

User Requirement Elicitation for Cross-Language Information Retrieval

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Abstract

Who are the users of a cross-language retrieval system? Under what circumstances do they need to perform such multi-language searches? How will the task and the context of use affect successful interaction with the system? Answers to these questions were explored in a user study performed as part of the design stages of Clarity, a EU founded project on cross-language information retrieval. The findings resulted in a rethink of the planned user interface and a consequent expansion of the set of services offered. This paper reports on the methodology and techniques used for the elicitation of user requirements as well as how these were in turn transformed into new design solutions.

1. INTRODUCTION

As access to multilingual document collections through the Internet has become more important, information retrieval research has increasingly paid attention to cross-language information retrieval (CLIR). CLIR systems allow users to retrieve documents written in one language using a query written in another. Those requiring CLIR services are varied: two common groups are users wishing to obtain a subset of documents to be manually translated; and bilingual users who wish to search for documents in all languages they know but all from a single query. Cross language searching is achieved through automatic translation of the query, or the document collection, or both. Despite the relatively poor accuracy of machine translation, CLIR can, with the right resources, retrieve almost as well as a monolingual system (1).

Whilst most research has been concerned with the retrieval effectiveness of cross-language systems through the application of established IR test collection approaches, (e.g. TREC and CLEF (2)), few studies have addressed user or interface issues related to retrieval in a multilingual environment (3). As Wang and Oard (4) point out, translation may be thought as a user interface challenge, where the user should be provided with the support to perform interactive CLIR related tasks. This support should be integrated into the user interface at important stages in the searching

process e.g. collection overviews, query formulation, reformulation, relevance judgement or document selection, etc.

It is now well understood that information seeking in electronic environments is a dynamic process (5) and that the interface plays a key role in supporting the user to explore the full functionality of a system effectively (6,7,8). Brajnic et al (7) suggest that studies of user behaviour interacting with IR systems may shed light on many important and vital issues when designing user interfaces, such as specific functionalities as well as procedural and conceptual support. Moreover it has been argued that users' work tasks and goals also need to be taken into account and understood in the context of information seeking and retrieval (9,10).

The design of a CLIR system presents a specific challenge regarding how best to handle the multiple language and translation elements in terms of the system capability as well as presentational requirements for the user. Collecting and specifying requirements is a crucial task in CLIR system design. As for other complex systems, poor or inadequate requirements specification generally results in interaction difficulties, including lack of facilities and usability problems (11).

Requirements can be considered from a system perspective (12,13), that is to define the goals that the system has to fulfill and formally describe how these goals will be achieved, or from a user perspective (11,14,15,16), that is focusing on psychological and social aspects of the user and the context of use. The purpose is to provide designers with some understanding of users' needs and behaviours. The focus is on interface layout and the functional presentation of the system to the user. One of the main goals with understanding the interaction between user and system and designing user interfaces is thus to overcome the *mismatch* between the user's goals when using the system, and the physical system mechanisms (17 p.38). Therefore the user needs assessment process for the development of a CLIR system must start with the identification of the users and the tasks that they will seek to accomplish (18).

Users play an important role in the Clarity¹ project. Users' representatives are part of the consortium and we will refer to them throughout the design, development, and evaluation process. Currently cross language searching is dependent on studies of monolingual tools. In order to design appropriate systems, it was important for Clarity to study cross-lingual information search tasks in real environments with real users.

A general overview of the user-centred design approach adopted in this study is given in Section 2. Sections 3, 4 and 5 describe the field study, data analysis and the user requirements derived from them. The implications of the results of the field study and their impact on the interface design are then discussed in Section 6, followed in 7 by conclusions and future work.

A USER-CENTRED DESIGN FOR Clarity

2.1. User-Centred System Design Framework

To be effective an information system has to be faithful to a real context and in keeping with the use the end-users will make of it. Designing with a user-centred approach (fig.1) requires that the user be involved from the very beginning. It is important to integrate users expertise and knowledge and to understand the reality:

¹ <http://clarity.shef.ac.uk/>

what are people doing, how, when, and why. There are varied sets of techniques that may be applied for this purpose (15,16).

