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SESSION II: The role of IT in collecting health information

THE GERMAN HEALTH INFORMATION SYSTEM

Invited paper submitted by the Federal Statistical Office of Germany[1]

Abstract

1. The German *Health Information System* (HIS) was created as part of the research project “Setting up a Federal Health Monitoring System”. Therefore, both contents and framework conditions are linked to the principles on which the research project is based.

2. The project target was to report in a comprehensive way on the health status of the German population and the factors influencing this health status – including health care. All information is grouped with respect to the following seven major topical areas:

- framework conditions of the health care system,
- health status,

[1] Prepared by Gunter Brückner, Health Monitoring Unit.

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- behavioral and risk aspects of health,
- diseases,
- resources of the health care sector,
- production and consumption of health care services, and
- expenditures for and costs and financing of health care.

3. The HIS as a by-product of those activities was primarily founded in order to create a consistent and easy-to-use common data infrastructure for those contributing to the first “Health Report for Germany”.

4. Rather shortly it became clear, however, that such a treasure should not remain unused after the report was finished, because it contained valuable information which had never been collected at one place before. With the Internet becoming more and more popular it seemed intuitive to make this information available to everybody using the means provided there. An *internet-based information system* not only serves the customers in a comfortable way, but at the same time makes efficient use of scarce manpower resources.

5. Quite substantial problems had to be solved before the systems could be released to the public. This paper reports on those problems and the solutions found. It refers to the framework conditions, the logical data model, the hard- and software used, the software-ergonomic efforts undertaken in order to make the system user-friendly and the security problems associated with such a system in an internet-intranet surrounding. *On-line analytical processing* (OLAP) is a cornerstone of information technology used in this project.

6. We believe that the basic principles of this system may well serve as a starting point to make available internationally comparable information on health-related topics.

I. Introduction

1. In 1992, the Federal Ministry of Research and Development and the Federal Ministry of Health jointly started a research project on “Setting up a Federal Health Monitoring System”. The purpose of this project was to report, for the first time, comprehensively on the health status of the German population and all health-related factors, including health care. It was explicitly mentioned that both epidemiological and health-economic aspects had to be covered in an integrated way. At the same time, the project was to lay grounds for those activities going on later on a routine basis.

2. At that time, the empirical situation in Germany was difficult – a situation well-known to everybody active in this field. Data were scattered among a variety of “owners”, inconsistently defined, non-standardized, and in most cases difficult to lay hands on. Indicators were calculated over and over again by different organizations – not always yielding identical results. A researcher’s work was cumbersome, because he could not start his work before he had found out, who owned which data and on what conditions would make it available.

3. In a four-year period we succeeded to include all contributors in a co-operation. They learned that it was profitable to join in because co-operation eases their own work. Now, expectations were high, and all efforts had to be undertaken in order to fulfill them.

II. Framework conditions

4. The research project “Setting up a Federal Health Monitoring System” was given the tasks,

- to provide the first “Health report for Germany” with more than 100 chapters on various health-related topics. All topics should be dealt with in a consistent and comprehensive way, covering the aspects “health status”, “health risks”, “diseases”, “health care activities”, “health care resources” and “expenditures, costs and financing”. The respective reports were to be empirically based and to address the general public in an easy-to-understand way;
- to provide at least two special health reports on topics controversially discussed or of high political relevance; the topics “Allergies” and “Interrelating ambulatory and stationary care” were chosen;
- to set up an “Information and documentation center ‘Health Data’ (IDC)” as a joint data infrastructure for all reporting activities;
- to conduct special methodological research projects in order to enlarge or to improve the empirical database or the data presentation. The topics “A new concept for health expenditure calculation”, “Costs of illnesses ” and

"Retrieving population-based disease-specific health care treatment information from remuneration records" were chosen.

- All activities were to be conducted in a way that would allow a future continuation of the work on a routine basis. A specific request was that new topics should be easy to include, and shifting priorities easy to handle.
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5. Because of the future-orientation mentioned above, the wide span of topics covered, and the varying level of detail used in dealing with those topics, the data model of the information system had to be extremely flexible.

6. Meanwhile, users' expectations had risen substantially, as new information technology became widely accessible, primarily via the Internet. Internet search engines turned out to be one of the major reference points, and people got increasingly used to keyword search, full text retrieval, partly qualified search strings and multi-lingual systems. Therefore, it was decided that the HIS should not fall behind the results already achieved elsewhere.

7. Furthermore, we were confident that such an information system would once and for all solve the problems associated with calculating indicator values. Everybody in the information business is familiar with some of the following the intricacies:

8. No matter how many indicators you may calculate and keep on stock in a pre-tabulated way, the first customer wants a combination or breakdown position not included, although the request is both legitimate and possible on the basis of the existing data.

- A revision of a number in a data source may influence a huge number of indicator values. Therefore, either all indicators have to be recalculated, or one has to live with such indicator values remaining inconsistent.
- Whenever a new indicator is introduced, it causes insurmountable problems concerning back dated data. In most cases, such indicator values cannot be provided for past periods.
- Duplication of work is common. Nobody can estimate how many people e.g. "program" life tables in a spreadsheet software – or whether those tables will reach comparable results.

III. Shaping the Health Information System

III.1 Basic principles

9. From the problems and framework conditions discussed above, the following guiding principles were deducted:

- *Information* refers to both text and numbers; any information system must contain both. Text as well as numbers transport information, each in a specific form. Numbers can be provided in form of tables or diagrams. Text may contain tables or graphs as objects. Information can use different carriers, the most important nowadays being “printed” and “electronic device”. Information is an answer to a question and there is no answer without a question. Therefore any information system must be able to read or extract the user’s question; otherwise the system will not be able to respond properly even if it contained all data necessary to do so.
- *Text* is the most important communication tool between the user and the system. Therefore, all information objects included need a proper text description to be retrieved. This is especially important for numbers. E.g., no customer will look for “81.785.625” and expect the answer “German population 1995”.
- *Users* are the challenging part of any information system. They vary both with respect to computer literacy and topical expertise. The majority of users put “fuzzy questions”, i.e. the do not phrase their questions precisely. Virtually nobody is familiar with the hierarchy of topics – because there is no commonly agreed hierarchy, and most pieces of information relate to more than one topical area. Users use different languages and language levels.
- To transport numerical information is an especially difficult piece of work, because numbers are never self-explanatory and are meaningful in a very specific context only. This context has to be well understood both by the customer and the provider, otherwise misinterpretation and wrong conclusions cannot be avoided. *Indicators* play an important role here; they are answers to commonly put questions which experts have agreed on. Indicators indicate – and are useless without the respective indicandum. This indicandum is extremely useful for guiding the user through the labyrinth of the information system.
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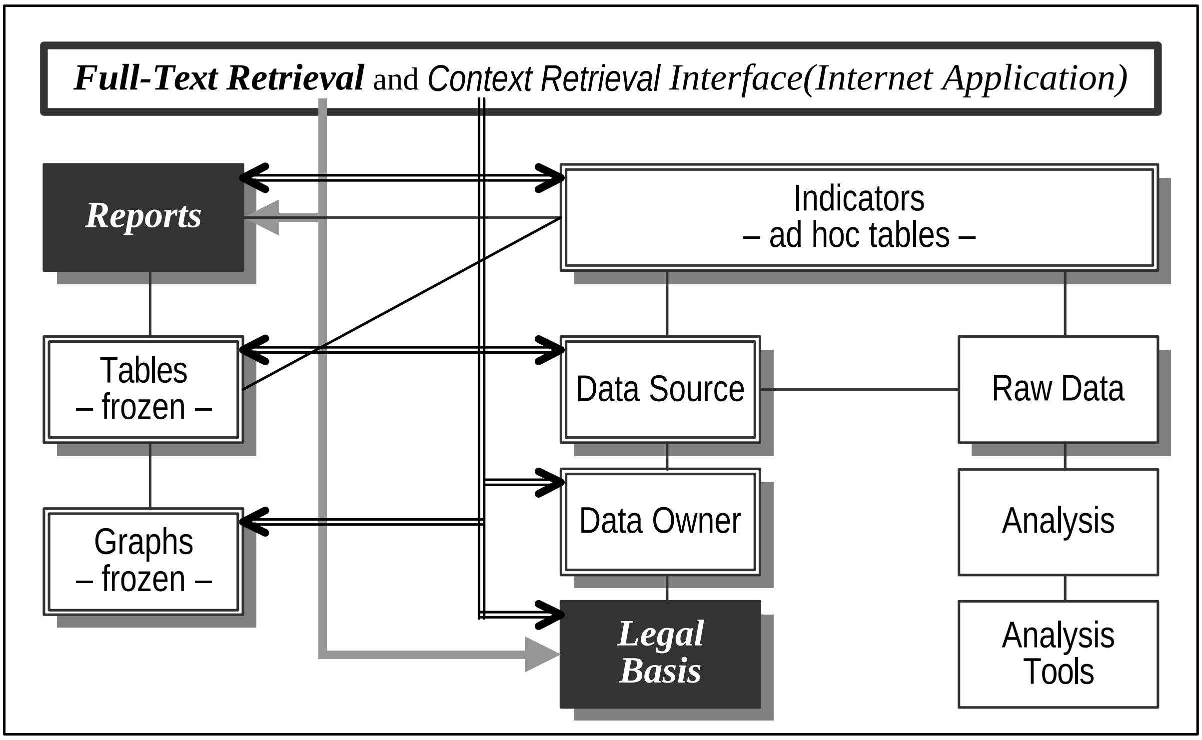
III.2 The logical data model

