Training on the Job: Learning While Searching in an Engineering Workplace

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ABSTRACT

Professional search in an engineering context includes users on different stages from novice to expert. We discuss how searching as learning can help to understand searching in a larger information seeking, workspace, and learning environment, giving users the tools and understanding to become experts over time. We present some findings of user interaction with engineering domain retrieval systems where the searching as learning perspective can improve our understanding of information seeking behaviour.

CCS Concepts

•**Information systems** → *Information retrieval; Users and interactive retrieval;* •**Human-centered computing** → *Computer supported cooperative work;*

Keywords

Information Seeking, Information Access, Engineering, Professional Search

1. INTRODUCTION

In a number of professional search settings the goal is not only to retrieve a particular isolated fact or document, but also to satisfy more complex information needs as part of a surrounding work task. In an inherently knowledge-driven work environment, searching for and working with documents is a common task that is considered especially challenging for new personnel in a team or company due to an often steep learning curve.

In our ongoing work, we examine the use of search, recommendation, and knowledge management tools to support engineers [5] in information seeking tasks in their daily work [2]. Our users work in larger interdisciplinary teams, designing and building complex products, with engineers from many different disciplines as well as project managers and finance, legal, or HR contributors. Due to the large number of files generated and the preferred way of the teams to handle files, we focus on an intranet or internal network file system as a corpus [1] on top of which we are developing an expert search system [2].

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2. WORK, SEARCH, TRAINING

In a specialised professional search system that is a large part of daily information seeking activities and work tasks, users gain increasing knowledge and expertise over time by interacting with the search system. We argue in this paper that the information seeking tasks of engineers working on a complex project can be understood from a searching as learning perspective. This perspective can help understand the users as it better fits their progress from novice to expert, both in the short and long term, it may explain certain changes of information seeking behaviour over time, and also inform the adaptability of the system. Previous work has looked at conceptual types of learning as searching in the workplace [3], here we examine a concrete example.

Learning in this search scenario takes place at at least two levels. The simpler and more general one is that users learn how to use the system, especially learning how to formulate queries to better retrieve relevant documents, how to judge relevance of results, etc. This is basically learning how to search and already a well-explored area. Still, from a research perspective, we are also interested to see how judgements are made in this context.

On a more specific case, users learn where to find documents, which type or source of document is more useful for a certain task, and also learn the relevant documents and processes in their work environment, the unwritten (and written) rules of the company or the team. Undoubtedly, a learning effect occurs when retrieved documents are studied. Users internalize gained information and knowledge, changing the information needs they will have from the search system in the future. This last part is the most interesting from the searching as learning angle. If we take the definitions of learning as a change in the knowledge structures of a user [8], learning should occur for the engineers on their way to higher expertise in their job in general and also in smaller units within a smaller project.

The basis for the discussions in this paper are a number of informal interviews and discussions with engineers from a large engineering company that builds large-scale offshore structures [2] and others and more formal interviews with a number of student groups at our university that take part in a challenge to build an energy-efficient race car from scratch. In the former case, team sizes range from around 5 to large international teams of hundreds, in the latter case, there are

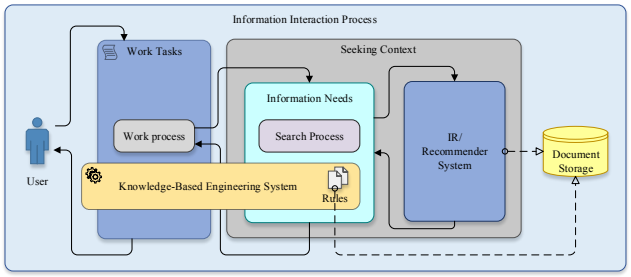

Figure 1: Information seeking tasks embedded in work tasks with engineering tools integration (Figure from [2] adapted from [6])

around 10-15 students per group. We interviewed about 5 engineers and about 20 students. They all come from different disciplines and have different backgrounds and different roles in the project.

Engineering large complex products or projects is inherently a collaborative exercise. In the student example, learning is of course the main desired outcome. Students share knowledge directly, but also search and read documents from their own and previous groups as well as general documentation to advance their knowledge. In the company example with a large workplace organization, the same happens, and novices are also guided by expert engineers. However, an additional task there is expert search, in which users search for experts in the system to know whom to ask for particular questions. Information needs also change depending on the work and project context [4].

Figure 1 shows a simplified view of an engineer's work situation, work tasks, resulting information needs, and possible engagement with a retrieval system from the view of information seeking [6]. Overlayed is the support by certain types of engineering tools that may integrate some parts of these layers. So-called Knowledge-based engineering (KBE) systems allow construction of parameterised solutions to standard engineering questions [7] and are very knowledge-intensive. Not presented is the social environment consisting of team members, hierarchical relations, or expert mentors. This reflects concepts of individual, social, and technical dimensions of learning activities [3].

One important thing to note is that there is a lot of interaction with documents, external Web sources, discussions with colleagues or project verification and reviews that takes place outside the context of the search system and may be invisible from that system. From a learning perspective, information needs even for the exactly same work task may change over time. Novices need to find their way around the system, find out where documents are stored and how they are organised, and need to familiarise themselves with the relevant standards and processes while experts have learned a lot of these already. On the other hand, there are certain standards and protocols that need always be followed in the latest version for specific parameters or processes. However, this may still mean that users have bookmarked the latest source and need not search for it or that they have a physical printout in the office for reference.

Understanding information seeking tasks with the searching as learning view helps understand some of our initial findings in a new light. For example, an initial idea that by observing the interaction of experts with a retrieval system, certain document characteristics and relations as well as interesting workflow aspects could be mined. This proved extremely hard, as one of the findings of our interviews was that for many tasks, expert searchers use less searching inside the system. In short, experts use retrieval systems a lot less and with a different focus due to their experience and expertise. This means that they may not need to use search to find the relevant information or that they do know much more facts and processes and thus do not have any information need at all. Thus simply observing an expert to train or support novices turned out to be not feasible.

However, another finding is that engineering experts search for answers that support more complex or unfamiliar tasks. Because search tasks often consist of multiple linked searches for different snippets of information, this is inherently difficult to model. These findings are consistent with results from a study of another aspect of engineering support [7]. Saved time is not fully assigned to other tasks. Instead, it is often used for increased breadth and depth of the search for solutions to harder and more complex problems. This basically frees up time and resources to rethink existing solutions or tackle harder issues on higher complexity levels.

3. CONCLUSION

We see some angles to explore in future work. It would be interesting to more systematically map previous work [8] more systematically to deeper explore this context. The issue of 'good abandonment' where a result page already covers the information need and no further interaction takes place is stronger in this scenario as in many cases, we would not even see the user in the system in the first place. A decreased use could also hint towards an advancement of the user who is well on his learning path. Connected to this would be a measure of the complexity of the search task to better support users in their different stage of expertise. This could inform understanding for future retrieval system design in professional search.

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