EUPHIX
European Union Public Health Information System

EUPHIX Final Report

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Abstract

On June 20, 2008, the EUPHIX website (www.EUPHIX.org) was officially launched. EUPHIX aims to provide policy relevant health information, data and knowledge for policy makers, public health experts and educated lay people in the European Union (EU). The project was carried out by a partnership of European health reporting experts.

The conceptual structure of EUPHIX resembles the one used for the ECHI-indicator framework, but adds health policies. EUPHIX includes texts (EUphacts) next to indicator data, as well as links to organisations, data and literature. Other contributions, called EUphocus, address broader agenda issues, such as mental health and health inequalities. Some EUphocus contributions contain summarised outcomes of EU projects. In this sense EUPHIX has a European platform function as well.

Beneath the surface of the EUPHIX website lies a complex internet application, including databases, i.e. for indicator data, for internal and external web links and for references and definitions. This back-office contains a Content Management System that guides an editorial process allowing the differentiation of the roles of authors, reviewers and content editors. User oriented functionalities include different ways to interactively manipulate data for personal presentation needs. Some EUphacts are linked to the Health-EU Portal.

EUPHIX is drawing increasing numbers of visitors and has the potential to become the nucleus of a health monitoring system for the EU. However, current financing practice puts serious limits to its sustainability.

The conclusion is that the EUPHIX model launched in June 2008 is integrating data, information and knowledge into a new type of Health Information System. The EUPHIX model is proposed to be the model in the future of European health reporting [1].

1 Introduction

This final report provides an overview of the EUPHIX project, its working process and its deliverables. It contains an elaborate description of the project's methods and design, the project organisation, the content design, the editorial process, the expert network, the dissemination and first evaluation of EUPHIX, the status of EUPHIX by June 2008 and an assessment of the future of the project. Besides this, there will be paragraphs providing background information about the technology behind the EUPHIX website, sometimes accompanied with annexes.

Evidently, the website 'www.euphix.org' is the main product coming out of the project. However, this final report is important to inform the Commission (DG SANCO) who funded the project, and anyone interested, about the backgrounds and documentation of the work carried out. This report can also be used by people interested in public health reporting as a kind of 'field guide' to what is needed in order to build a health reporting system similar to EUPHIX.

1.1 Background

The Maastricht Treaty of 1991 (article 129) followed by the Amsterdam Treaty of 1998 (article 152) have increased the competence of the European Union in the area of health protection and public health. In 1993 the Commission presented a Communication on the Framework for Action in the Field of Public Health as an initial strategy document to develop work on public health. On this basis, eight action programmes were agreed, i.e. on cancer, drug dependence, AIDS and other communicable diseases, rare diseases, accidents and injuries, pollution-related diseases, health promotion, and on health monitoring. These eight programmes were replaced by the Public Health Programme (2003-2008) and next by the Health Programme (2008-2013). In the meantime, in 1999, the Directorate of Health and Consumer Protection (DG SANCO) was established to stimulate and coordinate actions and policies in the public health area [1].

The Health Monitoring Programme had as objective to contribute to the establishment of a Community health monitoring system, in order to:

1. Measure health status, its determinants and the trends therein throughout the Community,
2. Facilitate the planning, monitoring and evaluation of Community Programmes and actions;
3. Provide Member States with appropriate health information to make comparisons and support their national health policies.

In similar wording, the 2008-2013 Health Programme highlights the 'Development of a sustainable health monitoring system with mechanisms for the collection of comparable data and information, with appropriate indicators'. In order to establish a structure for all this, the ECHI projects [7] have proposed the framework and shortlist for the ECHI

(European Community Health Indicators) indicators, in cooperation with many other EU-funded projects[1].

The ECHI projects mentioned before are at the core of EUPHIX. The short list of indicators, that was developed within these projects, and further developed within the ECHIM project, has been taken as the basis for the arrangement and selection of public health topics to be presented in the EUPHIX website. Furthermore, the ECHI(M) projects provide very important information about indicators, e.g. definitions, the (preferred) way to calculate the different indicators, and possible data sources related to specific indicators. For more information about the ECHI(M) projects check the website at www.echim.org.

The logical next step now is to link these EU indicators to a health reporting function. National practice, however, is moving from paper reports to web-based health reporting, e.g. in Norway, Germany and the Netherlands [6] and [11]. For the EU context, comprehensive paper reports on the health situation have been published in 1995 [3] and 2003 [4], as required by the Public Health programmes. The next one, to be produced by the EUGLOREH project [5], is due for 2008 [1]. Also for the EU, a web-based health monitoring and reporting system appeared the next logical step. This was the basic idea behind the development of the EUPHIX website (EU Public Health Information and Knowledge System). The EUPHIX system could be considered a *third generation* public health information system, because it integrates data, descriptive and analytical information, and digested and evidence based knowledge [11]. The integrated nature of the system makes it a new and unique model for public health reporting. In addition, the EUPHIX system can be used as a platform for integrating results and information from *other* projects funded by the EU Public Health Program. This way EUPHIX functions as a central point for reporting about project results, integrated with information within other EUphoci and EUphacts. As will be explained later this can be done by using the EUphocus concept.

EUPHIX strongly builds upon experience from national public health reporting systems like the Norwegian health reporting system and the Dutch National Compass. Norhealth (www.norgeshelsa.no) is a web-based health information system that monitors health and health related conditions, including risk- and protective factors over time [12]. It has the same target audience as EUPHIX and also combines public health knowledge with tables, graphs and maps. As will be explained later, the software that was developed for the Dutch National Compass (http://www.rivm.nl/vtv/object_document/o3743n16906.html) has also been used for EUPHIX, with some important adjustments and additions of other software, and the development of a special EUPHIX database.

Objective and intended audiences

The main aim of the EUPHIX project is ‘to develop a prototype for a sustainable, web-based health information and knowledge system for the European Union’, providing users with relevant, structured information on issues of public health across the EU and within its 27 Member States.

The EUPHIX project focuses on various target audiences: **policy makers** at European, national and regional level, including the Commission's services; **public health professionals and academia**; **the media and the better informed general public**. The site is also developed to serve as background information to the EU-health Portal.

The main aim of EUPHIX has been translated into three specific objectives:

- to deliver a functioning prototype for a web application
- to develop structured information on selected public health issues for that application
- to establish a network of organisations and experts that will maintain the application sustainably.

These objectives parallel the project's deliverables and the Work Packages.

Key features

EUPHIX has the following key features which distinguish the project from other available EU public health reporting systems.

Relevant and reliable information
EUPHIX offers:

- Integrated scientific information on the health of populations across the EU, the causes and consequences of (ill-) health, as well as on health policies and strategies at EU and national levels.
- aggregated data, related and linked to specific health indicators and derived from validated sources, such as DG Eurostat, WHO, OECD;
- tables, graphs and maps displaying national and regional health data, as well as international comparisons, and
- textual contributions providing knowledge, written and reviewed by experts and expert networks throughout the EU;
- internal and external links, references, definitions and other relevant information.

Conceptual approach
Public health topics are organised conceptually in a logical, coherent and structured manner, in line with the structure of the ECHI indicator system. Access via multiple, predetermined routes and search modalities are provided.

Sustainability
The EUPHIX prototype, with its expert network, offers a new and unique approach to EU health monitoring and reporting. This is to be ensured through continuous updating of data and information, as well as technical maintenance of the system. By the time of writing this report, this issue has not been finally settled. Chapter 5 gives many examples of how the project management has attempted to make the project sustainable.

The EUPHIX partner consortium

The EUPHIX partners worked together in many ways to make the EUPHIX project work. As partners for the project team, a group of representatives from public health organisations (see Table 1) got together and combined their experience in supranational, national and regional health monitoring, and/or active in indicator development at the EU level. Based on their experience, the EUPHIX project was designed in 2003 to develop a prototype of a web-based health reporting system or, more precisely, to develop a 'prototype for a sustainable, structured web-based health information and knowledge system for the European Union' [1]. When the project progressed the partners were heavily involved in developing the website, by giving comments and advice, related to both the content and the design of the website. Many of the partners were also involved in recruiting evaluators for the user panel and promoting the first publicly available prototypes at both national and international conferences.

Table 1: Partner institutes for EUPHIX

- National Institute for Public Health and the Environment (RIVM) – The Netherlands
- London School of Hygiene & Trop. Medicine - United Kingdom
- Norwegian Institute of Public Health - Norway
- HealthMonitor Non-profit Public Benefit Ltd. - Hungary
- National Institute of Public Health - Denmark
- Robert Koch Institute (RKI) - Germany
- FNORS - France
- National Institute for Public Health (KTL) - Finland
- Scientific Institute of Public Health - Belgium
- Institute of Public Health NRW (LOEGD) - Germany
- OEBIG - Austria
- Centre for Epidemiology, National Board of Health and Welfare - Sweden
- World Health Organisation – European Region – established in Denmark

The status of EUPHIX by June 2008

At the start of the project July 2004, the aforementioned three deliverables were foreseen (see paragraph 1.2), in short: a functioning prototype, structured information content and a plan for maintaining the system.

On June 20, 2008, the EUPHIX project was officially launched during a meeting in Leiden, the Netherlands. By that time these deliverables had been realised, some even beyond expectation.

In terms of structured content, 39 EUphacts and 5 EUphoci have been implemented (see paragraph 2.2 for an explanation of EUphacts and EUphoci). Of these 39 EUphacts, 16 were completed according to the full format; the remaining 23 were restricted to data presentations with relevant remarks and still are waiting for extension into the full format. In this way a major part of the items on the ECHI shortlist has been filled. For many of the content elements, a link from the EU health Portal, at an appropriate place, has been realised.

The website is fully operational now. This includes the features and guidelines used by the editors to fill the system as well as the user-oriented features such as different modes of data presentation, cross-links within the site, and reference links to other websites and to information sources. Yet, there are still issues for improvement, which are brought up by project partners, target panel members and other users [1].

2 Methods and design

The EUPHIX project work plan describes the work that was scheduled to be done for the project, as divided in 4 work packages (WPc). These work packages will be explained in the next paragraphs:

- WPc 1: Project management and co-ordination; ensuring sustainability
- WPc 2: Content design, development and structure
- WPc 3: Building and implementing the web application
- WPc 4: Building expert networks and ensuring expert input

2.1 Work package 1: Project management and co-ordination; ensuring sustainability

This work package implies steering and controlling the attainment of EUPHIX' deliverables and objectives, within the agreed budget and time frame. It includes

- project co-ordination
- ensuring of the coherence of activities, and guiding the system to the point of sustainability.

A web-based information system only makes sense if it is maintained and updated in a sustainable way. Therefore, all methodological and design issues have been worked out to support such sustainable maintenance. These include the development of the web application, the design of the content structure, the editorial process necessary to ensure the quality of the delivered content, and the establishment of an expert network to deliver the content [1], see chapter 5.

2.2 Work package 2: Content design, development and structure

This work package aimed to structure, select, gather, analyse and integrate the content within EUPHIX.

There are two guiding principles, EUPHIX aims:

1. to present public health information based upon indicators from the ECHI shortlist;
2. to deal with policy-relevant issues in a comprehensive and integrated manner.

The issue of policy relevance implies that information on (public) health policies, along with information and data on health status and determinants, will be included. In addition, it means that policy considerations will be leading in selecting the content issues.

In terms of the structure of the website, the principles (1) and (2) are translated into two types of content elements, called 'EUphact' and 'EUphocus'. EUphacts are concise information packs, including basic statistical information related to one or more indicators, presented in tables, graphs and maps. In addition, they feature some explanatory text and relevant links and references. EUphacts largely coincide with the indicators included in the ECHI shortlist, or at least these indicators will be used as a starting point.
EUphoci will be selected mainly on the basis of their policy relevance. They are broader and more comprehensive than EUphacts. EUphoci are built as comprehensive and structured documents containing integrative and analytical text and information, linked to a selected set of EUphacts that provide the necessary basic information. The information presented in a particular EUphocus will thus encompass more than the sum of the included separate EUphacts. For more information about EUphacts and EUphoci see paragraph 3.1.

2.3 Work package 3: Building and implementing the web application

The aim of this work package is to develop the EUPHIX web application which will provide access to all content matter described above in a systematic, logical and integrated way. This includes all characteristics that are needed to regularly update and maintain the system.

The web application is based on technology developed for the Dutch public health information websites the 'Dutch National Public Health Compass' and the 'Dutch National Public Health Atlas'. This includes a Content Management System (CMS) with functionalities needed to create the lay-out, to edit documents, and to use internal links to background databases containing literature references, abbreviations, and a glossary of terms. It also features functionalities for creating tables, graphs and maps, either stand-alone or in connection with a separate database containing an underlying data repository. This data repository has been developed specially for EUPHIX. Technically, the application uses ASP.NET as the internet software and MS SQL server as the database software. This work package will be discussed comprehensively in chapter 4.

2.4 Work package 4: Building expert networks and ensuring expert input

The aim of this work package is

- to map the existing expertise within and across EU Member States;
- to develop expert networks that will contribute to the content of EUPHIX, and
- to guide these experts in the process of contributing.

EUPHIX will derive its content matter from:

1. statistical data
2. reports and publications
3. actual expert input, e.g. expert opinions, specific expertise, information and data

While the project partners may be relatively well equipped to identify and access statistical data linked to ECHI shortlist indicators, some 'data doors' at national level may still need opening. In addition, the EUphocus approach requires in-depth understanding and specific expertise, both at cross-national and national level. External experts may help EUPHIX staff and partners to identify relevant reports and publications , including the work carried out by EU-funded projects and networks. They may also help to highlight the groundbreaking national approaches to public health reporting.

Expert advice on (public) health policy reports is also important, particularly when national structures and policy priorities are concerned.

The deliverable of this Work package thus consists of the 'expertise map' and a set of working procedures using and maintaining the expertise network. As will be explained in the next chapter, this has been done in many different ways.

3 Content production and building expert networks

This chapter will explain about different aspects of producing web content and, strongly related to this, building the necessary expert network and ensuring expert input, i.e. work packages 2 and 4.

From the beginning of the EUPHIX project, it has been one of the three main objectives to establish a network of organisations and experts that will sustainably maintain the application. For this EUPHIX needed project partners and one of the first steps taken by the RIVM was to search for project partners that could help develop the project.

When the project just started and it was still necessary to shape all the basic fundamentals of the project, such as the web design and the right format for writing the content, primarily the RIVM project team was involved in actually producing the first prototypes, i.e. producing content, developing and testing different designs, and software development. Gradually, when things progressed towards a more matured product, more and more external experts became involved in producing content and testing the prototypes presented on internet. This was the actual starting point of building the EUPHIX expert network, when experts were contacted to write specific content for the EUPHIX website. Currently there is an active expert network involved among other things in producing web text for EUPHIX and reviewing existing EUphacts and EUphoci.

Eventually there should be extensive knowledge about existing expertise within and across EU member states and how to use this knowledge for EUPHIX. However the process of building and maintaining an expert network is never finished because of many reasons, most importantly because expert networks change and new ones are formed over time. At many occasions the issue of building expert networks was discussed and proposals were made for the final stage of the project. Evidently this issue is closely connected to the strategies for the continuation of the system which will be discussed in the next chapter.

3.1 Content design, development and structure

The EUPHIX content structure was designed with the aim to comply with criteria for policy-relevant health monitoring and reporting (Table 2). These criteria have been developed by an EU project which was concerned with the evaluation of national and regional public health reports [6].

Table 2. Criteria for policy relevant health reporting

▪ **conceptual approach**:	use conceptual model in stead of being data-driven;
▪ **comprehensiveness**:	aiming for coverage of all different health issues;
▪ **structured approach**	to presentation of information;
▪ **policy orientation**:	provide support for health policy development;
▪ **integrative approach**:	interrelation of different health issues;
▪ **prospective approach**:	identification of trends, health targets and future aspects;
▪ **include relevant data**:	aim for data quality, comparability, validity.