10. The logical data model consists of three major parts (see figure 1). The user communicates with the application, which acts as a window to all the information stored. Retrieving information basically means text retrieval.

Figure 1: The logical data model of the German Health Information System



Accessible Objects

11. All objects framed with double lines in figure 1 may be directly accessed by the user. Those framed with single lines such as “raw data” or “analysis tools” are background services only, which cannot be directly addressed by the user.

12. *Background information* (BI) is available for all objects marked with a gray shadow box in figure 1; it primarily contains supporting information or meta data on the object. Such information will help to understand or correctly “read” the data contained in the object. BI on indicators, for example, may provide the formula or typical topical areas in which the indicator is used. Furthermore it may contain a warning as to which conclusions should not be drawn from its values. BI on data sources will e.g. relate to periodicity, sample size, or variable list of a data collection. It is especially helpful if variable definitions have changed in a regular data collection, or if variables have been added or dropped. BI on data owners will list name and address of the data collecting institution as well as a contact person. This information will be

helpful if an original data source contains variables interesting to a user, but not part of the HIS.

Retrieving Information

13. Retrieving information from accessible objects may be achieved in two forms: Regular *text retrieval* (labeled “Context Retrieval” in figure 1) uses text indexes which are automatically created whenever an object is loaded into the database. During loading, all descriptors associated with this object are checked, and all words are indexed, except those explicitly kept in the “stop word list”. This form of text retrieval is fast and available for all accessible objects.

14. *Full text retrieval* allows a more sophisticated text retrieval and is installed for the two objects marked black in figure 1 only: Reports and legal basis. Users may apply more delicate text strings, such as words appearing adjacent to each other, in one sentence or in one paragraph. One might also look for objects containing one text string but not another one.

Information Categories

15. All information objects are grouped into two major categories: *Reports, frozen tables* and *frozen graphs* form one group (the left column in figure one); they relate to analyzing and interpreting data in various forms. Tables and graphs are labeled “frozen”, because they are not automatically updated whenever new data are entered. This ascertains authenticity because reports containing these tables or graphs may have already been published previously in printed form.

16. The second category deals with objects related to numerical data. The *indicator* is the basic window to these data; raw data may not be accessed by the user unless explicitly defined as an indicator. On the other hand, information is provided on the *data sources* used when calculating the indicator, on the respective *data owners*, and on the *legal basis* of the respective data collection.

III.3 Software technology

17. The HIS was developed on the basis of existing software whenever possible, in order to keep the application itself relatively small and easy to maintain. The major parts are common data base technology – in our case a relational data base management system (RDBMS). The calculation of indicators created a more serious problem, because a regular RDBMS does not allow the flexibility

needed. Fortunately, a rather new technology became available just in time – *on line analytical processing* (OLAP).

18. OLAP handles data as n-dimensional arrays, with dimensions being identical to breakdown categories. Therefore it is often called a multidimensional database management system (MDBMS). Mortality data e.g. are typically collected annually and available broken down by age, sex, region, and cause of death (coded in ICD); therefore, OLAP organized mortality data as a 5-dimensional array with the four categories mentioned and time in addition. For all dimensions, multiple hierarchical breakdown levels may be defined: For age, this could be 5-year age groups together with 10-year ones and a category “under 65” and “over 65”. When data are loaded into the MDBMS, all subtotals for defined breakdown positions are generated automatically.

19. Calculating indicators now means applying matrix algebra rules to these arrays. The results are automatically calculated and presented in tabular form, based on a pre-defined “standard view”. The flexibility of the system is reached by two features: *Drill-down* and *Rotate*. Drill-down opens a more detailed hierarchical level down to the maximum span defined for the data set. Rotation allows shifting around dimensions in any possible way and, therefore, to determine the specific table layout with rows and columns.

20. *Indicator values are not stored in the database*, but calculated upon user request only. With OLAP, calculating an indicator on the fly does not take more time than retrieving it from the system. On the other hand, storing calculated indicator values would blow up the database size without creating additional value. Instead, only raw data are explicitly stored in the RDBMS and loaded into the MDMBS from there. Authenticity has to be checked for the RDBMS only. Indicators may be freely added by choosing a formula and specifying the placeholders and will we available to everybody from then. It may be interesting to know that the HIS contains more than 1 700 indicators based on less than 50 different formulas.

III.4 Hardware and software used

21. Choosing the hardware platform and software provider had to take into consideration the continuity required. We chose a UNIX platform and ORACLE products. The following system configuration is installed:

Hardware

22. The RDBMS and the OLAP-server are installed on a twin SUN-Enterprise 3000 parallel server. This system is guarded by a firewall – against the Internet as well as against the Intranet. A web server acts as a messenger and exchanges information between a user and the system through the firewall. Altogether, there are installed:

- 2 SUN Enterprise 3000 jointly using a 25 GB disk array;
- 1 SUN Ultra Enterprise 2 acting as the internet firewall;
- 1 SUN Ultra Enterprise 2 containing the web server for the internet;
- 1 SUN Sparcstation 5 acting as intranet firewall;
- 1 SUN Sparcstation 20 containing the web server for the Intranet.
- All platforms run under SUN OS 5.5.1.

Software

23. All HIS information is stored in a RDBMS acting as an online transaction processing component (OLTP). OLAP, text retrieval and Internet communication require additional components. Over-all, the following software is installed:

- ORACLE 7.3 parallel server as RDBMS;
- ORACLE Express Objects 6.0 as OLAP server ;
- ORACLE Context 2.0 as text retrieval component;
- ORACLE Web Server 3.0.x as web server.

