

Traceability-based Knowledge System

For the HR Contact Center of the Dutch Government

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P-Direkt
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Abstract

Managing Knowledge is important for an organization. A Knowledge Management System (KMS) helps with this, but only when is successful in retrieving the right knowledge. For starting companies, a self-developed system offers a solution, but provides challenges in the future. P-Direkt is at a stage where they encounter challenges with their current system and are searching for a new system. For this master thesis we identify the challenges that occur in the current tool and how they can be solved with a Traceability-based Knowledge System. The biggest identified challenge is searching for information, keeping information complete and up-to-date. By combining the challenges and common functionalities of a KMS, we developed a web-based prototype of a Traceability-based Knowledge System to validate how the identified challenges can be solved using a KMS. The aim of this study is compare two systems and how a new system is able solve existing challenges.

Keywords: Knowledge Management System, Traceability

Acknowledgement

After a long time of writing, researching and developing a demonstration tool, I can finally say that another era of my life is finished. This is the end result of my master thesis of Business Informatics. It has been an interesting time where I learned a lot about myself, Knowledge Management System, developing a web-based system, and working for a government organization. Since I would not have been able to gather all this knowledge alone, I want to acknowledge the people that supported me.

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1 Introduction

Knowledge is found everywhere and is becoming more important as competitive advantage [10]. Knowledge is based on information, which is based on data [13]. To effectively make use of all the knowledge in the organization, Knowledge Management (KM) initiatives are executed. One of the building blocks in a successful KM is a Knowledge Management System (KMS).

The implementation of KM and a KMS is not simple for every organization. This is also the case for P-Direkt, a Shared Service Center (SSC) for the Dutch government that provides Human Resource Management (HRM) services to civil servants.

In this research we discover the readiness of P-Direkt for a new Traceability-based Knowledge System, by conducting interviews and surveys among the employees, literature reviews about KMS and Traceability to find the current state of the organization. After that we design an artifact for a new system based on the requirements of the employees, and lastly we validate the design.

First we discuss the problem statement, followed by the Research Design. The Research Design explains the research method, the research questions and gives an elaborate description of the tasks in this research, followed by the design in a nutshell.

Chapter 2 provides background information about P-Direkt and the Kennis Direkt Tool (KDT), the current system.

Chapter 3 discusses the results of the first task Problem Investigation, with the empirical evidence of the management interviews, the survey among employees and the literature review. This chapter is concluded by answering the first research question.

Chapter 4 discusses the design of the artifact. The artifact is designed by implementing User Stories based on the results of the task Problem Investigation, and the result of the state of the art of KMSs. This chapter is concluded by answering the second research question.

Chapter 5 discusses the validation of the designed artifact by conducting an experiment. This chapter is concluded by answering the last research question.

In the last chapter, we conclude the research and look into future research.

1.1 Problem Statement

P-Direkt stands at the beginning of expanding the organization's communication channels and incorporating new technology. One of the new technologies is a new system to manage and store information and knowledge. Knowledge and information are necessary to perform their core duties of answering customer questions and processing requests.

The expansion is part of the master plan for 2016-2020 [28] to anticipate and react to new developments in the environment of P-Direkt and its customers. Themes in these developments are mobility, flexibility and working independently of time and place. The master plan defines five tracks to bring the services of P-Direkt to the next level and to connect with the various groups of customers. Since the customer is important for P-Direkt, one of the tracks in the master plan is to update the ICT landscape for customer interaction. The aim of this track is to provide a better and faster customer interaction and to update the technical and organizational design of the Contact Center.

The expansion of communication channels is included in the modernization of customer interaction. For this expansion, there need to be a good base for answering customer questions. The current system is a Microsoft Excel-based tool that conforms to minimal requirements, such as accessible by employees. The problem with the current system is that the tool is limited and inflexible. It is not stable enough for a long-term use and cannot facilitate the expansion into omni-channel communication and facilitate new functionality, such as automation and analysis. Beside the usability of the tool, the information in the tool is not of sufficient quality to directly transform it to a new system.

A new KMS will provide the foundation to facilitate the future vision, provided that the information and knowledge in the tool is of sufficient quality. A new system will also give the employee the necessary information in a fast and easy way, and can be integrated into the existing systems to provide more efficiency when answering customers' questions. With Traceability we help the system and employees in finding the correct and most recent information.

When the current system is not updated, the future adoption of this system by customer is not possible because of the local characteristic of the tool. Frustrations about the search functionality of the system will increase over time, giving the system a negative experience and employees will find their answers by colleagues. This results in distracted employees that cannot perform their own duties. This affects the service of P-Direkt to their customers.

From this scenario, we see that for this research the employees of the Contact Center (CC) are the most important stakeholders. They encounter the most direct problems while working with this system, for example while trying to find the correct and necessary information to help the customer. The customer is an indirect stakeholder of the system, because they do not work directly with it, but are dependent on the employees. The management is also a stakeholder, since they need to support their employees with the system and gets the most benefits from satisfied customers.

To satisfy these stakeholders, the right system needs to be selected to cater to the different wishes of management and employees. Therefore the frustrations of the current system need to be identified, so that selection criteria for the new system can focus on solving these frustrations.

1.1.1 Definitions

For this research it is important to define concepts that are used during the project. For each concept we highlight the important aspects of this definition.

Knowledge Management System (KMS)

"an *ICT system* in the sense of an application system or an ICT platform that *combines and integrates* functions for the contextualized handling of both, *explicit and tacit knowledge*, throughout the organization or that part of the organization that is targeted by a KM initiative." [26]

Knowledge Management (KM)

"the process of applying a systematic approach to the *capture, structure, management, and dissemination of knowledge* throughout an organization in order to *work faster, reuse best practices, and reduce costly rework* from project to project." [10]

Traceability

"the ability to *follow* the life of an *object developed* during software engineering from its *creation* to its *use*." [34]

Traceability is grafted to system development, but can also be applied to document traceability and knowledge traceability.

Kennis Direkt Tool (KDT)

the current Microsoft-Excel-based tool for the employee to find relevant information about process information, instructions and other knowledge.

Traceability-based Knowledge System (TKS)

the designed artifact for this research. This is a web-based tool for an employee to find relevant information about process information, instructions and other knowledge.

1.2 Research Design

This section describes the Research Design of the project. First we describe the research method, followed by the research questions and a short description of each task in the Design Cycle.

1.2.1 Research Method

We are going to conduct a Design Science project that consists of several tasks (comparable to phases). Design Science is the design and investigation of artifacts in context [42]. In this case, we are going to investigate the design of a novel traceability-based knowledge system in the context of P-Direct. This is translated to the following main research goal:

Translating the current system to a new Traceability-based Knowledge System.

Within Design Science, there are two cycles: the Design Cycle and the Empirical Cycle. For this project we follow the Design Cycle with the intention to design a new artifact to mitigate the current needs of P-Direct regarding to the improvement of the current knowledge system for finding the correct information to answer the customer's questions. This Design Cycle guides the execution of three main tasks: Problem Investigation, Treatment Design, and Treatment Validation. Each task is further explained in section [Design Cycle](#).

1.2.2 Research questions

To achieve the main research goal, we formulate a set of research questions. Each task in the Design Cycle has a corresponding main research question, which is accompanied by subquestions.

In Problem Investigation we are going to analyze the current phenomena at P-Direkt. The main research question to be answered in this task is:

RQ1: What is the existing support for a Traceability-based Knowledge System?

To answer this question we are going to perform interviews within management and a survey among employees to identify challenges in the current organizations, and establish related work of traceability and knowledge systems.

In Treatment Design we are going to design a possible solution for the challenges found in the first task. The main research question to be answered in this task is:

RQ2: How to build a traceability-based knowledge system?

To answer this question we are going to divide it into the following subquestions:

RQ2.1: What are requirements of a Traceability-based Knowledge System?

To answer this question we are going to analyze the inputs of the main results of the survey, interviews and literature review as part of RQ1. With the results of the analysis, we specify the requirements for a new knowledge system.

RQ2.2: What are the available tools to support a new system?

To answer this question we are going to review the state of the art.

In Treatment Validation we are going to validate the design of the second task. The main research question to be answered in this task is:

RQ3: What are the effects produced by the implementation of a Traceability-based Knowledge System in real world context?

To answer this question we are going to conduct an experiment to evaluate the stakeholders' perceptions.

1.2.3 Design Cycle

In this section, we describe the activities that take place in each task, and their corresponding method to extract the necessary information. The figure 1 presents the tasks (T) of the Design Cycle and their relationships with the research questions that we established in the previous section.

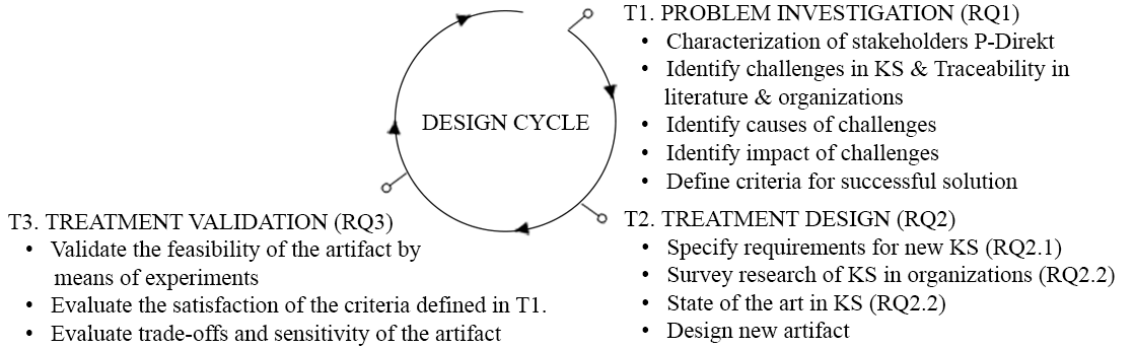


Figure 1: Design Cycle for a Traceability-based Knowledge System.

1.2.3.1 Problem Investigation

In the first task of the Design Cycle, Problem Investigation (T1), we investigate the phenomena before an artifact is designed and when no requirements for an artifact have been identified yet [42]. In other words, we need in-depth knowledge about how the current tool (KDT) works and where the problem lies. In chapter 2 we described how the KDT works as part of the background information. This information is collected by observing employees on the work floor who are using the KDT, demonstrations of the KDT, reading internal documents, and interacting with employees.

