Information Portals for the Social Sciences – Integration vs. Aggregation

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Abstract. Information portals currently follow the principle of aggregation – connecting previously unconnected collections of information to give users a single place of access to this information. The paper argues that aggregation alone will not guaranty the level of quality of service which scientific users demand. Starting with findings from recent user surveys, essential features of information portals are presented and the problems and shortcomings of current solutions are discussed. The second part of the paper presents a model for scientific information portals which focuses on integration, which means that information is not only collected but semantic differences between individual offerings are treated in a coordinated way. As an example for transferring the model to real world information portals, the new social science portal SOWIPORT is used.

Introduction

Looking at the landscape of scientific information, many different offerings can be found. In most cases they are provided by libraries, information centres, research institutes and commercial information providers, which make their results, services or the materials they collected publicly available. Besides this, the new publishing paradigm of the World Wide Web allows every single user to simultaneously collect and redistribute information with only a very low barrier concerning costs and technology. This leads to a polycentric information landscape (see figure 1) – without a central institution organizing collaboration and workflow – and a fragmentation of information and information services, mostly due to organizational and domain-specific aspects, personal preferences and interests, and available resources.

Challenges in a changing information landscape

Up to only a few years ago it was the task of traditional information providers (publishers with their print publications, libraries with their catalogues and information centres with their reference databases) to coordinate access to information and guarantee a homogeneous level of service on the bases of sophisticated standards (right part of figure 1). But with the advent of electronic publishing and reduced entry barriers in the market of scientific information (Cigan 2002), researchers and publishers make use of the new technologies and offer complementary services to the public. Library catalogues and reference databases now are only additional modules in a worldwide and connected portfolio of information offerings, where standards are no longer applied. Most evidently, the loss of standardization is seen when looking at the methods of content indexing applied by different players (M1 to M6 in figure 1). Besides reference databases with a full set of metadata, abstract and keywords from a controlled, domain-specific vocabulary – but often without the full text document - (M1)

nearly every type of content indexing can be found down to the full text document put on a researchers website without any further bibliographic information and indexed only by search engines (M5).