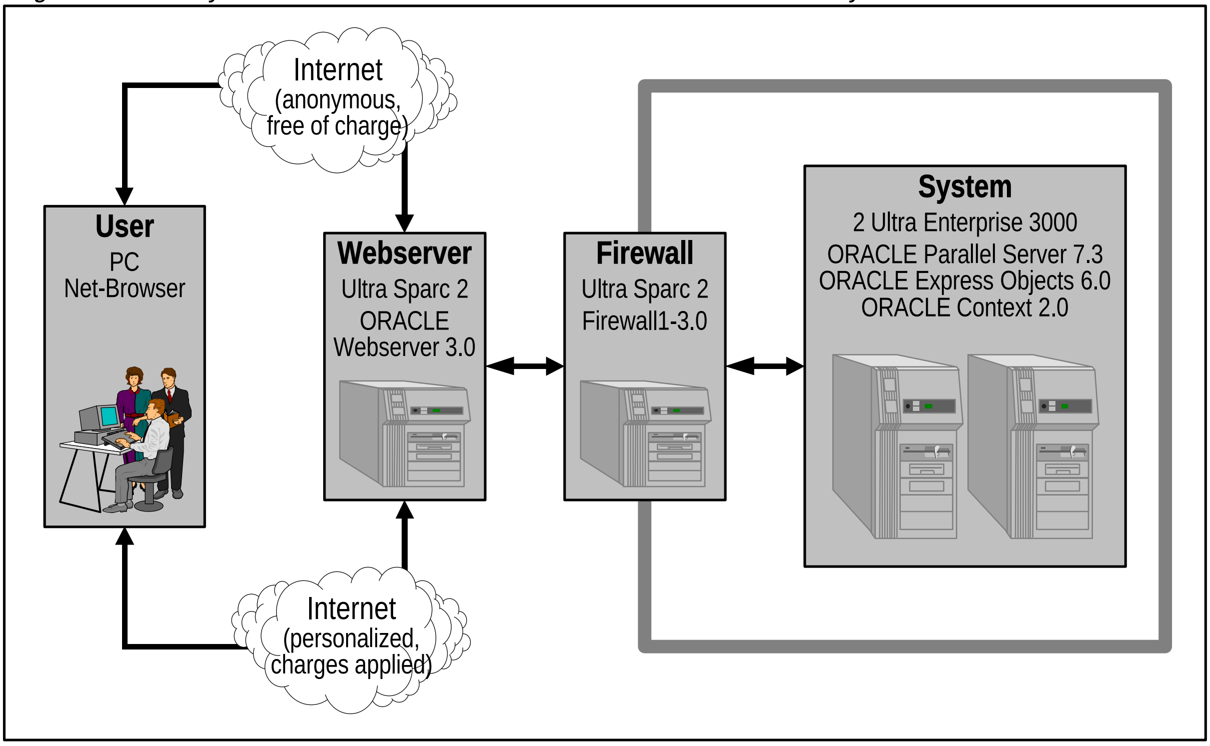
User Software

24. A user needs only a common Internet browser such as Netscape Navigator or Microsoft Internet Explorer in addition to Internet access. In case he wants to post-process or further analyze information retrieved from the system on his own platform, he will need the respective software, e.g. a word processor, a spreadsheet program or a statistical analysis system.

III.5 System access

25. Figure 2 shows which components are active during a typical Internet contact. Everybody is free to choose whether to use the system as an anonymous user (free of charge) or as a personalized user with more options (charges applied).

Figure 2: System access to the Health Information System



III.6 Software ergonomic requirements

26. Since 1 January 1998, all member states of the European Union are required to meet defined ergonomic standards with respect to software development. The HIS was the first software development of the Federal Statistical Office to be tested with respect to these requirements. An external counseling office specializing in this field supported the development team in this respect. Furthermore it conducted an internal usability test with employees of the Statistical Office who had not participated in the development, and an external “beta test” with selected peer users. All results gained during both the usability and the beta test are channeled back to the developer and used to further improve the system.

IV. Using the Health Information System

27. The developers allocated considerable resources in order to make the HIS easy to use. Furthermore, online help will be available for those interested, including a retrieval demonstration. Everybody familiar with an Internet search

engine such as Altavista or Yahoo will find many similarities. This *déja vu* feature was chosen deliberately.

28. The system may be accessed with any common Internet browser. Even older versions that cannot cope with HTML frames are supported. The internet address is:

HTTP://WWW.GBE-BUND.DE

29. “GBE” is the German acronym for health monitoring (Gesundheitsberichterstattung), “Bund” indicates that this system focuses on the top regional levels and does not contain data for counties or municipalities. The decision to restrict the HIS to two regional levels – Germany and the Länder – follows traditional work sharing between the administrative bodies in Germany; it was not influenced by technical limitations.

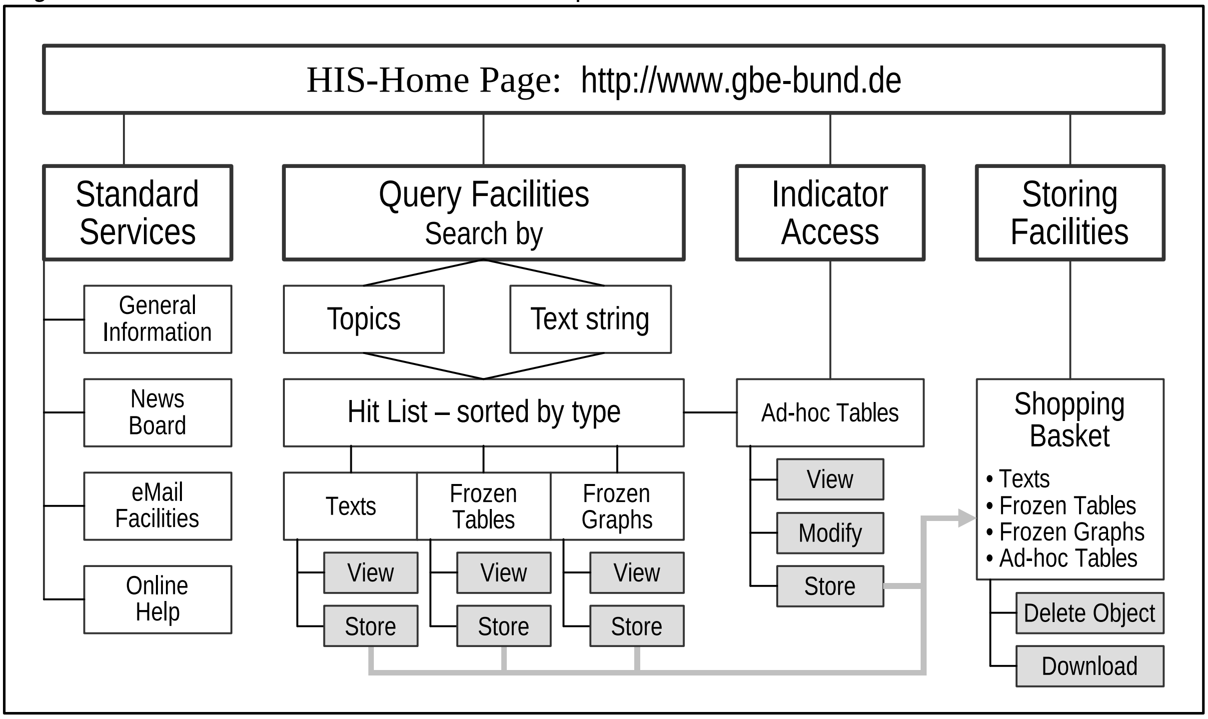
IV.1 Facilities provided

30. The Health Information System provides the user with all facilities necessary to retrieve information and to transfer it to his own PC for further processing if desired.

31. Some of those facilities, which are not continuously, used such as “General information on the system”, “News board” or “Communication with the Administrator and the team” are concentrated on the home page and available from there only. Other facilities, e.g. navigating tools, are available during the whole session, because they are part of every screen shown.

32. Figure 3 shows all facilities in a structured form. Facility types are indicated by bold frames, user activities are shown in grayed boxes.

Figure 3: Chart of the facilities provided to the user



IV.2 The HIS home page

33. The system is available in two languages – German and English. The German version is displayed as the default; switching to the English version is reached to activating the union jack symbol on the home page. The result of this action is displayed in figure 4.

34. The six elements on top of the page are used for navigating and will also appear on all subsequent pages. During a session one may “switch” between one of these options at any given moment and as often as desired. Using the built-in browser functions such as “Back” or “Home” should be avoided, because the system cannot guarantee proper reaction.

35. The “active” navigating position is marked by an underlining bar and shown in a special color, which reappears in a vertical band on the left side of the screen. This color is green for the home page, as shown in figure 4.

