DESIGN 2006

ASSESSING RELEVANCE: DESIGNERS' PERCEPTION OF INFORMATION USEFULNESS

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1. Introduction

A designer's conception of a design and its context is built up over time, using information from the designer's existing knowledge and experience, and from external sources of information [Eastman 2001]. However, designers tend to favor and to rely more on prior knowledge and experience than on external sources of information, either because they are not aware of the information they might need or because they are not motivated to consult the external sources. This lack of awareness produces as a result many designs being generated without the benefit of information that does exist and that is available to the designers. [Cross et al., 2001; Court, 1997].

Many researchers have studied the information requests of design engineers, the intention being establishing the requirements for the ideal information system or to try to determine how to measure the usefulness of information in design engineering. Several of these studies have found that accessibility is the factor that most influenced the engineers' selection of information sources [Fidel et al, 2003]. Accessibility is understood as a subjective measure of the effort that a designer needs to make in order to access such an information source. An information system is considered more accessible when the effort required to find and/or get a document is reduced, that is, when the system provides the maximum number of relevant documents and the minimum number of irrelevant ones [Borlund, 2003; Schamber, 1994]. Relevance is the perceived degree to which information meets the designer's information needs, that is to say, the perceived usefulness of a retrieved document. This paper focuses on relevance as perceived and judged by the designers when interacting with computer based information systems.

The concept of relevance is a complex one, and requires at least two degrees of intellectual involvement. One relates to system-driven relevance and the other to human-driven relevance. The system-driven approach views relevance as an objective, static concept and determines it using two parameters: the ratio of the relevant documents retrieved to the total amount of relevant documents in the system (recall) and the ratio of the relevant documents in the system to the total amount of documents retrieved (precision). Recall poses a big problem, because the absolute number of relevant documents in a system cannot be determined without the evaluation of each one of them. However, it can be estimated by calculating the overlap of the results in different searches, or by comparing the results of the same search in different databases.

The human-driven (designer-driven) view recognizes that relevance is subjective, cognitive, situational and dynamic. Relevance is subjective because it cannot be considered a property of the information itself, instead, it has to be seen as an attribute endowed by the designer to the information in a certain situation. But it is also cognitive: it depends on the designer's knowledge and perceptions, and it is situational, for it relates to the designer's need for information to complete a particular design task. Additionally, relevance is dynamic, the users perception of relevance change as they progress in the information-seeking process [Schamber, 1994].

This paper is based on the designer-driven approach to relevance. By means of an empirical study, it investigates the criteria used by designers to assess the relevance of accessed information. It proposes that relevance judgments are cognitive, situational and dynamic: that they depend on the designer's previous knowledge and understanding of the situation, on the particular information needs to perform a task and that they change as the designer progresses in the information seeking process. The empirical study shown how these relevance criteria are used in determining the usefulness of information in a design process.

2. The Study

The objective of this study is to explore the various criteria affecting relevance judgments about (design) information throughout the design process. For this purpose, relevance will be understood as the designer's perception of the usefulness of the information accessed. To achieve this objective, the following research questions are proposed:

- What role does the information provided play in the manner in which designers structure the design problem?
- Which criteria are used by designers to assess the relevance of the information accessed?
- Does the relative importance the designers assign to relevance criteria before accessing information change after accessing it?

These questions are discussed via the study discussed in the next section.

2.1 The assignment

The assignment was introduced with a text explaining the problems modern offices have dealing with floating personnel who do not spend all of their working time in the office. It was also stated that floating employees have to use what is called flexible workplaces. However, employees do not feel comfortable working in a place that they do not feel is their own. The text also emphasized topics like the role of information in changing environments, developments in the area of technology, the change in work culture that can be characterized as 'flexible', etc. The core of the design assignment was formulated as: "*the problem is that employees must have at their disposal the things they need for their specific tasks at any time and in any place. Also, they want to be able to adapt the desktop to make it their own personal work station at any time and in any place.*" Participants were asked to produce a design concept and to make presentation drawings of such concept for the company for which they were designing.

