- Chain editor (to graphically design chains)

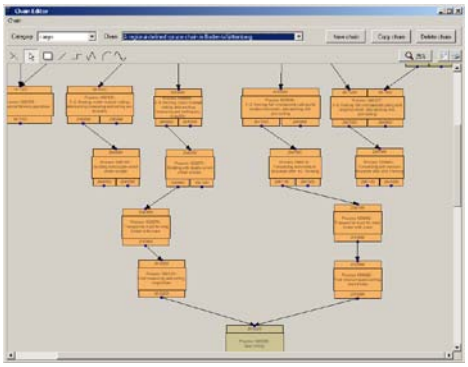

*Fig. 6. EFORWOOD Database Client: Chain editor*

A process is graphically represented in the following way:

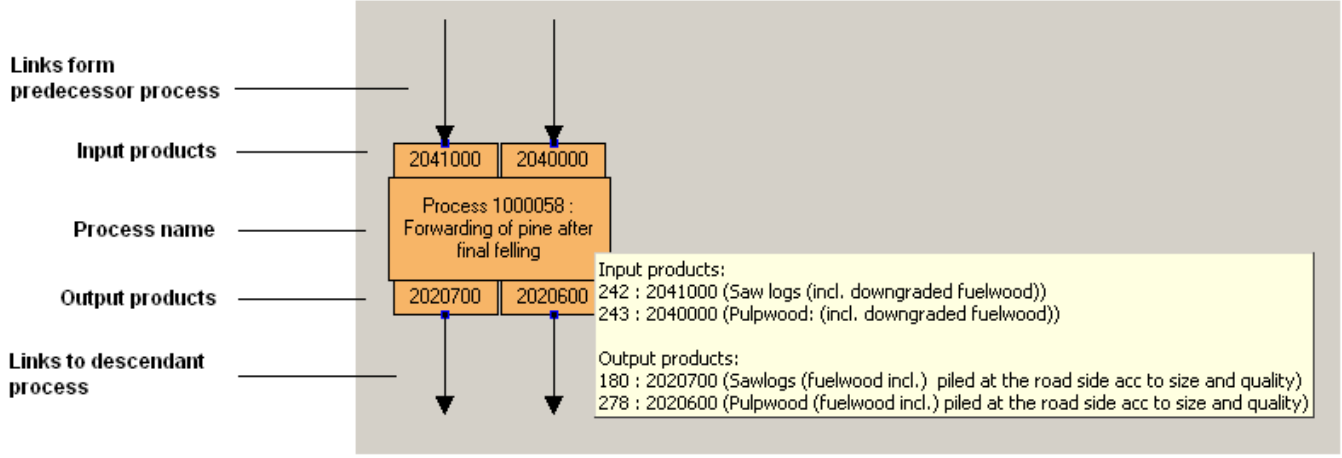


*Fig. 7. EFORWOOD Database Client: Graphical representation of a process*

Processes are colored according to modules.

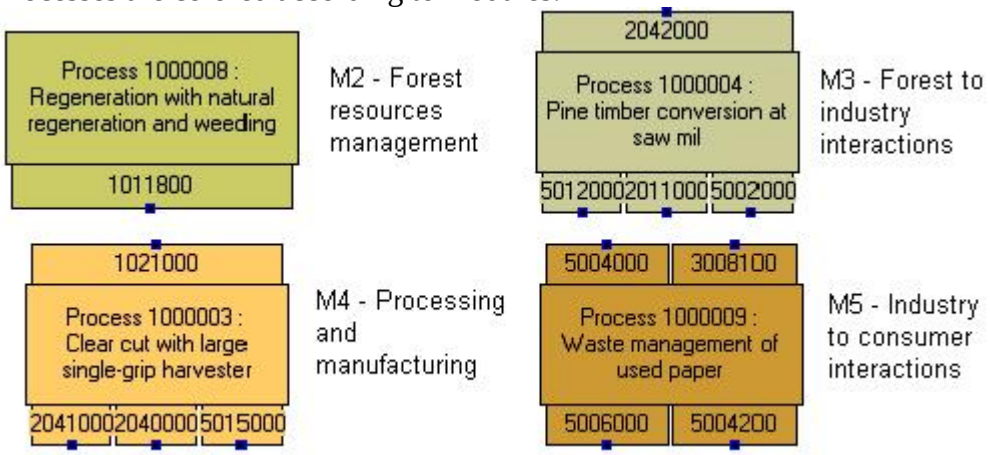


*Fig. 8. EFORWOOD Database Client: Graphical representation of a process – colours of modules*

There is a system of user permissions to ensure the data consistency.