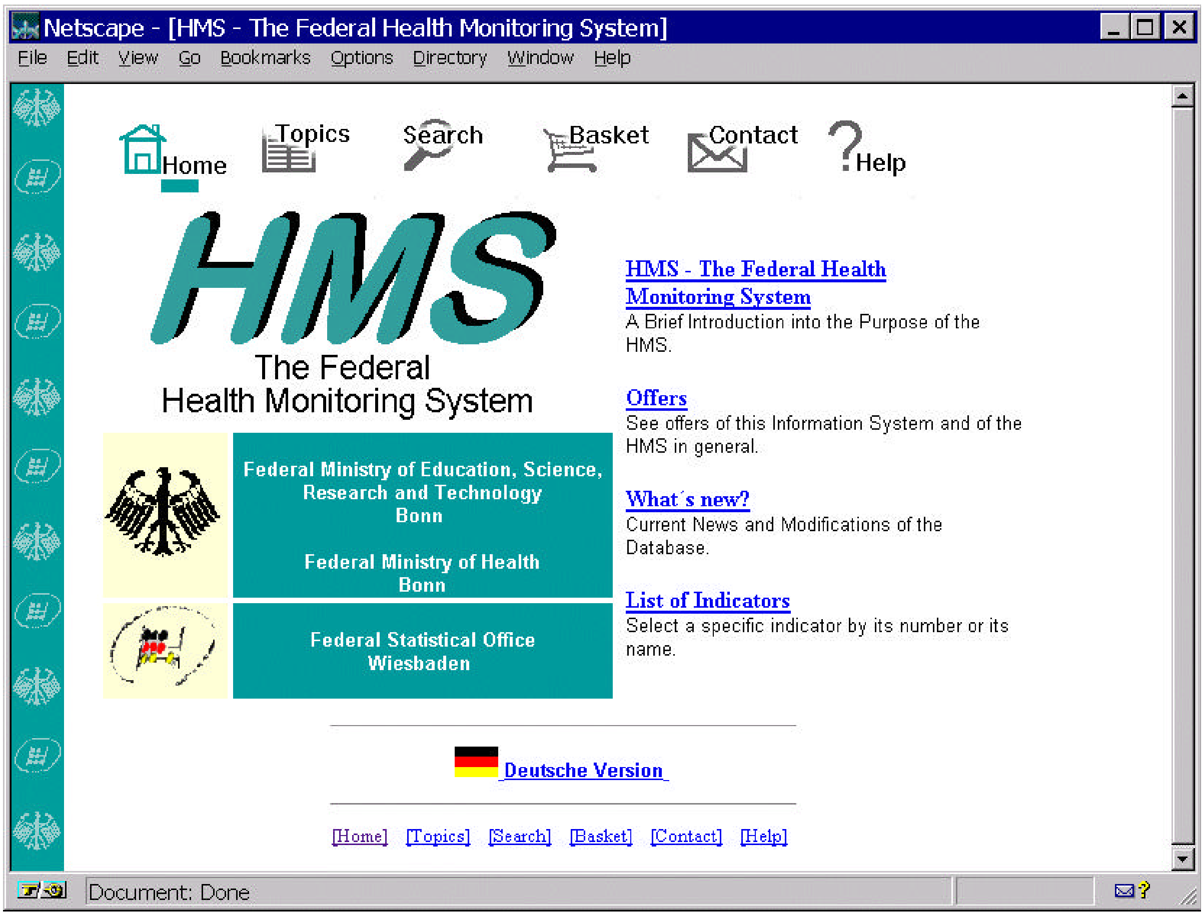
36. Navigating includes three self-explanatory options. “Contact” enables the user to communicate with the HMS team via email (see “email Facilities” in Fig-

ure 3), "Help" activates the online help, and "Home" returns the user to the home page.

37. The remaining three navigation tools allow the user to choose one of two different retrieving techniques – search by topics ("Topics") and search by text strings ("Search") – and to store objects into a personal shopping basket ("Basket") for a later download.

38. Among other common home page features like a news board, the HIS home page allows experienced users to directly choose indicators from a list – quite comparable to the WHO-Euro online version of the HFA database (see chapter 4.6 "The indicator page – OLAP facilities" for details) This feature is described as the "Indicator Access"-facility in figure 3.

Figure 4: The HIS home page



IV.3 Searching by topics

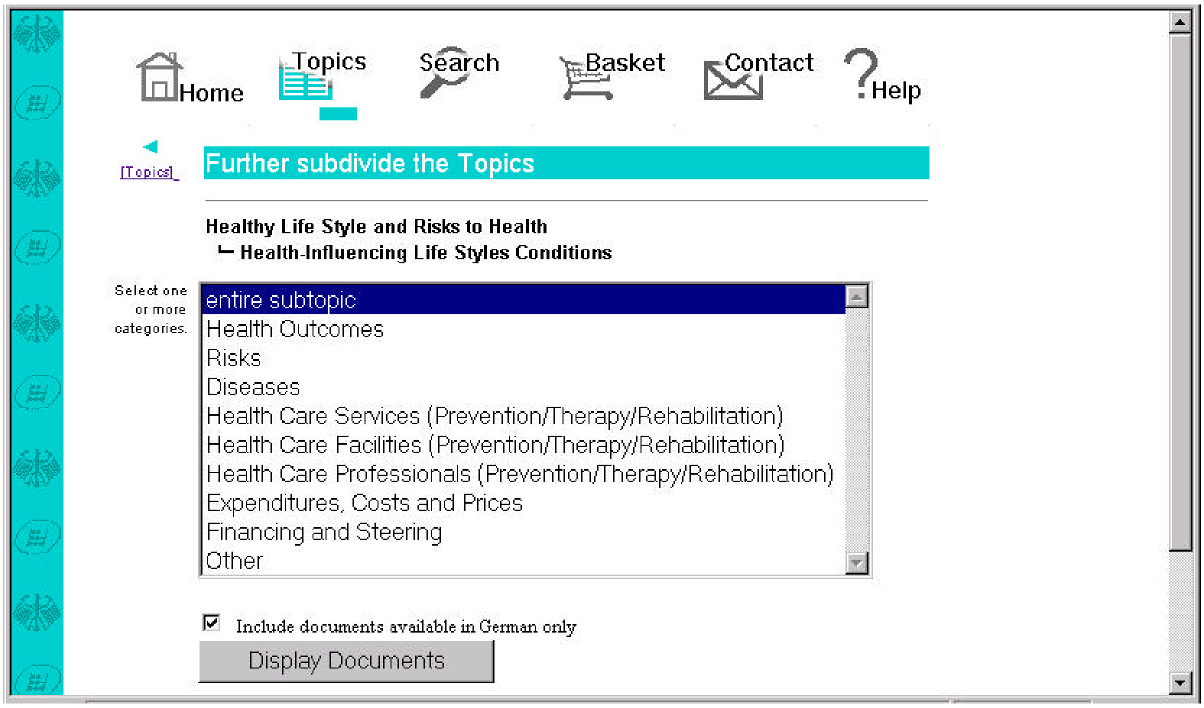
39. “Search by topics” gives an overview of the topical structure of the HIS. This structure follows the seven main categories of the “Health report for Germany” and the 32 respective subcategories. Although the number of detailed topics included in the system will grow in the future, the list of topics and subtopics was defined to already cover the full range of health related information ever to be dealt with. Therefore, it can be expected to remain unchanged.

40. Search by topics, as a strategy is especially useful for a beginner or somebody with less specific interests. With the system growing, this strategy may be expected to become less attractive after some years. Excessively high numbers of hits will make it difficult to browse through the objects shown, although the system supports setting priorities by ordering the objects with the most recent shown first.

41. Whenever a topic and a subtopic have been chosen, the user is given the chance to further reduce the retrieval appropriately or to chose “entire subtopic” as an alternative. Again, “entire subtopic” may be the most meaningful option with a relatively small system but is not advised in the future, when the system will have grown considerably.

