

Development of a website and an information system for an European R&D project : the example of the STRATFEED project

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The multidisciplinary nature, the international partnership and the large amount of information to be managed in an European project such as STRATFEED, require the development of an information management system. Within the framework of this project, the development of the Internet-oriented computer system required three facets: the data and information collection, the database building and the development of different applications. A tool for the dissemination of results (*STRATFEED website*) with both a public part and a confidential part, a tool for data management (*STRATFEED manager*), a tool for data queries (*STRATFEED explorer*) and two tools for decision-making (*ARIES Decision Support System* — CD-Rom release and *STRATFEED Decision Support System* – Internet release) were developed. The modular concept, which relates to the different topics of the project, facilitates the updating and development of a system according to research progress and user needs. The concept developed for this project can be used for any other project and can easily be adapted to meet new requirements. The example of the STRATFEED project can be accessed at: <http://stratfeed.cra.wallonie.be>

Keywords. Databases, internet, project management, decision support, knowledge based systems, computer systems (applications), information systems.

Développement d'un site web et d'un système d'information pour un projet européen R&D. L'exemple du projet STRATFEED. La nature multidisciplinaire, le partenariat international et l'importante quantité d'informations à gérer dans un projet Européen comme STRATFEED, demandent le développement d'un système de gestion de l'information. Dans le cadre de ce projet, le développement du système informatique, orienté Internet, implique trois aspects : la collecte des données et de l'information, la création de la base de données et le développement des différentes applications. Un outil de dissémination des résultats (Site web *STRATFEED*) incluant une partie publique et une partie confidentielle, un outil de gestion des données (Gestionnaire *STRATFEED*), un outil de création de requêtes (Explorateur *STRATFEED*) et deux outils d'aide à la décision (Système d'aide à la décision *ARIES - version CD-Rom et Système d'aide à la décision STRATFEED - version Internet*) ont été développés. Le concept modulaire lié aux différents thèmes du projet facilite la mise à jour et permet le développement du système en rapport avec l'évolution de la recherche et des besoins des utilisateurs. Le concept développé pour ce projet peut être étendu à d'autres projets et peut facilement être adapté en fonction des nouvelles exigences. L'exemple du projet STRATFEED est accessible à l'adresse suivante: <http://stratfeed.cra.wallonie.be>

Mots-clés. Base de données, internet, gestion de projet, aide à la décision, système basé sur la connaissance, système informatique (application), système d'information.

1. INTRODUCTION

In 2000, the European Commission gave a grant to the project called STRATFEED, which was focused on the detection of animal tissue in animal feeds for the eradication of BSE in the animal production chain.

The scope of the project was intended to support the EU legislation in force; however, in the past two years, identification of the type of animal tissue rather than its mere detection has become increasingly important. Current EU legislation that has come into force since May 2003 includes the classification of animal tissue

according to the different sources of origin (mammalian, avian and fish) (Gizzi *et al.*, 2003). The partnership for the project included scientists from 10 research institutes, universities or companies, originating from five different EU Member States and, since the start of the project, three extra institutes from two additional Member States and from Switzerland have been invited to join. The scientific structure of the project includes three distinct disciplines: classical microscopy (EU, 1998; Frick *et al.*, 2002), molecular biology (PCR) (Berben *et al.*, 2000) and near infrared technology (NIR) (Baeten *et al.*, 2001; Dardenne *et al.*, 2001; Murray *et al.*, 2001), each with its own specificity and requirements.

Fully reliable research material must be available to facilitate research in an assured and scientific manner. This basic requirement implied the development of a sample bank that now contains almost 2500 pure animal ingredients, and pure or spiked feeds. Additionally, within the framework of the STRATFEED project, several special sample sets of authorized material are currently being developed. All the basic data and scientific results need to be stored in a transparent manner and made available to all the partners.

In order to comply with the management, organizational and communication requirements of the project, a dedicated work package for the development of management and scientific tools has been set up. Modern information technology offers the necessary

flexibility to comply with the changing demands as described. The features of STRATFEED – the multidisciplinary nature, the international partnership, the quantity of information to be managed and the huge mass of analytical data – basically apply to all international projects. In this paper several tools will be described which have been developed and are currently available in the STRATFEED project.