- Module data editing permission specifies whether the user has the permission to edit data of a certain module. The data of processes for which the user does not have "Module data editing permission" are visible but read-only.
- Chain editing permission specifies whether the user has the permission to open the chain editor and work with chains according to their "Chain category permission" and "Process category permission"
- Chain category permission specifies whether the user has the permission to create, delete and modify the chains of a certain category. The category of the chain is specified during its creation by the authorized user and cannot be changed later. The chains from categories for which the user does not have "Chain category permission" are open as read-only in the chain editor (but still can be used as templates to create chains in categories for which the user has this permission).
- Process category permission specifies whether the user has the permission to create and modify the processes of a certain category. The category of the process is specified during its creation by the authorized user and cannot be changed later.
- The lookup list editing permission specifies whether the user has the permission to open the lookup list editor and edit lookup lists.

The client was instantly developed to mirror changes in the database and to ease handling the huge EU-FWC chain. The main issues from the point of view of the client there were:

- Time dimension related changes: The Case Studies introduced the scenario and reference future specific data of indicators, product shares, conversion factors and also split ratios used in the chains. These features added a whole new dimension to several key tables in the database. This change had to be implemented to the application server providing data to database client that involved changes in the internal mechanism of providing data together with the change of XML format for data export and structure of generated XLS overviews. The time dimension support had to be implemented also to the database client itself. The changes were made to the internal data modules and also the user interface had to support the fact that the same kind of value can be entered for different time dimensions. The chain editor was adjusted to be able to hold any number of time specific split ratios assigned to one link in the chain diagram. The implementation of time dimension also brought one key issue to be solved. In the version of the system used for single chain there were pre-generated empty data records for all expected indicator values. Those rows were accessed remotely by Database Client and filled via user interface. When indicator values became time/reference future/scenario specific using the same principle was found to be unusable as the pre-generated database became extremely large and sparse which was extremely slowing the system response and increased amount of data traffic. The new solution was developed where empty record for new time specific data was generated by server only when requested by the client that kept database dense and having reasonable size. Also the system of custom data filtering on the server side was introduced so the only filtered data requested by the user was transferred over the network to the Client. These technological improvements increased complexity of the system a lot.
- Increased amount of data: Even when using the technological improvements described above to ensure maximal database efficiency the amount of received data was constantly increasing during the data collection for Case Studies and especially for the EUFWC. There were several revisions of data serving and filtering system of the server to keep the system usable and maintain good response.
- Case Studies and EU-FWC specific features: When adjusting database structure for EUFWC it turned out that it would be difficult to maintain all the differences in database structure in a single application. So the development of the Client for EU-FWC was moved to a new branch from the point of view of the software developer and the client application for Case Studies and EU-FWC were developed and maintained separately. The application server remained the same but it was connected to both databases simultaneously and internally divided according to database type. As the topology of the EU-FWC is quite complicated, functionality to handle the huge chain was added.

**System Requirements:**

- Database: Windows OS (XP or newer, Server edition not required)
- Application Server: Windows OS (XP or newer, Server edition not required), broadband internet connection, ADO installed together with MS Access driver, Borland socket server to allow remote connections, MS Excel if XLS export is required

- Database Client: Windows OS (XP or newer), broadband internet connection, administrator rights for installation

