Abstract: The paper reports the results of studies assessing the adequacy of information resources in the electronic environment and human interaction with the agent for information retrieval. Revolution is explained as an interactive force drive for innovation in information retrieval and information retrieval. Collaboration, community-based interactions lead to new integration features interactive models of information use. The human behavior in the environment of electronic information is described with an emphasis on easy access, quick to read them online, cognitive mapping, visualization and social networking. Research findings on the relevance are briefly reported and illustrated by a map concept of relevance in the environment. Implications for the design of digital environments and organization of knowledge in the electronic environment are derived. A new project based on the concept of information ecology is proposed.

Key Words: IT Interaction, Web 2.0, Digital Convergence, Computer Human Interaction

1 Introduction
New concepts of relevance are conditioned by the current "interactive revolution" in information science. The "interactive revolution" was noted in the literature of information retrieval based on the reconceptualization of the user as a social actor in the electronic environment. Recent interpretations regarding the interaction as multiple processes that integrate information retrieval, information retrieval and human behavior information [Ingwersen, Jarvelin 2005].

Interaction covers mutual influence of actors in different situations of use of the information. If human behavior information in the electronic environment of the interaction of man and the system (computer) is being studied in a discipline of HCI. The interactive nature of information retrieval has changed the concepts of relevance both in theory and in practice, procedures of research. We can say that the interaction led to the emergence of a new quality of the relevance of information in human behavior.

These changes are reflected in the results of our research projects for users of empirical investigations. In this article we present the results of studies assessing the adequacy of information resources in the electronic environment and human interaction with the agent for information retrieval. We applied quantitative and qualitative methods including questionnaire surveys, semi-structured interviews, focus groups and think-aloud protocols.

2 Principles of interaction - the driving forces of Web 2.0 and Science
Interactive revolution caused a major paradigm shift that increased the importance of collaboration and participation of community-based. Many
professionals say it is necessary to combine technological innovation with knowledge of social systems and that "science 2.0" emerges from this integration [Schneiderman, 2008]. 2.0 especially for science collaboration centered socio-technical systems are important. Examples include Web 2.0 social networking like MySpace and Facebook, blogs and citizen journalism, patient-centered health information systems, etc. Science 2.0 will be oriented towards human relations in social networks, including trust, empathy, responsibility and privacy.

Principles embedded in the interactive information processing and uses are the heart of these innovations. They can be divided into several levels of multiple interactions.

The first level is the interaction of the human interface and information system as a mediator of the recovery system information while searching for information.

The second level includes human behavior information in the electronic environment, especially using web services, tools and products.

The third level of social interaction mediated by social networks and social media. The principle of community is close to the activities of interactive information support learning and education.

Community is built into the cultural patterns of behavior of information. It is based in particular on the unwritten rules. Much of the cultural knowledge of the university community can be represented in the new intelligent systems and knowledge bases. We can see new opportunities for digital libraries, which could help form different levels of the learning organization of knowledge.

Development of user interfaces shows that interactive features always increase information search. The first and second generations of interfaces online through recovery system online public access catalogs to the user interfaces of the third generation of power over communication occurs in digital libraries. Visualization includes interactions with the needs and preferences. Ubiquitous access brings a vision of the electronic environment integrated into the activities of life greater. Principles of cognition, interaction and evaluation of the relevance of becoming part of universal access to information objects [Marchionini, 1998 Komlodi].

Interactive revolution has an impact on three main processes related to information, namely the creation sensemaking, knowledge and decision making. In these processes the basic components of human behavior works information, namely the cognitive, affective and situational. The third triad-related information includes a behavioral need for information, research information and use of information. By combining these aspects, activities and components of an information space in three dimensions emerge [Choo, 2007].

In the electronic behavior of the academic environment of information group is reflected in information retrieval integrated collaborative use in school (teaching, research). This collaboration can be divided into collaborative application development, collaborative filtering, collaborative browsing (synchronous or asynchronous social navigation), and sharing information.

3 interactive models of the use of information

New models use information are interactive, focused on social processes and communication supported by technology. Interdisciplinary cooperation of social sciences, humanities and computer science is essential.

Traditional models do not consider social communication, flexibility, interaction and sharing of informal knowledge. Only a few systems made use of previous expertise. It seems that new information tools for communities combine the attractiveness and simplicity of Web tools for organizing deep knowledge and representations based on the traditional library paradigm intellectual.