Source: EVA PHR (June 2003) = http://www.eva-phr.nrw.de/1_pdf/Eva Final Report.pdf

Applying a conceptual approach is one of the key features of policy-relevant health monitoring and reporting. The model that is used for EUPHIX is somewhat similar to the famous Lalonde model [8], similar to the model used in making the Dutch Public Health Status and Forecasts reports [10] and very similar to the one developed and used in the ECHI-1, ECHI-2 projects. In the ECHI-model [7] the EU health indicators are being divided into several general areas, including health status, determinants of health, health systems and demographic and socio-economic factors (Table 3). EUPHIX also uses this structure to organise its content areas, and has added the area of 'health policies' as a special area of interest to policy makers. By filling all these content areas, the EUPHIX system will attain the desired comprehensiveness. Integration is achieved, for example, by appropriate cross-links both within and between text and data components. Trends are identified, if possible, and much attention is being paid to data quality and comparability. This approach requires qualitative information, i.e. texts explaining epidemiological relations, next to indicator data as part of a monitoring and reporting system [1].

Table 3: Conceptual categories for the ECHI framework

1 Demographic and socio-economic situation
1.1 Population
1.2 Socio-economic factors

2 Health status
2.1 Mortality
2.2 Morbidity, disease-specific
2.3 Generic health status
2.4 Composite health status measures

3 Determinants of health
3.1 Personal and biological factors
3.2 Health behaviours
3.3 Living and working conditions

4 Health systems
4.1 Prevention, health protection and health promotion
4.2 Health care resources
4.3 Health care utilisation
4.4 Health expenditures and financing
4.5 Health care quality/performance

3.1.1 EUphact and EUphocus

The EUPHIX system has two kinds of textual content: EUphacts and EUphocus contributions. As can be seen in figure 1, the homepage provides direct access to the different EUphacts and EUphoci.

A EUphact basically corresponds to one ECHI (shortlist) indicator, but may be wider in its scope. Each EUphact contains information that is structured in a systematic and consistent way, thus allowing comparisons between diseases or risk factors. EUphacts on diseases e.g. contain a short summary, a text with definition and scope, followed by texts on occurrence (i.e. incidence and prevalence), on mortality, on consequences for individual and society, on causes and risk factors, and finally on interventions for those diseases (Figure 2)[1].

Figure 1: Homepage of EUPHIX

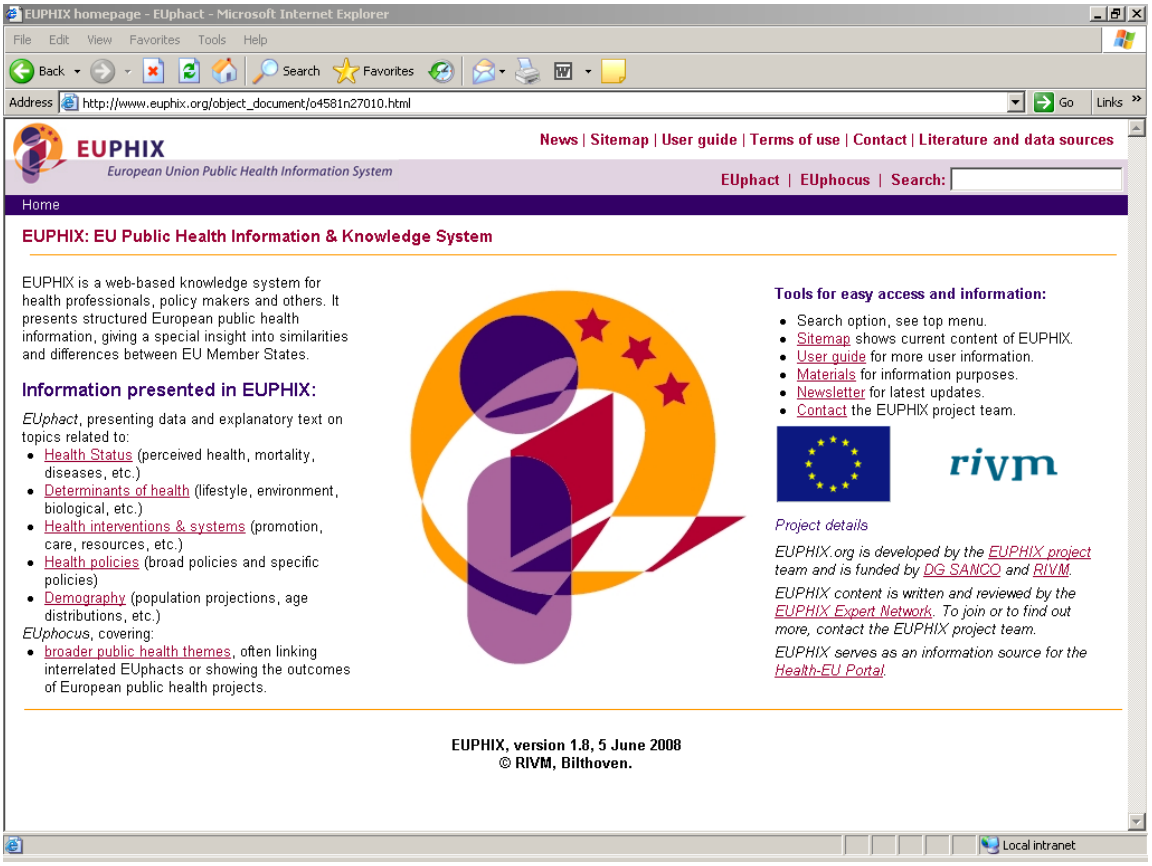
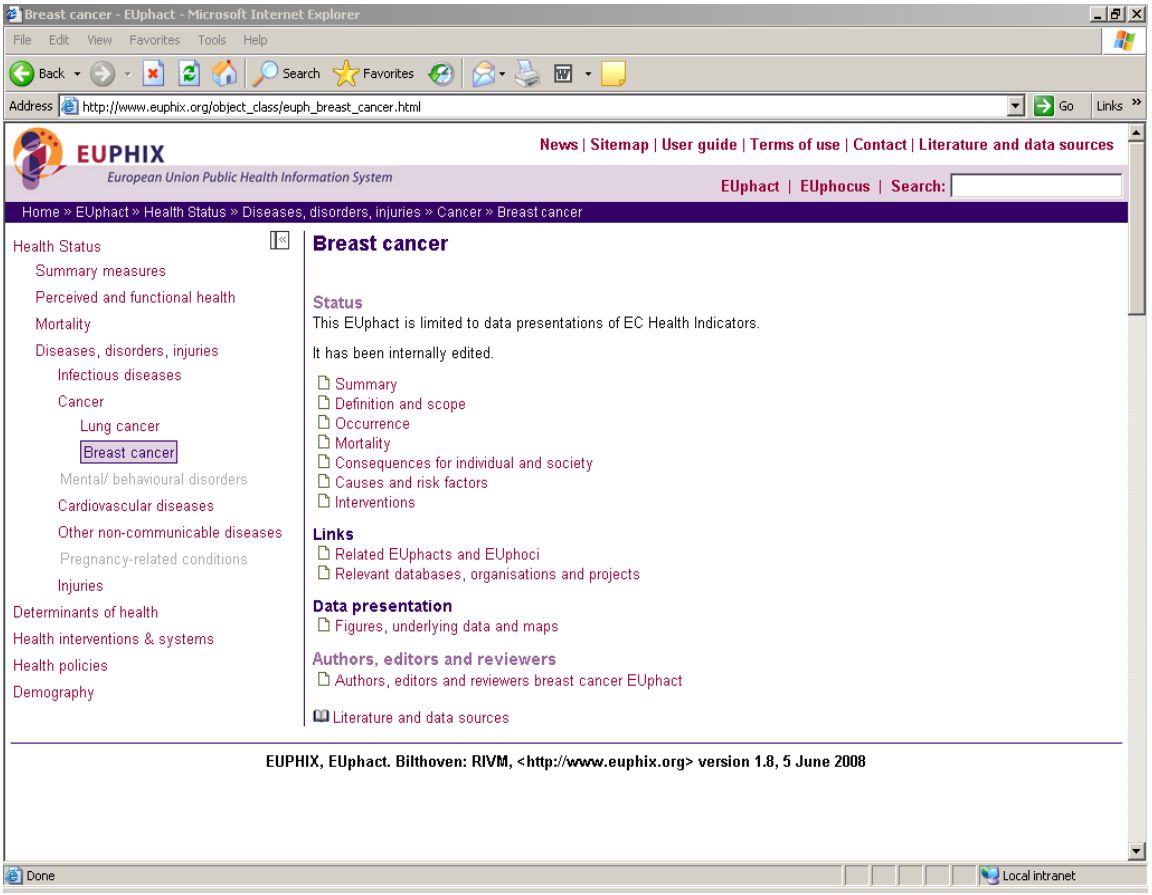


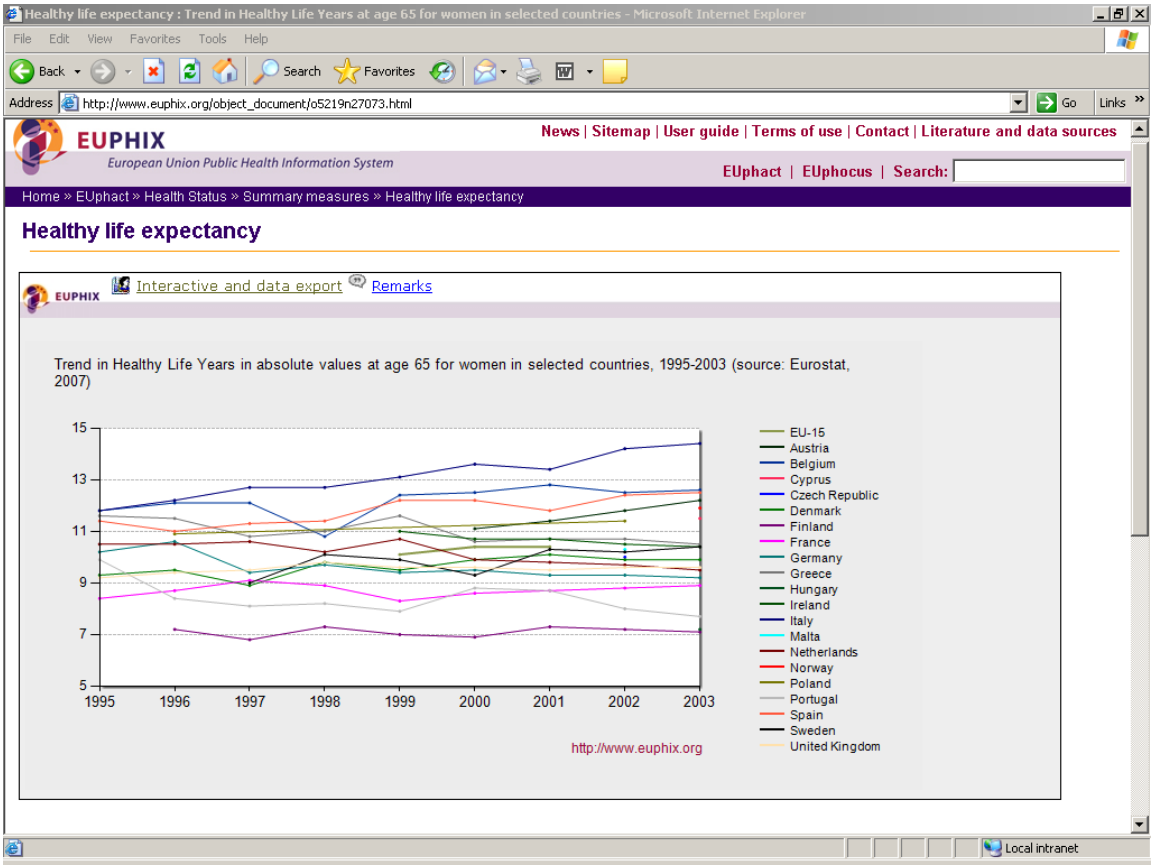
Figure 2: Page view of EUPHACT on breast cancer



EUphacts on risk factors have a consistent content structure. EUphacts on policies focus on EU policies and strategies, policies by intergovernmental organisations such as WHO, followed by texts on evidence for effective policy, on policies to reduce socio-economic differences and on national policies and strategies in EU Member States [1].

In the current prototype stage of EUPHIX a series of EUphacts has been worked out in two different ways. The first way is a full EUphact containing structured texts as well as indicator data sets, the latter in the form of tables and/or maps and/or in various forms of 'flexible graphics'. Graphic tools have been introduced to provide optimal and flexible possibilities for presenting a personal selection of the data (Figure 3 and Figure 4 at page 33).

Figure 4: page view of interactive graph



The EUphact texts also contain links to references, data sources, projects and relevant organisations. The second way in which EUphacts are presented is in the form of providing just indicator data, according to the ECHI indicator list.

EUphocus contributions are aiming for policy relevance and are generally concerned with broader public health issues, often political agenda issues. In the 'launch-version' of EUPHIX examples of such areas are 'mental health' and 'health inequalities'. A EUphocus may also contain the outcomes of important international and EU projects. 'Health inequalities' is a good example of a project related EUphocus containing elements of the final report of the EUROTHINE project [9]. In this way EUPHIX may function as a platform for future EU project outcomes in specific EUphocus contributions[1].

3.1.2 EUPHIX editorial process

In any reporting exercise, quality control is a crucial issue. For a system like EUPHIX, this includes, for each Euphact or Euphocus, the selection of adequate and valid data,

the generation of appropriate text, and the consistency of each contribution within the entire context of the website. Again, the EUPHIX project has used the experience from the Dutch National Compass Public Health. During the project period, the process of generating and editing content has been developed to include the following roles:

- Editor; responsible for a specific Euphact or Euphocus; selects the author and guides him/her concerning the desired format; places the contribution into the website's CMS and takes care of appropriate external reviewing. During the current project period, about eight persons within the RIVM team have served as editors. As the working procedures have been established now, it is envisaged to work in the future, with an editorial board consisting of partners in a consortium of public health institutes throughout the EU.
- Author; expert in the area; responsible for selecting 'best' data, working together with the editor for the website's internal consistency and standards for data presentation; produces text according to current scientific knowledge. For the first pilot Euphacts, members of the RIVM team have served as authors. After that, external experts have been approached, often as being involved in specific projects carried out under the EU Public Health Programme. Examples of this are the Euphacts on ischaemic heart disease, airborne particulate matter and social support, and the Euphoci on children's health and the environment, health inequalities and diabetes prevention and care.
- Reviewer; expert responsible for checking the validity and scientific quality of the contribution. Reviewers have often been selected on the basis of their involvement in relevant international networks or organisations.
- Content coordinator; allocates the tasks to the editors; checks on adequate progress of the work; carries out a final consistency and language check [1].

3.2 Roles and goals in the EUPHIX network

Basically, the network around EUPHIX has two different functions:

1. To gather and mobilize the necessary public health expertise and to ensure the adequate implementation of the website's content. This implies general expertise in public health, and specialized knowledge in the variety of existing public health areas (= content network: function A).
2. To create commitment from the users of the information systems, i.e. from policy makers and public health professionals in the EU and the Member States, to support the sustained existence of the system (= support network: function B).

Each of these functions call for the participation of different persons and organizations. This chapter focuses on the content function (A). The network that is responsible for the support function (B) is the major concern in the 'sustainability' strategy, discussed in chapter 5.

The following categories of people have been identified at forehand by EUPHIX as people who should be involved in the content network function:

- The EUPHIX project partners team.
- The external authors and reviewers.
- Participants from other EU public health programme projects.
- Representatives from expert EU institutions, such as European Centre of Disease Control, European Monitoring Centre for Drugs and Drug Addiction, European Food Safety Authority, and the European Environmental Agency.
- Target Group Panel.
- DG SANCO Officers.
- The members of the editorial team at RIVM.

