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Bachelor Thesis

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Design, Piloting, and Evaluation of an Expert Finder System Prototype for Enterprise Organizational Structures

by

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List of Abbreviations

EFS	Expert Finding System
ELS	Expertise Location System
DTT	Deutsche Telekom Technik GmbH
T-FOPS	Field Operations Mobile
T-FOBIZ	Business Operations
T-FOC	Field Operations Mobile CORE
T-FORN	RAN Norddeutschland
T-FORS	RAN Süddeutschland
T-FOBOD	Digital Unit
T-FOBOS	Operations Support
T-FOBOT	Temporäre Mobilfunkversorgung
F-FOBOV	Vergabemanagement
NLP	Natural Language Processing
AI	Artificial Intelligence
UI	User Interface
ML	Machine Learning

1 Introduction

1.1 Background

In this section, the background of the thesis is presented. The section is divided into five parts. First the term EFS is defined, followed by providing a historical overview of the developments in the field of EFS. Afterwards the current state of EFS is briefly discussed. Finally, the organizational structures and technological foundations are presented in the last two parts of the section.

1.1.1 Definition of EFS

Traditionally, an EFS or Expertise Location System (ELS) is a tool or technology, that enables users to identify and locate subject matter experts with the aim of acquiring or utilizing the expert's knowledge (M. T. Maybury 2006, p. 1). According to M. T. Maybury (ibid., pp. vii, 3), an EFS must fulfill certain key requirements:

- **Identification:** An EFS must be able to identify experts. This can be achieved through self-nomination by the expert, or the automated identification based on documents like publications (ibid., pp. vii, 3), (Stankovic et al. 2010, p. 3), expert communication or the analysis of expert activities.
- **Classification:** An EFS, based on a variety of different sources of evidence, must classify the specific type and level of expertise an expert possesses, and
- **Validation:** Assess the range and depth of an expert's professional knowledge and skills. This can be done by human validation in the form of assessing qualification evidence, or by automated user feedback in the form of ratings or reviews.
- **Ranking:** The system must have the ability to rank experts based on different factors like field of expertise, experience, certification, publications and reputation.
- **Recommendation:** An EFS has to be able to return an ordered list of experts or groups of experts based on specific expertise needs in combination with importance criteria (e.g., experience, reputation etc.)

While the traditional definition of EFS offers a comprehensive overview regarding the requirements for identification and classification of experts effectively, the specific context of this thesis requires some modifications for the definition to be applicable to the thesises

use case. The thesis is less focused on the knowledge transfer between experts and users, but rather on a much more goal-oriented approach in which the main objectice is to find specific contacts in the company in order to solve or complete certain problems or tasks. The focus is therefore less on learning what the experts know but more on the system telling the user who the experts are and what they need to complete certain tasks, or even providing the user with workflows to solve the task. Based on this, the following definition for EFS is proposed: An EFS is a specialized system, that not only identifies relevant experts and contact persons within an organization, but also provides the user with concrete recommendations for solving specific problems and providing the user with resources to solve the problems and tasks efficiently. In contrast to the traditional definition, where transfer of knowledge is the main focus, the main goal of the EFS in this thesis is the direct support in accomplishing tasks.

1.1.2 Historical Context of EFS

First appearances of the concept of EFS can be traced back to the late 1990s and early 2000s with contributions like “Enterprise expert and knowledge discovery” (Mattox, M. Maybury, and Morey 1999) and “Facilitating the Online Search of Experts at NASA Using Expert Seeker People-Finder” (Irma Becerra-Fernandez n.d.) as well as "Searchable Answer Generating Environment (SAGE): A Knowledge Management System for Searching for Experts in Florida" (Irma Becerra-Fernandez 1999). These early systems had the primary goal of connecting users with experts in order to facilitate knowledge transfer and collaboration, often in an academic setting. (Mattox, M. Maybury, and Morey 1999, p. 1) (Irma Becerra-Fernandez n.d., pp. 3–3) (Irma Becerra-Fernandez 1999, p. 3). Technologically, these systems relied heavily on keyword search with basic search approaches as can be seen in Mattox, M. Maybury, and Morey (1999, pp. 4–5) for example. However, early approaches of Artificial Intelligence (AI) in the form of data mining and clustering techniques were utilized in Irma Becerra-Fernandez (n.d., pp. 3–1) to enhance their functionality, and early research on the role of AI technologies in EFS was conducted by Becerra-Fernandez (2000). Following, M. T. Maybury (2006) conducted extensive research on the topic of EFS in the Paper “Expert Finding Systems”. Those early research efforts not only laid the foundation for the research on the topic, but also highlighted the potential, future technologies could have on the field of EFS. Over the years, the need for EFS has only increased, with expertise becoming more and more recognition as a key asset for companies (Husain et al. 2019, p. 1). Developments of the last 20 years like globalization, digitization or remote work and trends such as agile working have, on the other hand, added a new layer of complexity in this field.