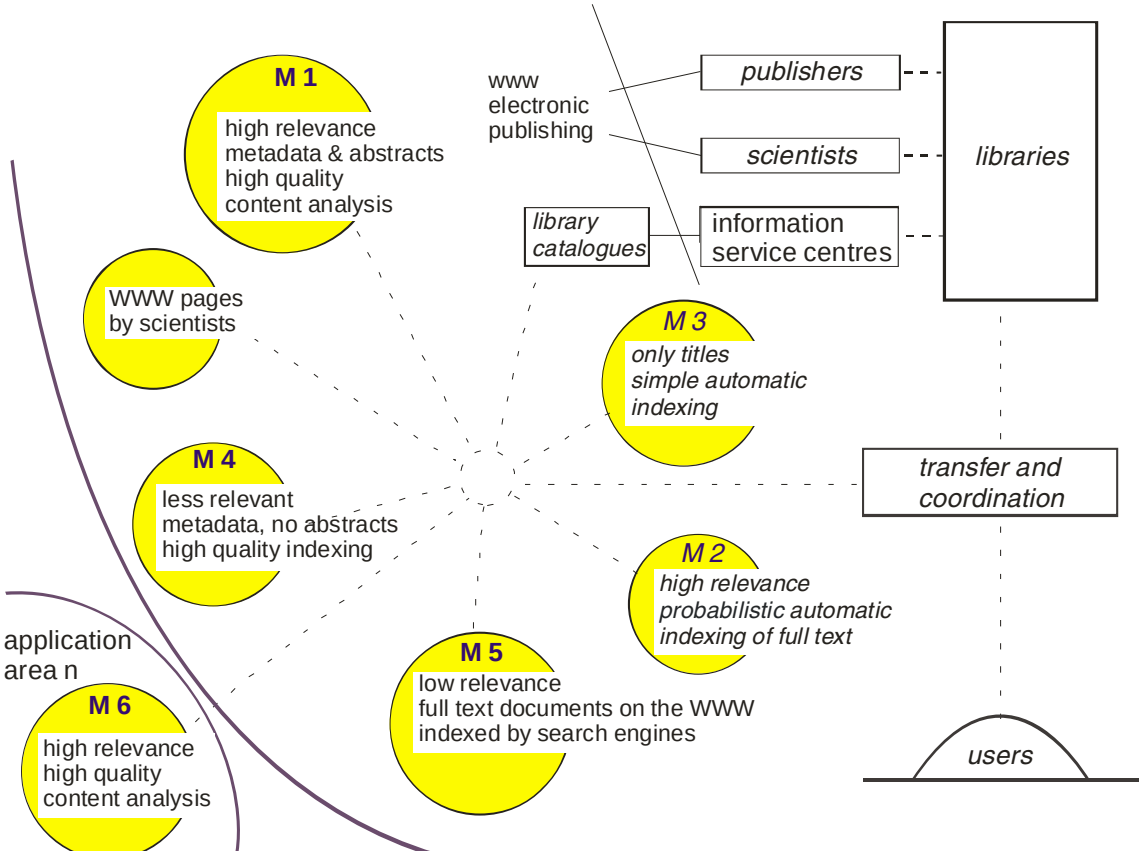

Figure 1: The change from a centralistic to a polycentric information landscape (Krause 2006, modified)

In addition, primary and secondary (empirical) data, literature references, research projects, internet resources and information about the structure of a scientific domain (e.g. journals, institutes and experts) are distributed across many offerings and sites, different methodologies for organizing and presenting this offerings are applied (e.g. for structuring information and for content indexing), and different technologies and access modes are used.

For the user, this situation has a number of implications. To access all materials relevant to his information need he has to locate these single offerings, has to assess the quality of the materials they offer, and has to cope with the way information and services are presented: Different user interfaces, metadata schemas, indexing vocabularies, query languages, languages in which the content is presented, and legal access restrictions. Theories and models from information science suggest other, more user oriented ways of designing and building information systems, but many times practical aspects – or missing awareness on the side of information providers – prevent improvements in usability and quality of service.

A number of surveys for (Mann 2006, Poll 2004, RSLG 2002a & 2002b) tried to assess user satisfaction with scientific information services in Germany and in the UK during the last few years. They now support the theories and models from information science and give a clearer picture of what users really want:

- *Domain-specific organization*: Users demand for domain-specific organization of information, so they have a single point of access to all potentially relevant materials from their discipline. With it goes extensive and precise content indexing – especially in cases where only metadata or references to the primary information is available – allowing them to search for specific semantic features of documents or survey data at a very detailed level. In the social sciences, this can be realized by using domain-specific thesauri and classifications, and by additionally describing the content with e.g. the scientific methods used or the time frame or geographic region under study.

- *Interdisciplinary connections*: At the same time, users see the need for crossing the borders between domains and disciplines. Since more and more research is carried out at the intersection of multiple disciplines, it is essential that the access to information accommodates for these complex information needs. Given the fact, that on average a researcher spends only half a day per week for information procurement[1], information systems have to support this type of searching in a way the burden on the user is minimized and queries to different data collections can be carried out efficiently. Similarly, connections between disciplines allow users who can not determine the most relevant domain for their information need to start their search on a more general level and then drill down to the discipline or information source suited which suits them best.

- *Broad scope of information*: To satisfy most information needs, all relevant types of information should be made accessible at one place: Primary data (e.g. surveys and other raw data), secondary data (e.g. aggregate and time series data), and references to literature, research projects, internet resources, experts, networks, software etc. The benefit for the user is maximized if all different types of content are accessible in an integrated (and interlinked) way and indexed semantically rich so that users may seamlessly switch between the different modes of access of these heterogeneous data.