**Technical description:**

- Database: The database in contained in standard MS Access database file. It consists of tables containing data, metadata ,system tables (user accounts etc.) and lookup lists (enumerated data types). There are also auxiliary SQL queries stored
- Application Server: Application Server is a native Windows application developed using Delphi development environment. It has to be installed on the same computer as the database resides. To be able to access the database, Microsoft's ActiveX Data Objects (ADO) has to be installed together with MS Access driver. Computer running Application Server needs to have broadband internet connection and there has to be possibility to connect it using port 211 so the firewall has to be properly configured. This application makes use of Borland DataSnap technology so remote connections are accepted via Borland Socket Server which has to be installed and running before Application Server is executed. Application server makes use of Microsoft Excel when generating XLS overviews so this application has to be installed if this functionality is required. When the application server is run it serves as remotely accessible interface for the database. It has very simple user interface which allows a system administrator to alter basic settings of the server, manage user accounts and permissions and also monitor server functionality and connected users
- Database Client: Database client is a native Windows application developed using Delphi development environment. It has to be installed on computer with broadband internet connection and firewall configured to allow connections via port 211. When it is executed on the user's computer the Database Client connects to the application server and provides access to the data. Administrator’s rights are required when the client is executed for the first time as it registers in the system. Database client communicates with application server using internal protocol which allows to transfer data from the server and propagate changes of it back

# 5 Database overview

## 5.1 Case studies

Case study chains were designed using the EFORWOOD data client / Chain editor.

There are three case study chains in the case study database:

1. Baden-Württemberg General Structure Case Study
2. Scandinavian General Structure Case Study
3. Iberian General Structure Case Study

There are 392 processes used in the case study chains:

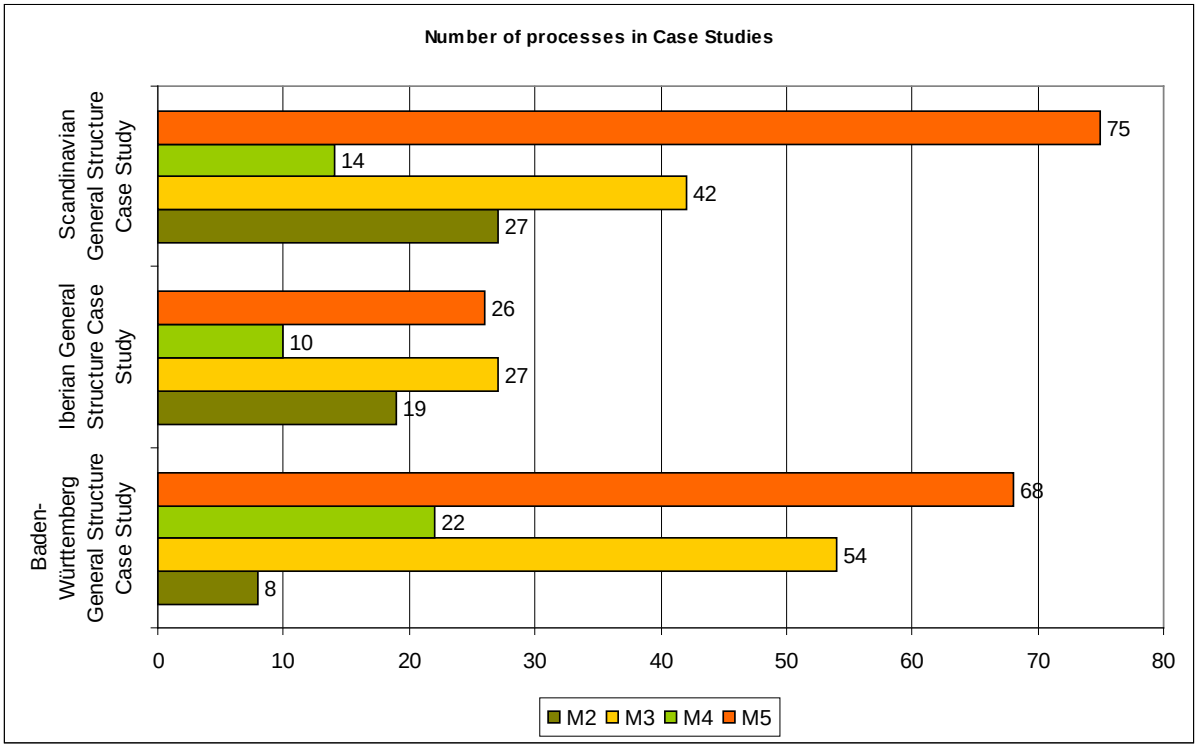


*Chart 1. Number of processes within case study chains*

The set of indicators used in the database reflects the Data collection protocols. All statistics are calculated for the indicators selected for demonstration.

