Semantic Social Recommendations in Knowledge-Based Engineering

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ABSTRACT

We examine the application of semantic context-aware Recommender Systems to improve interaction and navigation in a design-centric engineering domain. The small scale of this specialised environment renders most Web-scale solutions unsuitable, mandating tailored approaches. We report on initial work to identify challenges and promising categories of personalisation and adaptation together with relevant context features taken from the whole environment consisting of users, organisation, and documents to overcome the sparsity issue in professional Information Access.

Categories and Subject Descriptors

H.3.3 [**Information Systems**]: Information Storage and Retrieval—*Information Search and Retrieval*; J.6 [**Computer Applications**]: Computer-Aided Engineering

General Terms

Design, Documentation

Keywords

Manufacturing, CAx, Digital factories, Manufacturing design and product lifecycle management, Information Access

1. INTRODUCTION

In this paper, we examine social recommendation from an angle that has not yet received much attention. The angle is that of professional search and recommendation systems. In that case, social does not mean friends, followees and followers, or people who used the same Web site, but the social network of colleagues who work on similar projects or the same discipline. While this may limit the information to be gathered from the social circle, the focus on a specific domain can partly make up for it. For example, an engineer in a product design company can have overlapping social circles and implicit connections. One can be the organisation chart of the hierarchy, setting her up in relation to people within her department, her supervisors, her team, or her staff. Additionally, she will be part of the engineers that work in the company in different departments and different fields, and she may also be part of one or multiple projects. She might additionally be part of a management group or a specific specialization. All these roles and task mean different information access demands for her.

The setting we are examining is that of Knowledge-Based Engineering (KBE), which is an approach used in manufacturing and design engineering to not only capture available process and product knowledge, but to use it systematically in the design process. A focus lies on the reuse of knowledge and knowledge sharing between the involved engineers [7]. Our research is anchored in the LinkedDesign project[1] [2] which aims to provide integrated information and knowledge handling to improve engineering product development.

2. CONTEXT-AWARE APPROACH

The KBE scenario is a good case for personalisation in professional search. The application domain involves knowledge workers and domain experts who need improved Information Access for complex problems and work tasks, based on complex and heterogeneous documents. Even if the knowledge base is a limited in-house system, the documents therein are mission-critical and contain valuable heterogeneous knowledge. Our aim is to enhance the Information Access to provide improved semantic *navigation and interaction in information spaces*.

We follow an exploratory approach to work towards semantic contextual recommendations [1] and structured semantic search [6]. A sole recommendation system with no user refinement can be insufficient. We therefore will adapt it towards an improved navigation which presents suggestions, but is open to user refinement [5]. Furthermore, there are different categories of recommendations based on different information needs. These navigational categories from different perspectives could include:

- hierarchically related documents
- related or similar projects, workflows, and tasks
- project overviews
- documents accessed by colleagues in similar tasks
- workflows used by colleagues
- similar parts of a similar project

[1] `http://www.linkeddesign.eu/`

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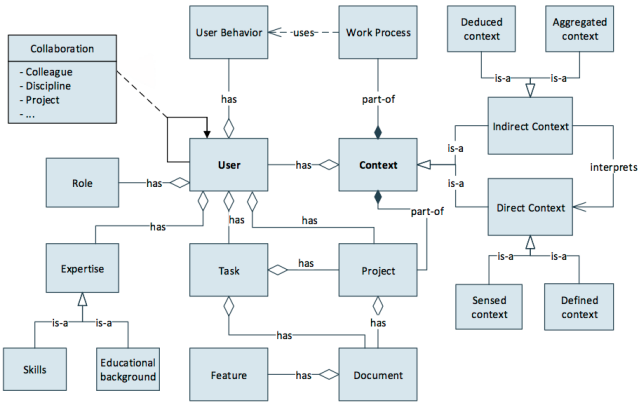

Figure 1: Conceptual model of available context

- related parts in similar projects
- specializations / generalizations
- similar type of document (project documents, module documentation, design drawings, lessons learned, best practices, etc.)
- different organizational perspectives (engineering, management, client relations, controlling, ...)

To understand and retrieve these relations, we need to understand the context and tasks [4]. Some domain-specific context features are already available for the user context, work-task [2], and project context, and context from the knowledge base and the individual document. We can further break these down into links and relations between documents or metadata describing, e.g., conceptual level, level of detail, phase of the lifecycle, project environment, type of document, and the more commonly used metadata such as author, date, topic, etc. Selected context features are shown in Fig. 1. These will be complemented with content-based methods and with data gathered from user behaviour.

Usually, recommendations are generated by inferring relations between documents based on users' interaction with them, with common challenges regarding the level of uncertainty for their results. In our case, a major challenge is estimating which of the mentioned social circles contribute to what extent to the search tasks and how they can be made to work in her favour by supplying the right information by direct recommendation, inform the ranking when she is searching for information, of help her to better filter and manage data, documents, or knowledge objects. Another challenge is that personalisation goals can change a lot during a work task, as she can take on different roles. Finally, there is the problem of sparse and insufficient data, as we have a much smaller number of documents, users, and interactions than in large-scale systems, which can make statistical approaches biased or wholly inapplicable [8]. Using conventional approaches, this would put us into a permanent cold start condition.

We therefore exploit the rich domain-specific context we get from the scenario to better focus the recommendation. In first feasibility analyses, we take hints from the literature [1, 6, 8, 2, 3, 9] and include additional context features lead to the conceptual context model in the engineering environment shown in Fig. 1. The context model is work in progress and will be refined with context features of users and documents as well as document metadata and content taken from a reference ontology developed in parallel.

The personalisation is still informed by the interaction of the users with the document database, but the context is used to offset the sparsity of interaction data. One exemplary task is to retrieve and understand the design decisions leading to a certain set of rules for structural components. The system will enable users to not only search for similar structures or access relevant documentation, but also for cases where similar problems had to be solved, which can give hints towards high-level alternatives. It might also be possible to learn certain workflows or best practices from other engineers. This is complicated by the fact that the more experienced an engineer is, the less they need to access related documents. This is one of the questions we aim to explore in interviews and later from the live system as part of the evaluation.

3. CONCLUSION

We have presented our initial work towards the integration of KBE and Recommendation Systems in a domain-specific and context-rich application scenario. The domain is different from those examined in the literature which means that we will have to heavily adapt and refine existing solutions as well as develop tailored methods. Our goal is to use the described context information of the users and their connections, the organisation, and the documents space to enrich, support, and improve workflows in the manufacturing engineering domain. We will further extend this preliminary work towards a better understanding of the design workflows and information needs [10] and an identification of those parts that would most benefit from personalised recommendations and navigation.

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