- *Quality of service*: To help users satisfy their information needs, results should be limited to a manageable amount of relevant information (no information overflow), noise and low quality content should be avoided and all materials should be instantly accessible right from the desktop ("now-or-never" paradigm) or they might not be used at all. This implies extending – or even replacing – the Boolean retrieval model often used with scientific information by alternative models which allow for relevance ranked results, and bringing content into a digital form so that it can directly be downloaded and used on the researcher's computer.

- *Search engines are not enough*: Besides services from libraries and other institutional information providers, search engines are used for a number of reasons. Most likely, the very simple user interface (in comparison with that of OPACS, Online Public Access Library catalogues), the relevance ranking of the results and the direct access to the materials found add to the popularity of these general – not domain-specific – search engines. Interestingly, older researchers seem to be less critical about what can be found with search engines than younger researchers which tend to stress the sometimes low quality and incompleteness of the results. Google Scholar[2] is an effort to restrict the search space of general search engines to scientific documents by

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1 Friedlander 2002 (table 15) states that around 16 hours per week are used for obtaining, reviewing, and analyzing information from all sources to support both teaching and research, with the highest numbers in the social sciences.

2 See http://scholar.google.com

acquiring scientific content from publishers, hoping to get more relevant results and less noise.

- *Informal communication*: Besides the need for accessing information for carrying out research is also a strong need for communication, like discussing results with colleagues in discussion boards or exchanging information and papers via e-mail. This informal communication (in contrast to the formal communication by means of classical publications) is of more dynamic nature, subject to small and even closed groups of researches (invisible colleges), and currently often separated from the information services offered to a discipline. The growing importance of this type of interaction for the generation of new ideas and even of new types of research and publications (Harnad 1991, Nentwich 2003) makes it inevitable to integrate it more seamlessly with traditional offerings.

To satisfy the formulated user needs, many activities already have been started aiming at the aggregation of content within information portals. Starting with the Open Archives Initiative[3] (OAI) where initially data archives – and nowadays also libraries of universities and institutes – supply metadata on the materials they have stored locally, a culture of sharing and (re-) distributing content of different types has grown. International federated information gateways, like RENARDUS[4], exchange metadata to make their offerings more visible and more easily findable to national and international users. And on the national level, infrastructures like the German-based vascoda[5] portal allow searching and accessing the databases, library catalogues and subject gateways of over 30 German scientific information providers and libraries.

But still, central problems with great influence on the user experience with information services have not been tackled. Despite existing – and often adhered to – standards for user interface design, switching between offerings most of the time involves learning to efficiently interact with the system from scratch. Neither interaction models nor menu structures or feature sets are matched, and the more systems or offerings are connected, the smaller is the number of common features which can be realized at the level of an information portal – a common gateway to distinct services and products which share enough similarities so that users see them as a whole.

Looking at the content level, we face nearly the same situation. Content harvested from or ingested by individual information providers is combined – aggregated – in information portals for searching and browsing. Most effort is currently spent on syntactic and structural aspects, standardizing sets of elements by which content can be described to allow field-based searching (e.g. the Dublin Core Metadata Element Set[6], DC, or the Data Documentation Initiative[7], DDI). What currently are not sufficiently handled are the differences in the indexing vocabularies used for filling in the metadata elements. Since many information providers use their own vocabulary (e.g. a specialized thesaurus or classification), a user's query (i.e. the keywords used for searching) can not easily be matched with the variety of keywords used to describe the same semantic concept in all the different

3 See http://www.openarchives.org

4 See http://www.renardus.org

5 See http://www.vascoda.de

6 See http://www.dublincore.org/

7 See https://www.icpsr.umich.edu/DDI/index.html

metadata collections aggregated in the portal. This leads to imprecise results, leaving out relevant materials and possibly containing unwanted information.

At the same time, traditional information providers, especially libraries and information centres, face a growing competition by internet search engines with their easy to use user interfaces, relevance ranking, and direct linking to electronic resources and are simultaneously challenged by shrinking – or at least not growing – budgets. Models proposed for strengthening the position of scholarly information services are normally a reduction of complexity by simplifying workflow, metadata creation or context indexing (Calhoun 2006; for a critique to this position see Mann 2006), sometimes neglecting that only this assets would allow for advanced retrieval services in the absence of full texts or original data.