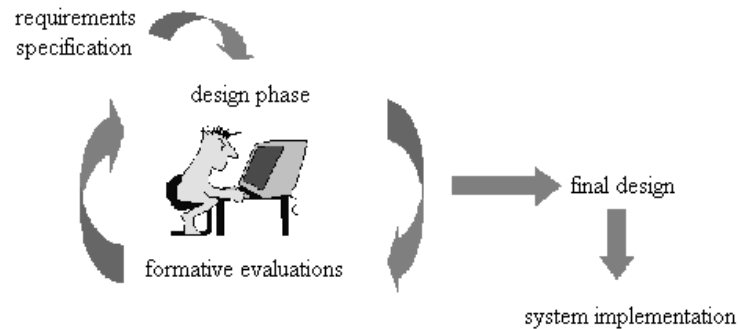


Figure 1. User-Centred System Design

Elaborating on the outcome of the knowledge acquisition phase, designers define a first version of the system using techniques like task analysis or scenarios of use. Promising solutions can then be tested with users. This *formative evaluation* verifies choices and indicates design revisions.

The design cycle ends when a satisfying solution is reached and implemented. The prototype generated at this stage should be close to the final system and is tested in a *summative evaluation* to detect any minor problems.

The work reported in this paper focuses on the first part of the user-centred design cycle as illustrated in Figure 1. The following steps were applied:

1. **Preliminary Requirements Specification:** an informal initial definition of users' needs was gathered via a discussion with end-users' representatives;
2. **Scenarios and Preliminary Design Phase:** on the basis of what emerged in the informal discussion above, two *proposed scenarios* were written, representing the designers' view of possible users, their tasks and their interaction with the proposed system;
3. **Formative Evaluation:** the proposed scenarios were then used to design a *proposed user interface*; mock-ups were drawn to address the different steps of an information seeking behaviour and these were submitted to users' judgement when the detailed user field study took place;
4. **Detailed Requirements Specification:** direct observation of users at work were conducted to get as much detail as possible on real users performing real tasks in real environments; other additional techniques, i.e. interviews, user feedback, participatory design, and questionnaires, were used to complement the main data collection method.
5. **Main Design Phase:** the integration and combination of the results of the previous step led to a revision of the first mock-ups and a new solution was reached based on the knowledge acquired.

The form and use of the *proposed scenarios* (point 2 above) is worth a brief discussion. As stated by Carroll (19), a scenario is a story describing a person with specific characteristics and motivations who performs a specific task by interacting with a specific system. The proposed scenarios (fig.2 shows an excerpt) were used in Clarity as a tool to stimulate discussion on what was feasible or not. Indeed the right

column reports the interface designer's questions (to be discussed with the technical colleagues) on what the system should offer to users in term of both system's capabilities and interface features.

Joannes Scenario	
Joannes is a journalist. He is from Finland. He is fluent in English and French, but does not speak any Italian at all.	Any other relevant skill?
He has to write an article about the follow-up actions taken by the Italian government after the disorder in Genoa during last G8 meeting. He is interested in the political discussion that also followed those facts. Images are important too.	The task requires to find information on a single topic; only the most important ones matter.
He does not have a precise idea of what happened after. He heard rumours about public inquiry and parliament clarification done by the government after the Left asked for explanation.	
He sits at his computer and uses his usual browser to connect to CLARITY site. He is asked for login and password.	Clarity has to be multi-browser e.g.. Netscape and Explorer
He enters his domain, customised respect to his profile. Here the history of past searches is kept.	Is customisation important?
The screen for new search is displayed as default. Joannes types in few words: Genoa G8 disorder political discussion	Should Clarity translated proper names e.g. Genoa – Genova ?
Given his information need, his search will be more effective if Italian newspapers are searched. Nevertheless other international agencies may have reported about it already. So he sets the language to "search in" to Italian, but did not excluded other languages ("only" tick box left blank).	