Figure 5: The "Search by topics" page

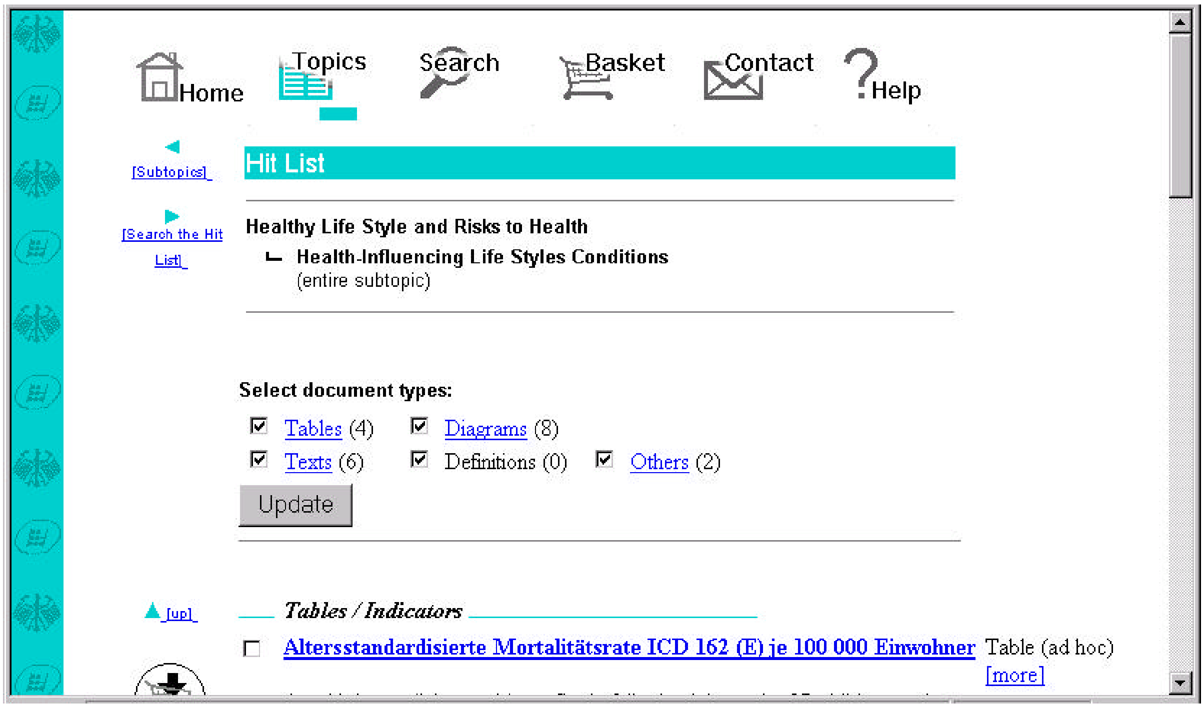
Figure 6: The "Display documents" page



42. The checkbox “Include documents available in German only” needs some further comments. The HIS was developed for Germany first and foremost, so the major language is German. We aim at having the basic description bilingual, but this will not be the case from the very beginning. Priorities are to fill the system and make it available in the reference language. Only after that we will be able to translate all descriptions and to provide English abstracts for all reports. However, we will never have all texts translated, because we don’t have sufficient translation capacity to do so. Nevertheless, we hope that the following solution will be accepted: If a user is not sufficiently familiar with German to understand a given text, but concludes from the abstract that a text may be relevant for him, he may download it and have it translated on his own.

43. Therefore, the checkbox “include documents available in German only” should be activated, because otherwise potentially relevant objects are excluded from being displayed.

Figure 7: Displaying found objects



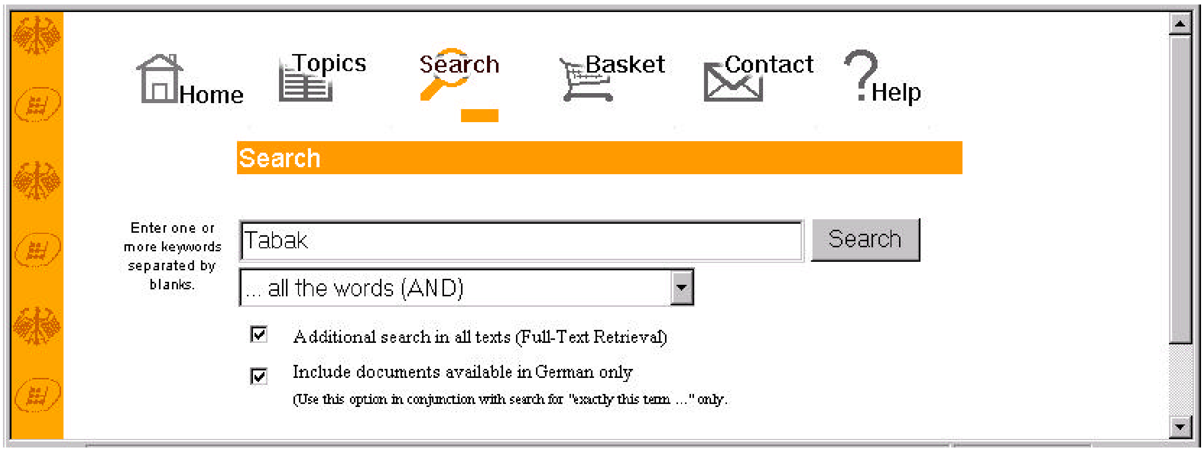
44. Displaying found objects starts with a hit count by type of document. Checking one of the categories leads to the document description. Clicking a document title will display this document, clicking the associated “more” link

will display a longer description or an abstract of the document. One may directly put the object into the basket without having browsed through it first by activating the respective checkbox and pushing the “put into basket” symbol at the left side of the window. Successful “shopping” is indicated by the page scrolling up and the symbol “put into basket” temporarily changing to “OK”.

IV.4 Searching by text strings

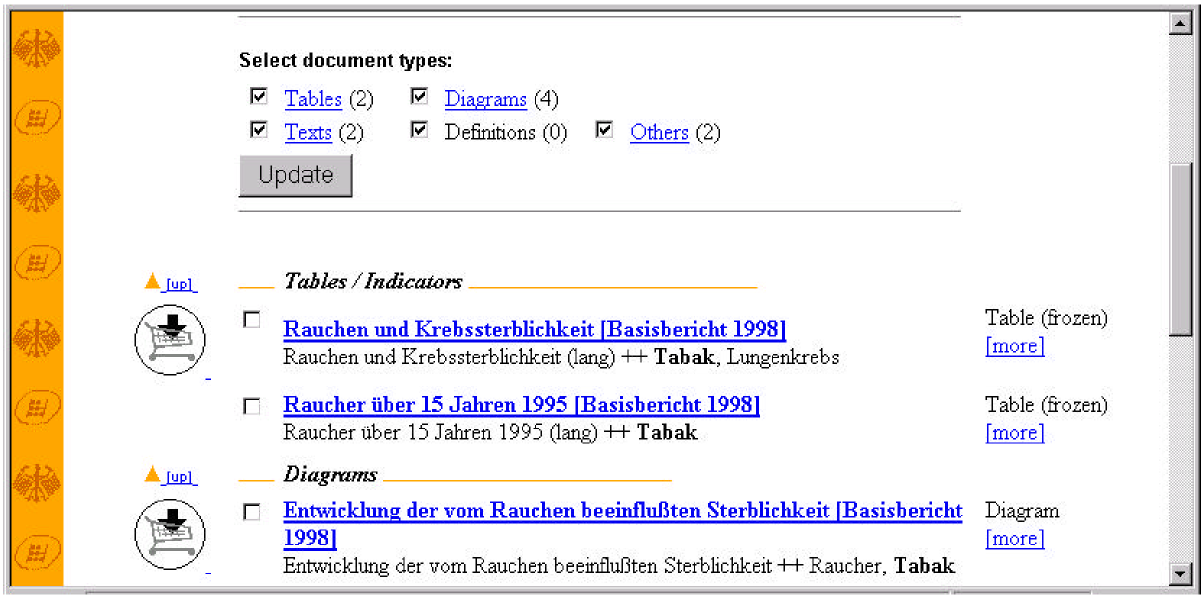
45. Pressing the “Search” navigation symbol gives access to the “Search by text strings” facility. Text strings entered with the options: “... all the word (AND)” and “... any of the words (OR)” will return objects containing all text strings simultaneously or at least one of the text strings, respectively. Alternatives are “... exactly this term (“...”)”, “... exactly this term and its synonyms” and “... exactly this term and similar sounding terms”.

Figure 8: The “Search by text strings” page



Entering “Tabak” – the German word for tobacco – will display the hitlist, with the search string printed in bold.