By June 2008 the following groups have been established which will be explained below:
- The EUPHIX project partners.
- The EUPHIX Expert Network.
- The User Panel.

The project partners

As was also mentioned in paragraph 1.4, the project partners play an important role within EUPHIX. They, first of all are the first echelon of advice and feedback for the EUPHIX team at the RIVM. Next, they can make a significant contribution with regards to all three key deliverables, and the respective Work Packages. The project partners have been approached and selected because their organisations have a track record in health information and on that basis are able to contribute to the overall quality of the project.

More specifically, the project partners:
- Provide advice and feedback on the overall aspects of project development, implementation, progress, relevance and sustainability. This includes advice on topics and themes to choose for development.
- Share their specific expertise on content and/or functional aspects. Project partners are experts on certain public health topics. In that case, they could act as an author or editor of the information provided on this topic via the EUPHIX web site in addition to being a very valuable source of contact/network information.
- Share their expertise on web technology and GIS.
- Share their contacts to help build expertise networks as a key deliverable of the EUPHIX project. These contacts would imply national as well as international networks, including EU-funded projects, professional organisations, and policy-oriented researchers and organisations.

The EUPHIX Expert Network

For the maintenance, updating and quality check of the EUPHIX system, a group of committed external experts has gradually been established, currently consisting of the authors and reviewers of current contributions, which includes representatives of specialised institutes, networks or EU projects. At present these include:

- The EMCDDA, Lisbon, EU Drug Agency
- WHO European Centre for Environment and Health
- European Health Expectancy Monitoring Unit (EHEMU)
- The EUGLOREH project (2008 European health report)
- The EUCID project report (for diabetes prevention and care)
- The EUROCISS project (for cardiovascular diseases)
- The ALPHA project (assessing levels of physical activity and fitness)
- The MINDFUL project (for issues in mental health)

Members of the EUPHIX Expert Network will be consulted for updates in their own field, but they are also invited to comment at their own initiative. When the content of EUPHIX is to be expanded, this expert network will have to be expanded as well [1].

The User Panel

Has been established by asking relevant experts known by the EUPHIX staff to participate in expert panel evaluations of the EUPHIX system. The user panel has been asked for their opinion about the content of the website, the structure and the design. At this moment the user panel consists of 7 people who have been actively asked to comment on the website (at FPM and through a survey), or have commented at their own initiative. Suggestions such as making information also more or less suitable for 'normal' citizens and using less complicated language, changing the rather confusing structure-division between ECHI indicators and EUphacts into a less confusing structure, have all been taken into serious consideration, and the latter has resulted in an actual structural change. In any case, all suggestions were taken seriously and follow-up steps have been taken when feasible and reasonable within the time frame of the project.

In conclusion:

The ideal and sustainable end situation for the EUPHIX application would be that the best experts within the EU will contribute as an author or a peer reviewer, and that EUPHIX is widely recognized as a primary source of reliable and comprehensive public health information in the EU. By June 2008 this ideal situation has not been met yet but things look promising because many European public health experts have committed themselves to the project and have been very positive about the project results so far.

4 The web-based information system

This chapter describes the EUPHIX technical deliverables as described in work package 3 (WPc3) 'Building and implementing the web application' of the EUPHIX work plan (annex 1). The actual technical products that have been developed within the EUPHIX project will be discussed quite extensively because most of the other project deliverables are more or less related to the technical products.

4.1 Deliverables of work package three

The following deliverables are described in work package 3 (WPc3) 'Building and implementing the web application' (annex 1):

1. WPc3 deliverable (del.) 1: Building the web application
2. WPc3 del. 2: Developing the Content Management System
3. WPc3 del. 3: Developing the underlying database
4. WPc3 del. 4: Developing a geographical display tool
5. WPc3 del. 5: The EUPHIX web application and the EU public health portal
6. WPc3 del. 6: The EUPHIX Work-in-Progress (WiP) site

The EUPHIX Work-in-Progress (WiP) website (work package 3 deliverable 6) is a separate product (website) that was developed using the same content management system as was used for the actual website. The design, i.e. look and feel of the website is also the same as the EUPHIX website. Both have been developed in parallel to each other and should technically be regarded as one application.

4.2 Technical products overview

The following products and activities have been developed for EUPHIX:

Deliverable	Product
Building the web application (WPc3 del. 1)	Within a time span of 3 years, *8* consecutive html releases of the EUPHIX website on the internet (www.EUPHIX.org) have been published (first password protected and later freely accessible). These releases were developed from basic prototype web applications, in which only a few preliminary topics were filled, into a fully functioning website with substantial content. All releases are html releases with some interactivity through connected (in-house developed) Microsoft ASP.NET applications for searching (annex 3) and using interactive charts. After each release a EUPHIX newsletter has been published using a special application allowing people to subscribe to this newsletter (http://www.rivm.nl/nieuwsbrieven/nbr0-it-0010.nsf). A EUPHIX logo and web design has been developed at the RIVM and has been fully implemented within the website releases, also within the Work-in-Progress website (www.EUPHIX.info).
Developing the Content Management System (CMS) *(WPc3 del. 2)*	*EUPHIX* uses the RIVM Netwriter content management system (annex 2). This CMS has also been used for two Dutch national public health information systems and for the Environment and Health Information System, ENHIS (www.ENHIS.org). Specific adaptations have been made to the Netwriter CMS for the EUPHIX project, e.g. to ensure proper connection to the search application and to the interactive chart application. Furthermore the specific EUPHIX design has been implemented using tailor-made style sheets.
Developing the underlying database (WPc3 del. 3)	A specific EUPHIX database (annex 5) was developed throughout the course of the project. This database ensures that data presented within the website is properly stored, with their respective meta data. Specific tools and procedures (SQL stored procedures and an Access front-end meta data editor) have been developed

	to transform data, found on the internet from organizations like the WHO, OECD and DG Eurostat, into data presentation formats for EUPHIX. Therewith of course not changing the actual data (numbers). Besides this, the EUPHIX database stores the data used by the interactive chart tool and maps (even though some additional transformations still need to take place). The EUPHIX website connects to specific interactive charts at designated places within the website. This is done by EUPHIX editors using the Netwriter CMS. They decide which charts (and maps) should be at designated places in the website, always in connection to specific web content. End-users can download data from the database in Excel format through special download features within the chart tool, therewith allowing end-users of the website to use the (transformed) data stored in the EUPHIX database.
Developing a geographical display tool (WPc3 del. 4)	The geographical maps visible within the website have been tailor-made by RIVM PHF geographers and are based upon EUPHIX-adjusted shape files and procedures for creating the maps within ArcGIS software. Besides this, two pilots are relevant to this discussion. One pilot has been done in cooperation with geographers from the RIVM PHF department and geographers from the commercial Nieuwland company, to develop a dynamic and interactive map tool. This pilot is however not fully operational for EUPHIX yet and needs to be further developed. However, results within other RIVM projects are positive. A second pilot exploring another way of creating and dynamically presenting maps within the EUPHIX website has been developed for the EUPHIX project and is already widely used by other health reporting systems. This is a pilot using the commercially available InstantAtlas (IA) software. The first results have been incorporated within the EUPHIX website, resulting in three implementations related to three different health topics (Life expectancy, Healthy life expectancy and Breast cancer). The InstantAtlas implementations can be found in the EUPHIX websites EUphacts.
The EUPHIX web application and the EU public health	Specific protocols have been developed in order to connect the EUPHIX website to the EU public health portal. Specific targeted links have been established

portal (WPc3 del. 5)	between the portal and the EUPHIX website.
The EUPHIX Work-in-Progress (WiP) site (WPc3 del. 6)	Using the Netwriter CMS and the EUPHIX design, an easy to update Work-in-Progress website has been developed and made available on the internet at: www.EUPHIX.info.

The EUPHIX website is available at http://www.EUPHIX.org and http://www.EUPHIX.eu and the work in progress website at www.EUPHIX.info.

Because the EUPHIX project requires a team of editors and technical people to work together, some additional administrative systems were introduced in the project. These administrative systems are especially helpful for administering work related issues and are both technical of nature and content oriented, and were setup to assist the people working for EUPHIX in the best possible way. These tools will be described in more detail in chapter 4, but here's a short summary of what has been developed alongside the aforementioned tools to administer and run the project in an orderly fashion:

- An issue tracking system called Gemini which allows both technicians and editors to administer different types of issues within one central system. Issues can range from a note on a technical bug in one of the interfaces to a memo about a specific author who needs to be asked to deliver a certain piece of content.
- A Microsoft Access front-end tool, used by data managers and editors to administer and view datasets used within the EUPHIX SQL database. It consists of specific Access tailor-made interfaces that enable editors to check which datasets are in the database and to view meta data within the database. It is also important for entering new datasets in the database because it can be used for coupling dimensions to datasets.
- Protocols have been developed to be used for requesting datasets, entering data in the database and finding data on the internet; see also 'EUPHIX Publishing Protocols' for more details.
- MS SQL Stored procedures to import and transform datasets taken from e.g. the WHO, DG Eurostat and OECD, with protocols and documentation for data managers.
- A specific tool for comparing different versions of databases called the Red Gate SQL data compare software. This is necessary for maintaining data integrity within the different database versions of the publication and production databases.

4.3 Building the web application and developing the CMS

This paragraph describes the technical setup of the EUPHIX website, the CMS database and the infrastructure for maintaining the EUPHIX website. It therefore describes the deliverables 1, 2 and 3 of work package 3 in annex 1. Documentation of some parts of the system is referenced, rather than duplicated. More technical and detailed information is therefore provided in several annexes.

The great majority of the functionality used in the EUPHIX website has already been developed within the RIVM/PHF CMS (called Netwriter) for two Dutch national health reporting websites namely the Dutch National Health Compass (www.nationaalkompas.nl) and the Dutch National Health Atlas (www.www.zorgatlas.nl). The ENHIS website (www.ENHIS.org) was also developed with the same Netwriter CMS, almost at the same time the EUPHIX website was developed. Both projects have profited from each others knowledge and resources.

4.3.1 Content Management System (CMS)

During the first full project meeting of EUPHIX in June 2005 a first prototype was presented to the project partners. This prototype has been created by using the RIVM/PHF Netwriter CMS. This CMS allows editing of texts without IT knowledge, contains features such as authorization and authentication of editors; a word-like editor to enter and edit textual content; the possibility to work on documents that have different statuses (i.e. planned, editor processing/maintenance, approved by editor, approved by editor in chief, in production, removed) in order to have control over work-flow elements; as well as the possibility to enter geographical maps, charts and tables. To enable editors to work with the CMS it is not necessary to install software on their PC. Editors can use the system within MS Explorer, a normal web browser that the majority of users have pre-installed on their PC.

June 2008: The Netwriter CMS has been implemented for EUPHIX, for which style sheets were developed, the CMS database was adapted, and some adaptations to the CMS functionality were made. In addition, specific CMS training of the EUPHIX editors to enable them to use the Netwriter CMS, has been provided. A specific digital training course and an English manual were developed for the purpose of teaching. Throughout the project, technical support was provided for using the CMS, search tool and graphics tool by technical people from the RIVM (EMI).

The EUPHIX website is hosted on a Microsoft Windows Server 2003 at the RIVM in Bilthoven, The Netherlands. The live website consists of the following components:

- A large set of html files, style sheets, images files etc. that make up the static part of the website;
- An interactive search page that allows a free text search on all html content;
- An interactive chart component that can be embedded in the html pages to show charts created by editors;
- Three implemented and connected InstantAtlas (separately compiled) interfaces allowing users to choose a (sub)indicator and view maps and charts related to each other.

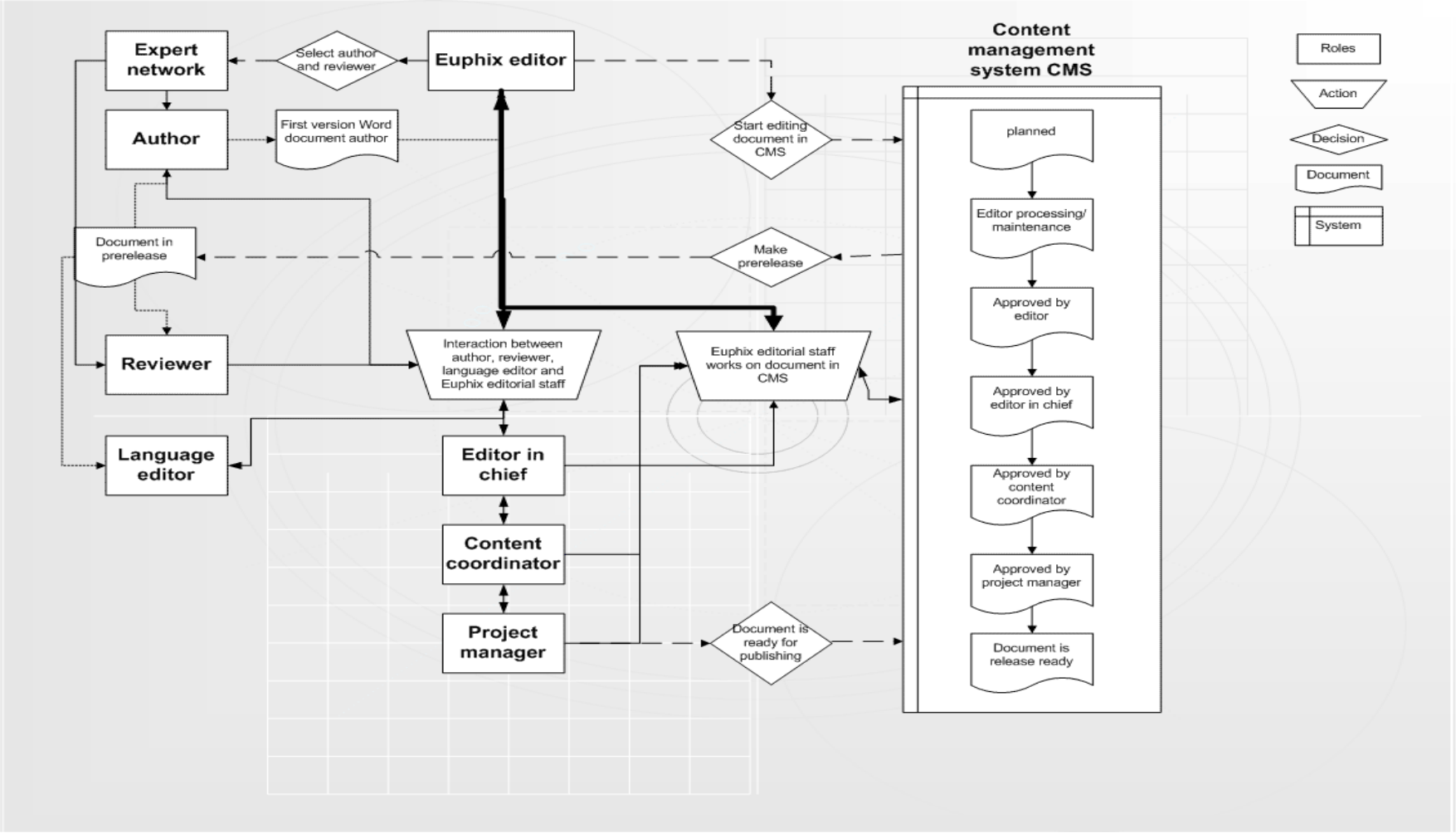
CMS workflow control

The functionality to control workflow within the CMS, important for entering and updating information on the website is important for ensuring proper and orderly production of content for the website. It supports the joint effort of several members of the EUPHIX

editorial team and of authors and reviewers to produce content, therewith allowing coordinated work done by people inside and outside the EUPHIX team.