The contribution of social sciences is essential to support to make sense, decision making, and sharing of information in the use of information in the electronic environment. Basic information activities are modeled, ie the creation, collection, sharing, archiving, analysis, synthesis, distribution, data and text mining, and social collaboration. The challenge of socio-technological modeling can be represented in particular by interactions, the different roles of actors, intellectual property rights, safety and ethical use of information. Many concepts that the e-research, grid computing, cyber infrastructure, e-science, e-Social Science, Humanities e-emerged. Common features of these concepts include places of ubiquitous information and areas inhabited by university communities in
social networks. Important questions arise, for example: How to form groups of creative people? What means of bringing the knowledge of users are beneficial for new user-oriented models of systems and services?

4 Behaviour of information rights in the electronic environment

More insight into Google generation (born since 1993) was presented in a recent study CIBER [Information Behavior 2008]. Horizontal information seeking, quick navigation, bouncing, and online reading are typical behaviors. However, skills can not replace digital information based on an understanding of information needs, information strategies and assessment of relevance. Google generations also lack mental maps of the Internet. They tend to take rapid action, superficial and simplistic. This is why traditional libraries are for them difficult to use. Visual search is very popular with them, as opposed to reading electronic texts. Preferences interactive media, self-directed learning and "cut and paste" behaviors were confirmed. Respect copyright and intellectual property right disappears. Deeper analytical information processing in the electronic environment is rare. Similar results were found in our studies of user information behavior in Slovakia.

Social networking in information behavior of younger generations in the electronic environment is the latest in fashion [Sharing 2007]. As much as 56% of students use social networks, MySpace, FaceBook (students) and Mixi (Japanese students). The social network is defined as the social structure related to relationships based on shared information, common interests and attitudes. The goal is an interaction based on shared values and friendship. New "Internet culture" means that the Internet is integrated into the household and daily life. A special case is represented by social media that facilitate the exchange of content (eg YouTube, Flickr, Snapfish, Delicious). Main motivations for these information activities are social ties with friends, fun and inclusion in the community. It is difficult for libraries based on the paradigm of intellectual depth information to compete with this internet chaotic "market".

Assist in the understanding of cognitive mapping, navigate and internalize the concept of structures subject areas. Learning and research depend on well-defined concepts, categories, terms. Resulting ontologies, concept maps, intelligent thesaurus can help information architectures in the form of academic information environment. Contexts can be added at levels of between about, collaboration (collective discourse, social tagging). Attributes of electronic resources (speed, recency, findability and multimedia) can support decision making in the use of information. Visualization is also important because it adds value through images, links and maps displayed flexible concept (for beginners and experts, etc.).

5 Relevance of research assessment

The results confirm that the library users appreciate the easy access and well organized forms of information. Research has confirmed two types of users from data analysis. Type S manifests pragmatic ways to get information, enjoy low cost and speed of electronic publishing. Type A is characterized by analysis, information processing deeper, emphasizing the prestige and review process of the publication of two original information seeking styles have been identified, namely, strategic and analytical style, which practical implications for information systems design, knowledge organization and libraries. [Steinerová, Šušol 2005, Steinerová, Šušol 2007, Steinerová et al. 2004].

As a method, we applied semi-structured interviews with 21 doctoral students and master of the Faculty of Philosophy, Comenius University in Bratislava, Slovakia. Participants were selected from various social science disciplines, most of them having a library and information science degree. The research objectives were formulated in the following research questions:

What are the perceptions of the relevance to doctoral students from different disciplines?
What are the manifestations of relevance in the electronic information environment?
What means are used for categorization of relevant information?
What is the type of relevant information?

Level synthesis and modeling led to four concept maps that represent the answers to four research questions. The cards summarize the collective
discourse of doctoral students. We viewed the cards with the use of C-card tool [Novak, Canas 2008]: 1. Perceived relevance, 2. Relevance in the electronic environment, 3. Sorting relevant information, 4. Types of relevance. We will present a map to illustrate the results of our study.

**Relevance card in the electronic environment** determines the use of electronic resources and electronic publishing (Fig.1). Main activities as verification, navigation and content manipulation are described. The process of relevance is supported by an assessment of technological features. The map of summary data on the differences between traditional and resources for electronics. Quest origin of the source is facilitated by features such as scattered information, serendipity, the context, the flexibility and nonlinearity.