The structure of the computer system can be described in three parts (**Figure 1**). The first part concerns data and information collection. On the one hand, the different labs produce a lot of data concerning the identification of the samples and regarding analyses by classical microscopy, polymerase chain reaction (PCR), near infrared spectroscopy (NIRS) or near infrared microscopy (NIRM). On the other hand, each participating team provides information that is useful for the management of the project. Such information includes, for instance, the project description, details of the partners, bibliographic references, newsletters, reports, lectures from meetings and EC documents. All of these types of information and data (symbolised on the flowchart by flying sheets) are available in different formats. The second part of the computer system, and one of the project's objectives, is to build a database to gather and store all the relevant data and information in a dedicated structure. From a well-defined and structured database, any application can be developed; this is the third part of the flowchart. In

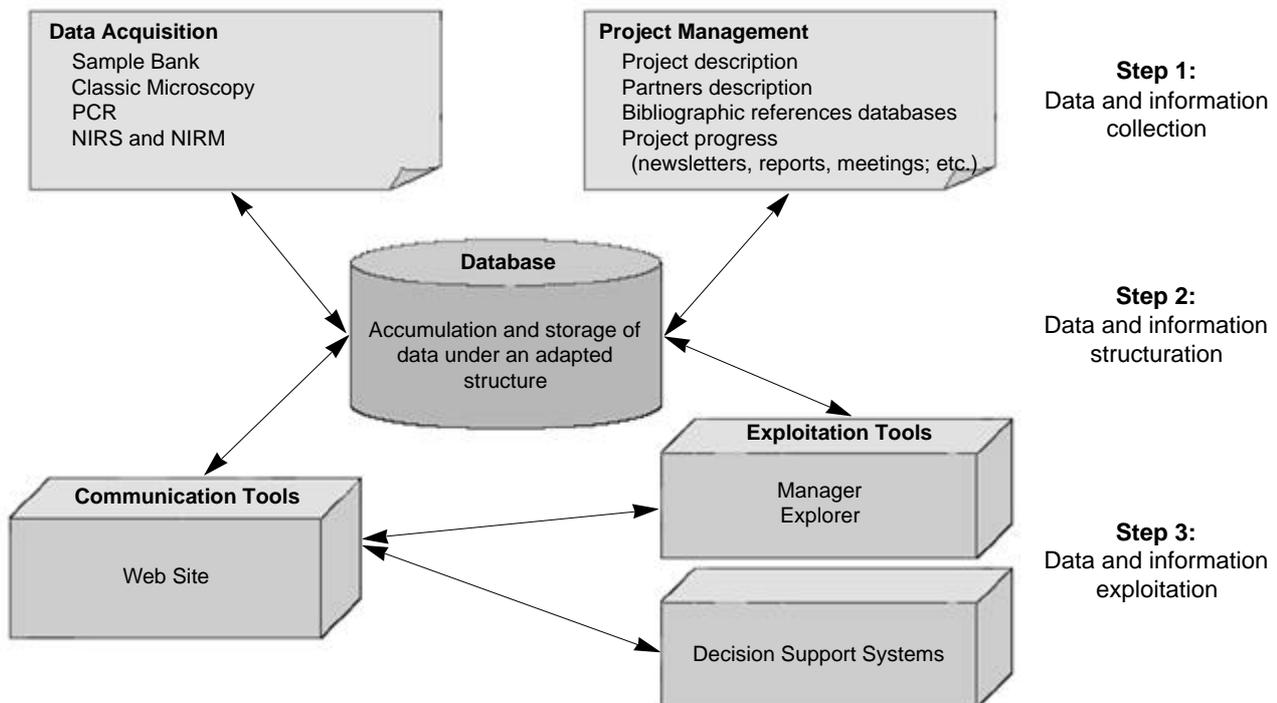


Figure 1. The computer system concept developed for the STRATFEED project — *Le concept du système informatique développé pour le projet STRATFEED.*

the frame of the project, two types of application have been developed: an information communication tool using the website to facilitate exchange between the partners and data exploitation tools including a manager specifically for the use of the database administrator, an explorer dedicated to the user to enable exploration of the available data, and a decision support system designed for the classical microscopy.