Figure 2 An excerpt of a proposed scenario.

The following sections elaborate on the main issues that arose in the design process relating to steps 3 to 5.

2.2. Proposed layout for the Clarity User Interface

One of the first steps in designing a new system in a user-centred way is to involve users and sketch the interface. In this way it is possible to envisage the relative importance of the system features and functionalities, their role and transparency with respect to use and usability. The initial Clarity interface layout sketches were based on proposed or assumed scenarios (point 2 above).

The six mock-ups described below correspond to individual panes, representing different stages of the searching process of a possible user-CLIR interaction. No attempt was made at this stage to relate the panes to overall screen layouts.

- The *system set-up* pane allows the user to set a Clarity working profile: the language (only one) used in the query; the language(s) of the documents to be retrieved; the collection(s) as well as the type of data (i.e. text, images, video, etc.), and other attributes.

- In cross-language information retrieval, one of the basic assumptions is that the user will type in the query in his/her own language; then it is translated by the system in the document language(s). A *query formulation and translation pane* (fig. 2) allows for typing in and for the user to have full control of the system's translation/expansion work (20,22,23).
- A *result overview pane* of the *retrieved set* can be represented graphically or content based (22,23). The ability to zoom in and out of a retrieved set through direct manipulation was deemed to be highly desirable by the designers. A graphical highly interactive representation of the ranked list was considered a starting point for the exploration of the retrieved documents. In the initial design this visualization was the first part shown to the user in the result pane. Clarity will also have a content-based visualization of the result will be based on the dynamic generation of a concept hierarchy (24) built on the retrieved set of documents.
- The retrieved documents are presented as a *ranked list* in a *result presentation pane* (fig.3). Judging the relevance of a document written in a foreign language requires both language skills from the user and support by the system. Thus the ranked list proposed provides as much information as possible about the individual documents retrieved (23).
- Another mock-up feature included a *multi document inspection pane*. This provides a concurrent display of several documents at the same time and allows the user to explore and compare the results more easily. Other works that propose tools for comparing retrieved documents are 3,25,26.
- The final pane sketched out for users to comment on was the *working area*. This is envisaged as a part of the screen where the user can save the cumulative results from sequential searches and any other information considered useful. Current user interfaces provide little support for keeping track of searches or saving queries and/or search results (27,28). Our first attempt was well received by users but more work is needed to clearly identify which parts of the search process needs to be retained and catered for by the interface.

2.3. Identifying Users' Characteristics and Tasks

As mentioned earlier, it is essential, that the designers gain as much prior understanding of users and usage as possible. As there are few examples of operational cross-language information retrieval systems, there are limited opportunities for gaining an understanding of the nature of the retrieval task in the multilingual context. Hence the Clarity project team considered that it was of paramount importance to find ways of eliciting the necessary in-depth understanding of how a cross-language IR system would be used. Indeed users have different knowledge and expertise, and may perform different tasks, as well as interact with different people (e.g. colleagues, customers) or work alone in the course of information seeking. Different users may need different features or may make different use of the same features. Moreover the place where the interaction takes place may affect its use and effectiveness.

These potential differences between users and uses may make it very difficult to design a single system valid for all. On the other hand it is not necessarily realistic to design different systems to suit each user class. Therefore some effort has to be spent in identifying the main user class(es) and to synthesise a set of features able to satisfy

the broadest, common uses. Therefore a wide user study was set-up with the purpose of collecting information on:

- **Potential users:** characteristics, needs and desires, opinions;
- **Different tasks:** goals, workflows, current practices;
- **Environments of use:** desktop or remote access, collaboration in information seeking.

In order to obtain a richer picture about users and tasks, a combination of data collection techniques was used in the field study (16). Each technique here described was adopted for its capability of eliciting different types of information.

The main technique used to get first hand experience of users searching for information was through *direct observation* in the actual work environment. Observations were undertaken simultaneously with interviews and made it possible to focus on concrete tasks and problems. The combined approach provided useful insight into the constraints of the environment as well as the dynamics of the social context where the action was taking place.