Figure 9: Displaying results for “Search by text strings”

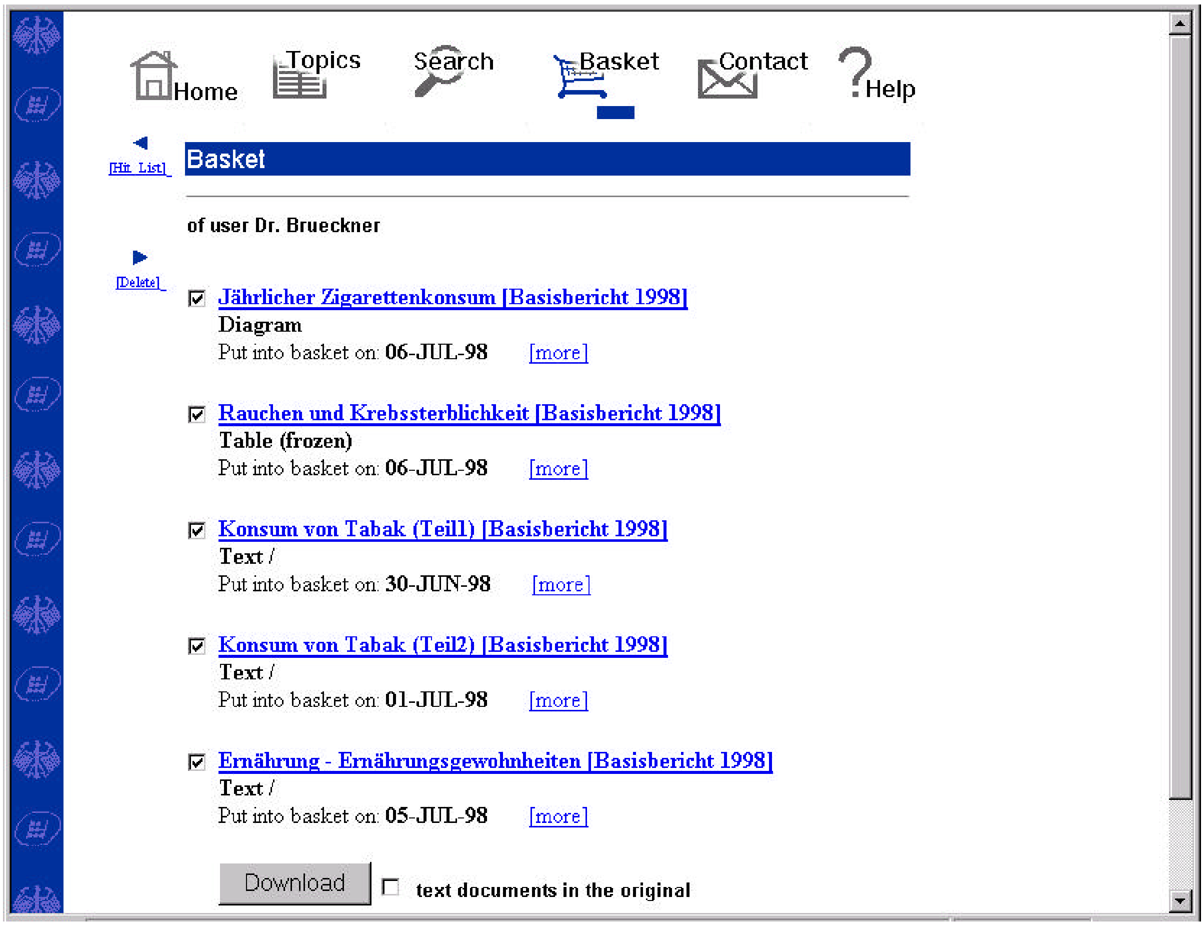


Proceeding from there does not differ from the “Search by topic” version described above.

IV.5 The shopping basket

46. The shopping basket contains all the objects which an anonymous guest user did put into it during the session; for a personalized user it may contain additional objects from previous sessions, as long as those objects have not been either downloaded or deleted from the basket.

Figure 10: The “Basket” page



47. The shopping basket can be emptied partially or completely by applying the delete option to the documents with ticked checkboxes. Furthermore, applying the “Download” option will download the marked documents as a compressed file. The user has to indicate whether he operates from an INTEL or a UNIX platform. Texts and frozen tables are coded as HTML; they can be post-processed with e.g. MS-Word 97. The format for graphs is GIF. Ad-hoc tables are in tab-delimited ASCII and can, therefore, be loaded into any spreadsheet program.

48. With the check box “text documents in the original” activated text documents will be downloaded in PDF format; both type face and page layout will exactly match those used in the printed version. As PDF in general cannot be processed any further, a user may want to download a text document in both HTML and PDF form.

IV.6 The indicator page – OLAP facilities

49. Indicators are the most innovative facility provided in the HIS. They can by accessed either by name via the respective link on the home page (see chapter 4.2), or – more often – via documents labeled “ad-hoc tables” in the hit list. “Life expectancy” is subsequently used as exemplary indicator because it incorporates a more sophisticated calculation. Before the table is shown, an abridged life table has been created from scratch using Farr’s method.

Figure 11: Ad-hoc tabulation of life expectancy

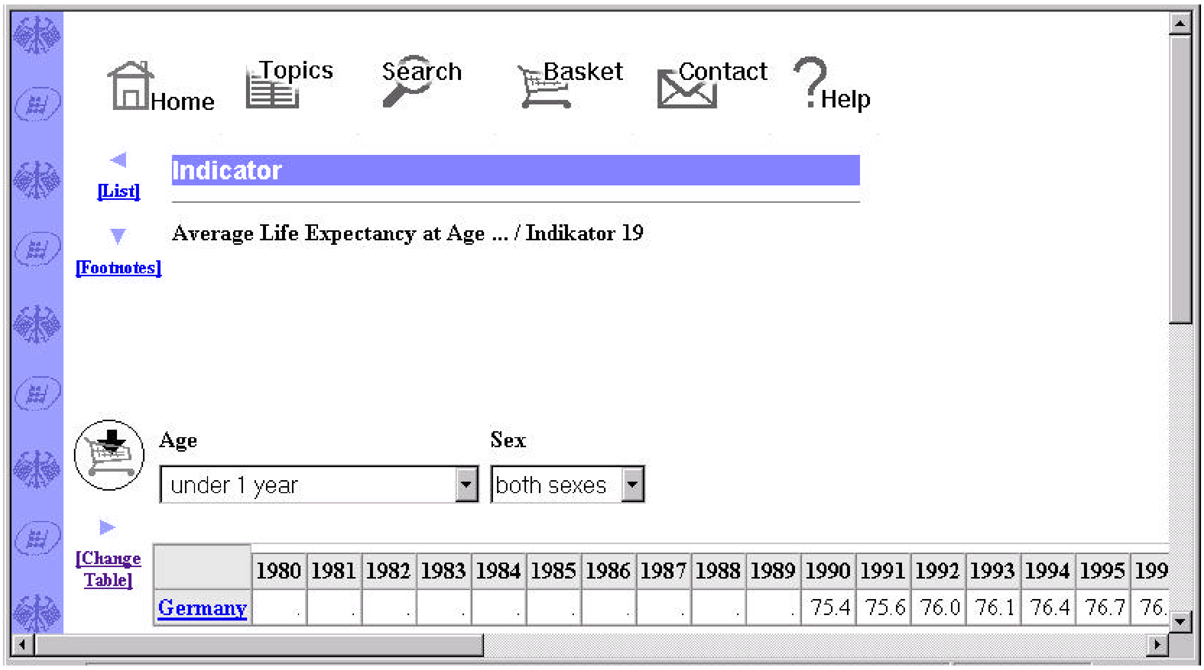
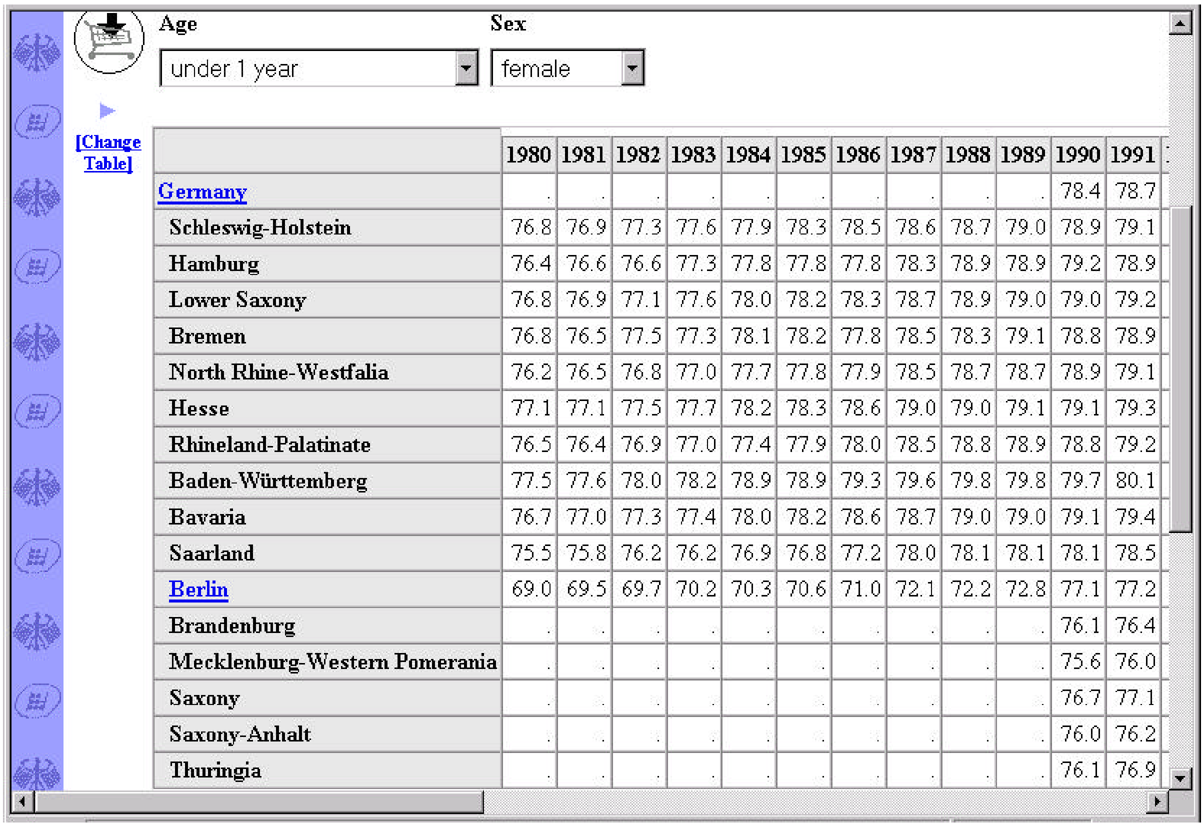