2.2 Participants

The participants in this study were 9 senior students (4 male, 5 female) from the faculty of Industrial Design Engineering at TUDelft. These designers participated voluntarily from a group that was contacted by email. The selection criteria was that they must be working on projects involving product development other than office furniture, and that they have been working for at least three months on their graduation project at the time this study was conducted.

2.3 The Information System

The information system provided contains a collection of more than 1000 documents covering aspects of furniture design, office furniture manufacturers, trends, mobility issues, legal issues, ergonomics, office interiors, etc. The information amounts to about 4000 A4 printed pages. About 70% of the content is in Dutch. This was done purposefully, as it is expected that information would be read and understood faster if it was in the designer's native language. There was as well a search engine which allowed the user to search by class (articles, folders, images, files, etc.) and by class attribute (title, keywords, abstract and content).

The information system was developed on a Linux platform running a web server (Apache) a database engine (MySQL) and a scripting language (PHP). It allowed the designers to bookmark documents and to see documents related to the one they were reading. This functionality is based on relationships between documents that were predefined by the editor of the collection. The system also generated log files in CVS format containing the date and time, IP address, user name, transaction (view, search,

download, add bookmark and view bookmark, etc.), title and type of document, path in the browsing structure and URL of the document.

2.4 Selection of the Relevance Criteria

The design of the study considered seven criteria that could be used by the designers in their assessments of the relevance of the information. These criteria were selected, based on the results of the studies by Schamber [1994], Choi et al [2002] and [Restrepo, 2004].These criteria are:

- Topicality: the information relates to the design assignment
- Accuracy: the information accurately reflects what the designer is looking for.
- Suggestiveness: the information suggests new ideas or provides new insight to the designer.
- Novelty: the information is new to the designer.
- Helps clarify the problem: The information helps the designer clarify important aspects of the design problem (presented in the design brief)
- Appeal of information: the information is interesting and attracts the attention of the designer.
- Technical attributes: format, use of language, illustrations, colour, perspective, etc.

It is acknowledged that relevance judgments can be influenced by criteria other than the ones presented here, and it was expected that designers would mention other criteria during the interviews.

2.5 Data Collection

In order to test if the relevance criteria changes as the information is being used, the designers were interviewed at two stages with 40 minutes intervals. Forty minutes intervals were appropriate as the designers could still remember what they were doing with the documents. The first stage, the pre-test, was conducted after they had read the design assignment, but before they could start looking for information. For the second stage, the designers were asked to point out which were the two or three documents that they considered the most important or that influenced them the most. They were then asked a number of questions about why these documents were important and how they influenced their design process.

The criteria used to assess the relevance of the accessed documents was determined from the grades given by the designers to each criterion during the interviews and the remarks explaining this choice of grade during each of the interviews. For each of the proposed relevance criteria, the designers were asked to give a grade in a scale from 1 to 7 and to explain their assessment. These grades are used to guide the discussion and to show trends (see figure 1), but the designers' remarks are more important to evaluate the differences in opinion. The entire process and the interviews were videotaped and transcribed. Two researchers observed the tapes individually, paying special attention to those documents that deviated from the trends as shown in the scatters in Figure 1. The documents that deviated from the general trend were discussed and in some cases, a new review of the data was necessary. The results section shows numerous examples as evidence to support the conclusions. The designers' were not asked to fill in a pro forma to rate each criterion. Instead, they were encouraged to give, along with the ratings, a full account of their judgments. During the last interview, the designers were asked to select the three documents they considered were the most important/influential in the exercise. They are referred to as doc1, doc2 and doc3 in figure 1.

The data collected was analyzed focusing on three aspects. How designers use information to structure the problem presented in the brief, the criteria used in relevance judgments and the use of the information system. This paper reports only on the relevance criteria.