We need a more extensive research to find the phenomena of the problem. The first activity in this research is to characterize the stakeholders. Most stakeholders are identified with the collection of background information about the organization. The second task of identifying challenges in KSM and Traceability, is divided into two parts: empirical and literature review.

The empirical evidence (chapter 3) is conducted in two parts. The first part is a semi-structured interview with management about the frustrations (challenges) they come across or hear from their employees, and their vision of a new system. For the interview protocol see appendix A. Their responses are analyzed and clustered into categories (see appendix B)[27].

The second part is a survey among a select number of employees of the Contact Center. This survey collects the responses to the Five W's and How questions about their frustrations while using the KDT (see appendix C). These responses are also analyzed and clustered into categories (appendix D). The interviews and survey are also used to identify the causes and the impact of the challenges, and the success criteria of the to-be-developed artifact in T2.

The literature review consists of gathering literature using the snowballing method and by using the keywords: Knowledge management, Knowledge management systems, traceability, challenges, benefits, and success factors. The findings of the literature review (appendix E) are compared to the findings of the empirical evidence, to give scientific proof of existing challenges in the organization and to identify gaps between theory and practice.

1.2.3.2 Treatment Design

In the second task, Treatment Design (T2), we design one or more artifacts that could treat the problem. This task is split into several activities and two subquestions. The first question (RQ2.1) and activity are about the requirements of the new system. We specify User Stories as requirements based on the surveys conducted in T1 with the employees and the management interviews. We divide the User Stories into three perspectives, work floor, future and technical perspective.

Simultaneously we conduct the second activity, a state of the art review, collecting all available tools offered by the current software supplier. This answers RQ2.2 about the available tools. In this review, we collect and compare functionalities to find the common features in a KMS.

The last activity of this task is to design the new artifact to solve (some of) the challenges identified in the previous task. We explain how the implemented functionalities differ from the KDT and how this solves the challenges. Together it answers the second research question (RQ2).

1.2.3.3 Treatment Validation

In the last task, Treatment Validation (T3), we validate the designs made in T2 by conducting an experiment. This experiment validates the feasibility and satisfaction of solving the challenges, and evaluate the effects of the artifact in a real world context. This answers the last research question (RQ3) about the effects produced by the implementation of the artifact. Dependent on the designed artifact, we formulate a validation method.

1.3 Design in a nutshell

The new KMS is a Traceability-based Knowledge System. This system consists of the management of knowledge and information throughout the organization, and providing traceability links between the knowledge, information, employees and customer's questions. The system's design is based on requirements which are formulated by the results of the empirical evidences of management and employees. On the way to the new system, requirements and the necessary maturity of the organization is documented and improved. The requirement and maturity level is validated by empirical evidence.

The overall design is developed as a demo prototype to display the possibilities a Traceability-based Knowledge System could have compared to the current system. The focus of this new system is to model search strategies and how a system needs to be configured to get the right results to overcome the SEARCH challenge.

Another aspect of the design is the Traceability of documents to people and documents to documents. This prepares the system for analysis, but also to set up the means to be able to manage the content better and overcome the challenge ANALYZABLE and COMPLETENESS AND VALIDITY OF INFORMATION.

1.4 Summary

P-Direkt stands at the beginning of changing the current knowledge system into a new Traceability-based Knowledge System. Management thinks that the current tool, the KDT, is not sufficient for the future vision of expanding communication channels, integrating the different systems and modernizing the ICT landscape.

In this thesis, we are exploring the problem and solutions to achieve the main research goal to translate the current tool to a new Traceability-based Knowledge System. This exploration is conducted by following the three tasks of the Design Cycle of Wieringa [42].

1. *Problem Investigation.* In this task we find current state of the system through empirical evidence of management interview and a survey among employees, and a literature review.
2. *Treatment Design.* In this task we design an artifact that treats the problem identified in the previous task.
3. *Treatment Validation.* In this task we validate the designed artifact in the second task.

In the following chapter [Background](#) we give some background information about P-Direkt and we discuss how the current tool, the KDT, works. In chapter [Problem Investigation](#) we describe the results of the interviews, the survey and the literature review. Chapter [Treatment Design](#) describes the design of the artifact, which is validated in chapter [Treatment Validation](#). This research is concluded in the last chapter.

2 Background

In this chapter we sketch the background and context of this project. We first discuss the organization of P-Direkt, what it does, how it began and the structure of the organization. This is followed by an explanation of the current situation in which we discuss the back-end of the system, the current developments and how the tool works.

2.1 About P-Direkt

In 2003, the former cabinet decided to found P-Direkt as compliance with the Shared Service Center HRM [40]. This decision was based on a business case with a focus on effectiveness and efficiency. The foundation of P-Direkt should result in a saving of 400 million euro for the Government. This could be realized by joint investment, with exception of the Ministry of Defense, in a new IT system for personnel registration and payroll. The system would have a focus on self-service by the civil servants. With this direction, personnel registration and payroll of the various departments would be centralized [40].

In collaboration with IBM, the IT trajectory was put in motion. At the end of 2005, this collaboration was terminated, resulting in a pause in the founding of P-Direkt. The ministries then decided to join in a task force to continue the founding independent of external organizations. After the sanctioning by the House of Representatives in 2007, P-Direkt could officially start forming the organization as a branch of the Ministry of the Interior and Kingdom Relations [30, 40, 41]. The forming of the organization consisted of two phases:

1. Centralization and standardization of HR processes, implementation of IT systems, and implementation of the new systems and procedures at the ministries.
2. Forming of the Contact Center.

P-Direkt operates on the mission to deliver modern, efficient, reliable and directly accessible business services with a focus on staff. The services are delivered by and for civil servants.

2.1.1 Services of P-Direkt

P-Direkt offers the services of automated administrative processing of personnel processes. P-Direkt also delivers current information about laws and regulations about personnel, salary and terms of employment. They offer management and policy support agencies information about personnel and salary, they manage and process documents for the personnel files of customers, and they communicate with third parties such as Belastingdienst and health & safety services [29].

The quality of the services are measured in Key Performance Indicators (KPIs) [31]. Every quarter the following KPIs are checked:

- Customer satisfaction higher than a 7.
- Processing of requests, questions, documentation and complaints within five workdays or before salary payment.
- Response time of a customer connecting with an employee is less than 60 seconds.
- P-Direktportaal is available 24/7.
- Contact Center is available between 8 a.m. and 10 p.m.
- Reliability

The supporting systems play an important role in helping employees to achieve these KPIs. Among the supporting systems are the telephone system, Customer Relationship Management (CRM) system and the KDT.

2.1.2 Organization structure of P-Direkt

The organization consists of several departments (see figure 2) and houses over 600 employees. The Contact Center (CC) is the largest department of about 500 employees and responsible for the handling customers' questions and tasks. This department is divided over three locations: Den Haag, Zwolle and Bonaire. The director of the CC is supported by seven group heads ('Groepshoofden'). Each group head directs several team leaders who are spread across the department.

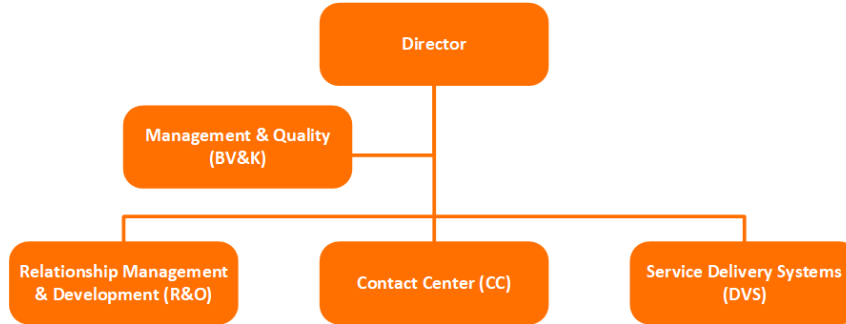


Figure 2: Organization structure of P-Direkt.

Below the director and management, the CC is split in two, so-called, lines. The First Line handles first contact with the customer and formulates tasks. This is the team Customer Contact & Implementation ('Klantcontact & Uitvoering', K&U). The Second Line is responsible for complicated customer questions and processing requests. It is divided into several teams. Each team is responsible for certain aspects of HR. For example Team Leave & Absence ('Verlof & Verzuim') is responsible for the process Leave.

Both lines are dependent on knowledge and information to perform their duties. The next section explains how the employees of the CC access the information through the KDT.

2.2 Current situation

The Kennis Direkt Tool (KDT) is the current tool for the employee to find relevant information about process information, instructions and other knowledge.

The goal of the KDT is to provide all the information an employee needs to answer the customer's question and to process requests. Before the introduction of the KDT in 2015, all necessary information could be found in different locations. For digital information they could go to the Rijksportaal and an internal shared drive, but they also had notebooks, post-it, Quick Reference Cards and printed instructions on their desk. This could result in different (wrong) answers for one single question. Searching for answers in multiple sources and manually searching the paper achieves for answers leads to inefficiency and low quality, resulting in not achieving the formulated KPIs. This is the main reason for the Management Team CC to approve the build of a knowledge base.

2.2.1 KDT Back-end

The KDT is programmed as a knowledge base in a Microsoft Excel application. A knowledge base is a store of information or data that is available to draw on [1]. The KDT itself does not store all the information, but it provides the means to easily access the information stored in different locations previously mentioned.

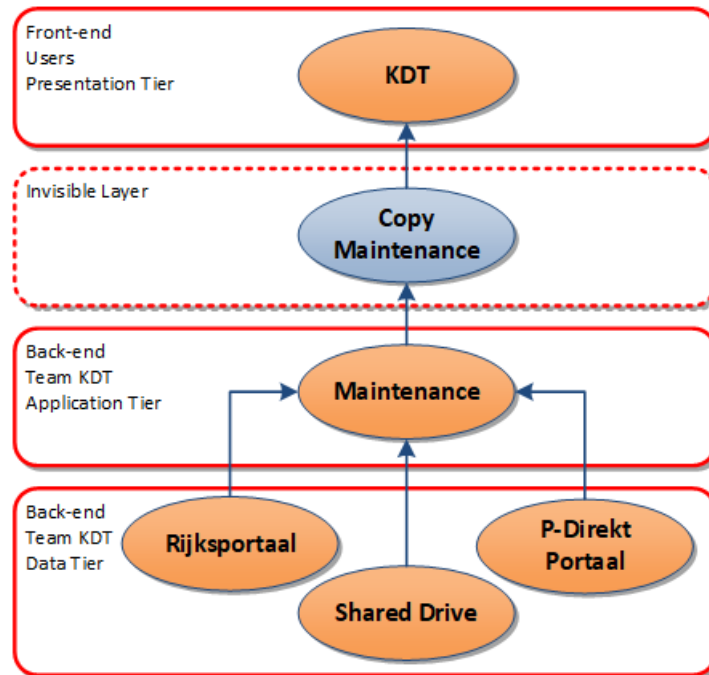


Figure 3: Backend of the KDT.