Direct observations are very expensive both in terms of users' time and researcher involvement. Moreover, if videotaped, the subsequent analysis can be a very long and elaborate process. Therefore direct observations were done to get qualitative data for a very limited number of subjects. As a complementary technique, to obtain quantitative data, *questionnaires* were used to survey a larger sample of potential users within the workplace. The questionnaires provided a measure of the different phenomena such as certain characteristics (i.e. searching expertise) and working practice (i.e. searching while writing) that have to be considered when designing the interface and the system features.

Being at the user premises was also an opportunity to ask users to try out a CLIR system available on the Web (ARCTOS²). This "informal test" provided further insight of what worked and what didn't in the interface and/or in the technical solutions adopted. This *collection of user feedback* revealed also further details about users' characteristics and the way they perform searching tasks.

Finally, in order to discuss design choices with end-users a *participatory design* session was undertaken. Subjects were shown the six prepared interface mock-ups and were invited to discuss and comment on the solutions presented. This technique enabled users to directly influence the design process itself. They were asked not only to judge the proposed design, but were also requested to suggest alternative solutions, thus contributing and sharing some responsibility over the eventual final design.

2. THE FIELD STUDY

The goal of the field study was to observe current practice on how real multi-language tasks are accomplished through monolingual tools and to imagine a multi-language system that would fully support multi-language information handling tasks. As described above, the field study incorporated four data collection exercises: real time user-task observation and interview; interaction with a cross-language information retrieval system available on the Web (ARCTOS) and machine-translated web pages (Google); user evaluation of the interface mock-ups and proposals on future improvements; and lastly filling in a questionnaire. Two sites were involved: Alma Media, Helsinki, Finland and BBC Monitoring, Caversham, UK. Alma Media is

² ARCTOS site <http://messene.nmsu.edu/ursa/arctos/> accessed 10.2.2002.

a media company and the Group's main business is newspaper publishing, production and distribution of business information, television and radio broadcasting, and new media. BBC Monitoring supplies the English speaking world with news, information and comment gathered from news agencies and mass media worldwide.

Although journalists are likely to be the main target user group of the Clarity system, they are unlikely to be the sole end users. Hence other categories of users with possible interests in cross-language tasks were also selected. A total of 10 subjects participated in the study across the two sites representing 4 different user categories. These included: business analysts (1), journalists (1), librarians (3), and translators (5).

Because of time constraints due to work commitments, subjects did not participate in all of the data collection components. The business information analyst was the only one who went through all four exercises. She was observed while searching information on “venture capitalism in Sweden”. Her final goal was to write a report on the topic, including the actors involved (companies and people). The journalist was observed while searching background information for writing an article for the evening newspaper. She was also asked to give her opinion and feedback on the cross-language information retrieval system and on the dynamically machine-translated pages. The three librarian/information specialists were only interviewed. Lastly the five translators of foreign broadcast news contributed in different degrees: three were observed and interviewed, while two were involved in a group session on the participatory design. Most of the participants observed filled out the questionnaire and a total of 20 questionnaires were collected.

Although it could be argued that a single representative of a user class may not be adequate, the strength of this type of study lies in the fusion of collected data, whereby even a single user counts in building a broad picture of requirements (15). On the one hand, it is the commonalities found across users and tasks, which will form the basic skeleton of the interface design. On the other hand, the differences found between users are more likely to account for the provision of different options within the design to meet more diverse needs. This will be discussed further in the presentation of the results below.

With the exception of the interviews with the librarians, all the field study sessions were video recorded. Despite the fact that a full analysis of the video recordings was undertaken, it is worth noting that retrospective analysis of video material does not replace the value and necessity of real time observation by researchers. The video evidence provided a valuable support for data analysis, but direct observation by the researchers and first hand interpretation recorded in real time notes with pen and paper were deemed to be essential. The surrogate record served to confirm or add to the certainty of the right intuition, which triggered the observer’s interpretation of the occurring phenomena in the first instance but was not a substitute for the intuition itself.