2. DATA AND INFORMATION COLLECTION

The most important step in a wide-ranging project is the data and information collection. It involves close collaboration between the information technology team (IT team) and the scientific research teams. For the STRATFEED project, this task was undertaken by a scientist with dual competence in computer systems and in agronomy who was integrated into the coordination team.

The methodology used to collect the data included three phases. Phase 1 consisted of defining the traits of each topic in the project in order to build the structure of the database. Phase 2 was dedicated to the data collection itself, based on the traits defined in Phase 1. For each technique, after the data acquisition by each laboratory, in accordance with the analytical protocol, the data files were collected by the work package leader for discussion and validation from a scientific point of view before being sent to the IT coordinator for validation from a computer point of view (Figure 2). Phase 3 consisted of defining the user requirements for the

different applications in order to encourage users to give their feedback on each release delivered on the private part of the website. In this way, each set of data or information was validated by both scientific experts and IT experts before being made available on the website.

3. DATABASE

The main objective of a database is to store the data in a specific structure that allows the easy retrieval of specified parts of the data via the applications. The MS Access platform has been selected to implement the database and to manage both numbers and text as well as figures and files. In order to have maximum flexibility for development, updating and dissemination, different tables have been created to suit each topic in the project (Figure 3). Tables containing the results of each of the scientific disciplines, in the form of numbers, text or images, are connected to the central table with sample characteristics such as origin, source, country and date. In this way, the features of the relational database provided by MS Access are fully exploited. The information about partners and their institutions has been defined in a table, and the bibliographic references have been described in a table using the norm ISO 690 (NLC, 2002). The formulae of samples gathered in the sample bank have been described according to the EC guidelines of the Commission Directive 98/67/EC (OJ, 1998) which amended Council Directive 96/25/EC.