The KDT is similar to a three tier model (see Figure 3). The tool consists of two files connected to each other, and the information stored at the previously mentioned locations (Data Tier). One of the files (KDT, front-end) consists of the layout and builds up of the interface. Based on macros that execute VBA scripts, the interface is initialized and updated. This is similar to the Presentation Tier. A copy of this file is distributed to the employees for their use. The other file (Maintenance, back-end) consists of all the links between clickable items in the KDT and the location of corresponding information, and what clickable items are connected to a specific subject or page. Any changes in information is applied in this file. This is similar to the Application Tier.

In order to continuously develop and update the KDT, an invisible layer is installed between the front-end (users) and back-end (developers) with a copy of the maintenance file. The front-end communicates with this invisible layer, so that a modification in the maintenance file does not disrupt the workflow of the employees using the KDT. This construction is necessary because an Excel file is locked for writing when the file is already opened by another user.

Before the information can be changed, there needs to be a notification on what information has to change. This can happen in multiple ways. The employee can inform the team that is responsible for the KDT (Team KDT) in the KDT itself. The KDT provides a button to react and send a mail with the relevant information on what to change. Team KDT then checks if the notification is indeed incorrect in the KDT. When it is identified as an issue, the information is checked by a Know-how ('Vraagbaak'). From there either the information is changed by Team KDT in the maintenance file, or it is discarded when the given information is incorrect.

Another way to change information in the KDT is when new information is provided by Process Owners. This information change can be directly implemented into the KDT. Bugs and other issues can also be reported via the react button in the KDT. This information is sent in the same way as a request for information change. Only after the initial check if it is indeed an issue, the developer of the KDT, who is a member of Team KDT, solves the bugs or expand the KDT with requested modules.

The various teams are responsible for the content management of the documents concerning their processes. The structure and format of the document and folders are not recorded in an organization wide agreement. Each team has their own method of placing documents in folders. So does one team places each document into a corresponding folder, while another team just randomly place documents in a folder. Also the type of documents differ per team, varying between PDF-files, Word-, PowerPoint- and Excel-documents. In addition version control is not placed in every document, even as an archive, resulting in old document that are still visible in the folder. In short, content management is not regulated.

2.2.2 Continued development of the KDT

Information changes continuously, therefore the KDT needs to be updated to give users the latest information. As mentioned earlier, users can react in the KDT to inform the Team KDT about missing or outdated information. Besides that, P-Direkt also looks into improving the user experience. At the time of the beginning of this research, P-Direkt is working to translate the processes one-by-one from the old version into a new KDT (KDT 2.0 Mijn P-Direkt). The vision of the KDT 2.0 is to provide a comprehensive knowledge system (tool) that is uniformly shaped per process and that meets the wishes of the employee and customer. At the end of 2018, the KDT 1.0 is completely translated into the new version and cease to exist.

2.2.3 How does the KDT work?

To get more insight in the differences between the two versions of the KDT, an example is described. This example also describes how the KDT is incorporated into the workflow of the employees.

The homepage of the KDT in both versions consist of three groups of tiles.

- Three options to search topics (and the search bar) (orange tiles).
- Applications and tools (dark blue tiles in the ribbon).
- Links to various sources (dark blue tiles below the ribbon and light blue tiles).

In the integrated version (Figure 5) there is also a big tile (picture tile) to go to the renewed processes.



Figure 4: Homepage of KDT 1.0



Figure 5: Homepage of KDT 2.0

Dependent on the customer's question and employee's knowledge, the employee selects either an application or tool, or search item or one of the various linked sources. For example, one of the processes that is renewed is the process to change the salary scale ('Salarisschaal wijzigen').

2.2.3.1 Example of workflow in KDT 1.0

Dependent on the preference of the user, he can select multiple options to search for the requested information. In case of choosing the A-Z list, the user selects the first letter of the search item. In this example 'S' of 'salarisschaal'. This generates a list with all topics beginning with the letter 'S'. One of the first topics is 'Salarisschaal wijzigen'. This generates an overview of all known information and links to the various sources regarding the modification of salary scale.

In this overview (Figure 6) the user can find the following information:

1. Process flow.
2. The goal of the form.
3. The corresponding form and where to find it.
4. Who is responsible for filling out this form.
5. Team that handles the process, process owner and contact points.
6. Info types that are linked to this form.
7. Further information.
8. Various links to external sources, like Rijksportaal or work instructions.
9. And frequently asked questions.

Salarisschaal wijzigen

1. Process flow: Persoonlijk overleg, P-Direktportaal, Aanvraag indienen (Manager), Verwerken aanvraag (Automatisch), Aanvraag verwerkt.

2. Doel van dit formulier? Voor het wijzigen van de salarisschaal.

3. Waar kan ik dit vinden? (SAP / CRM / P-Direktportaal)
1.0: P-Direktportaal> Financien> Salaris> salarisschaal wijzigen
2.0:

4. Wie mag deze opdracht indienen? Initiator formulier P-Portaal, Goedkeuring nodig? Bij ja, wie? n, Telefonisch indienen mogelijk? n

5. Team, Proces eigenaar, aanspreekpunt en overige informatie: P&S PE: Hugo Bas Noordhuizen. Aanspreekpunten: Charmaine van Rensburg en Ellen Buis

6. Infotypes/transactie: IT0008, IT0014

7. Uitgebreide informatie:

8. Sidebar: P-Direkt.nl, Rijksportaal Algemene informatie, Rijksportaal Veelgestelde Vragen, Wet & Regelgeving, Gebruikershandleiding manager, Werkinstructie HRV, Trainingsportaal manager, Diverse 1.

9. Klik op button met vraag voor antwoord ↓ Welk formulier gebruiken bij corrigeren salarisschaal/trede of periodiekdatum?

Figure 6: Overview 'Salarisschaal wijzigen' in KDT 1.0.

If the question asked is more complicated than finding the correct form and helping the customer to fill it out, the user needs to manually search for the necessary information in the various sources.

Searching per process is also possible in some cases. Not all the topics are accommodated in a process tile. For this example it is not possible to find the topic 'Salarisschaal wijzigen'.

Since Skill control ('Skillsturing') is a new concept at P-Direkt, not every topic and process is accommodated in this overview. This is also the case for 'Salarisschaal wijzigen'.

The last option to search is the search bar. Just like a normal search bar, the user types his search words to generate a list of topics corresponding with this search. From this list, the user can select the correct item and is redirected to the overview described above.

2.2.3.2 Example of workflow in KDT 2.0

Since the project of the KDT 2.0 is still under development, the renewed processes are integrated into the interface of the old version. In the A-Z list, the new processes are visualized in a different color. In this list we find 'Salarisschaal'. After clicking on the item, the user is able to choose from three options: apply, correct and withdraw. Changing the salary scale is equivalent to correcting it. Clicking on this item, the KDT generates an overview with the following information (Figure 7):

1. Process flow for customer.
2. The teams that are involved in the process.
3. Various links to work instructions, tools and checklists.
4. Process flow for employee.

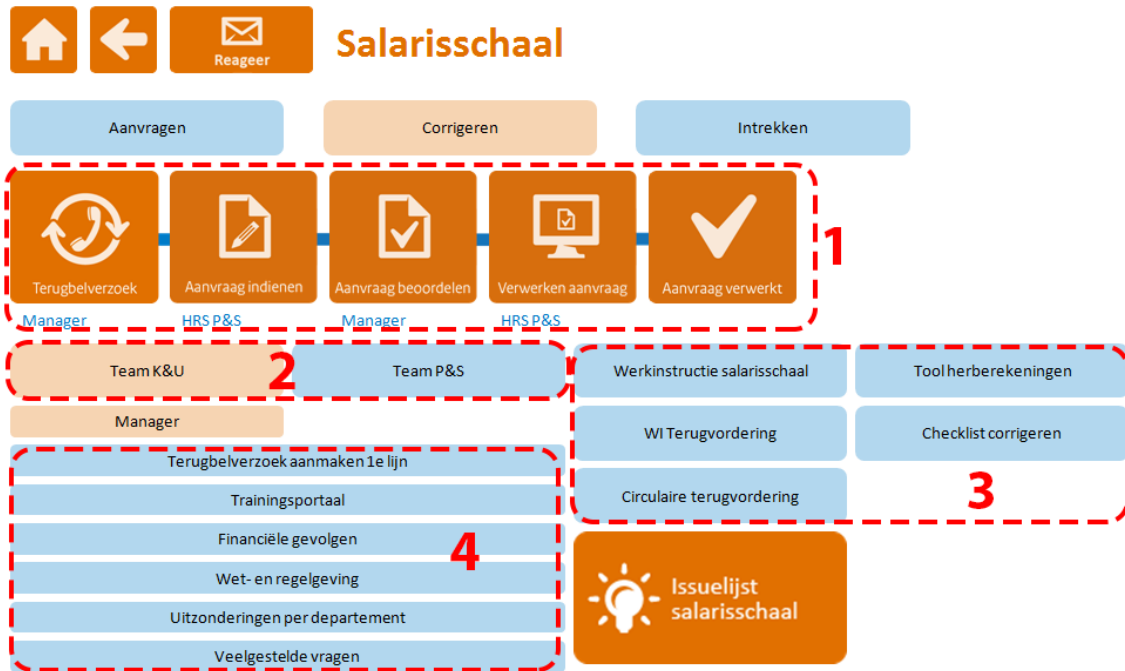


Figure 7: Overview 'Salarisschaal' in KDT 2.0.

The user then chooses a team depending on where the customer is located within the process. In this example, the customer is at the beginning of the process to change the salary scale. The first team (team K&U) is responsible for the first part of the process. The user can then select which role the customer belongs to. In this example, it is only possible to select a manager. This generates an additional overview (cluster 4 in image) that leads the user and customer through the process with work instructions, rules and legislation, exceptions and FAQ. These items link to external documents.

2.2.3.3 Comparison KDT 1.0 vs. KDT 2.0

As we see, there are quite some differences between the two versions, not only in the interface, but also in the workflow. In this paragraph, we give an overview of what is significantly changed in the new version.