3. Results

3.1 The information relates to the design assignment: Topicality

The first question asked to the designers during the pre-test was whether they would expect information on flexible workspaces (the topic of the design assignment) to be relevant. All of them ranked this criterion very highly, as shown in Figure 1. During the post-test, topicality continued to be an important criterion for judging the relevance of documents. A few exceptions to this are Doc 1

accessed by Designer 1 (Mobile professions) and Doc 3 access by Designer 2 (ways and means of expressing identity). The first document presented examples of other professions requiring mobility, and in which the users expressed a wish for personalizing their workspaces. Examples are bus drivers and crane operators. The second document presented examples of 'personalizing' in other contexts: it contained photos of how youngsters decorate their scooters, or how certain social groups express their identity by dressing in a particular way. Both designers mentioned that, not being office related, these documents did not belong to the topic of the assignment.

3.2 The information meets the designer's needs: Accuracy

Before the designers started their information search, they imagined that the documents had to represent their search intent accurately; this opinion changed after the interaction with the system. However, serendipitous (opportunistic) encounters with information were frequent and useful. The assessments of the 'accuracy' depend also on the designers' intentions. For instance, when using the search engine, which is an indication of a particular purpose, the quality of the results are assessed on how close they match what the designer expected. Designer 2 said *"[…] when I can say 'that's just what I was looking for', that's the best way of defining relevance".*

3.3 The information suggests new ideas or provides new insights to the designer: Suggestiveness

During the pre-test, designers speculated that they would consider documents that would suggest new ideas, or provide them with new insights, would be relevant. In general, it can be said that it continued to be an important aspect in the assessment of relevance of the documents tested during the fourth interview. There are a few exceptions to this. Take for instance document 2 by designer 6, an example of a trolley designed by Gispen, a Dutch furniture manufacturer. Although this is a prototypical solution, the designer indicated that, even though this document was relevant to the assignment, it did not contribute to the development of the solution.

3.4 The information is unknown to the designer: Novelty

The opinion on whether documents containing new information would be relevant is very divided, as it can be seen in Figure 1. It is interesting, however, to note that in all cases the relative importance given to this during the fourth interview was lower than in the pre-test. It is interesting because it indicates that the designers expected to learn new things from the information accessed, and therefore expected documents containing unknown information to be highly relevant. Three designers (1, 5, and 6) mentioned that this criterion would be important but only if it is related to the assignment, making reference to the criterion 'topicality'. This expectation was not fulfilled, as very little of the information provided was completely unknown to the designers. Still, the information was considered relevant because it either allowed them to consider aspects that would not have otherwise been considered, facilitated making associations to other domains, or served as a confirmation of what they already knew.

3.5 The information helps the designer clarify the problem

The perception of the designers, after having read the design brief, was that it was difficult to grasp. This is reflected in the great variety of interpretations they wrote of the problem as a response to tasks I and II. When asked about this criterion, they all responded that it would be very important to have some information that would help clarify the problem. However, in very few cases were the documents considered as relevant assessed on the basis of their capacity to help in understanding the problem. This is illustrated in Figure 1, where it is clear that in the majority of the cases the documents received lower scores in the post-test than in the pre-test.

Two cases that do not follow this trend are worth discussing. These are the cases of designers 9 and 2, who accessed the document 'in-depth interviews with users of flexible workspaces' (document 2 for both designers). Designer 9 had already, after the first segment of the study, some ideas about the solution to develop. Her solution consisted of a rucksack like device that would allow the user to transport personal documents and a laptop after having used the flexible workstations. During the