Figure 12: OLAP reaction on “Drill-down” and “Change Page”



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Germany	.	.	.	.	.	.	.	.	.	.	78.4	78.7
Schleswig-Holstein	76.8	76.9	77.3	77.6	77.9	78.3	78.5	78.6	78.7	79.0	78.9	79.1
Hamburg	76.4	76.6	76.6	77.3	77.8	77.8	77.8	78.3	78.9	78.9	79.2	78.9
Lower Saxony	76.8	76.9	77.1	77.6	78.0	78.2	78.3	78.7	78.9	79.0	79.0	79.2
Bremen	76.8	76.5	77.5	77.3	78.1	78.2	77.8	78.5	78.3	79.1	78.8	78.9
North Rhine-Westfalia	76.2	76.5	76.8	77.0	77.7	77.8	77.9	78.5	78.7	78.7	78.9	79.1
Hesse	77.1	77.1	77.5	77.7	78.2	78.3	78.6	79.0	79.0	79.1	79.1	79.3
Rhineland-Palatinate	76.5	76.4	76.9	77.0	77.4	77.9	78.0	78.5	78.8	78.9	78.8	79.2
Baden-Württemberg	77.5	77.6	78.0	78.2	78.9	78.9	79.3	79.6	79.8	79.8	79.7	80.1
Bavaria	76.7	77.0	77.3	77.4	78.0	78.2	78.6	78.7	79.0	79.0	79.1	79.4
Saarland	75.5	75.8	76.2	76.2	76.9	76.8	77.2	78.0	78.1	78.1	78.1	78.5
Berlin	69.0	69.5	69.7	70.2	70.3	70.6	71.0	72.1	72.2	72.8	77.1	77.2
Brandenburg	.	.	.	.	.	.	.	.	.	.	76.1	76.4
Mecklenburg-Western Pomerania	.	.	.	.	.	.	.	.	.	.	75.6	76.0
Saxony	.	.	.	.	.	.	.	.	.	.	76.7	77.1
Saxony-Anhalt	.	.	.	.	.	.	.	.	.	.	76.0	76.2
Thuringia	.	.	.	.	.	.	.	.	.	.	76.1	76.9

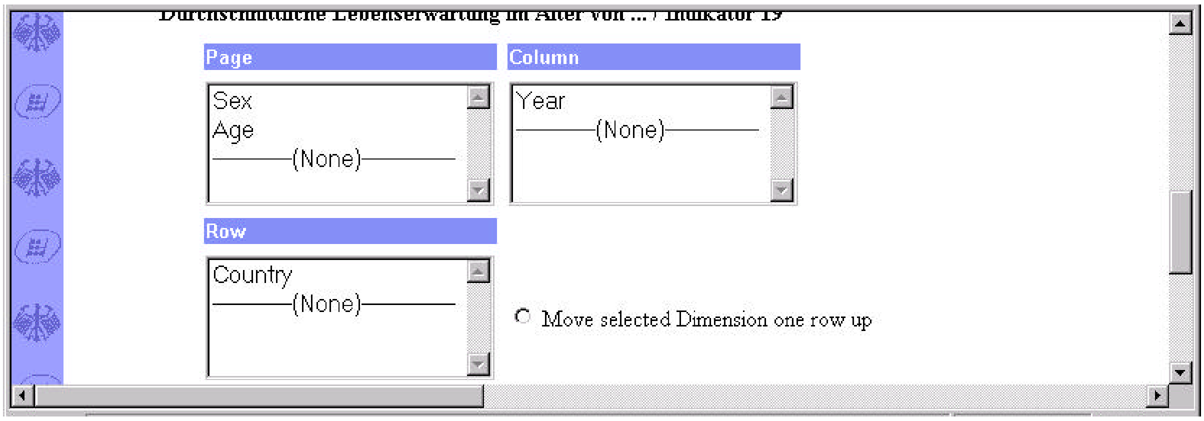
50. The default presentation of an indicator refers to Germany and the total for both sexes. Using the pull down menu allows choosing e.g. “female” as sex; clicking Germany opens the Länder level. The OLAP reaction is shown in figure 12.

51. Missing values are shown for life expectancy values before 1990 concerning New Länder in figure 12. These results from data on the average population not yet being available in a form adapted to the New Länder boundaries. OLAP automatically inserts respective missing value signs in the indicator values, if a missing value occurs in one of the data sources used for calculation.

IV.7 Additional OLAP facilities for personalized users

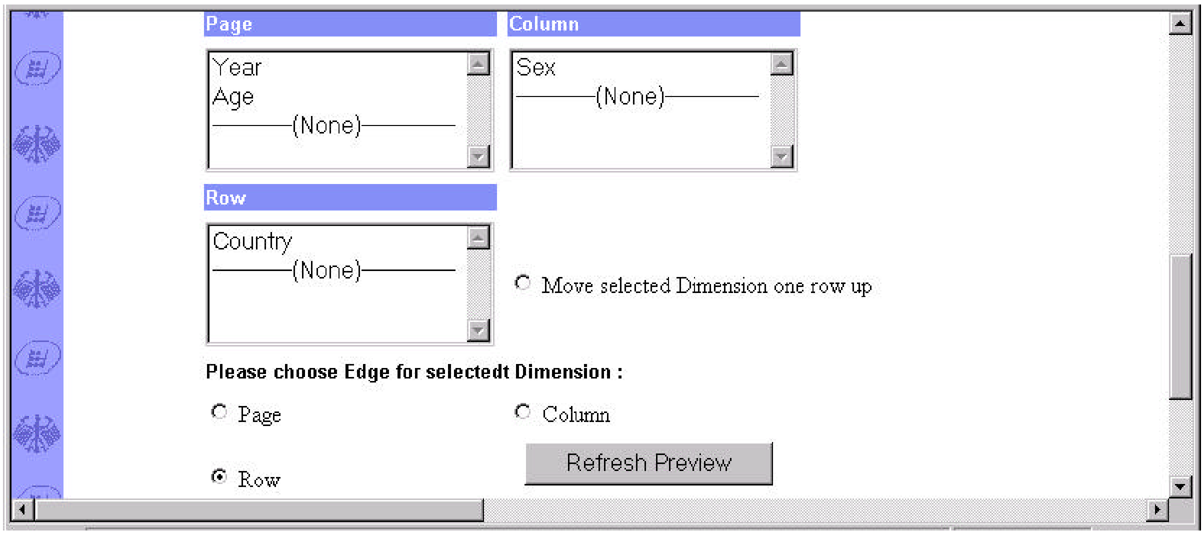
52. Personalized users have access to the “change table” option, which allows rotating a table in order to, adapt it to individual demands. The menu in figure 13 is used for this purpose.