In an entirely operational arrangement, the roles as represented in the schema below should be covered and coordinated (Schema 1). Please notice that some roles can be carried out by one person but what is essential is that the quality of the website is guaranteed or at least improved, by separating the writing of the content from the quality control of the content. This is accomplished by having the authors and the editors write content and subsequently having this content verified by experienced reviewers and other members of the editorial staff, namely editors in chief, content coordinators and the project manager (see flow chart on the next page).

More information about Netwriter is provided in annex 2.



Schema 1 Schema of necessary EUPHIX roles for editing and updating the website

Search functionality connected to CMS HTML output
An external programmer has developed a separate but highly integrated ASP.NET search tool providing search functionality for the EUPHIX project. This functionality allows for searching in the html content of the website.

The search application consists of one component, namely the search engine which searches the html content of the EUPHIX website using MS Index server. Within the ENHIS project another component has been implemented namely the search engine that searches the ENHIS SQL database for relevant indicators, linking these to the appropriate data.

Using only one search term provides the end user with two search results:
- a list of html content of documents pages (detailed information)
- a list of html content of subject pages (more general information)

More information about the search tool is provided in annex 3.

4.4 The EUPHIX Database

The EUPHIX database is specifically developed for entering and storing data sets for the EUPHIX project. These datasets are usually taken from the internet and most frequently originate from data published by the WHO-HFA, DG Eurostat and OECD. Sometimes data from specific projects is used. The data are transformed to fit the EUPHIX data model.

Within the architecture and design of the EUPHIX database the term variable is similar to an indicator (detailed enough to calculate actual numbers), like, for example 'Trend in mortality (SDR) from breast cancer per 100.000 women in selected countries (source: WHO-HFA, 2007)'. For a given variable, multiple sets of data can be available from various sources. Each specific value however belongs to exactly one data set. Over time, when new data becomes available, new data set versions can be added. Older data sets are kept in the database for archival purposes and it is important to notice that data sets are never updated. Instead, when a new data set is added to the database that has the same properties as an existing one, i.e. the dimensions match (e.g. both data sets contain information about male/female) and the variable is exactly the same, a new data set *version* is added.

Each value is mapped to up to five domain values for its dimensional determination: age group, period of time, geographical region, sex and socio-economic status. A specific domain value, like the year 2004, is mapped only to a given value, so it is stored only once in the database and can be mapped to other values as necessary. This reduces the amount of redundancy within the database and allows for flexibility.

Data exchange module and data import
The EUPHIX database consists of two logical parts: the database and the database feeder. The first contains the EUPHIX data and the feeder consists of utilities and stored procedures for data entry and database maintenance.

On a higher level, the EUPHIX system also comprises of two parts: the EUPHIX database and the EUPHIX website. The latter consist of the Content Management

System (CMS) and the presentation interface, which allows dynamic access by end users to EUPHIX data for display purposes. The CMS cannot be used for entering data into or maintaining the EUPHIX database. The CMS uses a separate internal database, which is independent of the EUPHIX database.

In the early stages of the project, various options were investigated for data retrieval from public international databases and other sources. As mentioned before, publicly available international databases, usually published and available on the internet, are the prime source of data for the EUPHIX system. In particular investigated was the feasibility to develop an automatic data retrieval utility for minimizing the need for manual selection and download of data. The conclusion was that **an automatic retrieval utility was not a realistic option** for the following reasons:

- Although all international databases of interest are accessible with standard Internet browser technologies, the available technologies for non-browser data retrieval are quite diverse. Thus a whole collection of utilities were needed, whose development would have been far beyond the capacities available to the project.
- Data retrieval is not just a technological exercise. Prior to retrieval, available data must be thoroughly checked for compliance with the methodologies of the indicators or variables at hand. Since the institutions who are the owners of the source databases might also evolve their own methodologies, this validation should always be carried out by health experts before any actual data retrieval. It is not possible to automate this vital step!
- Most indicator data of the EUPHIX system is assumed to be updated only once or twice a year. The technological changes within one year cannot be ignored. Thus, any data retrieval utility needs to be at least annually checked for the need of updating before retrieving new data. This step is vital also and has to be carried out by IT experts.

One may conclude that with the current, diverse technologies the development of an ‘automatic’ data retrieval tool is not yet feasible, because the unavoidable manual effort needed for annual validations and updates of the utility would outweigh any potential benefit.

The final approach to data retrieval was the development of procedures for retrieving data from the internet with corresponding stored procedures to enter the data sets into the SQL database. As mentioned before an Access tool has been developed for tailoring the data to be used within the EUPHIX database and subsequent tools. Gemini software (see paragraph 4.8.1) is used for storing and editing data set requests coming from editors, meant for data managers, in a centralised and organised way.

More information about the data import, database and the meta-data editor is provided in annex 4 and 5).

Chart editor connected to the database

The interactive charts available at the EUPHIX website are created by using a separate chart tool developed with ASP.NET software. This chart tool software connects to the EUPHIX SQL database. The chart definitions along with their respective data presentations are stored within the database.

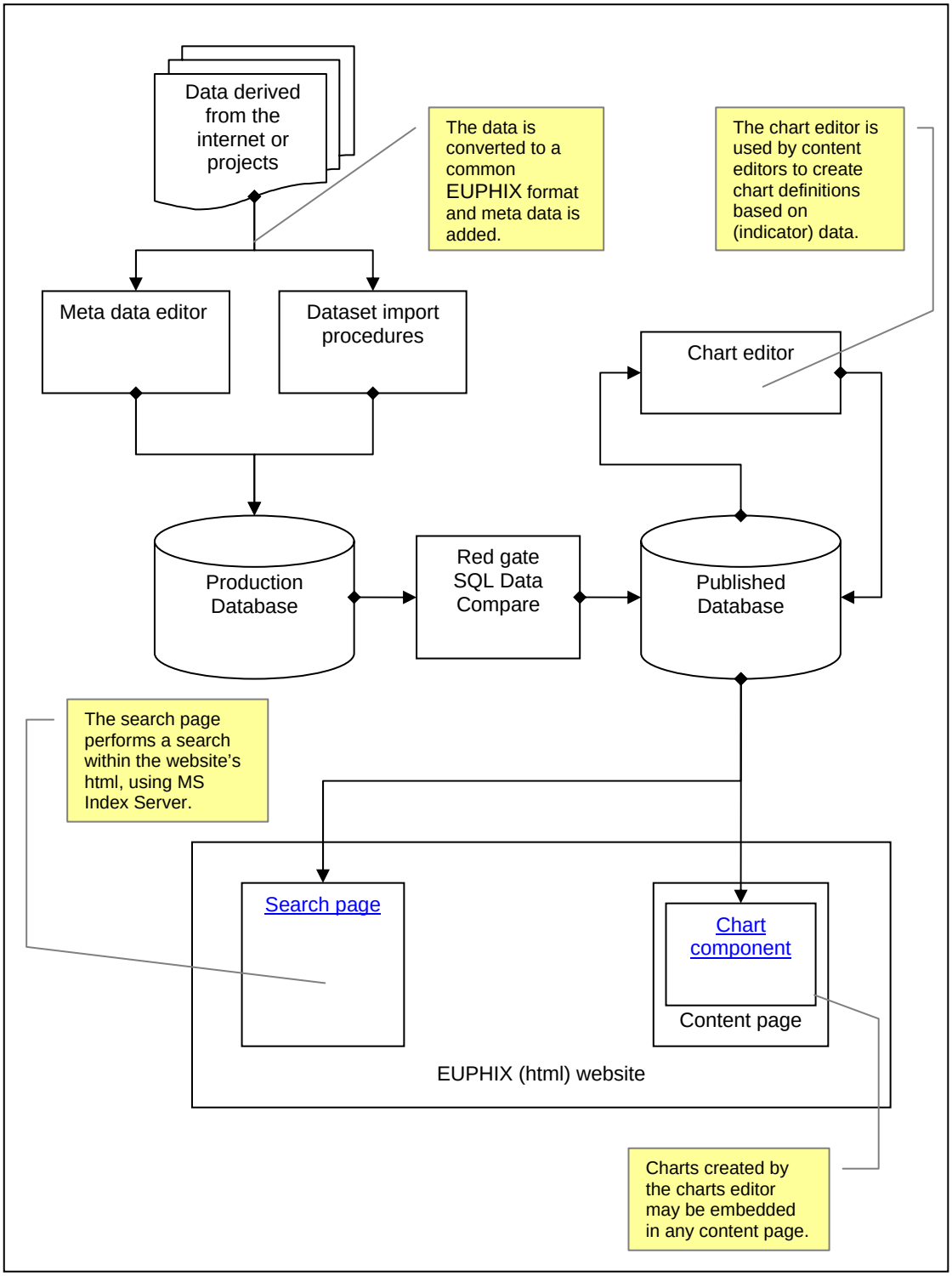
There are two different types of chart interfaces, one only used by editors for creating and editing the charts, and one interface for presenting the charts to the end users of

the EUPHIX website. In other words, the tool enables the editors to create customized graphs choosing data sets (based on variables or indicators) for specific years or countries. When the chart definitions are finished, the CMS is used by the editors to place the chart definitions at designated places within the website to make sure that specific textual content is linked to the specific charts.

The end-users of the EUPHIX website are able to choose different options within the end-user interface, such as the period or a selection of countries. This however depends on choices made by the editor while making the charts. End-users can also download Excel files with data from the database, using special export functionality within the chart tool.

RIVM-Public Health Forecasting developed this interactive chart tool firstly especially for EUPHIX, but later on it has also been made available for ENHIS.

The schema on the next page shows how the different parts of the system connect and relate to each other (Schema 2).



Schema 2 Flow of data from source to website

Before each release, data is transferred from the EUPHIX Production database to the Published (datasets) Database.

4.5 Developing a geographical display tool

This paragraph describes deliverable 4 of work package 3 in annex 1. An actual (new) geographical display tool has not been developed within the EUPHIX project. However, two pilots were done to experiment with different types of geographical information system (GIS) software that could be used as geographical display tools. Both pilots provided us with promising results, also because they both enabled us to connect GIS interfaces with data in the EUPHIX database. Besides the two pilots, different static maps have been created and published within the EUPHIX website as static pictures, which will be explained below.

Geographical maps have been developed by using specific geographical shape files and data from the EUPHIX database. These static maps, which were published within the website, are tailor-made by geographers using ArcGIS 9.1 (specialist geographical software often used by geographers) and placed at designated places within the website by using the CMS. Existing shape files were used as a starting point, but were altered, for instance because these were too detailed with respect to their country boundaries. These shape files have been transformed into Personal Geodatabases, i.e. made less detailed and easier to read, within ArcGIS 9.1. The data from the EUPHIX database were first exported to Access, after which the shape files and the data sets were linked and used within the maps.

The maps published in the website are both static maps and so-called map 'click files', which allow the end-user to click on them resulting in pop-up screens providing some additional information. This additional information is usually something like a specific value for a particular area within the map. The maps have been entered into the CMS, basically in the same way as pictures or other pieces of content.

Two geographical pilots have been done alongside the static maps, namely one with a dynamic map tool from Nieuwland and one with InstantAtlas. Even though both the pilots were promising, only the InstantAtlas pilot resulted in interactive maps which have been incorporated in the EUPHIX website, mostly because implementing both tools would have required too much resources.

Further investigation is still needed for EUPHIX but both tools have already been successfully incorporated in other projects within the RIVM.

Pilot 1; The Nieuwland mapserver tool

This was actually a pilot prepared by colleagues within our PHF department, in which the EUPHIX project participated. The main idea behind the pilot was to have a flexible interface connected to a database which allows non-geographers, with some basic technical skills, to create specific indicator based maps using templates and datasets.

Results
The pilot application allowed users of the system to first choose a data set based upon a specific variable or indicator. This dataset was then used within different types of maps using many different properties like colour schemes, different break-off

points for the legends and different end-user choices, etc. The most difficult part was to transform the EUPHIX database files into the format used by the Nieuwland tool and to make the geographical map templates. We did not have enough resources to implement the Nieuwland tool for EUPHIX, e.g. because along the way it became clear that the database file transformations where complicated and the end-user interfaces would require further adaptations.

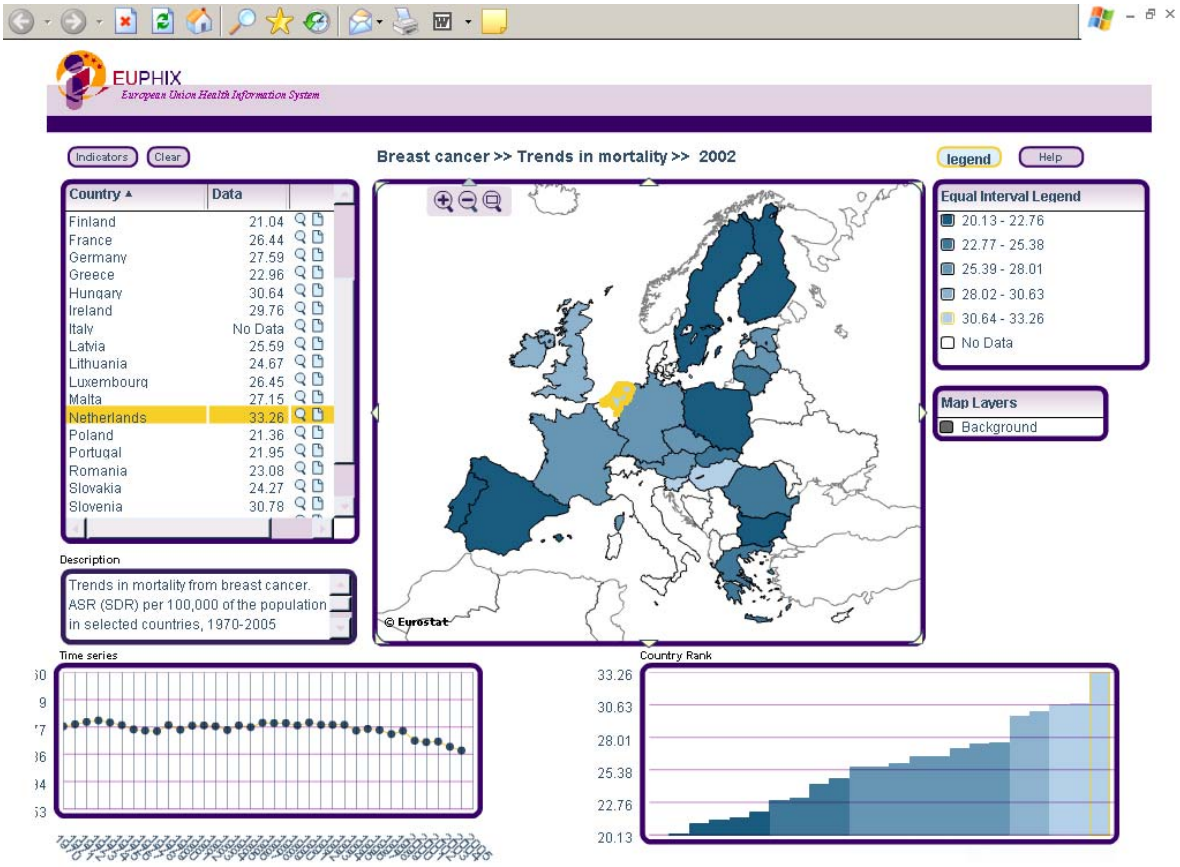
It is worthwhile to further explore the possibilities of the Nieuwland mapserver tool because it could provide a very user friendly way of making maps based upon, and linked to specific indicator based data sets.

Pilot 2; The Instant Atlas software

Currently there are several national and international websites that make use of the InstantAtlas (IA) web software (http://www.instantatlas.com). It is a commercially available product that provides geographical information system (GIS) professionals and information analysts with highly-interactive area profiles and it helps in making GIS data more accessible, assists interpretation, supporting better and more informed decision making (see InstantAtlas website).