The case study database uses 25 indicators and 168 sub-indicators. Number of sub-indicators selected for demonstration is:

- Baden-Württemberg General Structure Case Study: 87
- Scandinavian General Structure Case Study: 69
- Iberian General Structure Case Study: 67

The final status of collected data for case studies on the date 31/3/2010 is as follows:

| | | | Absolute numbers | | |
|---|---|---|---|---|---|
| Chain | Module | Number of processes | Delivered Values | Not applicable | Not feasible |
| Baden-Württemberg General Structure Case Study | M2 | 8 | 188 | 492 | 16 |
| | M3 | 54 | 1418 | 3191 | 89 |
| | M4 | 22 | 690 | 1020 | 204 |
| | M5 | 68 | 1412 | 3682 | 822 |
| Scandinavian General Structure Case Study | M2 | 27 | 214 | 1496 | 153 |
| | M3 | 42 | 1367 | 1392 | 139 |
| | M4 | 14 | 519 | 318 | 129 |
| | M5 | 75 | 2424 | 1964 | 787 |
| Iberian General Structure Case Study | M2 | 19 | 431 | 500 | 342 |
| | M3 | 27 | 774 | 920 | 115 |
| | M4 | 10 | 562 | 97 | 11 |
| | M5 | 26 | 867 | 622 | 253 |

*Table 1. Overview of collected values in Case Studies: Absolute numbers*

| | | | % | | |
|---|---|---|---|---|---|
| Chain | Module | Number of processes | Delivered Values [%] | Not applicable [%] | Not feasible [%] |
| Baden-Württemberg General Structure Case Study | M2 | 8 | 27.01 | 70.69 | 2.3 |
| | M3 | 54 | 30.18 | 67.92 | 1.89 |
| | M4 | 22 | 36.05 | 53.29 | 10.66 |
| | M5 | 68 | 23.87 | 62.24 | 13.9 |
| Scandinavian General Structure Case Study | M2 | 27 | 11.49 | 80.3 | 8.21 |
| | M3 | 42 | 47.17 | 48.03 | 4.8 |
| | M4 | 14 | 53.73 | 32.92 | 13.35 |
| | M5 | 75 | 46.84 | 37.95 | 15.21 |
| Iberian General Structure Case Study | M2 | 19 | 33.86 | 39.28 | 26.87 |
| | M3 | 27 | 42.79 | 50.86 | 6.36 |
| | M4 | 10 | 83.88 | 14.48 | 1.64 |
| | M5 | 26 | 49.77 | 35.71 | 14.53 |

*Table 2. Overview of collected values in Case Studies: Percentages*

Data sources used to collect data for case studies was as follows:

| IDSourceChain | Module | DataSource | Number | % |
|---|---|---|---|---|
| Baden-Württemberg General Structure Case Study | M2 | not provided | 178 | 40.09 |
| | | Data from experiments or scientific measurements | 58 | 13.06 |
| | | Branch statistics | 2 | 0.45 |
| | | Official statistics | 206 | 46.40 |
| | M3 | not provided | 418 | 17.12 |
| | | Follow up routines from enterprises | 65 | 2.66 |
| | | Data from experiments or scientific measurements | 161 | 6.60 |
| | | Branch statistics | 70 | 2.87 |
| | | Official statistics | 787 | 32.24 |
| | | Weighting or scaling factors | 494 | 20.24 |
| | | Modeling - process models | 386 | 15.81 |
| | | Expert judgement | 60 | 2.46 |
| | M4 | not provided | 138 | 14.41 |
| | | Follow up routines from enterprises | 2 | 0.21 |
| | | Branch statistics | 7 | 0.73 |
| | | Official statistics | 191 | 19.94 |
| | | Weighting or scaling factors | 3 | 0.31 |
| | | Modeling - process models | 444 | 46.35 |
| | | Modeling - spatial extrapolation | 50 | 5.22 |
| | | Expert judgement | 123 | 12.84 |
| | M5 | not provided | 1180 | 66.70 |
| | | Branch statistics | 53 | 3.00 |
| | | Official statistics | 16 | 0.90 |
| | | Modeling - process models | 345 | 19.50 |
| | | Expert judgement | 175 | 9.89 |
| Scandinavian General Structure Case Study | M2 | not provided | 241 | 87.00 |
| | | Branch statistics | 33 | 11.91 |
| | | Official statistics | 3 | 1.08 |
| | M3 | not provided | 2015 | 77.71 |
| | | Follow up routines from enterprises | 42 | 1.62 |
| | | Data from experiments or scientific measurements | 59 | 2.28 |
| | | Branch statistics | 23 | 0.89 |
| | | Official statistics | 441 | 17.01 |
| | | Weighting or scaling factors | 1 | 0.04 |
| | | Expert judgement | 12 | 0.46 |
| | M4 | not provided | 456 | 63.69 |
| | | Branch statistics | 23 | 3.21 |
| | | Official statistics | 17 | 2.37 |
| | | Weighting or scaling factors | 3 | 0.42 |
| | | Modeling - process models | 215 | 30.03 |
| | | Expert judgement | 2 | 0.28 |
| | M5 | not provided | 2228 | 75.96 |
| | | Follow up routines from enterprises | 71 | 2.42 |
| | | Branch statistics | 81 | 2.76 |