In short, many problems with information portals arise from aggregating heterogeneous content at different levels (e.g. structural, semantic and interaction level) without integrating it, which in turn is a prerequisite for high user satisfaction. The remainder of this paper will therefore focus on the semantic level of content integration – the level of heterogeneous vocabularies (e.g. thesauri and classifications) – and will present a model for integrating different types of information and different types of scholarly communication at the user level.

Dealing with heterogeneity in information systems

Heterogeneity can nowadays be seen as one of the central problems – or research challenges – when building integrated information systems. It arises from differences in data structures and content analysis between data collections as soon as these collections are brought together within one information system. At the user's side, the differences sometimes can be hidden by using simple search functions (e.g. the famous "Google-like" search) and full text indexing, omitting the richness and expressiveness the underlying data would allow for. But as soon as more details of the underlying structures have to be exposed (e.g. keyword search with thesaurus support or a field based search at a more detailed level) the user is faced with fields which are not valid for all databases or with only a basic index instead of a thesaurus (or no help for query formulation at all), because not all databases are indexed with a thesaurus – and those who are use different ones. Standardization might seem as a natural way of dealing with this heterogeneity.

But there are problems with standardization. In many areas where standardization is important for reasons of security, interchange ability, economic gain or technologic advancement, it is also realized that alternatives are needed to make the necessary progress. This is especially the case if regulations can not be imposed on all parties (e.g. information providers in different countries) or if the adaptation of standards is too slow or costly (e.g. in situations where alternative standards have already been applied). The solution may be to open the process of standardization to the idea that there always will be details which can not be standardized and that this fact should be kept in mind and accounted for right from the beginning of the standardization process. The German standardization body, DIN, adapted this strategy in its recent position papers (DIN 2003a, DIN 2003b) about standardization:

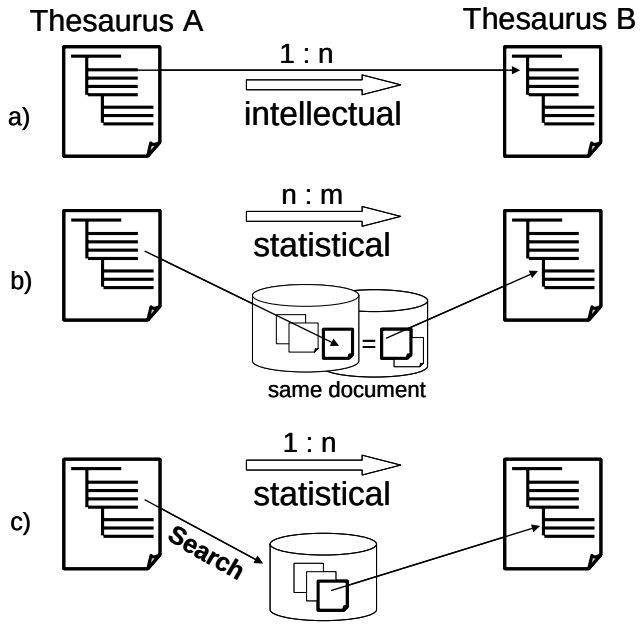
> "The classic approach to standardization, to achieve compatibility and interoperability by technical uniformity, reaches its limits where regional or industry-specific solutions have been implemented with great effort (e.g. infrastructures) and subsequently global interoperability has to be assured as a result of globalization or a changed business situation.

SICT recommends regarding standardization also from the viewpoint of providing 'interoperability for existing heterogeneity'.

This task consists of finding a reasonable balance between the desired scope of standardization and the remaining heterogeneity treatment. The costs and the quality losses possibly resulting from the heterogeneity treatment should be seen in relation to the expenditure and the chances of success of further intensified standardization." (DIN 2003a:7)

With this model in mind – to use standards wherever possible but develop alternative means for homogenization right from the start – the interdisciplinary information portal infoconnex[8] has been developed. Infoconnex integrates the German reference databases for pedagogic (FIS Bildung), social sciences (SOLIS) and psychology (PSYNDEX) under one roof and enables the user to cross-search the databases by using any of the three thesauri involved for context indexing of the databases.