3. DATA ANALYSIS APPROACH

The main source of data for analysis included the video recordings, together with the observer’s notes. The analysis will be complemented by the questionnaire to be exploited at a later stage. All user sessions were analysed to identify a number of points of interest as follows:

- **Goals:** final objective of the user's information seeking activity, e.g. write a report or write a translation.
- **Tasks:** addresses a set of coherent actions done for a purpose, e.g. find information about a person. Tasks could also be identifiable as sub-goals.
- **Acts:** the undertaking of a single atomic action, e.g. clicking an option to access a database, clicking on a retrieved document that seems promising.
- **Community context:** evidence of interaction between people, e.g. searching on behalf of a colleague.
- **Practices and procedures:** a common response to certain situations done despite its effectiveness, e.g. when results are not satisfactory changing the database instead of changing the query.
- **Design implications:** user suggested improvements related to existing design solutions, e.g. apply Boolean constraints over a probabilistic retrieved set.
- **Opinions:** when the user expresses an opinion or preference, e.g. on the usefulness of a list of proper names extracted from the documents.

Exploiting the videos generated long lists of factual observations. The next step was to make sense of all the apparently unrelated data. As suggested by Hackos and Redish (16) all the items in the lists were annotated and organized following the sequence of the observed users' tasks. This visual representation made it possible to identify commonalities across different users and tasks and relate them to the main system features, which supported them. For example it was observed that all the users accessed different information sources in a single search session, although they may do so for different reasons. For example, the expert user may exploit other sources to ensure a comprehensive coverage, whereas a less experienced user may access other sources as a result of a previously failed search, in either case, such common behaviour must be supported.

The observed "task-flows" were then translated into *task scenarios*, which provided a detailed description of each of the user profiles, goals, information task performance, and environment as well as individual requirements. Together with the observation notes, the task scenarios served to identify key factors for system design. The task scenarios form the basis for *scenarios of use*, that is to say how the user will undertake that task in the actual system being defined. For their capability to represent future uses, scenarios of use need to be taken into account throughout the design and implementation phases. This approach ensures that the information task performed in the scenarios will be supported by the final system.

The first result to emerge from the data analysis was the classification of the subjects with regard to different user characteristics that included:

- High quality goals vs. average quality goals.
- Broad as well as in-depth experienced searchers vs. advanced beginners.
- Search-only users vs. search-and-use users.
- Search for known topics vs. search for unknown topics.
- Search in a known language vs. search in an unknown language.

The last three bullet points in the list mainly account for the differences between the librarians and all the other end-users. Indeed librarians perform a classic intermediary information-seeking task. They receive a request from a customer who has an information need (possibly on a topic on which they have little previous knowledge),

documents judged to be relevant are collected and handed over to the enquirer who will make use of the information retrieved. Moreover they may also search for information in a language not known to them. Because of their deep differences with respect to the other groups, librarians will not be considered primary users, i.e. those for which the system is designed (16). As a consequence, the interface design would not be influenced by their specific needs even if they are still considered (secondary) users of the system. In the following only the other groups are considered.

4. USER REQUIREMENTS

Based on the user scenarios, the following list of user requirements was derived through extensive comparisons and detailed discussions (numbers do not reflect importance):