| | | | | |
|---|---|---|---|---|
| | | Official statistics | 13 | 0.44 |
| | | Modeling - process models | 485 | 16.54 |
| | | Expert judgement | 55 | 1.88 |
| Iberian General Structure Case Study | M2 | not provided | 472 | 97.72 |
| | | Branch statistics | 9 | 1.86 |
| | | Official statistics | 2 | 0.41 |
| | M3 | not provided | 1039 | 85.87 |
| | | Follow up routines from enterprises | 15 | 1.24 |
| | | Data from experiments or scientific measurements | 42 | 3.47 |
| | | Branch statistics | 3 | 0.25 |
| | | Official statistics | 46 | 3.80 |
| | | Weighting or scaling factors | 1 | 0.08 |
| | | Modeling - process models | 46 | 3.80 |
| | | Modeling - time extrapolation | 1 | 0.08 |
| | | Expert judgement | 17 | 1.40 |
| | M4 | not provided | 260 | 39.82 |
| | | Branch statistics | 73 | 11.18 |
| | | Official statistics | 103 | 15.77 |
| | | Weighting or scaling factors | 8 | 1.23 |
| | | Modeling - process models | 201 | 30.78 |
| | | Expert judgement | 8 | 1.23 |
| | M5 | not provided | 977 | 95.13 |
| | | Expert judgement | 50 | 4.87 |

*Table 3. Overview of data sources in case studies grouped by modules on the date 31/01/2010*

| Chain | Indicator Category | Data Source | Number | % |
|---|---|---|---|---|
| Baden-Württemberg General Structure Case Study | Economic | not provided | 596 | 36.63 |
| | | Follow up routines from enterprises | 2 | 0.12 |
| | | Data from experiments or scientific measurements | 45 | 2.77 |
| | | Branch statistics | 16 | 0.98 |
| | | Official statistics | 298 | 18.32 |
| | | Weighting or scaling factors | 138 | 8.48 |
| | | Modeling - process models | 412 | 25.32 |
| | | Expert judgement | 120 | 7.38 |
| | Social | not provided | 432 | 22.97 |
| | | Follow up routines from enterprises | 20 | 1.06 |
| | | Data from experiments or scientific measurements | 44 | 2.34 |
| | | Branch statistics | 45 | 2.39 |
| | | Official statistics | 887 | 47.16 |
| | | Weighting or scaling factors | 88 | 4.68 |
| | | Modeling - process models | 254 | 13.50 |
| | | Expert judgement | 111 | 5.90 |
| | Environmental | not provided | 886 | 42.11 |
| | | Follow up routines from enterprises | 45 | 2.14 |
| | | Data from experiments or scientific measurements | 130 | 6.18 |
| | | Branch statistics | 71 | 3.37 |
| | | Official statistics | 15 | 0.71 |
| | | Weighting or scaling factors | 271 | 12.88 |
| | | Modeling - process models | 509 | 24.19 |
| | | Modeling - spatial extrapolation | 50 | 2.38 |
| | | Expert judgement | 127 | 6.04 |
| Scandinavian General Structure Case Study | Economic | not provided | 999 | 70.45 |
| | | Follow up routines from enterprises | 33 | 2.33 |
| | | Data from experiments or scientific measurements | 15 | 1.06 |
| | | Branch statistics | 59 | 4.16 |
| | | Official statistics | 126 | 8.89 |
| | | Weighting or scaling factors | 1 | 0.07 |
| | | Modeling - process models | 165 | 11.64 |
| | | Expert judgement | 20 | 1.41 |
| | Social | not provided | 959 | 58.80 |
| | | Follow up routines from enterprises | 15 | 0.92 |
| | | Data from experiments or scientific measurements | 3 | 0.18 |
| | | Branch statistics | 56 | 3.43 |
| | | Official statistics | 314 | 19.25 |
| | | Weighting or scaling factors | 3 | 0.18 |
| | | Modeling - process models | 254 | 15.57 |
| | | Expert judgement | 27 | 1.66 |
| | Environmental | not provided | 2982 | 85.94 |
| | | Follow up routines from enterprises | 65 | 1.87 |
| | | Data from experiments or scientific measurements | 41 | 1.18 |