EUPHIX started a pilot with IA software to see whether this software may speed up the process of creating maps and charts, at the same time increasing the flexibility of data presentations (Figure 4).

Figure 4: page view of dynamic map using Instant-Atlas



Results
Important is that IA allows non-geographers to create maps and charts in a very easy way after some initial work from GIS specialists. A special IA template was created by a GIS specialist for (tailor-made) IA map presentations, which can be used in combination with e.g. a standard Excel file or the EUPHIX database. This way it is relatively easy for editors to create indicator based maps, and at the same time, chart presentations, using IA interfaces.

The results are very promising and further research should be done to explore the possibilities. The relatively easy adaptable IA interfaces make it easy for GIS specialists to ceate templates that editors, i.e. non GIS specialists, can use to make IA data presentations. The look-and-feel of the different IA presentations within EUPHIX is the same throughout the website, and flexible at the same time. Currently three IA examples can be found on the EUPHIX website, for Life expectancy, Healthy life expectancy and Breast cancer.

4.6 The EUPHIX website and the EU public health portal

This paragraph matches work package 3 deliverable 5, see annex 1.

The effort of building the EUPHIX website and network is too big and unique to pass unnoticed to people who are interested in the public health information presented in the EUPHIX website. This means that EUPHIX should be connected as much as possible to other relevant EU websites and projects. Relevant could mean: similar in content, scope or audience. The EU public health portal (http://ec.europa.eu/health-eu/index_en.htm) is such a website and it is crucial for the EUPHIX project to be interlinked with this project because many of its potential users use the portal as their first entry point for public health information.

Many contacts between the EUPHIX staff and the people responsible for the EU public health portal led to protocols and agreements on how to connect between both sites, i.e. how links should be established. The main agreements are:

- Links between the EU health portal and EUPHIX will be placed within the EU portal at designated places by linking on a topic level, i.e. linking specific topics within the portal to the same topics within EUPHIX.
- The name used for linking to EUPHIX topics within the EU portal is 'European health information', see for example: smoking at the bottom of the web page http://ec.europa.eu/health-eu/my_lifestyle/tobacco/index_en.htm. As can be seen within the above example, there is a general introduction text underneath the link to the EUPHIX website: *'Texts, links, references and data on smoking A website presenting comparative data and information on leading public health issues in the EU'*
- Both the EU health portal and the EUPHIX project have agreed to create as many links between both sides as possible, of course with the limitation that the links should be meaningful from the content point of view.
- At designated places within the EUPHIX website there will also be links to the EU health portal.

4.7 The EUPHIX Work-in-Progress (WIP) site

The EUPHIX Work-in-process (WIP) web site (work package 3; deliverable 6) was developed in parallel with the actual EUPHIX website. In some cases the WIP site served as a kind of testing platform for the actual website, for instance when deciding on design issues. Both the EUPHIX website and the WIP site use the Netwriter CMS to enter and maintain the websites.

The WIP site (www.EUPHIX.info) is meant to give general project information and information about the *progress* of the EUPHIX project, and it contains the following information:

- News and progress
- Aims and objectives
- Key features
- Work plan
- Participants
- Meetings
- Presentations
- Related projects
- Links to related websites

It will be maintained as long as the EUPHIX project is running to keep the people interested in the project, informed about what is going on in the project.

4.8 Additional systems supporting the EUPHIX project

Additional administrative systems were developed within the EUPHIX project to support the more organizational aspects of the project.
The first system to be explained is the issue tracking system called Gemini. The second is an Access front-end tool meant for data managers and editors. The third 'system' is a description of the procedures (and related systems) used to enter data into the EUPHIX system. In relation to this, a tool will be discussed related to the stored procedures that were developed for processing data within the EUPHIX database. The last additional software to be discussed is the software for creating and publishing the EUPHIX newsletter.

4.8.1 Gemini: issue tracking system

During the course of the project we were confronted with the fact that it became harder over time to administer who is doing what for which reasons, and at what moment in time. Therefore we started using Excel sheets to administer for instance "to-do" lists for both editors and technicians working on the system. As time went by, these lists however became more and more complicated and lengthy. Besides this, they were not centrally located and often, when one person was editing one of the lists, another person didn't have access and had to wait until the other person had finished editing. Eventually the lists became messy and the people working for the project couldn't keep track of what exactly had been done for the project (or what should be done). Therefore, half-way the project, we introduced an issue tracking system called Gemini (http://www.countersoft.com/). This is an intranet system with a central database that allows all members of the EUPHIX team, both technical and non-technical to enter and maintain running issues. Issues are daily project matters which can relate to all aspects of the project like filling in a special form for requesting data sets, or a list of partners e-mail addresses. Within the EUPHIX project the following Gemini projects were created and used within the issue tracking system:

- *EUPHIX*; with more 'general' project issues related to databases, important ICT or project decisions, manuals, test issues, to-do issues, and issues related to specific aspects of the project work packages.
- *EUPHIX status of EUphacts, indicators and EUphoci*; issues related to all aspects of developing and creating EUphacts, indicators and EUphoci.
- *EUPHIX data set requests*; all issues related to data set requests, export to map tool requests, import facilities and preparation and import issues.

The issue tracking system helped very much to keep track of many of the ongoing matters of the project in a central place, and is also very easy to maintain and accessible through a web browser.

4.8.2 The Access front-end for the EUPHIX data repository

This tool was first built in order to administer new data sets, to enter meta data into the EUPHIX database and to give data managers insight into what data sets and corresponding meta data are in the EUPHIX SQL server database. A restricted version of the tool is now also used by editors, only to view parts of the SQL

database, for instance to see which data sets are in the database together with their respective meta data.

The following meta data is administered using the Access front-end:

- When creating data sets in the system, providers can be added and their role in conjunction with the data in the data set.
- Keeping track of data set versions. A data collection: a number of data set versions that originate from one provider. The grouping is organisational, rather then related to the content of the data set. It helps to track the data to its source.
- Coupling of dimensions to data sets
- Mapping data sets to domain values within dimensions
- Some functionality to create map files (not finalized yet).

For more detailed information see annex 4.

4.8.3 Stored procedures, protocols and Red Gate compare software

As was mentioned before, different protocols have been developed to be used for requesting datasets, entering data in the database and finding data on the internet. More detailed information can also be found in the EUPHIX Publishing Protocols, annex 7.

The publishing protocols should provide insight into what needs to be done in order to find data on the internet, how to enter this information in the database or into the CMS, and how to finally publish this data on the internet.

There is a special template within Gemini, the issue tracking system mentioned before, to enter a request for a specific data set. This request is subsequently processed by a data manager who uses the information from the template to find the data, usually on the internet, searching the websites of the WHO, DG Eurostat and the OECD. When the data is found, the data manager uses both the Access front-end and SQL stored procedures to enter the data sets and the corresponding meta data. The stored procedures are a special kind of transact SQL, used within the SQL server interfaces to transform and enter data into the EUPHIX database. Usually the data from the providers are first entered into the SQL database and then, on a data set by data set basis, imported into the EUPHIX database. By using the Access front-end tool the corresponding meta data is also entered.

To make the story a bit more complicated there are different versions of the EUPHIX database, because we need to have full control over the publishing process. Therefore we do not want to directly enter data into the same physical database as the database being used to actually publish the data on the internet. Consequently there is a separate production and a publish database (see Schema 2). Both databases can be matched by using the aforementioned Red Gate SQL data compare software. This is a specific tool for comparing different versions of databases. It is used when data within the production database is ready for publication, i.e. has been tested by the data managers for technical correctness and by editors on the basis of content criteria. The tool provides data managers functionality to compare two or more databases and see what is the difference between the databases. This is important because only parts of the databases need

to be matched again and therefore only part of the databases needs to be transferred to the other. It clearly helps in controlling this process.

4.8.4 Software for creating and publishing the EUPHIX newsletter

After each release of the EUPHIX website a newsletter is sent to people who have subscribed to the EUPHIX newsletter. Subscribing to the newsletter is done by a special RIVM application which allows users to subscribe or to unsubscribe to the newsletter. The software, developed within the RIVM and integrated within Lotus Notes, has interfaces for creating and editing newsletters and publishing the newsletters on the internet. E-mail addresses and newsletters are stored in a special database connected to Lotus Notes. The newsletter application is connected to the EUPHIX website: http://www.rivm.nl/nieuwsbrieven/nbr0-it-0010.nsf. People who have a subscription receive the newsletters automatically by e-mail.

5 Project management and coordination; ensuring sustainability

This chapter explains about the work done for work package 1, “guiding and controlling the adequate realisation of EUPHIX’ deliverables and objectives, within the agreed budget and time frame”. It includes project co-ordination, ensuring coherence of activities and guiding the system to a sustainable one. The sustainability of EUPHIX, which has always been regarded as particularly important, has been incorporated within the project in many different ways. As will be explained in the next paragraphs, by June 2008 the foundation for sustainability was laid by the technical set-up, the expert network, the consortium of interested member states in follow-up, discussions with the Commission (DG SANCO) on options for continuation, and by two new proposals for continuation of the project.

5.1 Overall coordination

The EUPHIX project management has been located at the Centre for Public Health Forecasting (PHF) at the National Institute for Public Health and the Environment (RIVM) in the Netherlands. There have been some important changes in the EUPHIX staff like the change of the project leader, but continuity of the project has never been at stake. There has always been a ‘core’ of very motivated staff members that developed a couple of different prototypes, leading to the current website on the internet. The Dutch EUPHIX project team at RIVM consisted of Peter Achterberg, Lummy Blömer, Hagit Eliyahu, Martin Gommer, Maartje Harbers, Sanja Kaiser, Pieter Kramers, Monique Kuunders, Susan Meijer, Marieke van Middelaar, Rutger Nugteren, Hans van Oers, Carla Sanderse, Roel Schreurs, Anna Seatter, Patrick Steinberger, Nicoline Tamsma and Eveline van der Wilk.

The prototypes were developed by the above team together with public health experts throughout Europe, within periods of 6 months. The releases of the website visible on the internet, have been demonstrated to, and judged by the project partners on several occasions. Most importantly at the EUPHIX full project meetings (six in total), see http://www.EUPHIX.info/object_class/euwp_men_meetings.html.

EUPHIX staff members have given many presentations at EU meetings and at public health conferences like the EUPHA, to inform different public health specialists and other audiences about the key features of EUPHIX (see http://www.EUPHIX.info/object_class/euwp_EUPHIX_presentations.html). Besides this, DG SANCO has been informed on many occasions both through personal contact and at several meetings e.g. held in Luxembourg.

In addition, EUPHIX newsletters were created, with a special application allowing people to subscribe to the EUPHIX newsletter (213 subscriptions thus far). As mentioned before, the newsletter is published after each new release of the EUPHIX website, explaining about the new content of the website or for instance important changes to the way the information is presented.

Another way of communicating the project results to the outside world was a structured survey, sent out to key users of the website to inquire about the content and user friendliness of the website.

5.2 Ensuring coherence: management of integrated pilots

Ensuring coherence between the Work Packages is important for the overall success of EUPHIX and will depend on coordinated delivery of all objectives and on the project's ability to pull relevant information and expertise across EU member states and expert networks together. The management of 'Integrated Pilots' is an essential instrument in this process. Integrated pilots are subsequent working versions of the intended web application, like the aforementioned geographical pilots. The word 'integrated' refers to the simultaneous and coherent development of (1) content, (2) technical functionalities and (3) the process of participation by project partners and expert networks.

One of EUPHIX key features is the above mentioned integrated way of working towards a fully functioning web system, ensuring that work flow, content and technical aspects are well tuned and that developing the different parts are well coordinated. This was accomplished for instance by having an ICT coordinator present at all the EUPHIX meetings, making sure the coordinator is well informed about all different aspects of the project and at the same time giving him the opportunity to explain and discuss technical issues. This way many different aspects of the EUPHIX system have been changed, e.g. according to specific needs expressed by EUPHIX editors. At the same time, the content coordinator was aware of many different technical aspects of the project, as were most of the editors.
As mentioned before, the project partners have been kept up to date in many different ways and were given the opportunity to comment on the system on many different occasions. Furthermore, the expert networks have also been involved in creating content for the EUPHIX website. This was coordinated by the content coordinator and in some cases the EUPHIX editors. Standard letters and other ways of communication with the experts have been developed during the course of EUPHIX, resulting in a document called the EUPHIX publishing protocols, annex 7. This document plays an important part in helping and directing editors with all aspects of producing content for the website, like how to write web text and how to communicate with the outside world.

Technology itself also helped in coordinating the work for EUPHIX. The CMS has many features to ensure that documents can be created centrally and go through several stages with different people controlling different aspects. Editors can create documents that can be viewed and edited by editors-in-chief, to be finalized by the content coordinator and the project leader. Therewith providing different levels of control and functionality to staff members with different roles. Work flow control and version management within the CMS make sure that publishing content is done in an orderly and coordinated fashion. The issue tracking system and other administrative tools also helped tremendously to coordinate the work.

5.3 Joined action and IN-EUPHIX project proposal

As was illustrated before, the future of EUPHIX will strongly depend on the successful development of a consortium of EUPHIX editorial staff and project partners that will be able to build upon the experience of the EUPHIX thus far, and is committed enough to do the actual, sometimes cumbersome work necessary for EUPHIX. By the end of the project period (June 2008) there are 11 associated partners and 12 collaborating partners interested in supporting the new IN EUPHIX project proposal (see paragraph 5.3.2) meant to continue the project for at least another 3 years.

From a technical perspective, sustainability will mean that the design, maintenance and update of the system can, in due course, be transferred to the Commission Services or to an organisation appointed by the Commission. For the other project parts it is more difficult.

June 2008: Sustainability of the project is still a rather difficult matter for the EUPHIX project at the end of the project. We envisioned that activities such as presenting EUPHIX at conferences, liaising with and feedback from the project partners, embedding EUPHIX in the EU health portal of the Commission services, and developing a good strategy for transfer of EUPHIX methodology and maintenance could form the basis for sustainability of EUPHIX. Even though all of these activities have been successfully done in many ways, it is still not sure whether the EUPHIX system will prove to be sustainable in the long run. However, because of the successful project results so far and the wide interest in the project throughout the EU, there are two proposals for continuation of the EUPHIX project currently being evaluated by the Commission.

5.3.1 Joined action program for ECHIM

The joined action (JA) has been initiated by the Commission. The JA has the purpose of building on existing knowledge about health indicators and of further developing this knowledge. The JA is intended to make the European Union public health information system more sustainable at the core, namely by further supporting the development and publication of health indicators. KTL Finland has submitted a project proposal for a joined action, basically for continuation of ECHIM (see www.echim.org), which is under negotiation with the Commission. Within this proposal the EUPHIX system should provide the way to publish information related to the indicators from the ECHI short list, therewith reporting about comparable public health data based upon the indicators developed within ECHIM. By using the existing concept of the EUphacts, EUPHIX could eventually become the natural place for reporting about EU Member State policy relevant and comparable public health data.

The general purpose of the joined action has been formulated in the proposal in the following way:

‘The general objective of the Joint Action for ECHIM is threefold:
1. Improving, documenting and maintaining the ECHI indicators

2. Implementing the ECHI indicators in all Member States
3. Maintaining a network of national health indicator experts for ECHI indicators and their collection

Aims 1 and 2 will help to create and maintain the sustainable health monitoring system in Europe by collecting comparable health data and information. The focus will be on the ECHI shortlist. The work will be carried out in close collaboration with Member States, the European Commission, DG Eurostat, WHO, OECD and the other international organisations in order to implement the EU Health Strategy (aim 3).'