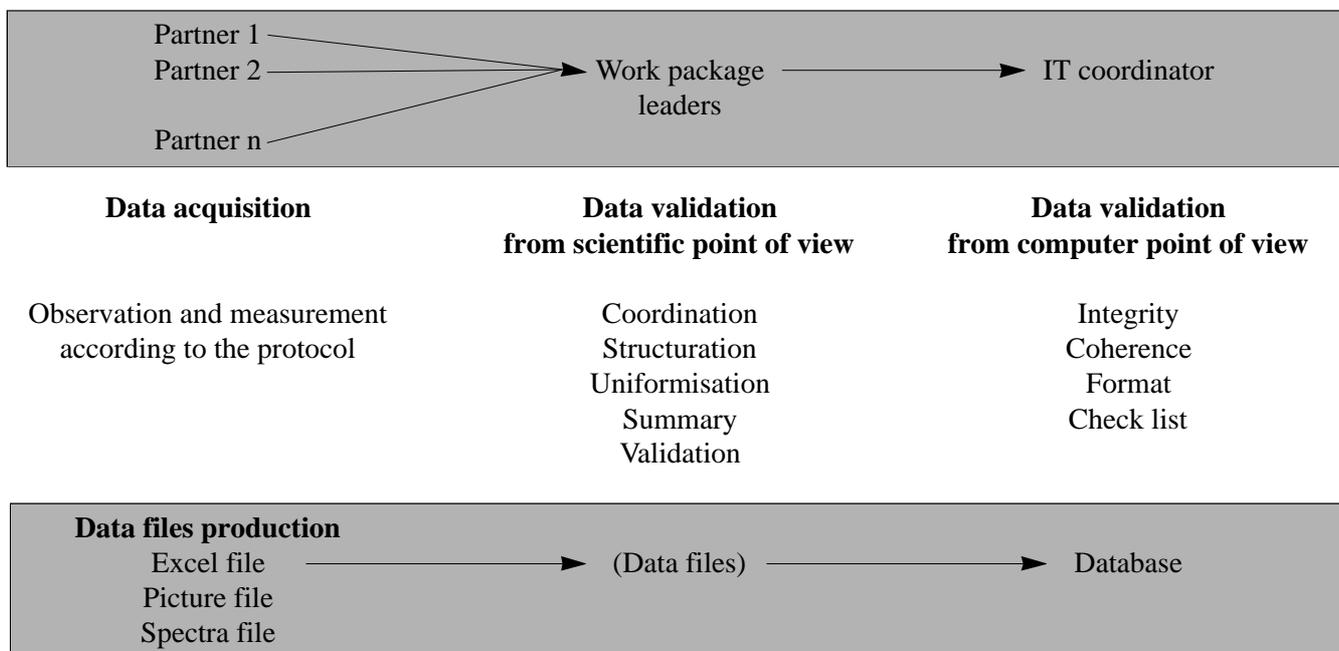


Figure 2. The data collection process applied for the STRATFEED project — *Le processus de collecte des données appliqué pour le projet STRATFEED.*

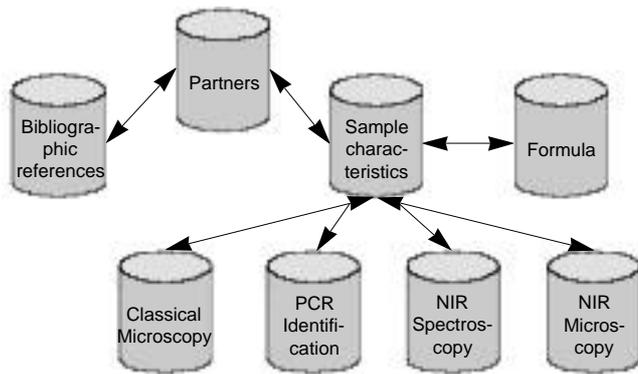


Figure 3. The database structure developed for the STRATFEED project — *La structure de la base de données créée pour le projet STRATFEED.*

4. INFORMATION COMMUNICATION TOOLS

The website has two main objectives: on the one hand to provide the general public with information about strategies that detect and quantify animal tissue in feedingstuffs, and on the other hand to be a platform, dedicated only to the partners involved in the project, for the exchange of data, ideas and information. To implement these two functions, a public section and a private section have been developed. The STRATFEED Internet site is based on an environment for development (*Cold fusion web application server*) that enables the user to create dynamic web pages.

The public section of the website is accessible through the Home page (**Figure 4**) which is divided into three frames: the main frame with specific icons for the different work packages and/or techniques placed around a central triangle on which the title of the project appears; the top frame with the logo and project number; and finally, the left frame with different topic buttons as described in the next paragraph.

The “**Project description**” topic is a web page that presents an outline of the project with Internet links to European Commission decisions. The “**Participants**” topic is divided into four subtopics: list, consortium, invited partners and collaborators. The subtopic “**List**” displays the name, institution, email address and phone number of each participant involved in the project. The subtopic “**Consortium**” presents the 10 partners (logo, institute, leader name) arranged around the European flag according to their geographical position. For both subtopics, by clicking on different fields, the user has access to various dynamic web pages describing either the institution and its role in the project or the staff, their backgrounds and relevant publications. The subtopics “**Invited partners**” and “**Collaborators**” display information about partners linked to the project by an agreement (invited partners) or otherwise (collaborators). The

“**References**” topic points to approximately 170 documents, as well as publications, books and website addresses referenced in the database. The search tool allows the user to define a request according to different fields. The result list, providing author, title and year, is displayed on a new frame. By clicking on a reference, the user can access more information about it and, for example, the abstract. The “**Services**” topic is a web page listing services, proposed by the consortium, which open the project to other collaborators. The “**Events**” topic is a web page that displays information about important public events related to the project. Behind those topics, links are included to access the confidential site and the STRATFEED Home page.