| | | | | |
|---|---|---|---|---|
| | | Branch statistics | 45 | 1.30 |
| | | Official statistics | 34 | 0.98 |
| | | Modeling - process models | 281 | 8.10 |
| | | Expert judgement | 22 | 0.63 |
| Iberian General Structure Case Study | Economic | not provided | 446 | 72.52 |
| | | Follow up routines from enterprises | 5 | 0.81 |
| | | Data from experiments or scientific measurements | 4 | 0.65 |
| | | Branch statistics | 3 | 0.49 |
| | | Official statistics | 4 | 0.65 |
| | | Weighting or scaling factors | 1 | 0.16 |
| | | Modeling - process models | 127 | 20.65 |
| | | Expert judgement | 25 | 4.07 |
| | Social | not provided | 594 | 75.77 |
| | | Data from experiments or scientific measurements | 1 | 0.13 |
| | | Branch statistics | 8 | 1.02 |
| | | Official statistics | 128 | 16.33 |
| | | Weighting or scaling factors | 8 | 1.02 |
| | | Modeling - process models | 31 | 3.95 |
| | | Modeling - time extrapolation | 1 | 0.13 |
| | | Expert judgement | 13 | 1.66 |
| | Environmental | not provided | 1708 | 86.52 |
| | | Follow up routines from enterprises | 10 | 0.51 |
| | | Data from experiments or scientific measurements | 37 | 1.87 |
| | | Branch statistics | 74 | 3.75 |
| | | Official statistics | 19 | 0.96 |
| | | Modeling - process models | 89 | 4.51 |
| | | Expert judgement | 37 | 1.87 |

*Table 4. Overview of data sources in case studies grouped by indicator classes*

## 5.2 EU-FWC

EU-FWC chain was designed using the EFORWOOD data client / Chain editor. As the EU-FWC includes topology for all EU countries, it was built based on the country group principle. The first step to build the country sub-chains was to build sub-chains for country groups, the relevant topology was then copied for each country in the particular country group. The country groups are: Eastern Europe, Nordic countries, Southern Europe, Western Central Europe.

There are 2188 processes used in the EU-FWC chain on the date 31/01/2010.