second segment, she accessed a document containing in-depth interviews with users of such systems in which these types of solutions were highly criticized.
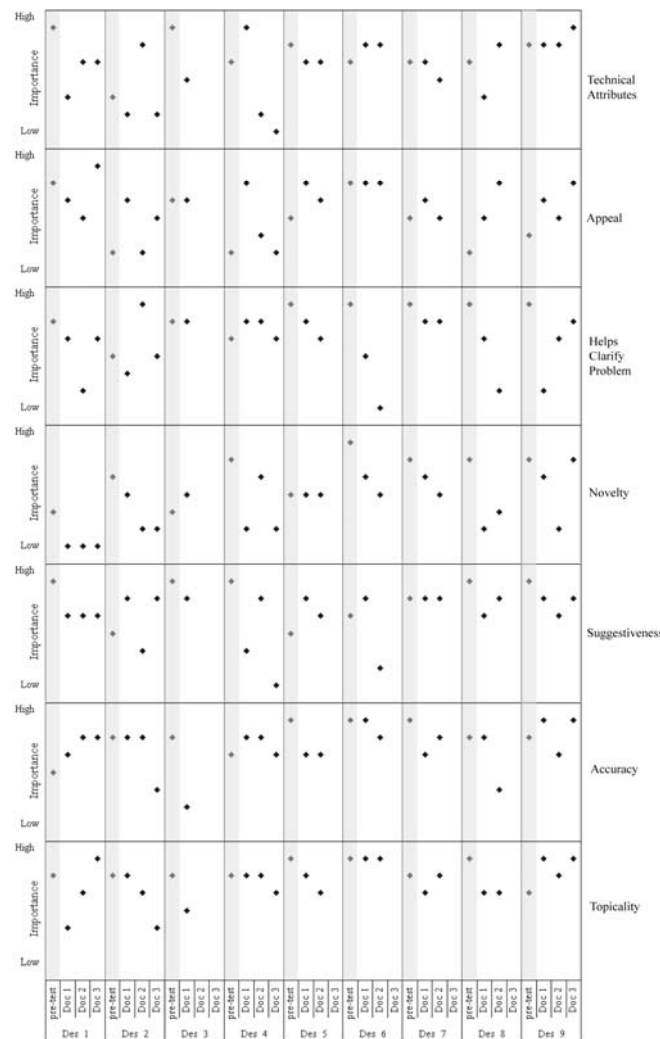

Figure 1. Perceived importance of various relevance criteria during the pre- and post tests

She said then *"I have to start again from scratch. This made me realize that the problem is much more complex and that this solution is not feasible"*. Designer 2 mentioned that from this document he realized that *"three relevant questions need to be answered: (1), what is the content that needs to be personalized; (2), what to do with the papers, documents and books that need to be carried and (3), what does the work look like [sic], what do people do and why when they decide to come together in a specific area"*.

3.6 The information is interesting, I like it: Appeal

Appeal is a subjective measure of a sympathetic response to a document. Though it is related to other aspects such as how the document looks (technical attributes) and how the document influences the designer, there are some aspects that cannot simply be put into rational terms. Of particular interest are those documents that, though relevant, were not appealing to the designer. An example is document 3 by designer 4. This was a very long document (over 12 pages). Skimming through the document, this

designer saw a paragraph discussing how a corporation organizes its offices to support a floating body of employees, which he considered interesting. However, the document was *"kind of dark, it is interesting at points, but the important information is difficult to extract […] I did not like the document, but I found this paragraph useful and inspiring"*. When different designers accessed the same document, they had different opinions about it. Take for instance documents 2 and 1 by designers 2 and 5 respectively. Being the same document, their judgment on the appeal of the information is very different (see Figure 1).

3.7 The information media is of high quality: Technical Attributes

Technical attributes refer to the quality of the documents in terms of use of language, format, graphical content, clarity, and easiness (to read) in the case of textual documents, or aspects such as colour, perspective or emotional response in case of graphical documents (pictures/images). Technical attributes is the perceived quality of the document in all aspects but content (which is considered to have been discussed with the previous criteria.

With the exception of designer 2, all the other designers considered this to be an important aspect in judging the relevance of a document: *"What is important is the content, if you are really interested, the format does not matter"*. However, this designer was not consistent with this observation in his latter responses. For instance, he graded documents 1 and 3 very low on technical attributes because *"They contain too much text, are long and difficult to read"*.