The private section of the website is accessible from the public Home page by clicking on the “Confidential site” topic. The confidentiality of data and information provided by the partners is assured by the use of a personal login and password system and by the use of a website secure server certificate for proving the identity and ownership of domain names and for enabling confidential communication between the web server and the connected STRATFEED users. The installation of the computer system on a dedicated machine (server) protected by a firewall between the Internet and the private zone of the STRATFEED website and the implementation of anti-virus software on the STRATFEED server ensure the protection of the website. Moreover, regular updating of the operating system and periodic change of personal passwords improve this security. Every occasion of access to the site, and particularly to the confidential part of the site, is logged in specific files in order to produce statistics.

The Home page of the confidential site is built in the same way as the Home page of the public section with, on the left frame, the following different topics available. The “**Newsletter**” topic refers to a web page that presents the newsletters with links to the documents in pdf format. The “**Meetings**” topic refers to a web page listing the meetings organised in the project area with links to the lectures in pdf or ppt format. The “**Reports**” topic opens a web page presenting the reports written for the European Commission with links to the documents in pdf format. The “**European Commission Documents**” topic informs the partner about the documents relating to European projects and, amongst others, about the Technological Implementation Plan (eTIP). The “**Consortium Documents**” topic provides information about the administrative documents defining the working conditions of the consortium. The “**Databases**” topic presents the different applications developed in the project: the “STRATFEED explorer” and the “decision support systems”.

5. DATA EXPLOITATION TOOLS

In order to enhance and exploit the database, different applications have been developed to manage, explore and use the data collected.

The “**STRATFEED manager**” aims to manage the data (i.e. add, delete or modify any data provided in the project). This application, developed with *MS Access*, can be accessed exclusively by the database administrator. It provides forms to input the data and reports to check the data (**Figure 5**).

The “**STRATFEED explorer**” provides the user with the tools to explore the database through queries. The development of this tool is based on client-server architecture using the Internet to provide the linkage between the two sides (**Figure 6**). The client side supports the user interface which is a web browser (Internet explorer or Netscape). The server side supports the web server, the database and the query tool. The query module receives the request from the client (HTML pages), accesses the database, depending on the request, and returns the answer to the client by means of the web server software and Internet protocol. With this application, on the one hand, the user can quickly get an overview of the “STRATFEED database” through predefined queries and, on the other hand, a user with more expertise can build his own query using different query modules which correspond to the different techniques (**Figure 7**).

Additional exploitation tools that have been developed include the *decision support systems* (DSS). The aim of the DSS is to offer scientists user-friendly assistance in detecting and identifying animal tissues in animal feeds through descriptive texts and pictures. They are based on the knowledge and expertise of the partners in the project and their structures differ from the described database

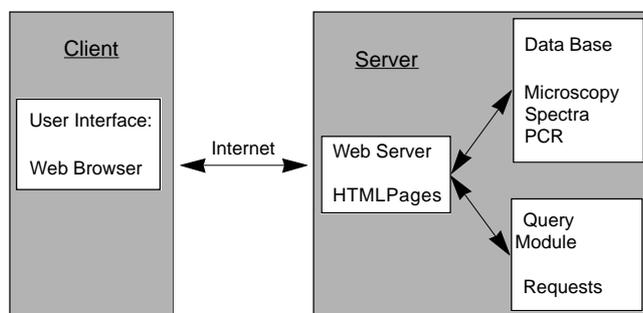


Figure 6. The Internet-based architecture of the “STRATFEED explorer” — *L’architecture orientée Internet de l’Explorateur STRATFEED*”.

management system, since the latter is sample oriented, whereas the DSS are type oriented. The development of a DSS requires the translation of data and results per sample into knowledge, e.g. per type of material. Knowledge may be expressed in the form of conclusions, conditions or character states. The structure in which this knowledge is formally represented depends on the chosen program. This might be a knowledge base or another type of presentation. DSS or more general Expert systems are available in two principal forms: rule-based (conditions) or matrix-based (character states). Two matrix-based systems have been chosen for the STRATFEED project. The main advantage of matrix-based systems is that the results can be presented, for instance, in the form of a percentage which indicates the match between the user observations and the type descriptions. Matrix-based systems also allow a better end-user oriented description of the conclusion. For the STRATFEED project, the two decision support systems currently in development are: a basic tool, the “STRATFEED Decision Support System” and a more elaborate tool, the “ARIES Decision Support System”.