The methods used are cross-concordances – bilateral, pair wise mappings between the three thesauri – which are used to transform a user's keyword query to every of the single thesauri. Cross-concordances are intellectually created relations between the terms of each thesaurus, connecting one start term with one or a combination of several target terms. Figure 2 shows the underlying principles of cross-concordances and alternative methods for term transfer.



Cross-concordances connect one term of the source vocabulary (thesaurus A in figure 2a) with one or (a combination of) more terms of the target vocabulary (thesaurus B) by the relationships equivalence, similarity or broader and narrower term. The relationships are defined by intellectually analyzing both vocabularies and are checked concerning their retrieval quality by using them for database queries and rating the relevance of the result as high, medium or low.

8 See http://www.infoconnex.de

Two alternative approaches to vocabulary switching are based on statistical analysis of the co-occurrence of terms of both thesauri for a single document. They require no intellectual input and reflect the actual use of the vocabularies for content indexing in the collections used for analysis. Ideally, the same document can be identified in two databases which respectively use one of the two thesauri under question (figure 2b). These two databases can be seen as parallel corpora, holding the same documents with the same content but expressing this content semantically different by using two different vocabularies. In practice, such corpora can be found (sometimes a single database or catalogue uses two different vocabularies for indexing) or they can be constructed by e.g. identifying identical pairs of documents in library catalogues (using a broad and interdisciplinary vocabulary) and reference databases (using a smaller domain-specific thesaurus). In contrast to cross-concordances, which look at individual terms, the statistical approach relates groups of terms from each thesaurus whose likelihood to be used together for describing the same semantic concepts exceeds a certain cut-off value. If no parallel corpora are available, one can simulate them by using terms from one vocabulary to find relevant documents (ranked by relevance) and then statistically relate the keywords of these documents to the terms used for searching (figure 2c).

It is important to notice that the approach based on cross-concordances is conceptually different from the statistical approaches in that former maps between vocabularies without taking the actual use of the vocabularies for content indexing into account, whereas the later is only based on the actual vocabulary use for indexing. The sets of terms mapped by cross-concordances normally are comprehensible for a user, while the sets of terms generated by statistics may sometimes look farfetched or even unrelated by themselves, but they reflect the frequent co-occurrence of semantic concepts in actual documents.

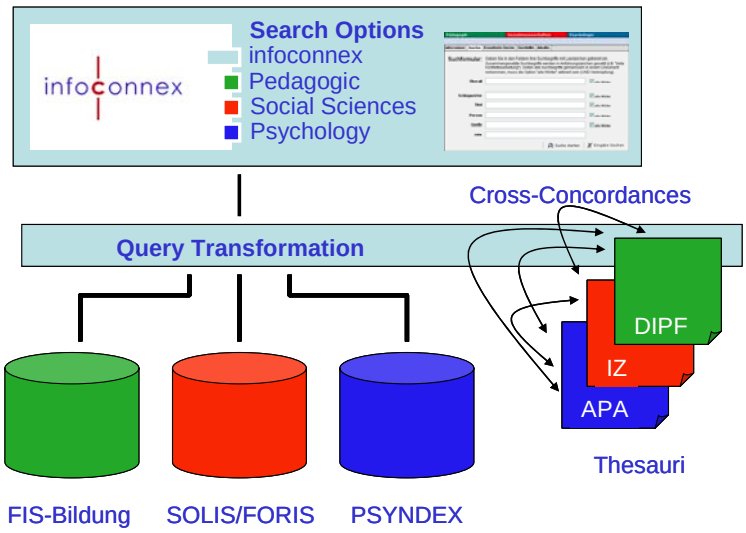


Figure 3: Treating heterogeneity with cross-concordances

The infoconnex portal currently uses cross-concordances to map between three thesauri allowing users to formulate interdisciplinary queries. The user may select keywords from any of the thesauri and the system will automatically determine the appropriate starting thesauri and generate mapped terms for any target database. By using only equivalence relations in a first step of the query process, no additional user interaction is necessary. Only after reviewing the first results, further decisions to expand or narrow the search are required. This puts the modules for treatment of semantic heterogeneity into action in a way totally transparent to the user, so he can focus on phrasing his information need without dealing with the complexity of the underlying transformations.