Names of the processes are changed. Some of the renewed processes have a generalized name to indicate the main process. In the example, we see that KDT 1.0 has the specific name of 'Salarisschaal wijzigen', whereas KDT 2.0 has a more general name of 'Salarisschaal'.

Also there have been changes in the structure of how the information is shown. In the KDT 1.0, the user immediately got an overview of all available information and instructions about that topic. To find the position of the customer in this process in the KDT is a slow going process of reading through long documents.

KDT 2.0 presents a clear overview of information in a structural way. The user is presented with choices to indicate what subprocess is applicable to the question. It follows the process flow and shows the user stepwise what actions needs to be taken in that process. This flow is based on the workflow of the users instead of only displaying the information. This also means a division in information between first and second line teams.

As above mentioned, KDT 1.0 has long documents containing information about work instructions for example. The user does not have the time to read this. Therefore KDT 2.0 documents are reduced to less pages and are specified to the specific process action the user has to do.

The last noticeable change is in the way the information being stored. KDT 1.0 does not have a structure to save documents in folders. KDT 2.0 follows a standard structure that is identical in both back- and front-end.

2.3 Summary

P-Direkt is a branch of the Dutch Government responsible for handling Human Resource (HR) processes of all ministries, with exception of the Ministry of Defense. The largest department is the Contact Center (CC) that is responsible for handling customer's questions, tasks and requests. The Kennis Direkt Tool (KDT) is the tool for employees of the CC to find relevant information about process information, instructions and other knowledge, from one access point.

The KDT is programmed as an Excel tool and the construction is similar to a three tier model, consisting of the following layers:

1. Frontend Presentation Tier; interface where the user can find, read and click on information.
2. Invisible layer with a copy of the Maintenance.
3. back-end Application Tier: the Maintenance file containing the links between the interface and the documents. The file is modified by the developers of the tool when new information or changes are available.
4. back-end Data Tier; storage of the information in different locations.

The KDT is continuous developed to provide accurate information, but also to optimize usability. This results in two versions of information presentation. Where KDT 1.0 presents all possible information and links to documents about the whole process on one page, KDT 2.0 presents the user with choices that follow the process flow of the customer and employee, filtering the information that is presented to the user. To find the information, the user has four options to search for topics. Through clicking on various tiles, the user navigates to the information page. Depending on the process the user is looking for, the flow and information presentation is either in the old KDT 1.0 style or the new style.

3 Problem Investigation

In this chapter we discuss the first task of the Design Cycle: Problem Investigation. This task answers the first research question stated as followed:

RQ1: What is the existing support for a Traceability-based Knowledge System?

As mentioned in the research design, this task consists of empirical evidences from interviews, a survey, and a literature review, concluded with the connection between the three outcomes.

3.1 empirical evidence from Management Interviews

As mentioned in the research design, one part of the empirical evidence is based on observations of semi-structured interviews with management staff. The second part is discussed in the next section.

At the beginning of this project, management stated that "we want a new knowledge system". This is simply a solution how management thinks to realize the future vision. Only this is not a good foundation to build a new system. The objective to conduct an exploratory interview with management is to gather more information about the problem to which the management statement is the solution. In this interview we explore the 'as is' and the 'to be' situation.

Figure 8 explains the composition of the interview questions (see appendix A). The first part of the interview explores the current 'as is' situation by gathering information about their employees' and their own frustrations with the KDT. In addition we also asked them how they share knowledge and if they know some positive aspects about the KDT.

The second part of the interview explores the ideal 'to be' situation by gathering information about the characteristics of a new system and their future vision. From the 'to be' situation we can derive the requirements for a new system.

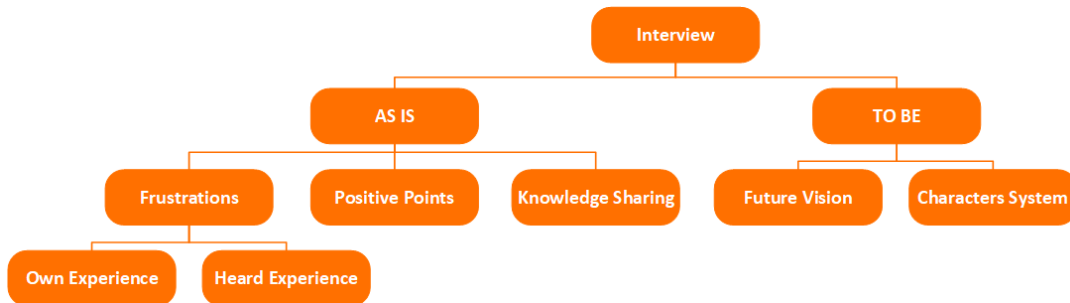


Figure 8: Composition of the interview questions.

To get different perspectives on both situations, the selected interviewees have different backgrounds and functions. For the technical perspective we interviewed an application architect. For the innovative and practical perspective, we interviewed a project initiator. And for the management perspective we interviewed several group heads ('Groepshoofden').

As mentioned in the Research Design, the interview is clustered into categories (see appendix B). These categories are established by highlighting the main statements in the transcription of each of the interviews. Then these highlights are clustered by similar meaning and labeled as a category. The main categories are based on the questions. The subcategories are based on the common meaning of the highlighted statements.

3.1.1 Knowledge and information sharing

Knowledge and information are important for the employees. For the first line there are several channels where employees share knowledge and information about current affairs. Examples are:

- ‘Vraagbaak’ (Know-How).
- Asking colleagues.
- ‘Dagstart’ (Stand-up meeting to discuss substantive information and malfunctions).
- Work agreements spread by e-mail.

The second line is also working with most of the above channels. They are also working on implementing the missing channels. For example, the second line knows how to approach a process owner and Know-Hows, but is missing the work agreements. In here we see a work in progress to unify knowledge and information sharing.

Other channels are news items, blogs, vlogs, and the information screens placed across the department displaying information about incoming calls, registered work items and announcements.

For the static information, the employees have four channels as mentioned before: the KDT, Rijksportaal, P-Direktportaal, and a shared drive. On these four locations, all information and links to other external sites, can be found.

3.1.2 Management Frustrations of the KDT

The KDT is the main entrance point to gather all the information and is the focus of this research. It is important to know where the bottlenecks and frustrations are in the system to gather wishes for a new knowledge system. This section describes the findings of management frustrations. These findings consist of either management’s own experience when working with the KDT, or what they hear from their employees.

As mentioned above, the frustrations are labeled into subcategories according to the similar meaning of the highlighted statements from the interviews.

AVAILABILITY One of the main findings is limited information that can be found. This is partly due to shortage of recorded information, and partly on how information is stored and managed. As mentioned before, the information sources in the KDT are being updated. This is a back-and-forth play between work floor and process owners for gathering and verifying the information.

CONTENT MANAGEMENT In line with the findings on information provision and gathering is the management of the information and the KDT. Right now a select number of employees are sufficient knowledgeable to update and maintain the KDT, which makes the system vulnerable. The content management is placed in the document itself, and management assumes that everybody follows the rules and takes their responsibilities. In practice, this is often not the case. Partly this results in long processing time regarding to updating information as requested by employees, since it is hard to track who is responsible for a document. And partly results in giving the customer incorrect information, because of the creation of different versions and not knowing which is the latest and correct version. In addition, the employees are able to save documents on their own drive that contribute to different versions of documents.

SEARCH Another main finding that is repeatedly mentioned is the search function. The search function in Excel is based on searching for the exact words in a predefined range. Whereas for example Google’s search engine breaks up the search query, reorders terms to reduce work, stems verbs, and fix spelling mistakes. In comparison, Google search is more extensive and flexible than Excel search. In the KDT, these results in search queries that are not or insufficiently answered, because of the limited search range and the fact that most information is stored in external documents and sources.

INTERNAL KNOWLEDGE Although the KDT is becoming more important and more used, still not every employee uses the tool. Some of the reasons they do not use the system are that they already know the information they are looking, or the colleague next to him knows it, so why do they have to look it up? This mindset not only results in the possibility to give an outdated answer or a different answer on the same question by multiple employees, but also keeps people from their own work.

3.1.3 Management vision for the future

In relation to the management vision of modernizing the ICT landscape for customer interaction, wishes and issues arise. The wishes are based on the statements from the interview, but also from the master plan of P-Direkt[28].

EXPANSION Excel is a spreadsheet application, and even though it serves a variety of purposes, there are some limitations. In the coming years, P-Direkt wants to implement additional channels the customer can use to ask their questions. This asks more capacity and functionality from the tool. With this expansion, the stability of the tool is questionable.

AUTOMATION Besides the additional communication channels, there is also a wish for more automation. To implement these features, a solid knowledge base is necessary. Since the tool does not contain the actual documents, this adds an extra step in finding the correct information since finding information in the documents itself is impossible.

IMPACT ANALYSIS In addition, an impact analysis is expressed as a desire for the future. When a document is changed, the system should be able to indicate all other documents and processes that are influenced by this change. The current KDT is not prepared for an analysis.

ACCESSIBLE FOR CUSTOMER The wish to expand the user base to include customers, is also not possible with an application in Excel. The KDT refers to documents on an internal shared drive. The customer does not have access to this shared drive and the tool becomes much too heavy if all the information is stored in the file. It is also not possible to install updates on the network of the customer. Even if the customer's IT department installs and maintains the tool, this is not an ideal situation. Keeping the tool up-to-date will have a low priority, resulting in customers searching in a tool with outdated information. We already see this in the slow updating of web browsers and Adobe Reader for the optimal user experience with the current systems.

INTERNAL KNOWLEDGE With regard to a new system, management wants employees to still think about the knowledge they already have or are easily able to access. Most work should still be done by the employees. The system should be a stepping stone to gather more knowledge.

INTEGRATION Integrating the new system with the existing telephone and CRM system is also mentioned. Dependent on the characteristics of the new system, the extend of how the new system should work with the other existing systems will vary.

3.1.4 Positive points of Management

The feedback on the KDT is not only doom and gloom. There are also positive remarks given. The look and feel of the tool is nice, even though the tool is made in Excel, which is not a program to develop this kind of application. The tool is also centrally accessible and maintained. With the KDT 2.0, the process flow is followed for a more natural flow in the tool.

Most of the management interviewees would recommend the tool to other organizations. An Excel tool is a great starting point of getting insight in the treasure of information the organization has and to build a base for a non-Excel system.