The “**STRATFEED Decision Support System**”, an Internet-oriented system developed in JAVA by CRA with the collaboration of RIKILT, supplies a stepwise identification of bone particles in animal feeds by classical microscopy. The first step provides a list of the types of observation (low magnification, high magnification, bones, additional inclusions) that are supported by the system. This list is proposed to the user who can make a selection. Depending on the choices made by the user, a series of questions, illustrated with pictures, has to be answered by pressing one of the following buttons: ‘yes’, ‘intermediate’, ‘no’ or ‘blank’. On answering, the program calculates the fit between the observations of the user and the referenced descriptions of mammalian, avian or fish tissue, and presents these fits in decreasing order. Finally, for each question, the user can check and compare his choices with the description of the different types of meat and bone meal (MBM) (**Figure 8**).

The “**Animal Remains Identification and Evaluation System (ARIES)**” is a stand-alone system produced by RIKILT (van Raamsdonk, 2002), based on the Linnaeus II software (ETI, 2003), in collaboration with partners NUTRECO, LAGC and ROLT. This system provides three identification modules (**Figure 9**): the first is based on text, while the second is based on pictures. These two modules are based on decision trees. Every window shows two or three buttons with choices (texts or images); pressing a button, i.e. making a choice, leads to a next



Figure 4. The home page of the “STRATFEED website” — *La page d’accueil du “Site web STRATFEED”.*

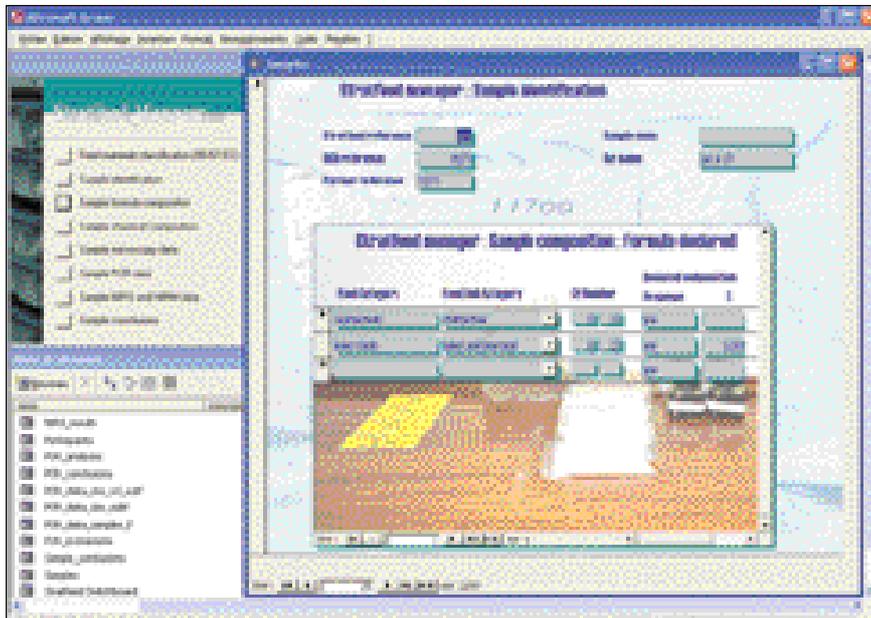


Figure 5. The user interface of the “STRATFEED manager” — *L’interface utilisateur du “Gestionnaire STRAT-FEED”.*