Relevance judgments are enhanced by advanced technology of the two interfaces and search engines. Students confirmed that they frequently use electronic sources, but it depends on the context: the subjects, disciplines, tasks. In the electronic environment, they like recently, speed and advanced features of the research, multimedia, connection. Several students expressed the differences between the perception of print and electronic texts. They agreed that mediation in the collection of electronic texts make the construction of more complex meanings. The emerging paradigm of the relevance 2.0 follows the efficient processing of electronic information, which includes the creation, research and use. Relevance in this environment is marked by the non-linearity, the flexibility of navigation, display high-level, and collective information processing.

![Figure 1: Conceptual Relevance card in the electronic environment](image)

Our results support the argument of the wealth of interactive environments, layered and dynamic use of academic information. The results also suggest that research information should consider the relevance of perception and cognition related to creativity. It is vital that services and systems designers to apply the knowledge of human behavior information. Our concept maps showed that the relevance is interpreted as an experience, as an interaction, and that the quality and personal creativity. Concept maps can be applied to digital libraries in new models of learning and scholarship.

**6 Impact of the Revolution the concept of interactive information ecology**

Based on previous analysis, studies and the results we proposed a new project based on the concept of information ecology. The ecology of information comes in the perspective of information
management in organizations [Davenport, Prusak 1997]. The core of this concept is expressed by sharing information, the ambiguity of meaning management, and information overload. Ecological aspects of information are covered by other books on the behavior of information rights [Choo 2006], [Nahl, 2007]. Ecologies of information that the interactions of humans and intelligent systems were presented by B. Nardi and O'Day [Nardi, O'Day 1999].

The ecology of information is shaped in the behavior of individual, group and organizational levels in the electronic environment. The ecological perspective on the use of information and optimization satisficing that includes key activities. They are mediated by the evaluation of information and the construction of relevance. The information ecology also implies ethical use of information, emotions and managing information overload.

We assume that the proposals for the protection of the human environment of the information at the individual, collective and institutional level will be derived. Our preliminary research questions are articulated as follows: How should the electronic information environment to make more effective use of information? How to provide context to make sense?

We will try to find the factors that impact the information environment and what cleaning mechanisms are available to solve the problems of information overload, redundancy and risks of using the information. We assume that the components of the ecology of information are people, smart technologies and use of organizational knowledge. Ethical, legal and safety precautions while sharing information on the Internet are considered part of the concept of information ecology.

The preliminary model of the ecology of information describes the transformation of university libraries from passive repositories for adaptive systems and interactive information organization based on the behavior of the information (Fig.2). Intelligent technologies and can provide environmental cyber infrastructure (rational and humane) approach to use the information. Ubiquitous and discrete technological mediation improving cognitive and affective behavior of human information can be considered the first step towards a new ecological model of information use.

![Figure 2: Comparison ecology concept of the traditional library and information](image)

7 Research on the interaction of humans with the agent information retrieval

7.1 Methods
models and recommendations for increasing the effectiveness of the agent. Due to recommendations are based on the results of the analysis of the behavior of cognitive and affective information.

Semi-structured interviews provided information on the identification of five respondents and their language skills description, future plans, tasks, and recent experiments (with technology, information retrieval on the Internet and Copernic Agent). Thinking aloud the collection of information has verbalized by respondents. They had to think aloud when solving the tasks related to information retrieval and filtering, organizing the results (grouping, sorting, categorization record), the summary, the annotation source Favorites and monitoring results. Analysis led to the description of the behavior of information and emotional respondents' cognitive. Interview final details of delivery problems interacting with Copernic Agent (CA), the boundaries of interface, the level of satisfaction with the agent research and proposals for improvement agent. We will describe the details of the recommendations (7.3) from the synthesis of the behavior of affective information by the interaction and comments made by respondents.

7.2 The generalized model of interaction with the researcher

Summary of results was inspired by the nature of information behavior trichotomous [Wilson, Walsh, 1996, Saracevic 1997, Kuhltau, 1993, Nahl, 2001]. The cognitive, emotional and sensorimotoric are present in our field model (Fig. 3). Specific categories from the analysis of the concept of human interaction with the researcher is viewed in three basic dimensions. As a major activity level category is shown, consisting primarily of the activities associated with the object (human) and the agent. Next level consists of objects and their manifestations of some. Interaction was mediated by the orientation of the subjects on the results of research and use. Besides the results, the subject (domain) has played a very important role. Assessments of respondents relevance of the information and skills for organizing information have been influenced by the level of knowledge of current affairs. Item Level also consists of sources. Respondents rated the content source based on specific criteria and according to their theme or task. CA (with its characteristics) in the category of tools. Respondents also listed other favorite search tools (Google, Yahoo). Time, place and manner dimensions are elements of the external environment. Our goal was not to specify all the categories in detail. Only the most prevalent resulting from the analysis of thinking aloud were selected. Specific levels are not isolated, but interconnected. Other configurations of levels and categories will depend on the specific situation. The cognitive, emotional and sensorimotoric are mixed with these configurations.