The strategic relevance of the joined action has been formulated in the proposal in the following way:
'Joint Action for ECHIM is the backbone for the whole Health Information and Knowledge system and for implementing comparable health indicators in Member States and at EU level. Therefore, its actions are a cornerstone of the strategy for improving the health information system in EU and all Member States. Its strategic importance can easily be seen by imagining a future without the outcome of these efforts. In due course, Joint Action for ECHIM can be expected to result in comprehensive and comparable information on health in all Member States. Without its efforts Europe would continue to have very uneven data on health in different Member States without any comparability. Indeed very few improvements of health information can be expected to occur without the proposed concise work.

ECHIM implements the core tasks of the EU Health Strategy, which reads: 'Health policy must be based on the best scientific evidence
derived from sound data and information, and relevant research. The Commission is in a unique position to assemble comparable data from the Member States and regions and must answer calls for better information and more transparent policy making, including through a system of indicators covering all levels (national and sub-national) (EU Health Strategy, page 4).'

Currently the following can be stated about the member states involved in the joined action, cited from the proposal:
'According to an informal inquiry in April 2008, carried out by the current ECHIM project Core Group, the following Member States will be involved in the Joint Action:

- Involved Member States (24): Belgium, Bulgaria, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, United Kingdom have preliminarily expressed their interest to be involved in the Joint Action.
- Other involved countries (3): Iceland, Norway, Republic of Moldova.
- No replies by 23.5.2008 from: Slovak Republic, Romania + Turkey, Croatia, Republic of Macedonia.
- It is proposed that further efforts are made to involve all Member States in this action.'

This information is important because it shows clearly that the proposal is strongly supported by a vast majority of the member states in the EU and 3 other European countries outside of the EU.

5.3.2 EUPHIX Intelligence Network

This project proposal for an intelligence network is meant to build upon the existing EUPHIX network and expand it where possible and suitable. A EUPHIX project proposal for an intelligence network has been submitted, see annex 6, within the Public Health Programme 2008-2013 with the following purpose (as written in the IN-EUPHIX project proposal, executive summary):
'The IN-EUPHIX project aims to deliver a large body of policy relevant, scientifically sound, content on an internet accessible, electronic health monitoring system that will serve the EU and its Member States. The project will deliver a large number of health topic reports. These will be produced in a process, jointly executed by the project partners, that involves mapping, developing and managing an intelligence network of committed experts and organizations to produce the health topic reports. The collective fields of interest of this intelligence network and the contents of the health topic reports should both match the comprehensive content area that is covered by the ECHI-indicator list. The peer reviewed content, including references and links, will be published on the previously developed EUPHIX pilot web application, according to existing publishing protocols.

The outcomes of the project will serve an audience within the EU and it's Member States that includes policy makers at all regional levels, public health professionals, the media, journalists and the educated general public. It will provide them with good quality, comparable and policy relevant health information and data. In this way the project will strongly support the general goal of the programme of community action in the field of health, especially in the health information area. The health topic reports and other information, e.g. on the outcomes of other EU projects, will be linked from the EUPHIX system to the Health EU Portal website.
In this way the IN-EUPHIX project will take a second step towards the creation of a sustainable health monitoring system for the EU.'

Other important ways of creating sustainability is by way of commitment and visibility, meaning that EUPHIX should be recognised and used by European professionals and citizens. For this, it is needed that the content is relevant for policy makers and the public, and that it is made known widely by appropriate means. This has been, and will be done by:

- presenting EUPHIX at conferences;
- liaising with and feedback from target group panel;
- developing opportunities for user panel member to champion EUPHIX after the project has ended;
- embedding EUPHIX in EU health portal of the Commission services;
- strategy for transfer of EUPHIX methodology and maintenance.

The involvement of the project partners has been described before and is the prime responsibility of the project management, also in the future. This means that the

future management should be very aware of the importance of the partners and should have substantial budget for the managerial tasks related to the partners.

Within the article from Achterberg et al, 2008 it has been formulated accurately because it sums up nearly everything that could be said about the future of EUPHIX in a concise way:

'Future perspective of EUPHIX

The future of EUPHIX is uncertain, however. What needs to be done next is the actual implementation of the following actions in a sustainable way:

- Expand the managing network that will be working with the publishing protocols and using the full guidelines for the process of writing, editing, reviewing, selection of data, and its implementation into the Content Management System.
- Maintain and adapt the Content Management System, including the underlying databases, and maintaining the technology to fully implement the publishing protocols and version control procedures for the editorial management.
- Expand and enforce the managing and expert networks. The current EUPHIX Expert Network will be instrumental in the future work on updating and expanding the content. Besides that, a consortium of 22 public health institutes in 21 Member States has been established, that is ready to be engaged in future work to enlarge and update the EUPHIX website content. A mapping exercise is needed to expand and enforce the expert network of authors and peer reviewers.'[1]

To conclude the matter of sustainability, seen from a more technical viewpoint, sustainability is also ensured by the following. All parts of the system have been documented and manuals are also available in English for some relevant parts of the system. The CMS can be easily used outside the RIVM and with (considerable effort) the system could be ported to servers outside of the RIVM. This means that the system could be handed over to, or incorporated in an existing arrangement (e.g. server infra structure), shifting development and maintenance to another organization.

6 Documentation of work processes

Throughout the project lifespan the EUPHIX staff has been experimenting, and sometimes struggling to find ways to publish the web content on internet in the best possible way. What type of language should be used, should the text be formal, short, always according to strict web writing guidelines? Should it be presented in one, two or three columns in a web page? What about tables, how should these be presented? What color schemes should be used throughout the website and last but not least, who is responsible for what activity? All of these project parts and activities have been documented in the EUPHIX publishing protocols, annex 7.

The **EUPHIX publishing protocols** document contains the following information:

- Dictionary of terms
- Publishing procedure
- EUphact design and presentation
- Indicator data presentation
- Style Guidelines
- Checklists
  a. Style and structure
  b. For those involved in the publishing procedure

With its own annexes about:

Annex 1 – Roles & Responsibilities
- Webmaster : website release ; server configuration and maintenance
- Editor: contacting and guiding authors; contacting and reminding
- Reviewers; filing publishing process agreements
- Editor and Project Assistant: obtaining publishing permission
- Project Assistant: answering emails

Annex 2 – Language & Style
- EUPHIX language and style rules
- (Scientific) writing in English – common errors, recommendations and sources

Annex 3 – EUphact Content & Design for authors

Another important part of the project has been the gradual development and implementation of the necessary software for the EUPHIX system. Even though the core of the system was already developed for national 'predecessors' of EUPHIX, there has been considerable effort put into fine-tuning the existing software and developing some new software. Many of the details have already been described before but some of the remaining descriptions and detailed information can be found in annexes below.

There's extensive technical documentation available at the RIVM, contact person R. Nugteren, rutger.nugteren@rivm.nl; tel. 0031 302744383

7 Discussion and conclusions

Cited from the article from Achterberg et al., 2008 about the EUPHIX project:

'A comprehensive picture of population health and its proximal and wider determinants is essential to feed into EU health policy and to provide a basic starting point for developing a new EU Health Strategy in the near future. This can be done by occasional 'comprehensive' health reports, every four or five years, such as is currently done in the EUGLOREH project [4].

The added value of the EUPHIX concept is that health reporting becomes more flexible and user oriented. More, but layered, information, such as background details and data as well as relevant meta-information can be included without disturbing the quick reading process. Updating a web based system is less complex and more flexible than updating a book. The concept takes advantage of the flexibility and linking options provided by internet and allows simultaneous interactive presentation of its results to a very broad audience.

The process of filling and updating EUPHIX with relevant, high-quality, peer reviewed and policy relevant content and data for the EU and its Member States has now been outlined as a feasible enterprise. Its financial sustainability, however, is a remaining challenge. A central form of organisation, i.e. a coordinating centre for health monitoring would seem an essential element of any sustainable effort and such a centre could become the 'owner' of the EUPHIX system. This would be in line with previous recommendations by EU experts [2] to set up a health observatory for the EU. Joint Actions and EU projects could also deliver major input to such an observatory.

The EUPHIX system can be viewed as a new concept for health reporting that actually works and provides high quality content and data. In order for EUPHIX to survive in the EU context, it has to be recognised, however, as a central element in the 'public health monitoring and reporting system' as envisaged by the EU Health Programme. It can also add more valuable information to the Health-EU portal and function as a platform for EU project outcomes.

For all this to be realised, EUPHIX needs to be recognised as something that is by nature a structurally maintained activity needing structural financing. At the date of writing this article, two proposals for future work contain elements of continuation of EUPHIX. The first is the proposal for a 'Joint Action on ECHIM', which involves the further implementation of the ECHI shortlist in EU Member States. The second is the project proposal 'IN-EUPHIX' (Intelligence Network for EUPHIX), meant to further build the editorial and intelligence capacity to expand and update the textual content of EUPHIX for a period of two years.

The conclusion is that the EUPHIX model launched in June 2008 is integrating data, information and knowledge into a new type of Health Information System. The EUPHIX model is proposed to be the future model for EU health reporting.'

References

[1] Peter W Achterberg, Pieter GN Kramers, Hans AM van Oers. European Community Health Monitoring: the EUPHIX-model. Scandinavian Journal of Public Health: 2008; 36: 676–684.

[2] Aromaa A. Health observation and health reporting in Europe. Rev Epidemiol Sante Publique: 1998: 46 (6), 481-490.

[3] EC. The State of Health in the European Community. European Commission. Luxembourg, 1995.

[4] EC. The Health Status of the European Union. Narrowing the health gap. European Commission. Luxembourg, 2003.

[5] EUGLOREH. Website: http://www.eugloreh.it/default.do; visited june 19, 2008.

[6] EVA PHR. Website: http://www.eva-phr.nrw.de/1_pdf/EvaFinalReport.pdf; visited june 23, 2008.

[7] Kramers PGN and the ECHI team. Public Health indicators for the European Union: context, selection, definition. Final report by the ECHI project. Phase II. RIVM report 271558006, June 20, 2005.

[8] Lalonde M. A new perspective on the health of Canadians. A working document. Ottawa, Canada, april 1974. http://www.hc-sc.gc.ca/hcs-sss/alt_formats/hpb-dgps/pdf/pubs/1974-lalonde/lalonde-eng.pdf; visited june 24, 2008.

[9] Mackenbach J, Kunst A, Stirbu I, Roskam A, Schaap M et al. Tackling Health Inequalities in Europe: An Integrated Approach. EUROTHINE Final Report. Rotterdam: Erasmus University Medical Centre, 2007.

[10] RIVM. Care for Health. The 2006 Dutch Public Health Status and Forecasts report. RIVM report 270061004, Bilthoven, 2006.

[11] Finn Kamper-Jorgensen. Public Health Information Systems- and EUPHIX, editorial. Scandinavian Journal of Public Health, 2008; 36: 673-675.

[12] Cassie Trewin, Bjorn Heine Strand, Else-Karin Groholt. Norhealth: Norwegian Health Information System. Scandinavian Journal of Public Health, 2008; 36: 685-689.

Annex 1 The EUPHIX Work Plan 2004-2007 (2008), Work Package 3, technical deliverables.

Work Package 3. Building and implementing the web application

The aim of this work package is to develop the EUPHIX web application through which all content matter described above will be made accessible in a systematic, logical and integrated way. This includes all characteristics that are needed to gradually update and maintain the system. Work Package 3 will include a series of tasks, as discussed in 3.3.1 through 3.3.6. Technical details will be elaborated later in an Annex.

3.3.1 Building the web application

For the user, the web application should provide the following facilities:

- An opening screen showing the way to the topics, the themes, and to other basic facilities.
- Entry to topics and indicators via a systematic 'topic tree' (see 3.2.2), including text, tables, graphs, and maps.
- Entry to themes, by a separate listing, providing access to the more comprehensive sections, and including topics as described above (see 3.2.3).
- Browse for keywords by a search function.
- Internal links to references, abbreviations and definitions, and to related topics or themes within the system.
- External links toward relevant documents, databases and websites elsewhere.
- Printing facilities.

The web application is based on technology devised for the Dutch Public health information sites the 'Dutch National Health Compass' and the 'Dutch National Health Atlas'. This includes functionalities to create the lay-out, to edit documents within the system after introduction, and to use internal references to background databases containing literature references, abbreviations and a glossary of definitions. It also has functionalities to represent tables, graphics and maps either 'stand-alone' or (at a later stage) in connection with a separate database containing an underlying data repository. This data repository will be developed especially for EUPHIX.

Technically, the application uses ASP.NET as the internet software and MS SQL server as the database software.

3.3.2 Developing the Content Management System

As indicated above, the Content Management System (CMS) is an editorial tool by which content editors can work on contributions within subsequent versions of the application, before actual release. It implies a workflow system for editing and approval by authorised persons. In connection with other projects at RIVM/PHF (such as Kompas), it is constantly improved to make it more user-friendly. It allows for introduction of tables, graphs, maps as well as the various types of links indicated above.

3.3.3 Developing the underlying database

Normally, topics contain presentation of numerical data and statistics. These are selectively derived (often as aggregates) from existing databases (such as DG Eurostat, WHO-HFA or OECD health data), from relevant publications or from specific networks, and stored in a data repository designed for EUPHIX. This repository is set up to store data with the appropriate meta-data, and allows for the production of tables, graphs and maps following predefined procedures, which will then be introduced into the CMS.

3.3.4 Developing a geographical display tool

This tool will be linked to the application to add maps that display national and regional health data. Similarly, information about the presence or absence of policies or the implementation of prevention measures will be displayed via this tool. The software used is ArcGIS9.

3.3.5 The EUPHIX web application and the EU public health portal.

It is intended to integrate EUPHIX within the EU public health portal. It has to be investigated which is the most practically feasible solution for this. After the first development phase, it is crucial to work towards the sustainability of the system. For this, it is needed to define the appropriate place of EUPHIX among related web-based information products. Technical solutions for integration or linking EUPHIX to other web-based systems should follow from this definition and from the state of the art of web technology, and especially the EU public health portal.

3.3.6 The EUPHIX Work-in-Progress (WiP) site

A separate task within this work package is to develop a second web site that will provide information on the organisation and progress of the EUPHIX project as such, while the 'real site' is under construction and not yet generally accessible. The site includes information on the participants, the project objectives, the planning and progress, the meetings, etc. The address is www.euphix.info.

Annex 2 RIVM NetWriter

1. Introduction

Today's publications for the web have to meet high standards. Users expect quick access to information and a consistent look and feel. On the other hand, editors should just add content and not have to worry about presentation details. Both goals can be achieved with the aid of a content management system.

2. Overview

The *Department for Public Health Forecasting* (PHF) of the RIVM has developed a content management system, called *NetWriter,* for the various websites maintained by this department. Since these websites bear a close resemblance to the projected EUPHIX website, the system will be well suited for EUPHIX.

The editorial interface is completely *web-based*, except for the publishing step, only performed by the webmaster, which requires a custom Windows application. Editors are able to edit content by navigating to a specific secure URL. Editors can access the system from any location world-wide, provided they have a connection to the internet, by using a web browser. Editors do not need to install any software in order to use the system.

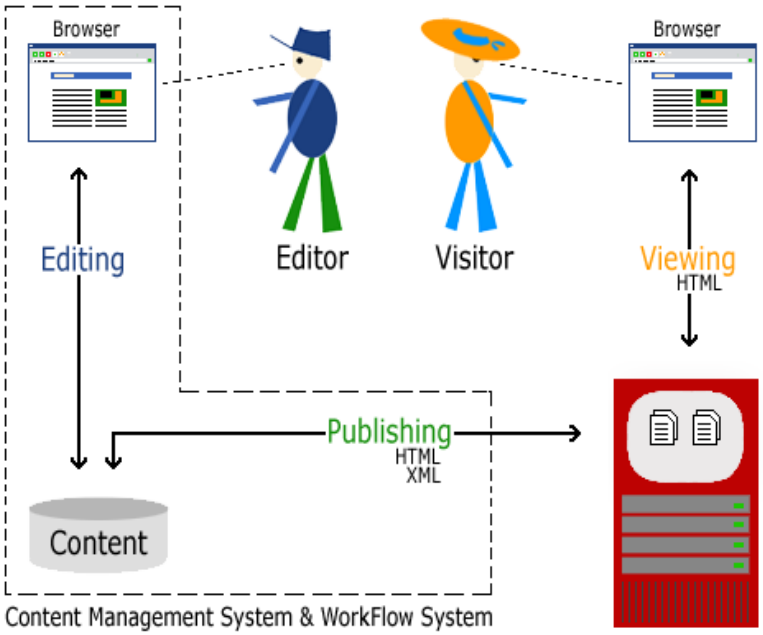


Figure 3 Overview of content management system, editors and users.