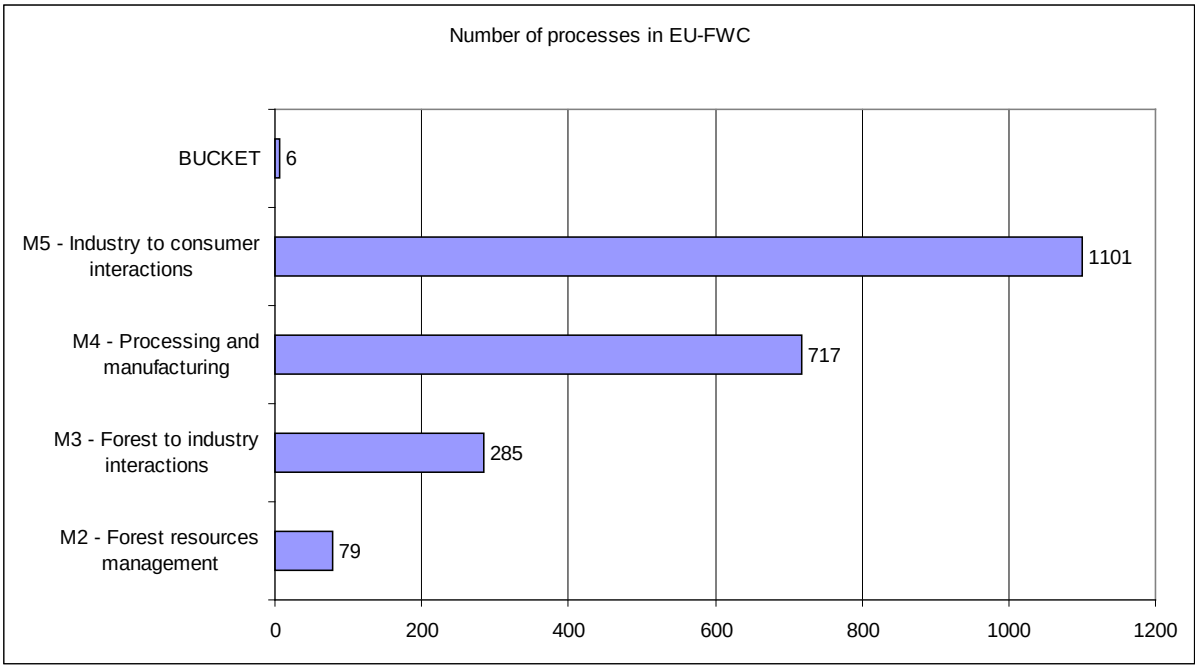


*Chart 2. Number of processes within EU-FWC chain*

The set of indicators used in the database reflects the Data collection protocols. All statistics are calculated for the indicators selected for demonstration.

The EU-FWC database uses 25 indicators and 168 sub-indicators. Number of sub-indicators selected for demonstration is 66.

The final status on the date 31/01/2010 of collected data for case studies is as follows:

| | | Absolute numbers | | |
|---|---|---|---|---|
| Module | Number of processes | Delivered Values | Not applicable | Not feasible |
| M2 | 79 | 3418 | 1796 | |
| M3 | 285 | 6303 | 12365 | 142 |
| M4 | 717 | 22033 | 22212 | 3078 |
| M5 | 1101 | 17533 | 53326 | 1810 |

*Table 5. Overview of collected values in EU-FWC: Absolute numbers*

| | | % | | |
|---|---|---|---|---|
| Module | Number of processes | Delivered Values [%] | Not applicable [%] | Not feasible [%] |
| M2 | 79 | 65.55 | 34.45 | 0.00 |
| M3 | 285 | 33.51 | 65.74 | 0.75 |
| M4 | 717 | 46.56 | 46.94 | 6.50 |
| M5 | 1101 | 24.13 | 73.39 | 2.49 |

*Table 6. Overview of collected values in EU-FWC: Percentages*

Data sources used to collect data for EU-FWC was as follows:

| **Module** | **Data source** | **Absolute number** | **%** |
|---|---|---|---|
| M2 - Forest resources management | Branch statistics | 4 | 0.12 |
| | Modeling - process models | 1348 | 39.44 |
| | not provided | 2066 | 60.44 |
| M3 - Forest to industry interactions | Data from experiments or scientific measurements | 1 | 0.01 |
| | Branch statistics | 538 | 7.87 |
| | Official statistics | 95 | 1.39 |
| | Weighting or scaling factors | 88 | 1.29 |
| | Modeling - process models | 1140 | 16.68 |
| | Modeling - time extrapolation | 7 | 0.10 |
| | Expert judgement | 69 | 1.01 |
| | not provided | 4898 | 71.65 |
| M4 - Processing and manufacturing | Branch statistics | 684 | 2.93 |
| | Official statistics | 424 | 1.82 |
| | Weighting or scaling factors | 1136 | 4.87 |
| | Modeling - process models | 7757 | 33.23 |
| | Modeling - spatial extrapolation | 90 | 0.39 |
| | Expert judgement | 430 | 1.84 |
| | not provided | 12822 | 54.93 |
| M5 - Industry to consumer interactions | Official statistics | 400 | 2.71 |
| | Modeling - process models | 6650 | 45.11 |
| | Expert judgement | 2795 | 18.96 |
| | not provided | 4898 | 33.22 |