1. **Search multiple sources of information at the same time:** all users accessed more than one database or Web search engines and sites to search for the same query; access to multiple sources at the same time would save user time;
2. **Same search query in multiple sources.** Users also used the same query term(s) when switching between sources. This may imply that the information need is the same even though sources and functionalities of search engines may differ;
3. **Search multiple languages at the same time:** while changing source users change the language; to save user's time, the query should be translated in many languages and then broadcasted to the different sources;
4. **Choose own query language:** it can be useful to be able to search in a different language other than the user's primary one; the language used depends on the user skills and on the task (in the translation process both source and target languages can be used alternately)
5. **Generate multilingual queries:** Although English will be used as the main pivot language for translation in the Clarity system, it could also be used in conjunction with the user's native language to cover all possibilities for retrieval.
6. **Generate queries with compound names and phrases:** users don't necessarily distinguish between multiple term expressions and single terms in generating queries and need support in handling both;
7. **Need synonyms and morphological aids:** non expert users do not have efficient strategies to identify effective terms; system should handle synonymous term variants (e.g. venture capital, venture capitalism, venture capitalist);
8. **Expectation for fast and efficient search engines:** searchers tend to look at only the top documents: professional searchers can overcome the system's limitations and can arrive at more satisfactory result, but most searchers do not have the time or the knowledge to try different strategies and exploit the system capabilities;
9. **Ability to combine Boolean and probabilistic retrieval approaches:** users want to use the "NOT" operator to refine a ranked list. This is deemed as a powerful strategy for speeding up the browsing of results;
10. **Filtering features:** different ways or criteria of sorting or reducing the retrieved set, i.e. language, date, source, genre/style to speed up browsing results;

11. **Import external documents as a starting point for a query:** the search can be triggered by the result of other tasks (e.g. through citation linking or serendipity during browsing);
12. **Support user-created dictionaries:** users often work in specific areas (e.g. only limited topics, only specific languages) and build up domain knowledge that can be shared with colleagues.

5. IMPLICATION FOR SYSTEM DESIGN

The initial ideas on Clarity capabilities were then revised to take account of the user study results. Furthermore, many points were raised in relation to the technical aspects of cross-language information retrieval as well as for interface design.

The user requirements list above can be divided with respect to the influence over different software module(s) of the system: a) the user interface (points 4, 10, 12), b) generic mechanism of information retrieval (1, 2, 6, 7, 8, 9 and 11), and c) specific of the cross-language task (3 and 5).

Interestingly, all the points addressed in the list above could be satisfied by current advanced technology in cross-language information retrieval (29). Thus it could be argued that the challenge in design is not primarily concerned with having the technological resources to provide what users want, but rather the real challenge appears to be able to make more intelligent use of the technology available based on a real context of use. For example what seemed very complicated to the observers, i.e. how to support a multi-language query, doesn't seem to be such a problem when the languages used are made explicit by the user, i.e. by ticking boxes. Interface designers need to mediate between the system and the user and work with information technologists to present the underlying functionality in such a way as to enable the system and the user to work collaboratively and to make searching a shared task.

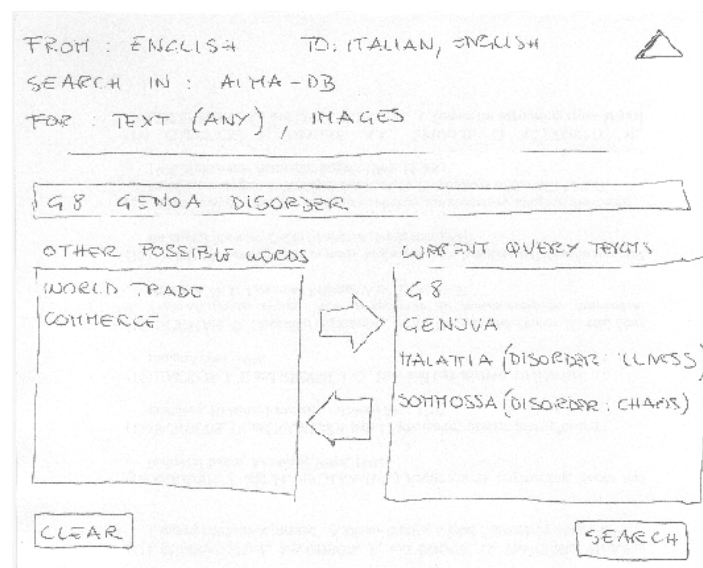


Figure 3. The mock-up of the query formulation and translation pane.

6.1. A New User Interface

The strongest impact of the user field study was on the user interface. Following the in-depth analysis of user information seeking behaviours, we recognised that some of our initial assumptions were wrong. The most important finding related to the

amount of control a user required over the translation process. With the exception of the expert user, none of the subjects were interested in seeing what the system was doing. They were primarily concerned with the actual search outcome. User control became an issue only when subjects encountered difficulties in getting satisfactory results. Only then did they need to bother about the appropriateness of the translation.