Figure 13: Changing the table layout for the indicator “Life expectancy”



53. The menu shows sex and age attributed to the dimension “page”, year to “column” and country to “row”. If life expectancy were to be displayed for 1995 only, with the regions in rows and sex in columns, rotating the table would be necessary.

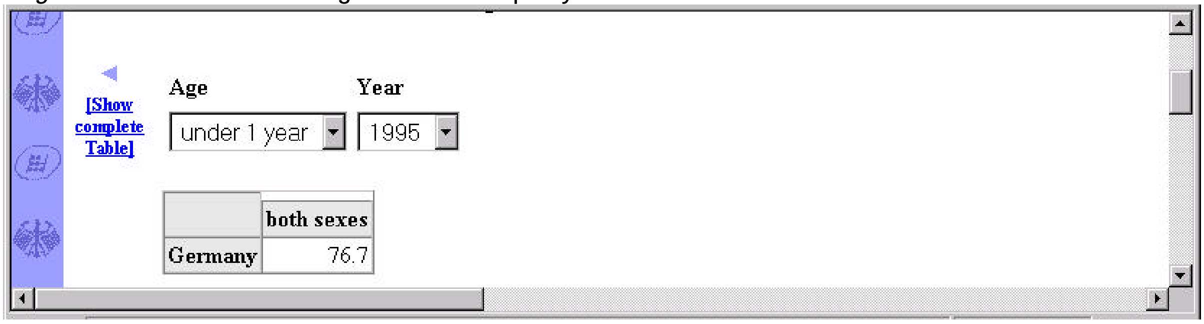
Figure 14: Rotating the table



54. “Sex” will have to be moved to “column”, and “year” to “page”. After that, 1995 can be chosen as the year to be displayed. Rotating a table requires the user to mark a dimension, to check the respective radio button and to push the “refresh preview” button as shown in figure 14. This procedure will have to be repeated for each dimension to be moved. After that, the modified table can

be displayed with the “show complete table” link shown in figure 15. The final step will be to choose “year 1995”.

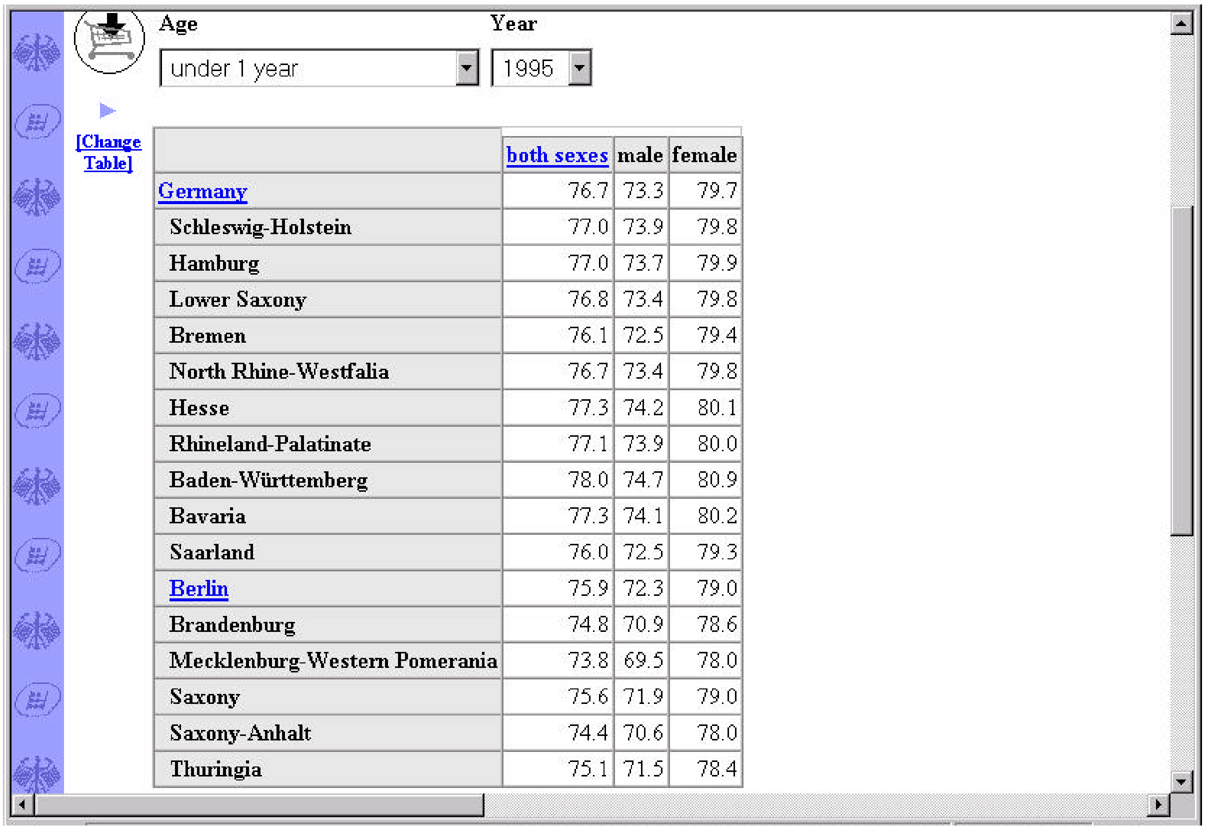
Figure 15: Activating table display after rotation



	both sexes
Germany	76.7

After that, OLAP will display the rearranged table for life expectancy at birth, broken down by region and sex, as shown in figure 16.

Figure 16: Table display after rotation



	both sexes	male	female
Germany	76.7	73.3	79.7
Schleswig-Holstein	77.0	73.9	79.8
Hamburg	77.0	73.7	79.9
Lower Saxony	76.8	73.4	79.8
Bremen	76.1	72.5	79.4
North Rhine-Westfalia	76.7	73.4	79.8
Hesse	77.3	74.2	80.1
Rhineland-Palatinate	77.1	73.9	80.0
Baden-Württemberg	78.0	74.7	80.9
Bavaria	77.3	74.1	80.2
Saarland	76.0	72.5	79.3
Berlin	75.9	72.3	79.0
Brandenburg	74.8	70.9	78.6
Mecklenburg-Western Pomerania	73.8	69.5	78.0
Saxony	75.6	71.9	79.0
Saxony-Anhalt	74.4	70.6	78.0
Thuringia	75.1	71.5	78.4

A user deciding to put this table into the shopping basket will only find the visible parts after downloading. If he wants to download information about additional years, he will have to repeat the above-mentioned procedure for each year, and put the results into the basket one by one.

Summary

55. To develop the HIS was a joint effort of “Robotron Data Systems in Dresden” (developing company), the Federal Statistical Office (client) and “Bureau for Applied Organizational Psychology” (software ergonomy). All in all, it took the team 12 months to develop the system. Robotron had up to seven people on the job, the Statistical Office three. The total manpower allocated amounted to roughly 10 person years.

56. The overall cost of the system was substantial, approaching 4.5 Mill. DM. The development of the application took roughly 60% of the amount; the remaining 40% went into purchasing hardware and software licenses. Nevertheless, the decision to develop an information system for the Internet based on standard database software and the OLAP tools proved to be a highly efficient one. To develop such a system completely from scratch would have required substantially more resources – with regard to both time and money.