3.1.5 Important starting points for building a new system

An important point that is repeated before a new system can be implemented, is to make sure the content is correct and complete. Without the right base, any system or tool will be inefficient or useless. In here, it is also important to determine the value of all knowledge.

For the first functionalities of a new system, management thinks it is important to have a good search function, a presentation of information and beforehand selecting of information based on a customer's journey.

The new system is part of the roadmap to improve the customer's interaction. This also includes implementing new contact channels such as chat(bot) and speech, and workload management.

3.2 empirical evidence of Survey

The second part of the empirical evidence is based on a survey among the employees of the Contact Center. The objective of the survey is to gather information about what the employees think of the KDT and on what points they experience frustrations.

As mentioned in the Research Method, the survey collects responses to questions based on the Five W's and How questions. By asking these questions, we gather information to understand what happened and how it affected the employee [18]. This information helps in the next task to formulate the requirements of a new system.

3.2.1 Demography

The survey was distributed to 26 team leaders with the request to let one or two of their team members complete the survey. This resulted in a total of 23 responses, leading to a response rate of 44%. In figure 9, we see how the number of responses are distributed over the teams. Most responses came from the first line. Most of the respondents (82.6%) are based in Den Haag, the others in Zwolle. There are no respondents from Bonaire.

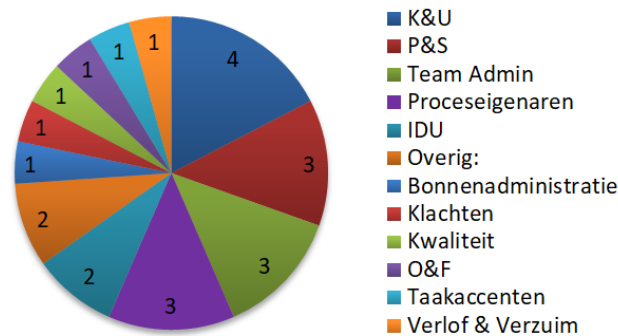


Figure 9: Distribution of responses per team.

3.2.2 Usage of the KDT

From all the respondents 48% does not or barely use the KDT. For 45% of these respondents (22% of total) it is not necessary for their job. The reasons the respondents gave for not using the KDT are mostly because the respondent already knows the information. Other reasons are finding the information in another source, such as Rijksportaal or other colleagues, or there is hardly any information to be found for that team.

3.2.3 Employee Frustrations in the KDT

For the respondents that do use the KDT, there are frustrations bound by the usage of the KDT. We used the NVivo tool to categorize the respondents' answers on the survey. The nodes represent the categories identified in the management frustrations in section 3.1.2. During the coding of the survey responses, additional categories (nodes) are created to host statements that did not fall into previously made categories. In the following paragraphs, we describe each category.

SEARCH A first point that is mentioned repeatedly is the search for information. To operate the search function, the user needs to think about the search key words. Since the search function operates on process names, the user needs the correct words to get the right hits. Repeatedly it is mentioned that the search function does not give any hits or not all of the hits the user hopes for.

When the search function is not sufficient enough to get the right information, the user has another search strategy. By means of the A-Z list, where the information is grouped per process or topics, the user is able to select a topic. A concern in this list is the number of topics that are stored. It costs the user time to get to the right topic. Another concern is the construction of the list. In some cases the structure is illogical. For example, a topic in ‘Verzuim’ (Absence of sickness) is not stored under ‘V’, but under ‘Ziekte’ (illness).

NAMES Not only the naming of topics is a concern, also naming of the forms and calculation sheets are sometimes unclear. In the KDT, there is a decision tool to find the correct form for the customer to fill in. The names for these forms are illogical and there is no description of what the form is about. The same applies to the calculation sheets. This results in the use of wrong forms or sheets.

STORAGE As mentioned earlier, a reason to not use the KDT is that information can be found at another source. This is also a concern for respondents that do use the KDT. If they are on a quest for information in the KDT, they want to find the information in the KDT and not on the Rijksportaal. Otherwise, they would begin their quest using that source. In addition, the information on the Rijksportaal is accessible to customers, resulting in the employee giving the same information the customer himself can find. When a customer calls, he expects more detailed information. When the employee cannot find this in one location, he needs to find another way to give the customer more details. When the details are missing, this results in an unsatisfied customer.

CONTENT MANAGEMENT & QUALITY Another frustration connected to finding information is finding the correct and most recent information. Not all information is kept up-to-date. This is a consequence of lack of a management process for storing information, version control on documents and lack of responsibility of team leaders regarding keeping the information up-to-date. For process owners this is a concern, because if they want to update the information, they have to trace the origin of the document and hope the information found is the most recent document. In addition, some of the links are linked to folders or non-existing files.

AVAILABILITY The availability of information is a big concern. In one case, there is an overload of information. The information about a topic is too much to read and will not give a solid answer. Or the opposite is true where the quantity of information is insufficient. The user can only find minimal, insufficient, incorrect, outdated information, or even no information at all.

SYSTEM & USABILITY The employees express some frustrations about the workflow and the usability of the system. For example the above mentioned frustration about the structure of the A-Z list, but also the stand-alone characteristic of the tool can be categorized as a usability frustration. This frustration can also amplify other categorized frustrations. In some cases the search frustration is amplified by the number of clicking that is necessary to arrive at the desired information. Resulting in difficulty to access the information.

3.2.4 Positive aspects mentioned by Employees

It is important to conclude a conversation, or in this case a survey, on a positive note. Therefore the last question in the survey asks about positive feedback on the KDT. The employees responded that the KDT is a good initiative. They repeatedly mention that they can find a lot of information in one place. It also gives a great overview of all the information that can be found. Others mention the improvements to KDT 2.0 as a positive direction.

3.3 Challenges from empirical evidence

Based on the empirical evidence of the management interviews and employee survey, we can formulate the following challenges.

1. **COMPLETENESS AND VALIDITY OF INFORMATION**

The user has access to complete and valid information to answer the customer's questions and process requests. This challenge is based on the frustrations AVAILABILITY and QUALITY. In this challenge we also see the lack of a management process for information, which is based on the frustration CONTENT MANAGEMENT.

2. **SEARCHABLE INFORMATION**

The information is compatible with the various search functionalities given by the system and the correct information is visible based on the search. This challenge is based on the frustrations SEARCH and NAMES.

3. **USABILITY**

The system should be easy to use, easy to learn, efficient, produce minimal errors, memorable and satisfy the user. This challenge is based on the frustrations SYSTEM & USABILITY.

4. **ANALYZABLE**

Management is able to perform multiple analysis. This challenge is based on the wish IMPACT ANALYSIS.

5. **SCALABLE**

The system should be scalable to support omni-channel communication between customer and organization. This challenge is based on the wish EXPANSION.

3.4 Literature Review

To support and add to the findings of the empirical evidences of the interviews and survey, a literature study is conducted on the subjects of Knowledge Management Systems and Traceability.

3.4.1 Findings on KMS

As described in the research method, literature is gathered based on keywords. Articles are evaluated on usefulness by reading the introduction and conclusion. An article is useful when it discusses success factors, disadvantages, problems, benefits, issues and challenges. From the useful articles, the above points are gathered in a document. With the NVivo tool these points are analyzed and clustered into the categories used for the clustering of the interviews and survey. Categories are added when necessary.

ANALYSIS Analysis is important in Knowledge Management. A KMS can be a tool to measure the benefits and effectiveness of KM, but also the effectiveness of the KMS. It can identify valuable information and knowledge, and gain insights into core problems and problem areas [2, 3, 4, 5, 39]. It is important to know what the KMS can add to the organization, not only on a business level, but also on a personal level for employees.

SUPPORT OF THE SYSTEM To support analysis it is important that the top management of the organization show support and commitment to the system [2, 4, 5, 17, 22, 39]. Ali et al. [5] identified that the success and perceived usefulness of the KMS is related to the perception of employees that important people expect them to share their knowledge. Management is able to influence the behavior of the employees to use the system and provide better knowledge content quality [22]. It is important to note that a system is only successful when the user is successful in using the system [16]. A successful system begins basically by setting up a strategy and goals and make them known in the organization [17]. As Tseng [39] mentioned that when the goals and strategy is clearly established, the employees are able to optimize their efforts to achieve the target, because they can better assess the value of knowledge.

SUPPORT FOR EMPLOYEES & ENVIRONMENT Besides the support of management, it is important to support the users by providing training programs, but also in change management [2, 3, 17]. Change management is important to guide employees to the new situation and accepting that the new situation is a better and more efficient way to perform their duties. Factors that come into play for changing the environment are transparency, trust, culture and atmosphere. It is necessary to create an environment where sharing knowledge is encouraged [2, 22, 37]. Sharing knowledge is one of the main focuses of KM. The employees need to be convinced to voluntarily share their knowledge with other people. It should not be a necessary ‘push’ for information from the system, but a ‘pull’ from other individuals [3, 43]. It is also a critical problem to motivate employees to share their knowledge. Possible ways to ensure this is by providing bonus points for quality contribution or monetary reward [2, 16, 17]. Incentives can also be used to promote the use of knowledge [22].

QUALITY A big risk when sharing knowledge is ensuring the quality of the knowledge. It requires a careful screening on validation, trustworthiness and congruence [20, 21]. A bad content quality has a negative relation on the use of the knowledge [22, 43]. Included in the insurance of data quality is the process of keeping the right knowledge and eliminating old or wrong knowledge [3, 11, 21].

USABILITY Also the usability of the knowledge is important. According to Ali et al. [5] the use of a KMS is dependent on the perceived usefulness of the knowledge. In addition to this, inconvenience, search and integration are also limitation factors for system quality [20].

SEARCH & AVAILABILITY If we focus on searching in the system, Hahn and Subramani [16], Tseng [39], and Joo and Lee [20] reiterate that this is important. A good search function not only enables the user to find information, but also prevents overwhelming the user with an overload of information. This gives the user a higher chance to find potential useful content. The key is to document metadata and keywords on each knowledge document to locate potentially useful content [16, 20, 23].

ACCESS The aspect of accessibility should also be taken into account. Without access, users cannot find the information they are looking for. A KMS can store knowledge as explicit knowledge in a text document or a link to an individual (domain expert) with tacit knowledge. A potential consequence of giving infinite access to a domain expert is that it could disturb the experts in their own work. This could result in unfinished work, reluctance to contribute to the system and help with inquiries [16]. In contrast, a KMS can also help to externalize the domain expert’s knowledge to provide other people the means to internalize this knowledge [39].