To allow advanced users to influence the search at a fine grained level and to visualize the influence the individual mappings between thesauri have at the result set, a graphical user interface based on visual formalisms has been developed (Stempfhuber 2003). Figure 4 shows the basic visualization, a table, used for displaying the structural heterogeneity in an information system.

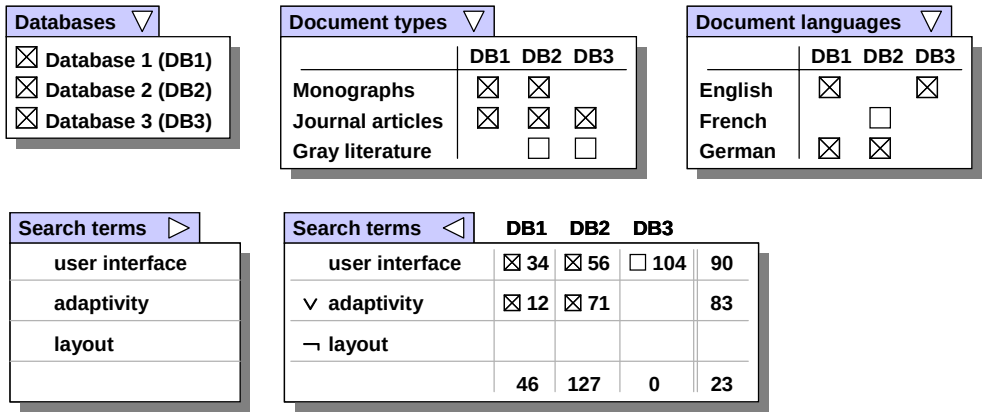


Figure 4: Visualizing heterogeneity in information systems

The top row of tables shows filters, by which a user may select databases and then restrict its search to specific document types or languages. The nature of visual formalisms (Nardi&Zarmer 1993) allows the user to simultaneously get an impression of the semantics in the underlying data (which databases contain what types of documents or documents in which languages) and at the same time interact with the data. In the case of an information system he might deselect certain document types or languages.

The same visualization can be used to let the user decide which vocabulary transformations are used for the individual databases or which of his search terms will be used in which databases. The lower row of tables in figure 4 shows a tabular entry field for search terms in compressed (left) and extended (right) view. Additional "fly-over" windows can also show the actual transformation for each search term and each database. This type of visualization has already been tested for literature databases and for geographic information and has proven its applicability in cross-cultural settings (Stempfhuber et al. 2003).

Integrating information in the social sciences

The methods for dealing with structural and semantic heterogeneity at the user interface level and at the retrieval level build the conceptual basis of a new social science portal, SOWIPORT, which is currently being built by the Social Science Information Centre in Bonn, Germany, and several partner institutes and libraries. The goal of SOWIPORT is to integrate all relevant types of scientific information without losing the expressiveness of the data through standardization: Primary and secondary data, literature references, online journals, scholarly discussion etc. This requires intensive work on the knowledge organization level to integrate heterogeneous indexing vocabularies and data structures. A paramount goal is also to bridge the boarders between different types of information so that users experience the collected data as a 'whole', allowing to search and navigate to a specific piece of information along different routes.

SOWIPORT has to been seen in the context of the currently reorganized structure of scientific information in Germany. Figure 5 shows the hierarchical – or cascading –

organization of disciplines and portals. The top level portal vascoda represents the central and interdisciplinary entry point to scientific information. Vascoda lets the user search across all disciplines or by selecting a cluster of disciplines, like the cluster Law, Economics & Social Sciences. The search is carried out across over 30 information providers (mostly domain-specific virtual libraries, information centres and commercial hosts) which classify their content according to a classification of disciplines.