3. Purpose

In the early days of the World Wide Web, sites were created by writing HTML pages. This tedious work is not needed when a content management system (CMS) is used. Such a system takes control of many cumbersome technical details, allowing editors to concentrate on writing content. Also, a CMS helps in protecting the content from unauthorized modifications and enables you to retain previous versions of content. Content is therefore well protected and will not be lost when a mistake is made.
Furthermore, a CMS allows editors to work on a conceptual level rather then a technical level. Content is interlinked by selecting target documents and resources from searchable lists rather then by entering URL's. Target documents and resources can only be deleted when all references are removed. As a result, dead links are virtually impossible.

4. Features

Separation of content and lay-out

The NetWriter system allows editors to define the general structure of a website, including menus, hierarchical topic lists, internal and external links, etc. Besides this navigational aspect, the textual content is stored in documents that can be edited through a powerful editor within a web browser.
Resources like images and diagrams, but also abbreviations and definitions, are stored in a repository and can be used anywhere. Changes in the resources are reflected automatically in all pages by which they are referenced.

The system does not store detailed information about the presentation of the site. The presentation details are defined in a *style sheet* or, more precisely, a CSS (cascading style sheets), a W3C (World Wide Web consortium) standard. These style sheets define the *physical presentation*, i.e. the font types and sized, ordering, colors etc., of conceptual elements like titles, headings, links, paragraph text. The style sheets can be adapted independently of the content.

The locations of all elements on a web page, like menus, a topic tree etc., are also controlled independently of the content. This is done by an XLST transformation, another W3C standard that is commonly used.

Editor

Editors use a special online interface that allows them to enter texts, tables, images and anything else needed to create an attractive presentation of content. This WYSIWYG (What-you-see-is-what-you-get) editor interface will show the web pages an editor is working on just like they will look on the screen. The editor can click on a piece of text and just start typing or insert resources.
The NetWriter editor interface has many features similar to a text editor like Microsoft Word: copying and pasting text, multiple undo/redo steps and objects like lists and tables. It is even capable of importing Microsoft Excel and Word documents and exporting Word documents.

Authorization

To start, NetWriter users must login to the system every time they access the system. While working with the system, virtually all actions that editors can perform are governed by a configurable authorization scheme. Users of the system are given roles and authorization is granted to members of these roles. Additionally, grants may apply to all content of a site, or only to specific sub sets of document and other objects. This way, responsibility can be distributed among multiple users.

Workflow management

A key feature of the system is workflow management. Specific content always has a current status and dedicated editors can transfer documents from one status to another. For example the status of a document can be transferred from 'editor processing/maintenance' to 'approved' by an editor, or from 'planned' to 'removed'. The status helps editors to determine the work to be done on content and it is also used to ensure that only complete and validated content is published. Workflow management is combined with authorization, allowing only appointed users to make specific status transitions.

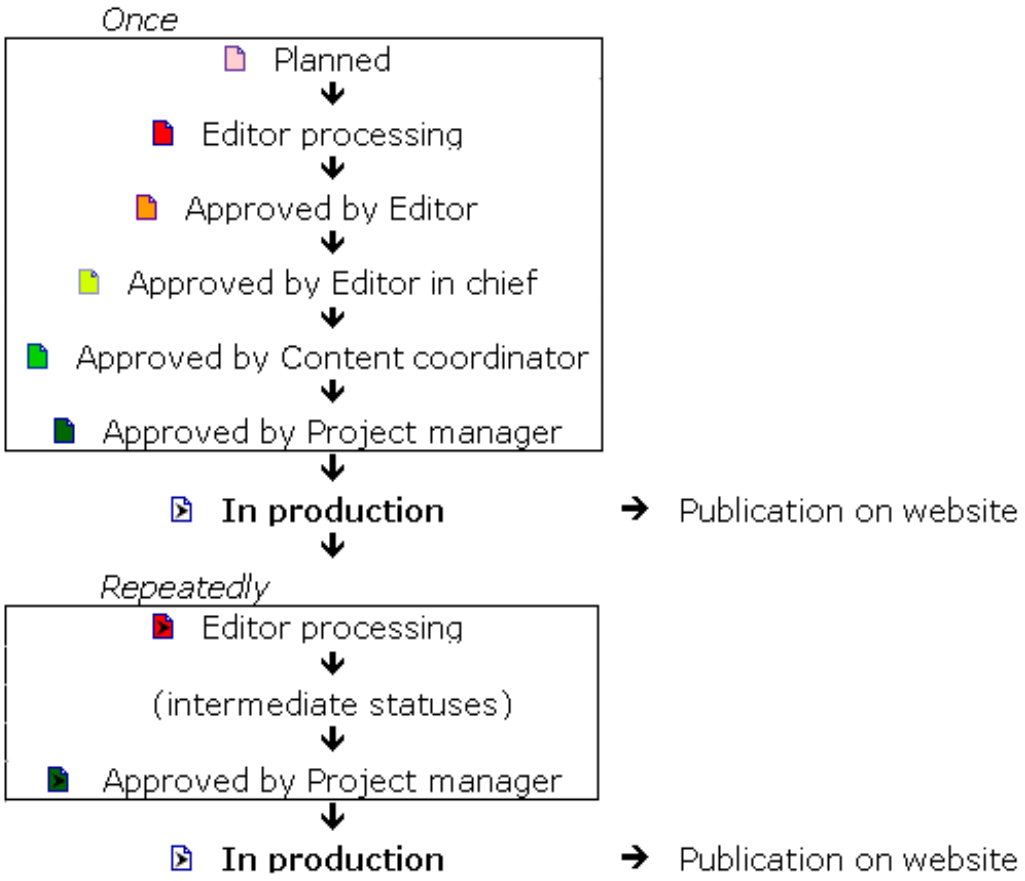


Figure 4 Scheme of statuses that content can have

Version management

Every time edited content is saved, a new version of the content is stored; together with the name of the editor and the data and time it was saved. Previous versions can be compared, showing additions, deletions and modifications.

Publication

In contrast to many content management systems, the web sites published by the webmaster using a special custom Windows application, are only updated after a release step. During this release procedure, the conversion to *static HTML* takes place. This greatly *improves reliability and performance*, since all pages are readily available as stored HTML files on the web server and need not be constructed at every request.
The publication mechanism is controlled by workflow management. Only documents with the right status will be published. In practice, a pre-release is used to validate modifications to the website, concerning both structure and content. The publication step thus helps to ensure that nothing but validated content is published.

Interactivity and dynamic content

The system is not specifically intended for creating interactive and dynamic web sites. The focus is on publication of information. However, it is possible to embed tailor-made interactive web pages in the system, so-called interactive web components. These web components will have the look and feel of any other page in the system but will function outside the scope of the system. Examples of web components are interactive graphs and maps.

Language independent interfaces

The NetWriter user interfaces for the editors are language independent. Currently, translations exist for both English and Dutch, but other languages can be added easily.
Of course, the content of the websites is not language independent or *localized* automatically. In practice, the website is in one language, possibly with an additional summary in other languages. The texts of these summaries must be written for each language, but resources can be linked and updated for all languages simultaneously.

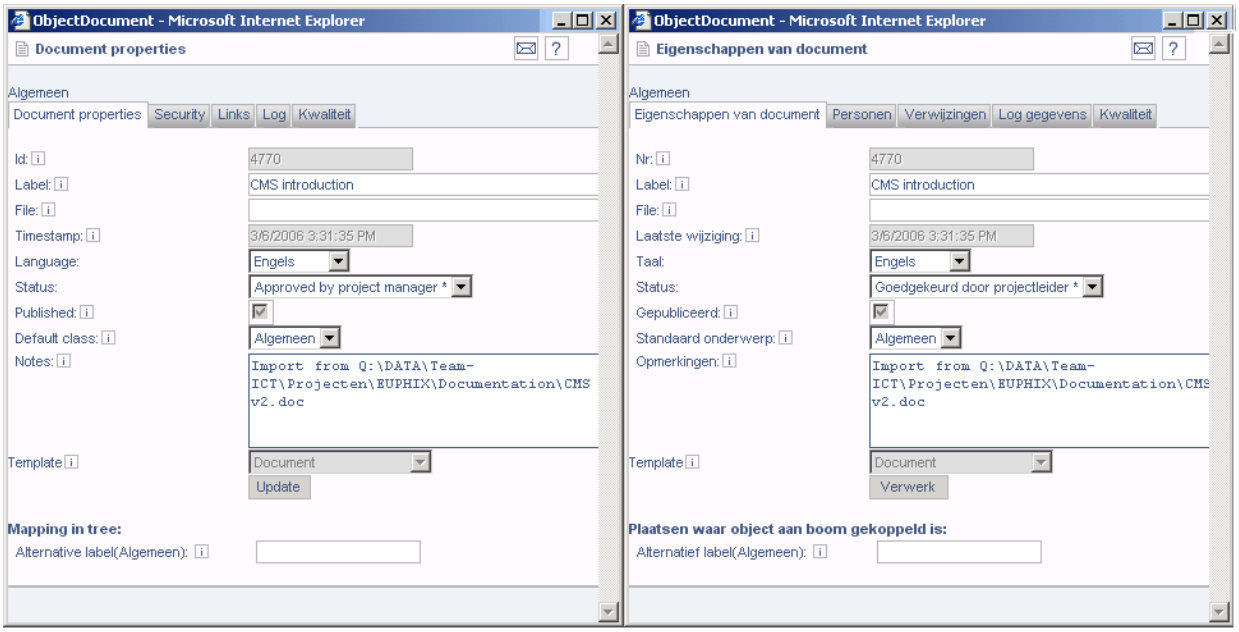


Figure 5 Examples of the same interfaces with different languages implemented

5. Examples

Below are some examples of systems created with the content management system.

http://www.EUPHIX.net

http://www.EUPHIX.info	The work in progress site of the EUPHIX project. (The EUPHIX site itself is not publicly available at this moment.)
http://www.nationaalkompas.nl	The National Public Health Compass is the gateway to information about health and disease, risk factors, care and prevention in the Netherlands.
http://www.zorgatlas.nl	The atlas provides a geographical view of public health and care in the Netherlands.

6. Technical specifications

The system has been built using the programming tool Microsoft ASP.NET 1.1 and the database server Microsoft SQL Server 2000. It uses the following standards:

- XML
- XLST
- CSS

A running system on the server needs a Microsoft IIS web server, an ASP.NET runtime and a SQL Server 2000 database instance, all on one or more hosts running the Microsoft Server (version 2000 or higher) operating system.
Editors must use the browser Microsoft Internet Explorer (version 5.5 or higher) for editing.

A release of a website can be hosted on any system capable of running a web server. The final websites are compatible with at least Internet Explorer and Mozilla Firefox.

Annex 3 Search tool

1. Summary

The search tool has been developed for the ENHIS project and was partly also used by the EUPHIX project. It provides two main functions: searching in the pages of a website; and searching indicator data.
In other words, the application consists of two components:
1) a search engine which searches the **html content** of the EUPHIX website using MS Index server; and
2) a search engine that searches within the **ENHIS SQL database** for relevant indicators, linking these to the appropriate data. This functionality was not used for the EUPHIX website (see explanation below)!

Using only **one search term** provides the end user with three search results:
- a list of html content of documents pages (detailed information)
- a list of html content of subject pages (more general information)
- **Only within the ENHIS project**: a list of related indicators with data. These data can be filtered and can also be exported to Excel. Besides, a face value graph can be produced of the (filtered) data.

For searching pages of a website, it used Microsoft Index Server. For searching indicator data (only within the ENHIS project), an legacy ASP.NET application has been built.

However, the EUPHIX project differs from the ENHIS project in many ways and for instance because of the fact that the relationship between indicators and data is less straightforward within EUPHIX as compared to ENHIS, it was decided that EUPHIX would not use the second search option. This may however change in the future; therefore the description of this functionality is given within this annex.

2. Design

User interface

Search page

Each subject page in the website shows a search option: a text box for entering a search term. When this option is used, a search is performed through the content of the website and the user is forwarded to a results page. At the top of the pages, there is a text box to enter a new search and three options to tune the search.

And	A page or indicator is listed when all of the words are found somewhere in the pages;
Or	A page or indicator is listed when at least one of the words is found somewhere in the page;
Exact	A page or indicator is listed when the phrase entered by the user is found in the page.

Note that these options only yield different results if more than one word is entered. Document and subject pages often contain information that is not immediately visible.

This information can be included in a definition or reference that appears once the user clicks an in-page link. This information is regarded as part of the page and make the page match the search criteria.

The results are grouped by a number of matches. The user may navigate through the results by clicking on the numbers below the results.

A document or subject match will link to the corresponding static page. Within the ENHIS implementation, an indicator match will link to the indicator data page, selecting the corresponding indicator.

Subject pages versus document pages

NetWriter uses two types of pages to show data:

1. Subject pages. These contain a navigation tree, bits of text and links to documents;
2. Document pages. These contain the main content on a certain subject.

The search tool distinguished between the two types, because subjects pages contain many irrelevant words that are found in the navigation tree, e.g. as siblings of the actual subject. Matches in document pages may be expected to be more significant. Therefore, it was chosen to make twow lists of matches, one for the subject pages and one for the document pages.

Indicator data (only ENHIS)

The third search result list shows indicators matching the search criteria. When clicking one of these results, the Indicator data page is shown for that indicator. This option is only supported for ENHIS.

Indicator data page

The use can query the data by filtering for specific periods (years) and/or regions (countries). The data is presented in three ways:

1. A cross table, with periods a columns and regions as rows;
2. A chart, showing periods on the X-axis and regions as series;
3. A flat data table with three columns: period, region and value.

The user can also export the data in a tab-separated format that can be opened in a spreadsheet program like Microsoft Excel. Depending on the configuration of that program, numbers should be formatted with a decimal point or a decimal comma. The user may choose the separator that applies to his or her MS Windows configuration. Selecting the wrong decimal separator may result in numbers being displayed incorrectly.

3. Technical Components

.Net

The indicator data user control uses the Session object for storing a serial number of downloads. (ViewState cannot be used because the Response is erased and replaced by the download). Therefore, the web application requires Sessions to be enabled.

Index Server

Index Server is configured with the management console snap-in that can be found under Computer management.

Catalog

In an Index Server environment, multiple catalogs may exists and each catalog may index a set of directories and subdirectories. At first sight, it may seem logical to create a catalog for each website release, but that does not work properly. At catalog may optionally be associated with a domain (not a URL) and this is needed if each matching result must have a hyperlink to go to that result. However, if a domain is associated with a catalog, all directories that are available on the domain as a virtual directory will be included in the index. So, if for instance, the domain is domain.org, and the following virtual directories exits:

- /
- /test/
- /prerelease/
- /old/

All of these will be included in the index automatically and searching will be performed in all directories. Directories can be excluded manually, but this has to be remembered. It is therefore recommended to have a single catalog for a complete domain and to search selectively in directories per website. This can be configured in the web.config of the search tool.