INTERNAL KNOWLEDGE Ko et al. [21] summarized that experience knowledge workers are able to act on the received or new knowledge faster than less experienced or novel knowledge workers. Experienced workers are able to recognize potential useful information at a faster rate.

INNOVATION A long-term potential issue of a KMS could be the stagnation of learning and innovation. With the availability of solutions at hand, the need and incentive to find new and innovative solutions to problems decrease [16].

SUCCESS OF A KMS To measure the success of a KMS, a starting point could be to measure the technological dimension with system and information quality, and the human dimension with user satisfaction, perceived system benefits and system use [22, 43]. These factors are based on the success model of DeLone and McLean [12, 32].

TRENDS The systematic literature review of Iskandar et al. [19] identified the top research topics as the evolution of KMS capabilities and features, Big Data and adoption of new technology for KMS. Shrafat [37] identified as future research a longitudinal study to get insights into the adoption process of a KMS, and researching other factors influencing KM. In addition, Ali et al. [5] mentioned a longitudinal study on the effects of leadership and strategy to keep the KMS successful.

3.4.2 Findings on Traceability

For Traceability we searched for literature about challenges in Traceability, but also for the combination between Traceability and a KMS. In this review we find that Traceability is usually mentioned in combination with software development. For software development it is important to trace the changes in requirements and the relation between requirements and the system. A part of software development is to manage the knowledge. For this research, we look into the Traceability between documents, knowledge and people to help a KMS to manage the information.

Ramesh [34] makes the connection between the importance of traceability to support KM processes for software organizations. Without a good traceability system to connect related knowledge fragments, traceability has a limited usefulness.

In 2012, Gotel et al. [14] provided an elaboration on the Grand Challenges of Traceability formed in a draft document in 2006. In here they stated that in 2035 Traceability will have overcome eight challenges. For this research we focus on the Traceability of knowledge items to the responsible employees, but also to connect knowledge items to each other for analysis. With this in mind, we focus on the following Traceability challenges:

1. **TRUSTED** All stakeholders have full confidence in the traceability, as it is created and maintained in the face of inconsistency, omissions and change; all stakeholders can and do depend upon the traceability provided.
2. **VALUED** Traceability is a strategic priority and valued by all; every stakeholder has a role to play and actively discharges his or her responsibilities.
3. **UBIQUITOUS** Traceability is always there, without ever having to think about getting it there, as it is built into the engineering process; traceability has effectively “disappeared without a trace.”
4. **SCALABLE** Varying types of artifact can be traced, at variable levels of granularity and in quantity, as the traceability extends through-life and across organizational and business boundaries.
5. **CONFIGURABLE** Traceability is established as specified, moment-to-moment, and accommodates changing stakeholder needs.

TRUSTED, VALUED and UBIQUITOUS are important challenges to set up Traceability, but also to maintain it. SCALABLE and CONFIGURABLE are important to keep Traceability dynamic and prepared for future changes in direction and stakeholder requirements.

3.4.3 Challenges from Literature

Based on the findings of the literature review, we can formulate the following challenges.

1. **SHARING KNOWLEDGE**
The user has to be motivated to share knowledge. Without knowledge sharing, KM is unsuccessful. In this challenge we see the aspects of organizational culture and atmosphere come back, which are based on the categories SUPPORT OF THE SYSTEM & EMPLOYEES and ENVIRONMENT.
2. **ANALYSIS**
Big Data is one of the recent hot research topics and analysis is based on Big Data. This challenge is based on category ANALYSIS and TRENDS.
3. **LEARNING AND INNOVATION**
The KMS should promote learning new knowledge and create new innovations. This challenge is based on the risk that a KMS can potentially stagnate innovation and learning from category INNOVATION and influenced by INTERNAL KNOWLEDGE.
4. **QUALITY OF KNOWLEDGE**
Knowledge should be of good quality. This challenge is based on the notion that bad quality knowledge discourage the use of that knowledge. This is derived from the category QUALITY.

5. **USABILITY**

Knowledge should be usable and accessible through the system. This challenge is based on the importance of accessibility to knowledge, search functionality in a system, and success factors of a KMS. In this challenge we see the categories **USABILITY**, **ACCESS**, **SEARCH** and **AVAILABILITY**.

6. **TRACEABILITY**

The links between knowledge fragments should be valued, trusted, ubiquitous, scalable and configurable.

3.5 Conclusion Problem Investigation

In this section we conclude how the literature review supports the challenges of the empirical evidence, and how the empirical evidence are able to contribute to the literature review challenges. Based on this, we can answer the research question stated as followed:

RQ1: What is the existing support for traceability-based knowledge system?

The challenges from the empirical evidence are supported by the challenges found in the literature.

COMPLETENESS AND VALIDITY OF INFORMATION is tied with the literature challenge of **QUALITY**. If the quality of knowledge is low, it means that the information is not accurate or complete. Literature also reiterates that without good quality of knowledge, that knowledge is not used, resulting in an unsuccessful system.

SEARCHABLE INFORMATION and **USABILITY** are tied to the literature challenge of **USABILITY**. Usability means the ease of use of a system. If a search function does not provide the right answers, the system is not practical for the user.

ANALYZABLE is tied to the literature challenge **ANALYSIS** and **TRACEABILITY**. Analysis is becoming a hot topic and can help improve the system. Collecting data from the system will not only help improve system quality, but can also give insights in knowledge distribution so knowledge gaps and knowledge shortages can be solved. Traceability can help with an impact analysis, to see what knowledge fragments are linked together, but also to connect knowledge to employees to find knowledge gaps and shortage.

SCALABLE is indirectly tied to **QUALITY OF KNOWLEDGE**. Knowledge is the foundation of the system. Developing a system based on a bad foundation (i.e., bad quality of knowledge) will result in a system that eventually crumbles down when expanding it.

The literature review also gives us additional challenges that did not come forward as a challenge in practice, but is important for building and maintaining a successful system.

SHARING KNOWLEDGE can be connected to the reasons for not using the KDT because the employees can find answer faster from their colleagues. By sharing their knowledge through a system, the knowledge is documented explicitly, and therefore faster accessible for other employees.

LEARNING AND INNOVATION can be connected to the management's wish of **INTERNAL KNOWLEDGE** where employees keep thinking for themselves, instead of having an automated system that provides every answer. This keeps employees motivated to learn new knowledge and find innovative ways to improve existing answers within the rules and regulations of the government.

Other points mentioned in the literature review are the importance of support of management for the system and process around the system, such as **Change Management** and **Content Management**. From the start of the KDT, management has encouraged employees to contribute to the system by providing feedback and improvement ideas. The challenge in here is to continue giving support to employees so they see the importance of the system and take their responsibility to keep it up-to-date.

The literature and the empirical evidences are pointing towards the challenges for P-Direkt to build and maintain a successful KMS. To realize the future vision of management and to overcome the challenges, the current system needs to be replaced. A Traceability-based Knowledge System is a good alternative for a KMS. Traceability provides information for analysis, but also keep knowledge up-to-date because the knowledge is more easily traceable to the source.

The answer to the research question is that P-Direkt does not have a solid support for building, installing and maintaining a Traceability-based Knowledge System. For a KMS to be installed, the foundation of the system, all the knowledge, has to be of good quality. Right now, the information and knowledge available is not sufficient enough. Also content management, which is related to traceability by combining people and knowledge, is lacking or even non-existent. With the ongoing project of cleaning up the knowledge, P-Direkt is making a head start to creating a good foundation for a new system and to get the needed support for this system.

3.6 Summary

In the task Problem Investigation, we conducted interviews with several management members to extract frustrations about the KDT and about their vision for the future for a new knowledge system. At the same time, we conducted a survey among employees to find their frustrations with the KDT. Together this resulted in a list of frustrations, which formed the base of the following challenges for the organization:

1. Completeness and validity of information
2. Searchable information
3. Usability
4. Analyzable
5. Scalable

A second part of the Problem Investigation was a literature review about Knowledge Management Systems and Traceability. Based on this review we formulated the following challenges:

1. Sharing knowledge
2. Analysis
3. Learning and innovation
4. Quality of knowledge
5. Usability
6. Traceability

The literature challenges support and add to the challenges from the empirical evidences. Based on these challenges, we concluded that the organization and literature are not supported enough for a Traceability-base Knowledge System, but the organization is working to form the basis for this support so that it will be possible in the future.

4 Treatment Design

In this chapter we discuss the second task of the Design Cycle: Treatment Design. In this task we answer the research questions stated as followed:

RQ2: How to build a traceability-based knowledge system?

RQ2.1: What are requirements of a traceability-based knowledge system?

RQ2.2: What are the available tools to support a new system?

As mentioned in the research design, this task consists of specifying requirements, a state of the art review of KMSs, and designing the artifact (TKS). This chapter concludes by answering the research questions.

4.1 Specifying Requirements

Requirement Specification is one of the Requirement Engineering Processes. Requirement Engineering is “the systematic process of developing requirements through an iterative co-operative process of analyzing the problem, documenting the resulting observations in a variety of representation formats and checking the accuracy of the understanding gained.” [24] The first process is Requirement Elicitation where we try to understand the problem. This coincides with the first task of this research.

The second process is Requirement Specification. In this process we describe the product to be delivered. The last process is the Validation and Verification of the requirements.

4.1.1 Introducing User Stories

At the time of this research, P-Direkt is changing their development method from document-driven with Request for Change (RfCs), to an Agile Scrum method in which User Stories play an important role. A User Story is a requirement expressed from the perspective of an end-user goal. Choosing User Stories to define requirements demonstrates an intention to work collaboratively with the users to discover what they really need [9]. This is especially crucial right now, when the actual end-system provider is not known yet. User Stories are formulated according to the following format:

As a < role >, I want < goal > so that < benefit >.

This format is perfect to capture the basic functionalities and later fill in the details when the system is known. Well-constructed User Stories are created by using the INVEST principle in which each User Story is: **I**ndependent, **N**egotiable, **V**aluable, **E**stimable, **S**mall, and **T**estable.

The roles in the User Stories are based on the identified stakeholders and roles identified by best practice in KM [38]. The roles are defined as followed:

- User: general user of the system, not specified to one of the roles.
- Content Specialist: responsible for writing service content, guarding the overview of the KSM, and assessing and processing feedback.
- Knowledge Owner: responsible for delivering the correct and up-to-date substantive information to the Content Specialist, and assessing and processing content feedback.
- Analyst: responsible for analyzing business processes and information flows within the organization.
- Employee: responsible for answering customer’s questions and process requests.
- Customer: civil servant who has a question about a HR issue.