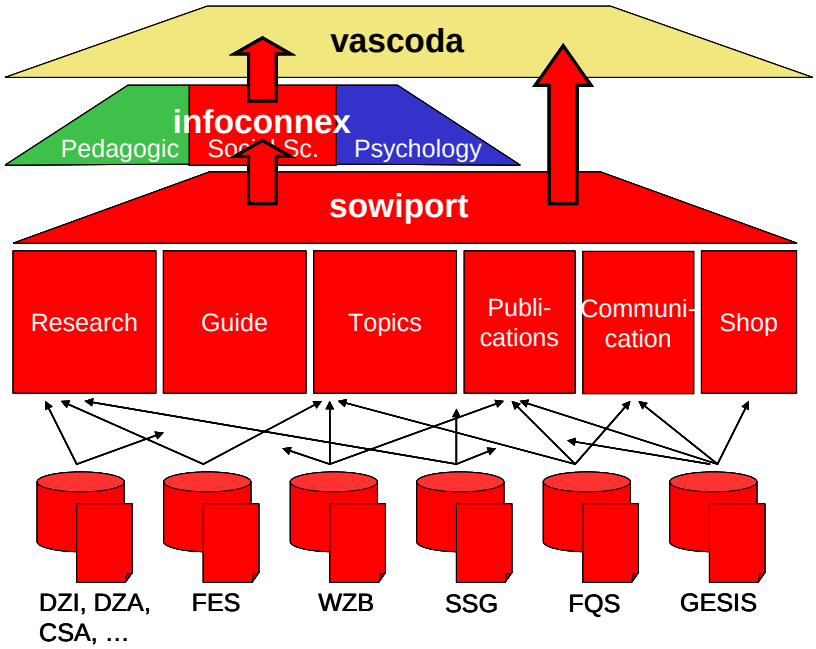


Figure 5: Cascading structure of scientific information offerings

At the level of the disciplines, some of them have closer connections than others, being candidates for a tighter integration which then facilitates interdisciplinary search and research. Infoconnex is a prototype of this kind of intermediary structure. The portal uses modules for the treatment of heterogeneity between the indexing vocabularies of the disciplines and supports users during cross-database (and discipline) search.

At the level of a single discipline, SOWIPORT takes on responsibility to integrate (heterogeneous) information in the social sciences. The portal will deliver this information directly to users from the social sciences as it will also provide the information at the cluster level (infoconnex) and at the top level of the vascoda portal. This cascading structure with divided responsibility (interdisciplinary – related disciplines – single discipline) reduces complexity at higher levels – sacrificing a certain level of detail – but allows for specific treatment of content heterogeneity and user needs at lower levels.

The content of the large number of information providers in SOWIPORT will be organized in several areas, like research (primary and secondary data, references to literature and research projects etc.), a guide to the structure of social sciences (institutes, experts, networks, journals, conferences etc.), topics (e.g. qualitative research, migration etc.), publications (online journals, books, newsletters etc.) and communication (mailing lists, discussion boards etc.).

Aggregating social science information

To collect a critical mass of information that will attract users, different policies have been used. The information available at the Social Science Information Centre, at its sister institutes within German Social Science Infrastructure Services[9] (GESIS) and at its institutional partners in the Social Sciences Virtual Library[10] (ViBSoz) form a nucleus of well-known and tightly integrated information offerings.

This nucleus is extended with external offerings. Two main policies are being followed, namely the integration of Open Access materials and the negotiation of national licences. In the area of Open Access, SOWIPORT will not only integrate three international journals but additionally materials from the social sciences will be harvested and a repository will be offered to allow researchers to deposit their publications. Concerning commercial offerings, we were able to get funding from Deutsche Forschungsgemeinschaft[11] (DFG) for 11 volumes (1999-2009) of each of six international databases: CSA Sociological Abstracts, CSA Social Services Abstracts, PAIS International, CSA Worldwide Political Science Abstracts, ASSIA: Applied Social Sciences Index and Abstracts, and Physical Education Index. These national licences entitle researchers with residence in Germany to access the licensed content free of cost. They complement the collections of the SOWIPORT partners at the international level.