3.8 Other relevance criteria mentioned

Besides the criteria already discussed, the designers had the opportunity to express other factors they would consider important in assessing the relevance of information. Some times these remarks came spontaneously, without the researcher specifically asking for it, in the middle of the discussions during the interviews.

Reliability was the most mentioned factor. Designer 3 mentioned that "The reliability of the source is important. Scientific articles are more reliable". Designer 2 mentioned that "It is important that the source is well known. I trust more universities than commercial companies […]". The reliability and authoritativeness of the information source was also mentioned as an important aspect by designers 4, and 7. In some cases, the authority of the source is considered so important that even when there are obvious faults in the information, the designers were willing to consider and use it [Restrepo, 2004].

Appropriate level of detail: whether the designer wants to have a broad overview of certain aspects, or a more detailed description, is a factor affecting relevance judgments. It could be that the document is so detailed that it becomes lengthy, difficult to read and uninteresting.

Ease of use: Some of the information in the system was easy to understand and the information was readily transferable to the task. Examples are a document that contained a summary of the aspects users consider important in flexible workstations, or a document with offices layouts. Other documents like the ways and means of expressing identity, or the document comparing the European and American traditions in offices required a much more active interpretation and were more difficult to apply.

The source is 'real' or interactive'. Most designers mentioned that they would have liked to go to an office with flexible workplaces to talk to people, to interact with them and to ask them questions. Although this is not so much a judgment on the information itself as on the information source, it is considered here because of the high number of occurrences (7 out of 9 designers mentioned it at some stage).

3.9 Does the relative importance the designers assign to criteria before accessing information change after accessing it?

Bateman [1999] found that the criteria used by her participants on relevance judgments changed very little as the users progressed in the information seeking process. Contrastingly, our results showed that designers do change some of the criteria whilst keeping some others relatively constant as they interact with the information sources. Take for instance topicality. This criterion was given high importance during the pre-test and was still very important during the post-test. Only in a few cases, when designers came across useful information in the system that they considered was not related to

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their topic, did this criterion become less important. However, other criteria such as novelty were considered relevant in the pre-test but only if the document was on the same topic.

Accuracy was ranked highly in both the pre and the post-test. Irrespective of whether the designers are able to make clear their intentions or their information needs to the system, the relevance of the results will always be evaluated in terms of the extent to which the information meet their information needs.

When an information system is presented to the designers prior to an assignment, it creates great expectations. These expectations are not always met. For instance, during the pre-test most designers said that they would consider as highly relevant documents capable of giving them new ideas or insights. However, in only 24% of the responses obtained in interview IV on this criterion did the designers consider that the document was important because it gave them new ideas or suggested new ways to a solution.

In the case of novelty, their expectations were even harder to meet. It was expressed that a document containing information unknown to the designer would be considered relevant if it was also ranked highly on topicality. A review of the scatter presented in Figure 1 reveals that with only two exceptions, documents were ranked lower in the post-test than in the pre-test. This leads to the question, if the information was already known to the designer, why was that document still considered relevant? This seems to indicate that the information was used as a means to underpin decisions or to back up their own knowledge rather than to learn new things.

3.10 Preferred criteria

The results show that the designers agreed on the criteria that have the highest impact on the relevance judgments, whereas on the criteria that have the lowest importance they have different opinions. In the same way, the criteria with the highest importance tended not to change as the designers progressed in the information seeking. These observations indicate that there are some static criteria, such as topicality and accuracy, that are not influenced by situational factors. They also indicate that some other criteria, such as technical attributes and appeal of the information, shape the user's perception of relevance depending on the information that is actually available.

3.11 Perception of relevance is situational and dynamic

The perceived relevance is always situational. That is to say, it depends on the user's intentions and needs for information. It changes, not only when the task changes, but also within a particular task. This point is illustrated in our data: even though all the participating designers have the same task, they did not assess the accessed documents in the same way.