1.1.3 Current State of EFS

Today, EFS are used in a variety of different contexts and industries like in academia, enterprise or medicine. Usecases range from finding research collaborators, over recommending developers for specific tasks, up to forming teams (Husain et al. 2019, pp. 2, 9). Additionaly the technologies used in EFS have evolved over the years. While traditional EFS relied heavily on keyword search as seen in Mattox, M. Maybury, and Morey (1999, pp. 4–5), modern EFS utilize AI technologies like Natural Language Processing (NLP) and Machine Learning (ML) to enhance their search quality aswell as information retrival (Husain et al. 2019, pp. 19–20). Those technologies also enable the processing of significantly larger amounts of data resulting in a more effective counter to the data overload problem, wich is one of the reasons EFS are needed in the first place (ibid., p. 1).

1.1.4 Organizational Structures

Corporations face the challenge of implementing EFS that fit their specific needs and organizational structures. Four of the most commonly used organizational structures are the functional structure, which focuses of a clear chain of command and separates the organization into different departments based of their expertise (*What is Matrix Organization?* 2024) , a product- or market-based structure where different departments are based on different products or markets instead of expertise, the geographical structure which divides teams based on their location and a process based structure which groups the employees into teams based on the business processes they are engaging in. (Organ 2023) An alternative approach is the matrix structure. The matrix structure is on the rise with 84% of employees being “matrixed” in some way according to a study of cross-functional teams conducted by Gallup (Inc 2024, page 65). The Matrix organization stands out by having multiple lines of reporting, meaning that employees have two or more bosses effectively (*What is a Functional Structure in an Organization?* 2024; Organ 2023). This makes the Matrix organization a great match for agile working and cross functional teams. The main challenge that needs to be addressed regarding an EFS in a Matrix organization are dynamic and constantly changing tasks and fields of expertise, as people are incentivized to grow in those environments. Therefore, an EFS has to be able to handle those constant changes in ability, especially because it is nearly impossible for the employees to keep track of all their colleagues’ skills over time.

1.1.5 Technologies

1.2 Research Question

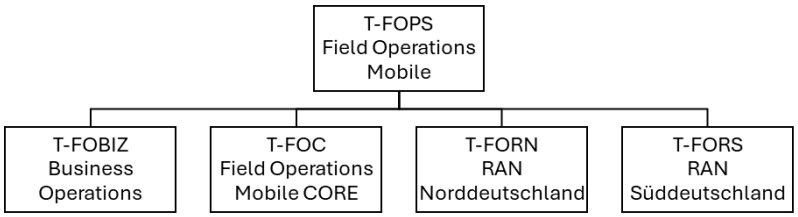
The main research question of the thesis is: How can an Expert Finder system for corporate structures be designed and implemented? In order to answer this question, the question is broken down into smaller subquestions:

- *What are the key functionalities an expert finder should possess?*
- *How can the user interface be designed to enable intuitive usage?*
- *Which AI supported search method is best suited for the expert finder based on accuracy, scalability and ease of integration?*
- *How can a workflow system be implemented to provide the user with concrete recommendations for solving specific problems?*

1.3 Problem Statement

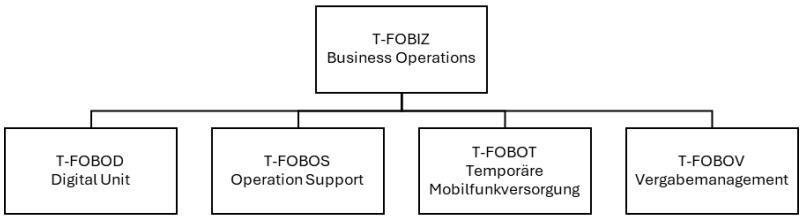
In an Harvard Business Review article, John Ferraro, the former COO of Ernst & Young suggests, that in order to keep up with the pace of change, companies have to constantly reorganize. (Heidari-Robinson and Heywood 2016) On the other hand, according to a McKinsey survey, over 80% fail to deliver the hoped-for value in time, with 10% even causing real damage to the company.(ibid.) The article also states that two-thirds of company reorganizations do at lease improve the performance to a degree. (ibid.) This suggests that there is still some room for improvement regarding the performance. This room can be utilized by increasing the efficiency of internal processes with an EFS in a few ways. This paper evaluates the design and piloting of such an EFS at the T-FOPS (Figure 1) team at Deutsche Telekom Technik GmbH (DTT). T-FOPS utilizes a mixture of different organizational structures. On the top-level it is a functionally and partially geographical divided in the sectors T-FOBIZ, Field Operations Mobile CORE (T-FOC), RAN Norddeutschland (T-FORN) and RAN Süddeutschland (T-FORS), the last two meaning North- and South-Germany. The Thesis will focus on T-FOBIZ (Figure 2) which is subdivided functionally into the Digital Unit (T-FOBOD), Operations Support (T-FOBOS), Temporäre Mobilfunkversorgung (T-FOBOT) meaning temporary mobile coverage, and Vergabemanagement (F-FOBOV) meaning procurement management.