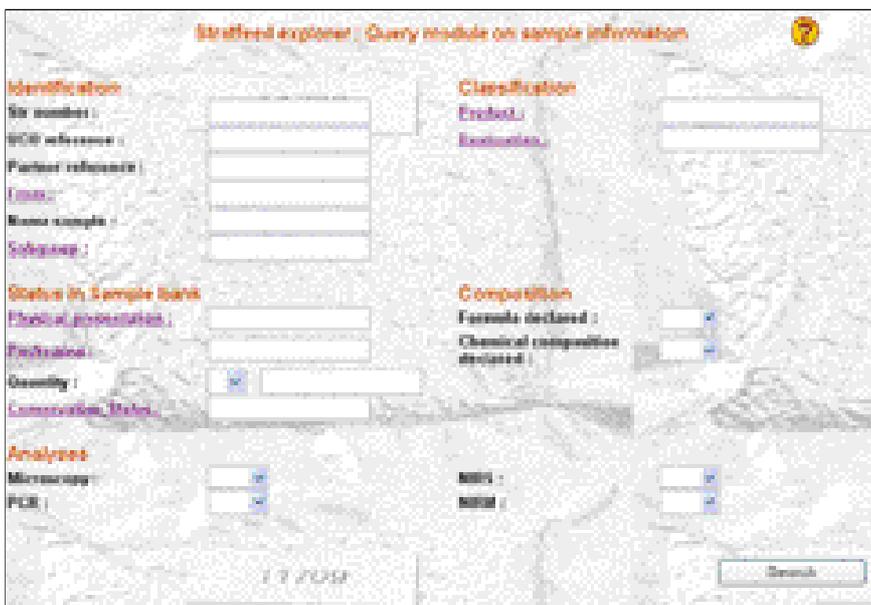


Figure 7. The query module on sample information provided by the “STRATFEED explorer” — *Le module de requêtes sur l’information d’un échantillon fourni par l’ “Explorateur STRATFEED”.*

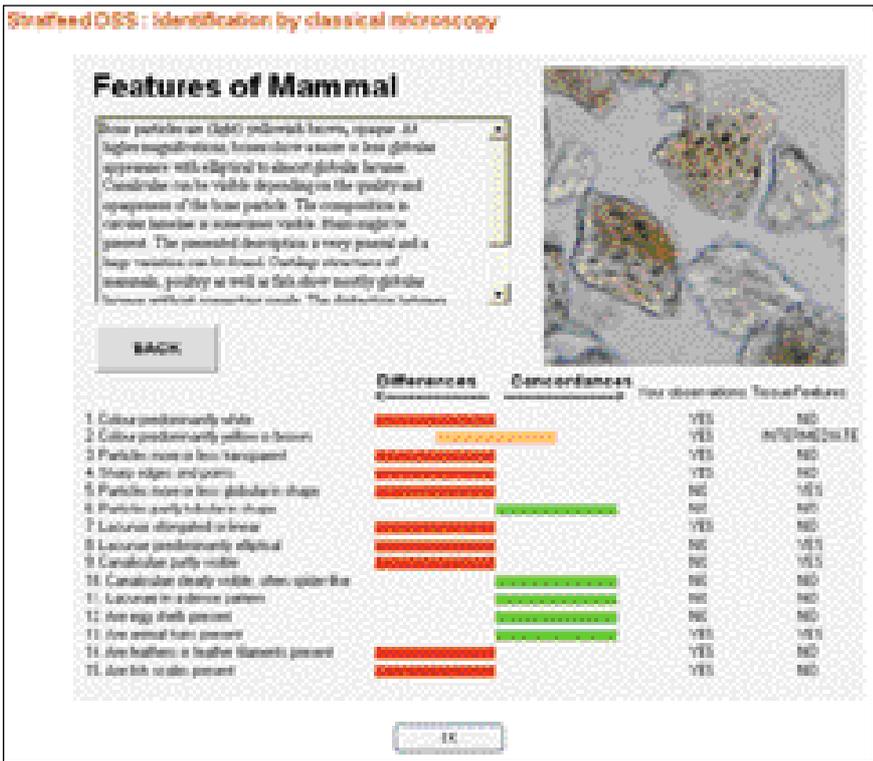


Figure 8. The microscopy expertise provided by the “STRATFEED decision support system” — *L’expertise en microscopie délivrée par le “Système d’aide à la décision STRATFEED”*.