The designers' understanding of the design task has a great influence in their relevance judgments. For instance, for Designer 1, the problem was *"to invent a system that offers the opportunity to employees to create a personal work environment in several workstations in an office building".* When the problem is formulated in those terms, a document with information about a similar situation but in a different context like construction or transport is more difficult to relate to the 'office environment'. Contrasting with this example is a designer that proposed that the problem was *"allowing the personalization of tasks, places and objects".* This designer found a document on ways and means of expressing identity and recognized it immediately as relevant. To this designer, the concept of personalizing was not limited to the workspace, and therefore he was not afraid of showing interest in a document that demonstrated the concept of personalizing on other elements outside of the office such as scooters and ways of dressing.

This perception of relevance is dynamic; it changes during the process and what is considered irrelevant suddenly becomes relevant. One of our designers mentioned that *"I found this document browsing and at that time I thought it was not relevant. Now I need it and have to search to find it again"* (Designer 7). Even though the perceived relevance of information changes, only some of the criteria used in this assessement changes.

4. Conclusions

This paper has presented a study where the focus is on the criteria used by the designers to assess the relevance of accessed information. It proposed that relevance judgments are cognitive, situational and

dynamic: i.e., they depend on the designer's previous knowledge and understanding of the situation, on the particular information needs to perform a task and change as the designer progresses in the information seeking process. The results suggest that the information the designers accessed was used more as a means to underpin decisions or to back up their own knowledge rather than to learn new things. This is caused perhaps by the time restrictions imposed by the experimental setting, but is not inconsistent with other studies done in industrial settings. The study also shows that, whilst the perceived relevance of documents change during the design process, not all the criteria used in this assessement changed. Some of the criteria used, such as appeal and technical attributes are affected by situational factors whereas some others are kept relatively constant such as topicality and accuracy.

References

Ahmed, S. and Wallace, K.M.Indexing design knowledge based upon descriptions of design processes. in ICED03, 14th International Conference on Engineering Design, Stockholm, Sweden, 2003 691-692

Bateman, J. Modeling the Importance of end Users Relevance Criteria. In Proceedings of the 62nd annual meeting of the American Society for Information Science. Vol. 36 1999 pp396-406.

Borlund, P. The concept of Relevance in IR. Journal of the American Society for Information Science and Technology, 2003 54(10) pp 913-925

Choi, Y., & Rasmussen, E. M. Users' Relevance Criteria in Image Retrieval in American History. Information Processing and Management, 38 2002, 695-726.

Court, A. W., Culley, S. J., & McMahon, C. A. The Influence of Information Technology in New Product Development: Observations of an Empirical Study of the Access of Engineering Design Information. International Journal of Information Management, 17(5), 1997 359-375.

Cross, N. Design Cognition: Results of Protocol and Other Empirical Studies of Design Activity. In C. M. Eastman, W. M. McCracken, & W. C. Newstetter (Eds.), Design Knowing and Learning: Cognition in Design Education. (pp. 79-103) 2001 Amsterdam: Elsevier.

Eastman, C. New Directions in Design Cognition: Studies on Representation and Recall. In C. M. Eastman, W. M. McCracken, & W. C. Newstetter (Eds.), Design Knowing and Learning: Cognition in Design Education. (pp. 79-103) 2001 Amsterdam: Elsevier.

Fidel, R., & Green, M. The many faces of accessibility: engineers' perception of information sources. Information Processing and Management. 2003

Leckie, G. J. Modeling the Information Seeking of Professionals: A General Model Derived from Research on Engineers, Health-Care Professionals and Lawyers. Library Quarterly, 66(2) 1996 Pp 161-193.

Restrepo, J. Information Processing in Design. Delft University Press. 2004 Delft, The Netherlands

Schamber, L. Relevance and information behavior. In M.E. Williams (Ed.) Annual review of information science and technology (ARIST) pp.3-488. Medford, NJ: Learned Information Inc. 1994

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