Figure 3: Summary of levels and categories of human interaction with the agent to search for information in the cognitive, affective and sensorimotoric.

7.3 Recommendations for improving performance

The following model (Fig. 4) displays the fields recommendation. Respondents' answers to the final interview and emotional aspects of behavior information was summarized in the recommendations. The recommendations are intended to increase the effectiveness of human interaction with the researcher and reduce cognitive load.

Figure 4: Fields of recommendations
The recommendations are organized into basic structure composed of general and concrete. General recommendations are classified as application, then the interface and the algorithm. The most frequent recommendations were related to specific functions of the researcher. First category included the following recommendations. Opening the application code may allow the development of sales by the wider community. CA could be implemented web applications using latest technologies. It may also enjoy benefits of social networks and provide space for collaborative research and customization. Increasing the efficiency of research and support the new model of relevance could be provided because of the participatory approach. It could provide an opportunity to collaborate in organizing, evaluating and commenting on news and search results. Natural language processing (NLP) could contribute to the quality of research information and the ease of solving problems.

Respondents were limited by some operations of time (information analysis, for example). This problem could be eliminated as soon as possible. Another step to increase the efficiency of the use of CA could be provided by simplifying the interface. Decrease in the amount of elements of the input screen should lead to easier memorization. Interface should be as flexible in the context of adaptation. It should provide opportunities to block move, delete etc.

Categorization of different users, such as novice / advanced user / expert could solve the problem of different levels of knowledge of the search system. Interface tailored to the needs of users must provide different levels of support.

Many respondents were not satisfied with the results of research say with sorting by relevance and score. New model of the relevance of collaboration must reflect the information explicit user profile and social networks (interests, connections, tags, etc.). Another problem is that CA does not support visualization techniques advanced. The results are presented in the form of text files. Assessment of relevance should be simplified by grouping or classification of the facets of performance. Annotations sources in specific files do not provide sufficient information on the source content or quality. Keywords are not present in the files. Users will appreciate options business information to distinguish the academic world. Respondents endorsed the name of "Score" is confusing. It would probably be renamed "relevance".

Helping CA contains tips for finding information with examples of syntax. Problem is that it is not available from the entry screen and he could not be found easily. Help should be available when needed by the user. CA should also support the automatic correction of errors and the recommendation of the request.

Search using CA is too complicated and slow. Support could be mediated by contextual assistant. Displaying toolbars on the choice could be very useful, too. CA may also provide links on the manual video with additional information on its basic functions. Problem-solving tips and explanatory introduction could be opened after the launch of CA (with cancellation of the option).

Field of basic research needs to be more dominant on the screen (the analogy with Google). Respondents indicated they missed more detailed form in the advanced search.

Product in the search result ("Search Results") must be located in a position more visible above the results list.

Add search results to a folder created was particularly difficult for respondents. Some of them did not know that the list of search results is automatically saved. Block with the search results are not differentiated by name understandable (for example, "Searches"). "My Searches" folder is after the creation and transfer of research results empty. It causes much confusion and so we recommend "My Searches" folder should contain the search history. Addition of search results could be simplified by using the item "Add". Item to add new folder is not clear and uniquely appointed in the main menu and context. This could be solved by giving the name of this more specific - "Add (new) search folder."

RSS is one of the technologies available in many search services today. CA should certainly provide RSS subscription for users to stay current with the latest information.