Following this result, the pane for the query formulation was substantially revised. The first version of the pane (fig. 3) has a (non editable) summary of the current language settings. To edit those values the user clicks on an arrow on the right upper corner to display all the possible settings. Below the setting summary, the query formulation section displays the translated query and other possible terms suggested by the system. The user can include new terms in the final query as well as remove current translations using the two arrows displayed between the two lists. Terms displayed in both lists are in the user language and the translation is included in brackets. Words with multiple meanings are expanded with a synonym so that the user can exclude those not related to the query. The example given in figure is the term “disorder” which could mean “chaos” or “illness”. When the user is satisfied with the translation, i.e, with the content of the window on the right, the user can click a button to initiate the search.

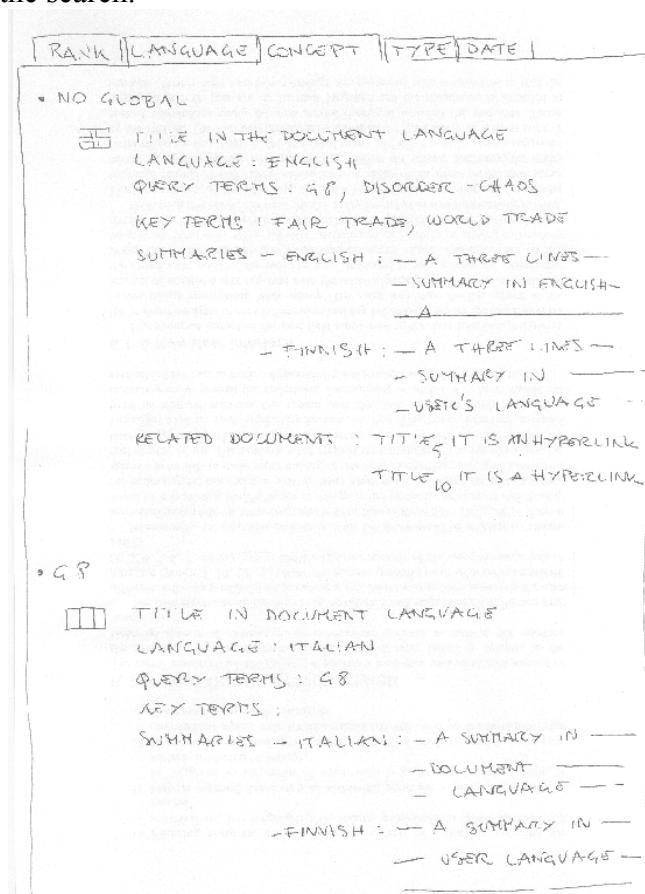


Figure 4. The mock-up of the first sketch of the ranked list pane.

In the new version (upper part of fig.5) the separate summary for the multi-language search settings was removed and what is considered essential has been imbedded within the query formulation pane. The motivation was to allow users the freedom to move from one language to another or expand the search by including

further languages, or reducing the number of languages if the result of a query was unmanageable. This “language shift” was performed by all the observed users: the business analysts started a search using English as the pivot language, moved to Finnish and finally to Swedish, the journalist searched in a number of European and American online newspapers thus using English, Spanish and German, and finally the translators shift from source to destination languages and vice versa.

Another major result that called for redesign related to the importance of the ranked list. Users expect to be presented with a list of results first. Any other form of graphical display for presenting results appears to confuse them. It is not that they cannot necessarily understand the new layout, but they simply expect a traditional list. Consequently the possibility of presenting an initial graphical overview of the results was set aside. Although it is recognised as a potentially useful tool, it was deemed inappropriate for the initial display of results but could be used as an additional aid at a later stage in the search process.