Stop words bug in Index Server

Index server uses a stop words list to reduce the size of the index. However, there is a bug in Index Server when running advanced queries (as we do) with Boolean 'And' operators. If the search terms are 'causes of death' and search option is 'And', it is changed to 'causes And of And death'. The word 'of' is by default a (Dutch) stop word. There will be an exception reporting the following:

> 'An error occurred: The query contained only ignored words.'.

We have applied the work around of deleting al words from the stop words list. Strange enough, we had to empty the noise.**nld** list, which is the Dutch stop word list. It is not clear which language applies. The language attribute of the html documents would seem to be the determining attribute. EUPHIX documents however, contain <html lang='en'>.

Anyway, the workaround works well.

Reserved words

Some words are reserved and can not be used in an advanced query just like that. If, for instance, one enters 'weight diabetes'

> An error occurred: Incorrect syntax near '"'. Expected '('. SQLSTATE=42000

This can be overcome by escaping the search term with a back slash, so '\weight diabetes'. This is done in the search tool for a selected list of words, configured in the key EscapedSearchKeyWords in web.config.

Dundas charts component (only ENHIS)

This component is used on the indicator data page. It needs a virtual directory for storing rendered charts. This is configured in the design time properties of the chart component and this is currently /search/Temp. The account that runs the ASP.NET workprocess needs read and write access to this folder. The account may be ASPNET (aspnet_wp account) or NETWORK SERVICE.

Annex 4 Data import

1. Summary

Data files are delivered in various formats and lay-outs. This document describes the steps to convert a general data file into the EUPHIX database. The main steps are:

1. preparing the input file
2. entering meta data
3. controlling the input file
4. importing to central database

As a result the data is stored in the generic EUPHIX database. During this process, dimension values are converted to standard EUPHIX values (e.g. M and F would be converted to Male and Female). For each new dimension value a match has to be made with a standard value. Before processing a data file the meta data has to be entered in the EUPHIX data repository. During the process information about the process is logged in the database.

2. Data processing

Preparing the input file

The delivered file is cleaned up and stored in a format SQL Server recognizes. The data is transformed to a normalized form. One row contains one value with all its dimensions. After that the file is imported into a new table of the EUPHIX database. Typically the table name of the imported file starts with 'imp_' followed by the original file name.

Entering meta data

A manual for entering meta data can be found in Access front-end for the Data repository.doc.

Controlling the input file

This step is carried out by stored procedure 'dp_app_input_values'. The procedure pre-processes the raw input table. It produces a standard input table for further processing by dp_process_input. Depending on the provider of the input data the procedure must be modified for each import batch in order to use the right columns for each dimension in the import table. Some providers (e.g: WHO HFA) use a standard format which results in standard processing. For each new provider or new-lay-out delivered by an existing provider a new branch is made in the stored procedure. The difference for each lay-out is in the insert statement for the temporary input table.

Example:

```
-- Modify before reusing.
insert into #input
    ( unit, age_group, period, region, sex, value, flag)
  EXEC('select [unit], [age], [time], [geo], [sex], [Value], [flag]
       from [' + @import_batch_source_table + ']
```

where ICD = '" + @filter_variable_code + "'
)

The second part of the query, after 'exec' is specific for a data-set. The select depends on the input table(s).

Standard formats are recognized in the procedure by the given provider id.
Not all dimensions occur in all datasets. In this case the query for the input into the temporary input table needs to be adjusted.
Row by row the temporary input table is processed. Each dimension is checked. If it already exists the id of the value is stored in table input. If it doesn't exist an error is raised and the unknown dimension value is stored in import_error_unknown_domain_value. An error doesn't stop processing. All rows are processed so finally all missing dimensions are stored in import_error_unknown_domain_value.
If there are no missing dimensions or flags processing can continue with dp_process_input. If there are missing dimensions or flags they have to be added to the corresponding tables and the process repeats.
When starting to use this process a lot of dimension descriptions have to be entered in the system. In time most descriptions will be available in the system and the number of unknown dimension values will decline.

Parameters

- data_set_version_id: integer, version of the dataset
- import_format_code: format as found in table import_format
- import_batch_source_table: name of the dataset
- filter_variable_code: input constraint

Input

- Source table
- Meta-information entered in the Acces front-end

Output:

- input: table, filled for further processing;
- import_batch: table, logging of the import;
- import_error_unknown_domain_value: logging of unknown domain values;
- import_error_unknown_flag: logging of unknown flags.

Importing to central database

This step is carried out by stored procedure 'dp_process_input'. The procedure processes the prepared table input. The values are added to the EUPHIX database after checking on errors in the preceding step. There is also a check on whether the input file has been processed before.
Normally the processed set is not yet in the EUPHIX database. To prevent processing of earlier processed data and creation of duplicates, there is a check on the existence of data with the version id of the processed data. The default setting doesn't allow additional inserts. By setting force_additional_values to 1 additional values can be inserted. Be careful with this option, it is recommended to create a new version of the dataset and not to use this option.
After succesfull processing of table input a row is added to the import register.

Parameters
- import_batch_id: integer, identification of the data-set
- force_additional_values: bit, whether or not additional values are allowed

Input
- input, result table of dp_app_input_values

Output:
- EUPHIX database
- import_batch: register of completed imports

3. Tables

For the process of importing data the follow tables are important. They contain logging information, references and the input data.

- data_set_version: Data set version information.
- #input: Temporary table, stores the input values.
- input: Pre-processed input values
- import_error_unknown_domain_value: Unknown dimension values. Here one can find the missing domain values for a specific import action.
- import_error_unknown_flag: Unknown flags Unknown dimension values Here one can find the missing flags for a specific import action.
- import_batch: Logging of the imported files
- ref_dimension: Dimensions
- provider: Providers

4. Special situations

New providers or import formats

When data from new providers or data in a new import format are to be imported, this needs some configuration steps as well as a modification of the importing stored procedure: dp_app_input_values. Typically, it will require a new section in the procedure, starting with an if-statement if @import_format_code ='…', that is mapping the correct fields in the import table to EUPHIX column names.

Annex 5 EUPHIX database

1. Summary

The starting point of this description is the choice to build a central database for generic storage of numerical data for EUPHIX. The purpose of the database will be discussed, followed by a description of the conceptual model and several use cases. Finally, the physical implementation of the database is documented.

2. Design

Purpose

The purpose of the database is to facilitate storage of varying data sets that are subsequently used to generate tables, diagrams and maps for presentation to end-users. The database will help to organize the data sets, by allowing editors to specify meta-data for data sets, browsing of available data sets and selecting subsets of data to be used for the presentation.

Characteristics

The main characteristics of the database can be stated as follows:

- The database will store independent data sets of scientific data, linked to a common, set of dimensions and domain values.
- Meta data is stored alongside the data itself.
- When data sets are retrieved from the database, cross sections for dimensions can be made and they can be filtered on specific domain values. Aggregation is not supported, because aggregation is a non-trivial processing step.

Conceptual model

Variable

A data set corresponds to a variable. This means that any value in the data set is the value, typically numerical, for that variable, given the domain value for each dimension on which the data set is defined. The system allows different types of variables, originating from different classification systems, the ICHI indicator list, etc. The versatility of these variables should not interfere with the basic concept of the EUPHIX database that data sets belong to a variable.

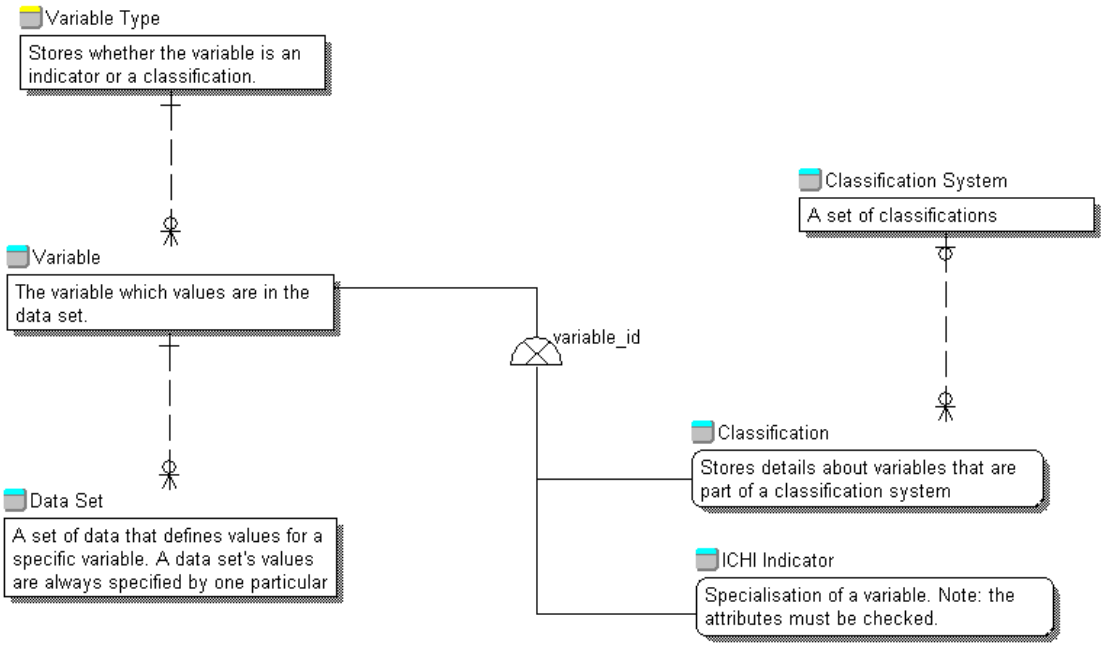


Figure 6 Data model for variables

Provider

Provider is a general term for any organisation or institute that publishes or collects data that are made available in EUPHIX. One or more providers may be linked to a data set and the role of these providers can be specified.

Data set

A data set is a set of values that constitutes the data for a specific variable. It has various attributes to help identifying the data set, like a description and the list of providers who have contributed to the data set. Also, the data set before importing data into the data set, the dimensions on which the data set is defined must explicitly be specified, to enabled recognition of invalid data.

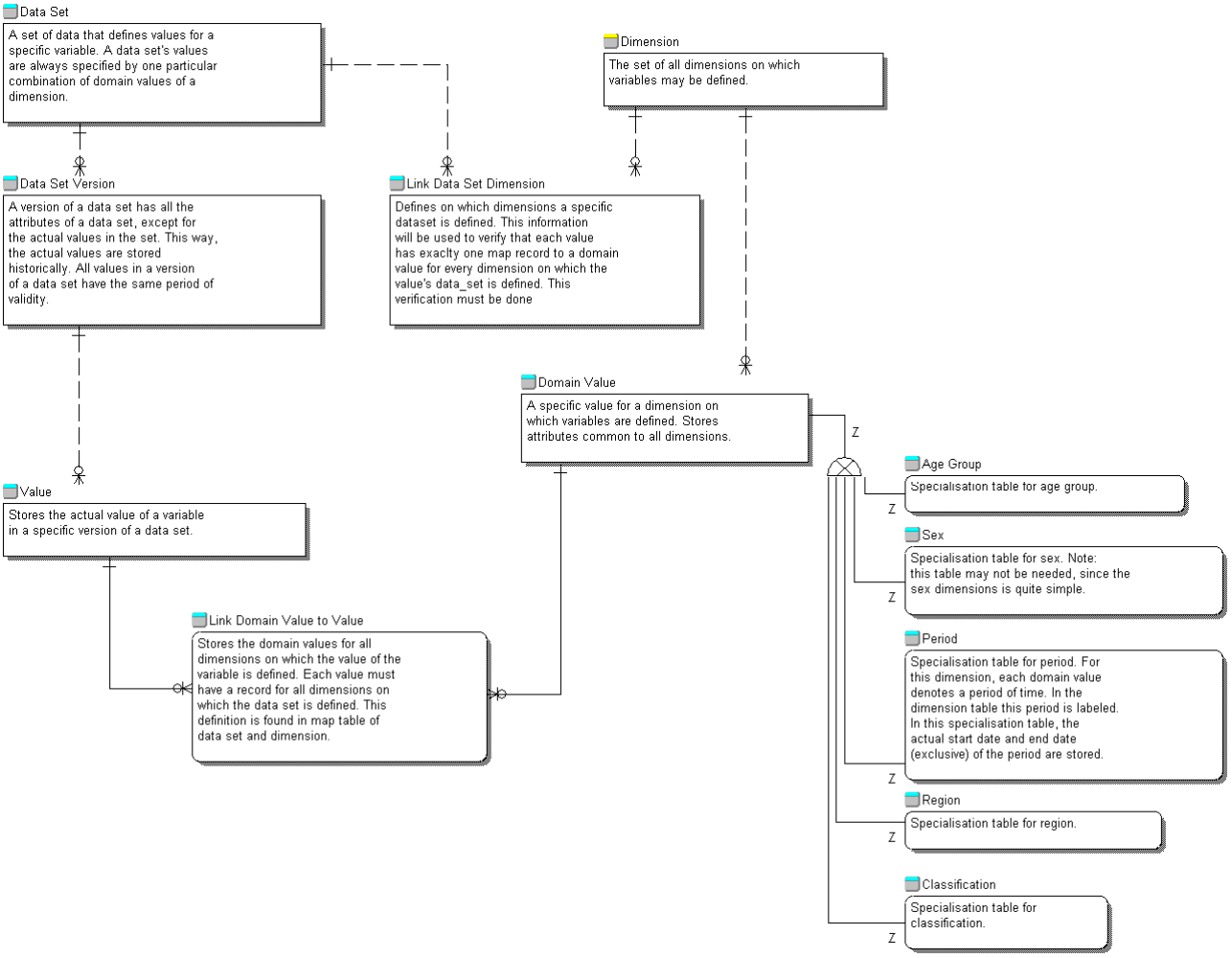


Figure 7 Data model for data set and related entities

Data set version

In the context of this database, history of data refers to the history of values stored in the database, not to the fact that data is time dependent, like an indicator that is available for a range of years. History of a data set is relevant when the actual values are updated due to corrections etc. The database retains all versions of a data set and could even return any of them, until an editor explicitly chooses to use a newer version.

Dimension

A variable has a functional dependence on one or more dimensions. The value of the variable will depend on the domain values, for each of the dimensions it is defined on. The dimensions in EUPHIX are not fixed, but extensible. However, in practise, the following dimensions will be used:

- Region (geographical area)
- Age group
- Gender
- Period (year)

- Social economic status (usually defined as education level and income, this depends on the dataset being used)

Domain value

A domain value is a valid value for a dimension. Some examples for the dimensions mentioned above:

Table 1 Examples of domain values

Region	The Netherlands	EU-25	Sjaelland
Age group	0 years	65+	20-29
Gender	Men	Women	Total
Period	2003	1999-2003	Jan 2003
Social economic status	*No examples yet*		

In the current version of the data model, hierarchic structures of domain values cannot be constructed. For some dimensions, the domain value has additional attributes for dimensions specific attributes.

Value

The value is the actual number representing the measured, estimated or calculated value of the variable for the specified combination of domain values. A value must be linked to exactly one domain value for each of the dimensions the data set is defined on. A data set must not contain more than one value for each unique combination of domain values. During import, this must be verified.

Footnote

Data sets may have related footnotes. Footnotes may apply to a data set as a whole or to a sub set of values only. Additionally, footnotes may also be needed for domain values used in a data set. For instance, a remark on a specific year may be needed, stating that only the first 10 months of that year were measured.
Footnotes should be stored with the data and it should be possible to show then when presenting the data.

Physical implementation

The physical implementation of the database is a database in the Microsoft SQL Server 2000 relational database management system.

Annex 6	**IN-EUPHIX (in PDF format)**
Annex 7	**Publishing Protocols (in PDF format)**
Annex 8	**Article: European community health monitoring: the EUPHIX-model (in PDF format)**
Annex 9	**Editorial: Public Health information systems – and EUPHIX; by Finn Kamper-Jorgensen (in PDF format)**
Annex 10	**Article: Norhealth: Norwegian Health Information System (in PDF format)**