In this section we discuss the requirements (User Stories) for the new system. We grouped the requirements into three perspectives: Work floor, Future and Technical. In appendix F we find the complete list of User Stories grouped per role.

4.1.2 Work floor perspective

This perspective defines User Stories based on the results of the employee survey and received comments from the work floor. It expresses the functionalities that the everyday user wants and needs in the system.

The User Stories with the role of EMPLOYEE are divided into three main categories. These categories can be linked to the challenges from empirical evidence (see appendix G for a complete overview).

- **SEARCH** The search functionality is one of the important aspects in the new system. empirical evidence reveals this in challenge SEARCHABLE INFORMATION and literature in challenge USABILITY. The User Stories in this category describe how the Employee is able to search and filter information.
- **FEEDBACK** Giving and receiving feedback is important to keep high quality information and to keep users invested in using and improving the system. In literature we can trace this to the challenges of SHARING KNOWLEDGE and QUALITY OF KNOWLEDGE. In empirical evidence we can link this to the challenge COMPLETENESS AND VALIDITY OF INFORMATION. The User Stories in this category describe what type of feedback the user is able to give in the system and what feedback he wishes to receive.
- **INFORMATION PRESENTATION** The presentation of information is briefly mentioned in one of the management staff interviews, but is not marked as a challenge in this research. Indirectly the presentation is linked to the Usability of the system. The User Stories in this category describe which information needs to be visible on a page.

The User Stories with the role CONTENT MAKER are divided into three categories.

- **DRAFTING OF KNOWLEDGE ITEMS** This category describes the process around the making of Knowledge Items. From initializing a new Knowledge Item with metadata, to updating outdated information.
- **FEEDBACK** The Employee is able to give feedback on a Knowledge Item. This category describes the process around processing feedback and the signals that are given.
- **APPROVAL** Before a Knowledge Item can be published, it needs to be approved. This is a back and forth play between the Content Specialist, the Knowledge Owner and possible other stakeholders. This category describes the process around approving a Knowledge Item.

The User Stories with the role CONTENT SPECIALIST describe the process around the publishing of a Knowledge Item. The User Stories with the role KNOWLEDGE OWNER describe the wish to perform a periodic review. The User Stories as ANALYST describe the wish for multiple analyzes and overviews.

4.1.3 Future perspective

This perspective defines User Stories based on the management staff interviews and the master plan of P-Direkt. It expresses the functionalities that are based on the future services P-Direkt wants to provide for customers and employees.

The customer is a new stakeholder in this perspective and has different functionalities available than an employee for example. The User Stories with the role of CUSTOMER describe additional functionalities that help the customer in finding the answer and redirecting him to the correct communication channel.

Other User Stories describe functionalities that can be automated and integrated with other existing systems, and how analytics can be applied.

4.1.4 Technical perspective

This perspective defines requirements and constraints based on informal interviews with the technical department (DVS) staff. It expresses the technical requirements and restrictions (appendix H) based on the current ICT-landscape and future developments in this landscape.

The current technical road is destined to be a dead end around 2025/2030. At the moment most software is on premise, while the market is heading to cloud solutions. Around 2025/2030 the road splits into two directions for P-Direkt. One direction migrates the current system to new (cloud) services of the same vendors, the other direction rebuilds systems by new vendors. We need to take this into account when selecting the new KMS.

P-Direkt maintains the principle to first look into reusing systems before buying a new system and lastly developing the system themselves. The first step into selecting a new system is looking into possibilities within the current system portfolio.

All the current systems are hosted in the ODC Rijswijk ('Overheidsdatacenter', government data center). The advantages to host a new system in the ODC is that the system is easily accessed from P-Direkt and it can communicate with the other systems that are also hosted at the ODC. The disadvantage at the moment is that the ODC cannot communicate with the shared drive as one of the information sources. This implicates that the content has to be stored at the ODC itself. We also need to take this into account for the new system.

Another point of discussion is the operating system. Most ministries work on the so-called Digitale Werkplek Rijksoverheid (DWR). This is a standardized digital work environment for most civil servants. This year, there is a transition to DWR-Next. The new system should run on this environment.

Other aspects that should be taken into account are the laws and regulations about privacy sensitive information, communication with open standards as HTTPS, REST and SOAP, and other systems like Genesys and SAP CRM.

4.1.5 Validating Requirements

The last step in the Requirement Engineering Process is Requirement Validation. For this step we asked several stakeholders to verify and validate the User Stories and technical requirements. Among these stakeholders are multiple Contact Center employees, employees who are responsible for the development of the current KDT and for updating the information to KDT 2.0, Process Owners, a Product Owner and a Domain Architect.

4.2 Available tools

SAP and Genesys are two household names for P-Direkt. To provide the employees a unified digital work environment, the first step is to look into these two companies and the services they provide for a KMS. Both companies provide these services.

4.2.1 Genesys Knowledge Center

The Genesys Knowledge Center has basic functionalities as:

- Selecting different Knowledge Bases.
- Viewing recently asked questions.
- Searching for answers in a Knowledge Base.
- View attachments.
- Copy found answers to a reply e-mail.
- Suggest answers for missing questions in Knowledge Base.
- Provide feedback on an answer in the Knowledge Base.
- Browsing the Knowledge Base and History.
- Adding and removing Favorites.
- Reviewing document data (modification date, number of views and added to Favorites).
- Set language, type of document, access right, publication schedule and category for Knowledge Items.

4.2.2 SAP NetWeaver Knowledge Management

SAP NetWeaver provides a Knowledge Management functional unit. This is a central, role-specific point of entry to unstructured information from various data sources. Basic functionalities are:

- Retrieve search results from different repositories (file servers or document management systems).
- Navigate in folders and categories.
- KM services as subscriptions, ratings, public reviews, feedback and personal notes.
- Assign metadata to documents.

4.2.3 Confluence

Confluence is content collaboration software [6]. The main features are the sharing of all types of documents and providing feedback on an article. Basic functionalities are:

- Document and version management.
- Providing feedback.
- Crowdsourcing answers.
- Identify experts.
- Browse through topics.

As we see, common functionalities between these systems are searching for content, browsing through topics or categories, giving and processing feedback, and setting metadata.

4.3 Design Artifact

In chapter 2 we discussed the operation of the KDT and in chapter 3 we identified the frustrations in the KDT. Together they indicate there is a need to design a new system. In the User Stories we also identified stakeholders whom the new system serves. For this research we focus on designing an artifact for the role of EMPLOYEE and the basic functionalities of a KMS.

We chose to design an interactive website as artifact, hereafter named as the Traceability-based Knowledge System (TKS). The TKS demonstrates the possibilities a new KMS can offer employees. In this section we discuss how we developed the TKS.

4.3.1 Implemented User Stories

In the following overview, we link the implemented functionalities to User Stories IDs (see appendix F).

- *Search field*: An input field in which the user is able to register his search query. Based on E1 the search query is split into keywords and matched with synonyms.
- *Filter options*: Filter options, such as department (E4), skill, process, (sub-)category, process step and document type (E6), to filter information.
- *Metadata-block*: A content block that displays selected known metadata. This block lists the Knowledge Owner (U1), rating of the article (E14), related content (E12) and modification date (E18).
- *Feedback*: There are multiple ways to give feedback, such as an indication that an article provided an answer (E13), rating of the quality of an article, providing feedback on missing or incorrect information in articles (E15), and an indication if a search query does not produce any hits (E16).
- *Forecast*: On the homepage there is space for predicted frequently asked questions or categories. The visible categories can be based on the role of the user.
- *Browse*: The possibility to browse through lists of available topics. The structure of the list is based on the selected option (E8).
- *Favorite*: A page with favorite articles of the user, based on functionalities of other KMS and in line of E19.
- *History*: A page with the search history of the user, based on functionalities of other KMS.

Other remarks:

- E3: Through a web-application it is possible to search for specific words on the web-page. Therefore, this User Story is automatically implemented in the system.
- E7: A FAQ page can be generated in two ways. Firstly to perform a search query with a document type filter. Secondly it is possible to go to FAQs using the related content on the article page itself.
- E9: By storing all the content in the system itself, it is automatically implemented to search from one point. Especially if higher ups decide to disable Rijksportaal and integrate a KMS into the P-Direktportaal.

A system without content cannot be tested or evaluated. For this research, we extracted content from the KDT about commuting allowance and IKAP. Some content is rewritten to match the requirements for the artifact.

4.3.2 Bringing the environment together

With the new system, we want to bring more unity in the environment. If we compare the current situation with the new situation in a figure (10 and 11), we can see how the environment and stakeholders are connected to the respective knowledge systems.

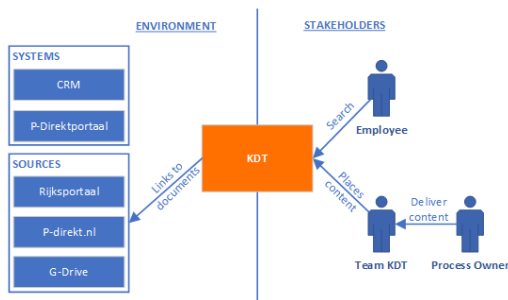


Figure 10: As-is situation (KDT).

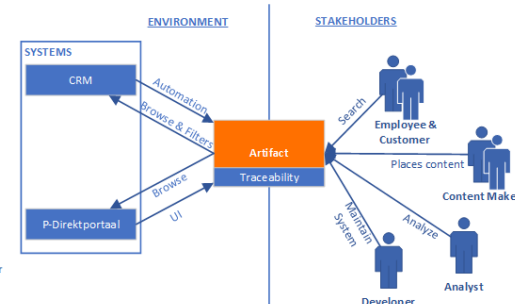


Figure 11: To-be situation (TKS).

As we see, the TKS is more connected to the systems in its environment. In both environments we see a two systems the employees in their work. In the current situation none of these systems are connected to the KDT. In contrast to the TKS where the systems have a two-way connection to the TKS. Both the P-Direktportaal and CRM system are represented in the TKS by browse categories. In addition, the CRM system is represented in the filter options and will be connected in the future through the automation of filters. The second connection of the P-Direktportaal is the User Interface. This is visible in the unification of the layout.