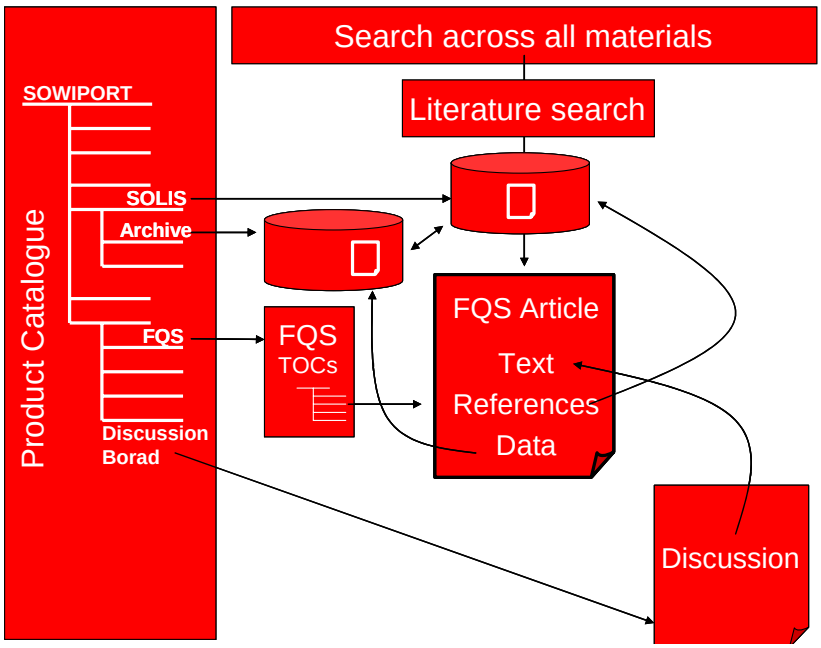


Figure 6: Integration across media

Integration of information in SOWIPORT

The content aggregated in SOWIPORT will be integrated not only at the semantic level – by treating the structural and semantic heterogeneity and organizing the content according to the quality of content indexing and integration (Krause 2006) – but also by bridging the boarders between different types of information and between formal and informal communication. Figure 6 gives an impression of how information will be accessible via searching and

9 See http://www.gesis.org

10 See http://www.vibsoz.de

11 See http://www.dfg.de

browsing using an online article of the open access journal FQS[12] as an example. By using the general or the literature-specific search one will find a reference to an FQS article in the literature database SOLIS and follow the link to the online version of the article. Alternatively the article is accessible from SOWIPORTS's product catalogue following the route from publications to FQS's table of contents and on to the article. Looking at the online article, links will be created from the reference section back to the literature databases and to the data archive, should there be any primary data available. The primary data, of cause could also be found by going to the archive section of SOWIPORT. To bridge between formal an informal communication, online discussion will be integrated into the online journal without the break in media currently found whenever discussion is handled in a separate discussion board and not as an integral part of an online publication.

Last but not least, we will try to transfer experiences with the integration of time-series data and literature made in the domain of market research (Stempfhuber et al. 2002) to the social sciences, supporting users to find related raw data and research activities (projects) and results (literature).

Conclusion

In this paper we argued that in many cases information portals aggregate content relevant to their user group. To cope with the heterogeneity of the content standardization is used which trades specific access to a single product for common access to all products. While aggregation of content is a prerequisite for building adequate information services, it falls short of handling areas which can not be standardized or to bring together different media to form new services and products. By the example of SOWIPORT we presented a model which integrates all types of information identified as relevant for a social science information portal. The model is based on modules for treating semantic and structural heterogeneity in information systems at different levels and connects different media, especially formal and informal communication to yield new – integrated – information services for the social sciences.

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12 See http://www.qualitative-research.net/fqs/fqs-eng.htm

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