*Table 7. Overview of data source in EU-FWC grouped by modules*

| Indicator category | Data source | Number | % |
|---|---|---|---|
| Economic | Data from experiments or scientific measurements | 1 | 0.01 |
| | Branch statistics | 378 | 2.63 |
| | Official statistics | 207 | 1.44 |
| | Weighting or scaling factors | 37 | 0.26 |
| | Modeling - process models | 6639 | 46.17 |
| | Modeling - time extrapolation | 6 | 0.04 |
| | Expert judgement | 789 | 5.49 |
| | not provided | 6323 | 43.97 |
| Social | Branch statistics | 105 | 1.53 |
| | Official statistics | 712 | 10.35 |
| | Weighting or scaling factors | 27 | 0.39 |
| | Modeling - process models | 3238 | 47.07 |
| | Modeling - time extrapolation | 1 | 0.01 |
| | Expert judgement | 586 | 8.52 |
| | not provided | 2210 | 32.13 |
| Environmental | Branch statistics | 743 | 2.20 |
| | Weighting or scaling factors | 1160 | 3.44 |
| | Modeling - process models | 7018 | 20.82 |
| | Modeling - spatial extrapolation | 90 | 0.27 |
| | Expert judgement | 1919 | 5.69 |
| | not provided | 22784 | 67.58 |

*Table 8. Overview of data source in EU-FWC grouped by indicator categories*

# 6 Conclusions and outlook

WP 1.2 facilitates data collection and data sharing for other project components, specifically to WP 1.4 and 1.5. Therefore the database structure respects the specific requirements of ToSIA developers. The set of indicators used in the EFORWOOD database was implemented by WP 1.2 based on information from WP 1.1; information on FWC structures, production processes and indicators is provided by modules 2-5.

All EFORWOOD data are stored in the central EFORWOOD database. Software tool called EFORWOOD Database Client allows the user to access contents of the database using hierarchically organized forms and overview tables. The client also contains the chain editor which enables the users to design chains visually using graphical representation of processes and their interconnections. The authorized users can also use the Client to obtain the complete content of the database in XML format that is used as ToSIA input.

The database structure is open to be further adapted and developed in line with the development of data needs and data availability. The principle of using lookup lists enables authorized users to change the database structure using the EFORWOOD database client; such changes do not require further changes in the client or in the export to XML functionality. Other changes in the database structure require changes in the database client as well as in the XML.

During the process of collecting data for the case study chains several bugs in the EFORWOOD database client were fixed and the database structure was slightly adjusted to fit the ToSIA requirements. It turned out that detailed data collection protocols are very important for the data quality. The data collection for the case studies is based on the experience with the test chains. As the EU-FWC is a very huge chain, new functionality to the EFORWOOD database client was implemented to enable handling such a number of processes, links and products.

EFORWOOD database as well as the application server is stored and mintained at IFER. Data can be accesssed and edited using the EFORWOOD Database Client; bulk data imports (indicator values, conversion factors, product shares) are only possible directly in the database; the only bulk import available in the client is the import of split ratios.

## 6.1 Possibilities of the future functioning

### 6.1.1 State-of-the-art

EFORWOOD database is developed in Access format; it means no network access is possible. Network access is provided by the Eforwood Application Server (referred as Server) that serves as the interface between users and the database. The users connect to the Server using the client software (Eforwood Database Client, referred as Client) and access data. The only possibility how to get data is the export in XML format using the Server. No other applications except of the Client can connect to the database.

### 6.1.2 Possibilities of the future functioning: database format:

a) The database will remain in Access format

- The database will remain at IFER. IFER will maintain the database. No need to change the Client or the Server.
- The database will be moved to EFI. IFER will provide the Server and the Client as they are.

b) The database will be converted to other format / database server (Oracle, MSSQL, MySQL ... ): The database would be directly accessible for other applications. To keep the Client working, it would be necessary to adjust the Server.

### 6.1.3 Possibilities of the future functioning: location of the database and the server

a) Database server at IFER + application server at IFER: IFER would maintain the database and implement possible future software changes (Client, Server).
b) Database server at EFI + application server at IFER: EFI would maintain the database; IFER would implement possible future software changes (Client, Server).
c) All at EFI