Point bookmarks are not visible to the user because it is hidden from the main menu. "Favorites" will be available directly from the results list. Best options for organizing the information could be provided by the marking. One respondent suggested that the CA could integrate variable plug-in support for saving and tagging
favorites. CA also failed to export any possibility bookmark.
Respondents had problems to find out what is the difference between visited and unvisited links. Visited links should be distinguished through the application of different colors.
Information on the number of results found will disappear after some time. This information is crucial when limiting the results. Data on the number of results must be available at any time of the search for information.
Respondents reported serious complications in the name of several functions. Annotate items / Summarize, track search / page, Sort / group and add the / Save Page to be distinguished more easily by users and be more understandable to them. "Analyze results" is represented by the yellow star. It was misinterpreted by users as the yellow star is frequently used in browsers as a function symbol bookmark.
Filtering function is available from the main menu (Results - Filter) and the context menu. Filtering was present at positions multiplied and mixed with advanced search options. A number of respondents verbalized their preference to simplify filter function and its integration into the advanced search. Remove the filter may be provided by clicking on the item "No filter".
The respondents were heavy users of MS Office and search tools on the Web. He made that point they have missed the Back / Cancel.
Respondents found there were some problems connected using CA in PDF format. They could not save directly to PDF (only after opening the browser). What is surprising, PDF is not indexed and CA can not create abstract or generate keywords from it.
Page Preview was not only open too slowly, but in the window too small that was not possible to enlarge it.
Several other limitations were associated with a summary. CA does not support adaptation and export of text summarized. Not only the ability to manipulate the content would be useful, but also provide an opportunity to change, highlight, add or delete keywords. Naming this function as "summary" was not seized for several respondents. One solution would be optional renaming the function "Extract" or "Create abstract." Item "Options" could be simplified because they are dissolved with options for monitoring, display and advanced. Produced with advanced options is also absent in the main menu.
Description of the "class" would also be appreciated by users. It should be renamed "categories of search tools", because many users had serious problems with understanding the concept of categories. Added optional tools / sources and the category of scientific information in directories should also be taken supported by the CA. Some users have therefore confused with the classes they wanted to hide. It is possible, but only hides the field of basic research. Categories and basic research tool to be divided because of their ease of manipulation.
Adding new search tools could be more interactive and not provided on the basis of traditional contact form. Easement could be mediated by adding item "Add new engine" to the list. Research tools mentioned may be deleted or added. Link to the list (eg "engine turned 12") is not understandable and could be replaced by "research tools Add / Customize".
Choice of multi-level sorting CA are too limited. The standard ascending / descending sorting results by title, for example, the URL, the relevance is provided. A certain level of automatic grouping (clustering) should be supported by CA.
One respondent stated that he would prefer annotations to instantly display results in the file. This function is analog with many recent "Search 2.0" tools that provide results commenting, rating and tagging by users. The "Annotate" could be renamed "Comment". It would solve problems with understanding the difference between the annotation, summarizing or commenting.
Several respondents were not sure until the results of the analysis. They did not know whether to wait or not completed. CA should provide information on progress of analysis and the option to hide the window at the bottom.CA does not provide sustainable access to test results (eg information on the double or broken links). History and statistics on the results of the analysis might be interesting for users of CA.
Problems of the respondents were connected to the naming and understanding of the elements in "Tracking Options".
CA assessments made by many respondents view the limits of CA that should be reviewed. CA appears to be the system that does not take many aspects of information seeking behavior and use
The architecture of the functional system is too complicated and does not reflect the natural flow of information retrieval influenced by chance and chaos. Input interface too complicated to CA caused increased cognitive load and uncertainty. Uncertainty is the source of the interaction problems reflected in the cognitive and affective aspects of research. The uncertainty should be reduced by system support, which is quite low recently incorporated by CA. CA does not implement the latest trends in the field of search tools tailored to the social context. Isolated and closed nature of sales could eventually lead to its own melt.

8 Conclusion
Patterns of student information in the electronic environment indicate that uses simplicity, attractiveness and immediate will persist. In this regard, new models should focus on navigation, personalization and visualization. New Approaches to media literacy of information are required. Especially in Judging relevance, mental maps of the Internet and to respect copyright. Explosion of digital content HAS to Be Harmonized with organization and access to information. Reduction of cognitive load in information search and use IS needed. Research results are of human interaction with information search agent PROVE the Complexity of tasks and direct That Emotion and cognitive information processing sensorimotoric DURING information seeking. Relevance in light of the interactive revolution based on IS Strategies that integrate interactive media with Integrity of scientific information provided by libraries. In scholarly communication services tailored to groups Should Be and Changing Information Needs. Information uses IS driven by simple access ubiquitous and rich interactions. However, the surface (horizontal) Consumption of information in the internet has impact on relevance Judgment. The idea of "the social networked library" Becomes true by interactive features of collaboration, creativity and community building. Interactive relevance 2.0 points to libraries Which Should Be open not only to use information, to order production and social interaction. New rules of information processing and use still emerge from interactions and dynamics of Changing information environment.

References