Figure 1: Organization Chart T-FOPS



source: own illustration

Figure 2: Organization Chart T-FOBIZ



source: own illustration

1.4 Structure of the Thesis

This thesis is structured in seven chapters to provide the reader with a comprehensive understanding of the topic and the research conducted. The first chapter introduces the topic in highlighting the background of the thesis as well as the research questioin. It also defines the scope and limitations of the thesis. The second chapter outlines previous research conducted on the topic of EFS and provides the fundamentals of the technologies utilized in this thesis. Additionaly it identifies the research gap that this thesis adresses. In the third chapter the methods used for research and development are highlighted to provide the reader with an understanding of the research process. The fourth chapter presents the implementation of the EFS and discusses technical details of the implemented system. The fifth chapter evaluates the proposed system in establishing evaluation critera, and analyzing feedback and performance. It also tries to adress the strengths and weaknesses of the system. In the sixth chapter, the results of the previous chapters are interpreted and discussed. Lastly, in the seventh chapter concludes the work by summarizing the findings, pointing out potential optimizations and proposing future work.

1.5 Scope and Limitations

1.6 Background

Expert finding is an important asset especially for big corporations, as it can boost efficiency and lower the barrier of entry for new employees.

In the context of this thesis, an (EFS) is defined as a specialized system, designed to help employees identify and find:

- Individuals with specific expertise, skills or responsibilities
- Relevant topics and information
- Workflows to solve specific concerns

In addition the (EFS) is characterized by:

- An AI search to match the user's query with the most relevant results
- A user interface that is intuitive and easy to use
- An administration and maintenance system that allows the administrators to manage the data and the users to report changes and errors in the data

While examples like Research Gate or LinkedIn are more general approaches to EFS, corporations face the challenge of implementing EFS that fit their specific needs and organizational structures. Four of the most commonly used organizational structures are the functional structure, which focuses of a clear chain of command and separates the organization into different departments based of their expertise (*What is Matrix Organization?* 2024) , a product- or market-based structure where different departments are based on different products or markets instead of expertise, the geographical structure which divides teams based on their location and a process based structure which groups the employees into teams based on the business processes they are engaging in. (Organ 2023) An alternative approach is the matrix structure. The matrix structure is on the rise with 84% of employees being "matrixed" in some way according to a study of cross-functional teams conducted by Gallup. (Inc 2024, page 65) The Matrix organization stands out by having multiple lines of reporting, meaning that employees have two or more bosses effectively. (*What is a Functional Structure in an Organization?* 2024)(Organ 2023) This makes the Matrix organization a great match for agile working and cross functional teams. The main challenge that needs to be addressed regarding an EFS in a

Matrix organization are dynamic and constantly changing tasks and fields of expertise, as people are incentivized to grow in those environments. Therefore, an EFS has to be able to handle those constant changes in ability, especially because it nearly impossible for the employees to keep track of all their colleagues' skills over time.

The efficiency of EFS is closely tied to the different technologies that are being used. Therefore the following components and technologies are of interest for the EFS:

- **Reliable data:** Data quality is one of the most important factors for the success of an EFS as it is the basis for the search algorithm. Some of the more popular data sources of commercial tools are Self declared data, Documents and Databases (M. T. Maybury 2006, page 18)
- **Search algorithm:** The search algorithm is the core of the EFS. It has to be able to handle the data and provide the user with the most relevant results. Here Keyword search, and Boolean search are the most common methods with the Natural Language Search which utilizes NLP being on the third place, thogh since the release of the paper by Mark T. Maybury in 2006 (ibid., page 18), NLP has gained a lot of popularity especially through the rise of AI and Machine Learning with applications in Chatbots, Voice Assistants and Sentiment analysis (Administrator 2023).
- **User Interface (UI):** The UI is the interface between the user and the EFS. It has to be intuitive and easy to use in order for the user to actually use the EFS. The UI of an EFS most commonly consists of different components like a search bar, a results overview and detail pages for each result based on the review of big EFS like LinkedIn (*LinkedIn* 2024), Research Gate (*ResearchGate | Find and share research* 2024) or Expertise Finder (*Expertise Finder | Expert Systems, Online Directory* 2024). Regarding the results overview, a list of experts seems to be the most common approach, with related documents and related concepts also being provided in some cases. (M. T. Maybury 2006, page 18)
- **Administration and Maintenance:** The EFS has to be maintained and updated regularly in order to keep up with the changes in the organization. This includes an Admin-Panel for the administrators to manage the data, as well as a feedback system for the users to report changes and errors in the data.

2 State of Research

2.1 Expert Finder Systems

2.2 Technological Foundations

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4.2 Technical Challenges and Solutions

4.3 Testing and Debugging

5 Evaluation

5.1 Evaluation Criteria

5.2 User Testing

5.3 Strengths and Weaknesses

6 Conclusion and Outlook

6.1 Conclusion

6.2 Outlook

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Reference of AI Tools

I hereby declare that I have used the following AI tools for this thesis:
• DeepL for translating parts of the thesis from German to English
• GitHub Copilot for code suggestions and completions for the LaTeX code
• OpenAI ChatGPT for supporting the brainstorming ideas for the thesis

Declaration in lieu of oath

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