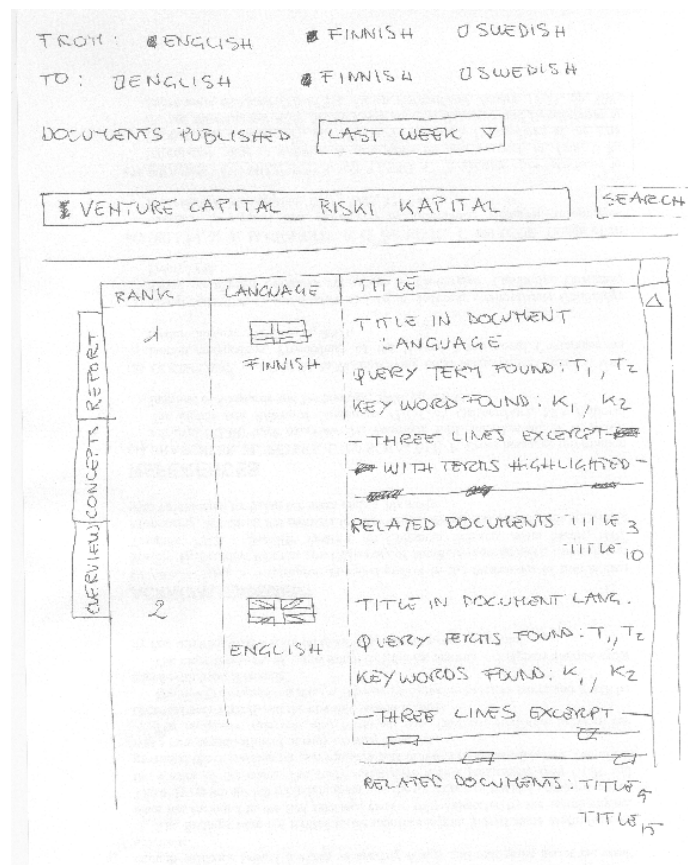


Figure 5. The mock-up of the revised interface of Clarity

The presentation of information for each item in the ranked list was also revised. In the first version (fig.5) a rich representation of each document is proposed including: title, document language, query terms contained in the document, additional key term concepts, a summary in the document language, a summary in the user language, and a list of other related documents. In this design, the set of retrieved documents can be filtered using some of the above criteria associated with the documents, for example the language or key term concepts, but also including other attributes like the date/time or source. Such a different organization of the results is obtained by simply clicking on the tab labels displayed on the upper border.

In the revised version (fig.4, lower part) the basic display has been simplified. Because all the users have linguistic skills, there is no need for a summary of the document in the user language. Thus the possibility of giving the user the freedom to display more details or not (as in MULINEX (20)) can be reconsidered. With respect to filtering, it should be applicable to only the features of each single document, i.e. the language, the ranking, the date and so on. Features related to the content such as concepts or style have to be kept separated to avoid confusion. In the revised design, tabs are used for accessing different views of the same data (e.g. the concept hierarchy or the graphical presentation) while the filtering options based only on document attributes are selected by clicking on the head cell of the column. Although the interface design features discussed above were the main ones emanating from the field study, further improvements and alternatives are likely to be considered, as further formative evaluations will be conducted in order to arrive at a design that will be fully compatible with our users and context of use.

6.2. CONCLUSIONS AND FUTURE WORK

By observing current practices with monolingual search engines, we were able to come some way in assessing what support users would require in using a cross-language information retrieval system. The findings led to the redesign of a number of different components of the use interface. In some cases enough evidence was gathered to suggest a sound solution whereas for other aspects the redesign remains tentative and will require further user evaluation.

The study provided a new perspective on CLIR and grounded the discussion on user requirements in terms of system features which led in turn to the reorganization of already existing underlying functions. Indeed, some functional features such as allow multi-language queries, were not incorporated in the first interface even if these could be supported by the search engine. The main reason for not including them was lack of knowledge on users and uses.

The redesigned interface will be implemented in the near future and will undergo further user testing. It is likely that some of the weaker solutions will lead to a further iteration of the design-evaluation cycle

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