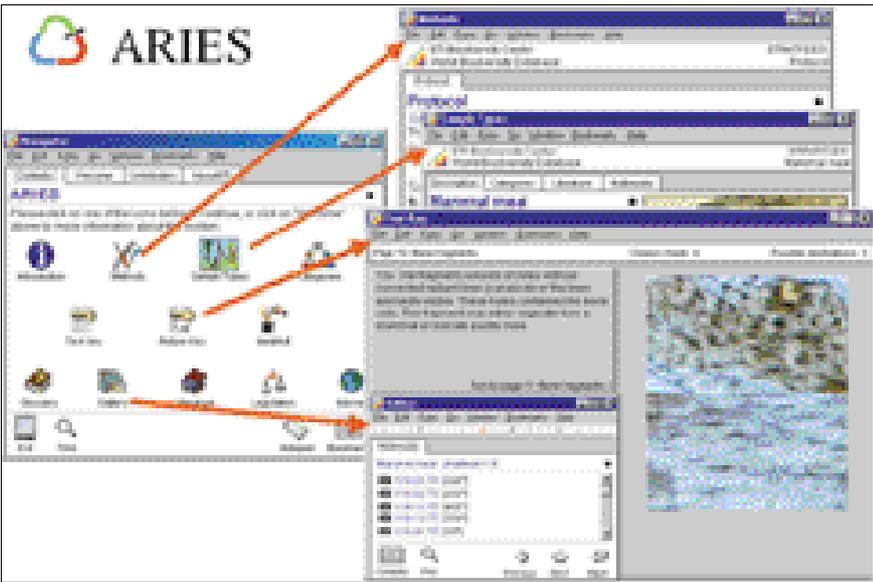


Figure 9. The microscopy expertise provided by the ARIES decision support system — *L’expertise en microscopie délivrée par le “Système d’aide à la décision ARIES”*.

window with either new choices or a conclusion. Both modules can produce a report of the identification pathway. The third identification module, which is more powerful, is based on a multiple-entry key (matrix of taxa, characters and character states). Observations can be entered in a user-defined order, and after each input the user is informed about the match of the most probable conclusions. ARIES also provides an introduction to the system, protocol and

recipe explanation, a databank with descriptions and images for each MBM type and possible confusing vegetable ingredients, a glossary of terms, a comprehensive gallery of images, full information on legislation, literature and internet links. The Linnaeus II system currently does not support access via Internet using a browser and is therefore presented as a stand-alone system to be released on CD-Rom. A show demo is nevertheless presented on the website.

6. DISCUSSION AND PERSPECTIVES

On the one hand, the intention of the “**STRATFEED website**” is to gather a lot of general, legislative and scientific information around the problematic of the project, all of which is accessible to a large public. On the other hand, the private part of the website is a confidential platform for information exchange between the partners in the consortium and which facilitates the gathering of scientific data with high added value.

The “**STRATFEED database**” can be used as a reference for the detection and quantification of mammalian tissues in animal feeds and is dedicated to each lab or manufacturer working in the feed sector. This is the first reference database gathering so much information on feed samples adulterated or not with animal tissue. Currently (November 2003), the database includes descriptions of around 2500 samples and scientific data from analyses using new methodologies on 100 samples.

General applications such as the “**STRATFEED manager**” and the “**STRATFEED explorer**” provide real added value to the STRATFEED database, enabling the management of data and the building of queries.

Specific applications such as the “**ARIES Decision Support System**” (CD-Rom release) and the “**STRATFEED Decision Support System**” (Internet release) give responses to specific requests. In particular, these decision support systems are the first known systems applied to the detection of mammalian tissues in feedingstuffs, in support of current EU legislation.

At the end of the project, the website will be used as the main tool for the dissemination and valorisation of the results. The goal is to give a larger public, outside of the consortium, access to the database and to the linked applications. It will also facilitate follow-up on the project. The website and the applications will be maintained and updated as often as necessary, depending on the development of the BSE problem and on the research. Other tools may also be developed around the database. The modular structure of the system, according to the different topics of the project, facilitates updating and favours the development of further tools. The concept developed for the STRATFEED project can be used for any other project and can easily be adapted to meet new requirements. The example of the STRATFEED project can be accessed at:

<<http://STRATFEED.cra.wallonie.be>> (CRA, 2003).

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