Another big difference is the lack of sources for the TKS. As mentioned in chapter 2, the KDT links to three external sources. In this case of the TKS, the system itself contains the source of the content. In the KDT only team KDT is able to place content and maintain the system. In contrast to the to-be situation, the maintenance and placing of content are separated stakeholders with a direct link to the system. In addition, a new stakeholder Analyst is identified.

The last difference is Traceability. This aspect is more pronounced and integrated in the TKS by providing links to related content and tagging the articles with categories for better search results.

4.3.3 KDT vs. TKS

Now the functionalities of the TKS and the links to the elements in the environment are known, we are able to compare the functionalities of both knowledge systems. This comparison shows how the functionalities have improved, and what challenges they resolve. In table 1 we see per challenge how it occurs in the KDT and how it is solved in the TKS. Statements marked with (f) indicate future features that highlight an optimal KMS.

Table 1: Comparison in functionalities between KDT and TKS.

Challenge	KDT	TKS
UI	<p>Standalone layout.</p> <p>Standalone application.</p>	<p>Layout based on P-Direktportaal to create more unity between the systems. Integration of categories and workflow of other systems on the browse page. In the system the user can browse using different options:</p> <ul style="list-style-type: none"> • A-Z list & Skills: based on the same principle as the KDT. • CRM-categories: based on categories that identify the customer's question in the CRM system. • P-Direktportaal: based on the structure, categories and layout of the P-Direktportaal.
Search & Availability	<p>The system uses the structure as a decision tree to open a specific document about the process flow, resulting in multiple clicks to open a document.</p> <p>Long articles. For example: exceptions per department are placed in one document. It takes longer to search for specific content.</p> <p>Metadata as Process Owner and contact persons are visible per process. Revision history is visible in selected documents.</p> <p>Search field that performs a query of the exact search words on the title and the keywords. For example: 'IKAP aanvraag' presents one result, 'aanvraag IKAP' none.</p> <p>No filters.</p>	<p>The user can specify his search query so that filters are automatically applied and the user can access the article in one or two clicks.</p> <p>Articles are smaller en more specific. For example: each exception per department is placed in a single article and tagged by department.</p> <p>Metadata as Knowledge Owner, modification date, department, rating, favorite and related articles are visible in a right side panel for easy access.</p> <p>Search field that performs a query of the search words on the title and content. In addition the search words are split, checked as keywords and matched to synonyms. For example: 'woon-werkverkeervergoeding' is matched with 'wv'. The total query searches on keywords, synonyms and additional filters.</p> <p>Filters to exclude non-related articles, resulting in a reduced number of hits, and a less overwhelmed user.</p> <ul style="list-style-type: none"> • Department: exceptions for departments to rules stated in the process. • Skills: skill control ('Skillsturing') is becoming an important work mechanism. • Process: main identification of an article. • Category & Subcategory: categories used to identify the customer's question in CRM system. • Process step: each process has a maximum of four process steps.
Storage	<p>Alphabetical ordered list of results.</p> <p>Articles are PDF-documents placed on the shared drive.</p>	<p>(f) List ordered by relevancy.</p> <p>Articles are formatted text stored in a database accessible by the website.</p>

Challenge	KDT	TKS
Content Management	Information is linked to Rijksportaal, P-Direkt website, and laws and regulations website.	Content is placed in the system, except links to the laws and regulations website.
	Modification/review date is placed on the last page of the document.	Modification/review date is visible in the right side panel, so it is easier to check whether an article is outdated.
	Only team KDT is able to place and link buttons to documents.	(f) Knowledge Owners (and authorized people) can place articles in the system.
Access	Documents can be saved on a personal drive, resulting in different versions.	The information is only accessible in the system as static information.
	No possibility to create an alert when information is not changed/reviewed after a certain period.	(f) Dates of articles are digital and can be used to initiate alerts to review the content of an article.
	Every user has the same functionalities.	(f) Functionalities are based on the role of the user.
Quality	Only textual feedback can be given about a page/document.	Textual feedback can be given about the article. In addition, user can rate the quality of the article by giving stars.
	No connection between search words and feedback.	User can indicate whether a search query has results. The feedback is linked to the search query.
	Automation & System	Standalone application.
Documents can only be updated if it is not opened by an employee.		Articles can be updated at any time.
No history or Favorite documents.		Search queries are stored in the history. It is also possible to mark an article (and category/process) as Favorite, so the user can easily and quickly access a certain document.
Expansion	No forecast.	Forecast of frequently asked categories is placed on the home page or when there is no search active. This too is for a quicker and easier access to a frequently asked question. In here it can be possible to add favorite categories.
	Difficult to add new sorts of documents related to new, additional communication channels.	Easy to tag an article for a new communication channel and be able to filter on the new tag.
	Accessible for Customer Analysis	Only employees have access to the system and documents.
Minimal data is gathered, and the gathered data is not analyzed.		(f) Data is more easily gathered and analyzed since it is digitally stored.
Traceability		Documents are linked to a process, a process step and a Skill.

4.3.4 Implemented functionalities

In this section we show a selection of screenshots of the TKS and explain how the functionalities are implemented. To visualize the unification of the TKS, figure 12 is a screenshot of the P-Direktportaal. Compared to the TKS, we see similar colors and layout. More screenshots can be found in appendix L.

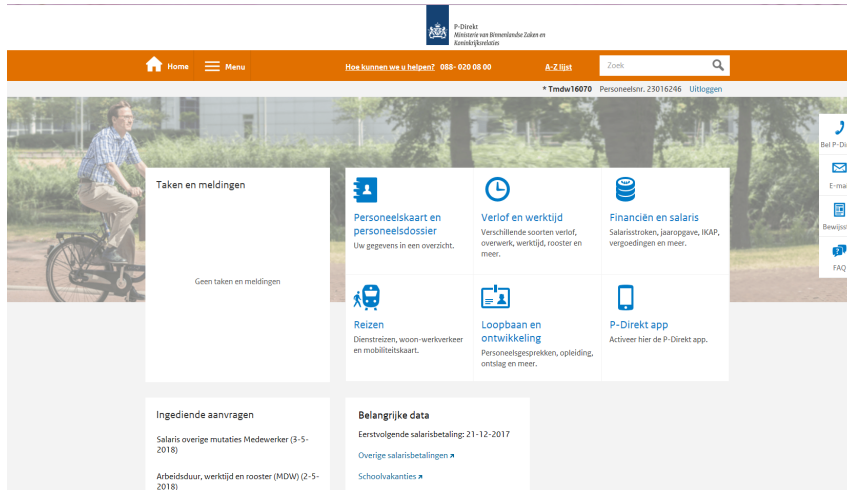


Figure 12: UI of P-Direktportaal.



Figure 13: Homepage of the TKS.

In figure 13 we see the homepage of the TKS. On this page the user is able to navigate to other pages, enter a search query, filter search results and access predicted frequently asked categories. The most important part of the system is the search functionality. Not only how it looks in the interface, but also the search algorithm behind a search query. We have to think about splitting the search query into individual words, filter on keywords, and match them with synonyms and abbreviations. Then identify the search range and how to match the search words with the content in the database. And lastly, the order of the results. In the TKS we implemented a basic search query that split the search words, filtered on keywords and matched them with known synonyms and abbreviations.

In addition to only have a textual search, we can filter the results using multiple criteria. For the employees it is important to know the department of the customer, since most departments have exceptions to the rule for some processes. Each filter is linked to a meta-tag of an article in the database of the system. After a search query is entered, the system executes a simple database query with the keywords, synonyms and the applied filters. The result is a list of all articles that match with the database query (see figure 18 in appendix L). The list contains titles of the article, the actual article or a short summary for larger articles, and the rating of the article.

The block at the bottom of the page links to articles that provide answers to predicted frequently asked questions in that week. The idea is that this will be a dynamically altered content-block based on function and role of the user, so that the most relevant results are shown. In the prototype the buttons perform a simple search query to show how this functionality can perform.

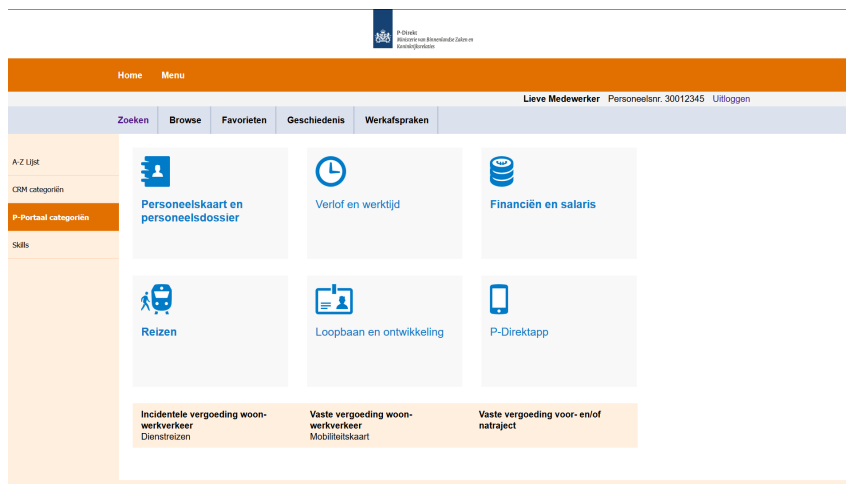


Figure 14: Browse page of the TKS.

Another common way to search is browsing. Using categories, the user is able to easily go to his topic of interest. In the TKS we choose to incorporate multiple options to browse. Some options are familiar for the employee, such as the A-Z list and the Skills list. Other options are familiar in the sense that they represent categories from other existing systems, such as CRM and P-Direktportaal. In figure 14 we see the browse-page using the P-Direktportaal category. In here we see the similar tile structure and icons as in figure 12. In the TKS the tiles expand to show a selection of articles that are linked to that tile. In the future this can possible extended to include subcategories. We choose to integrate these categories to provide familiar search functionalities and provide quick access to articles. Figure 24, 25 and 26 in appendix L show the other browse-categories.

Another basic functionality of a KMS is giving and processing feedback. In the TKS we choose to only implement giving feedback, since processing feedback is not included in the role of Employee. There are multiple forms of giving feedback, such as rating the articles quality, reporting missing, incorrect or outdated information, and indicating a search query has no hits. In figure 15 we see how the user can give stars to indicate the quality of the article. Each feedback option is displayed as a question at the bottom of the page. The user's answer to the question enables a pop-up screen containing the related feedback option. Figure 21, 22 and 23 in appendix L show the other feedback possibilities.

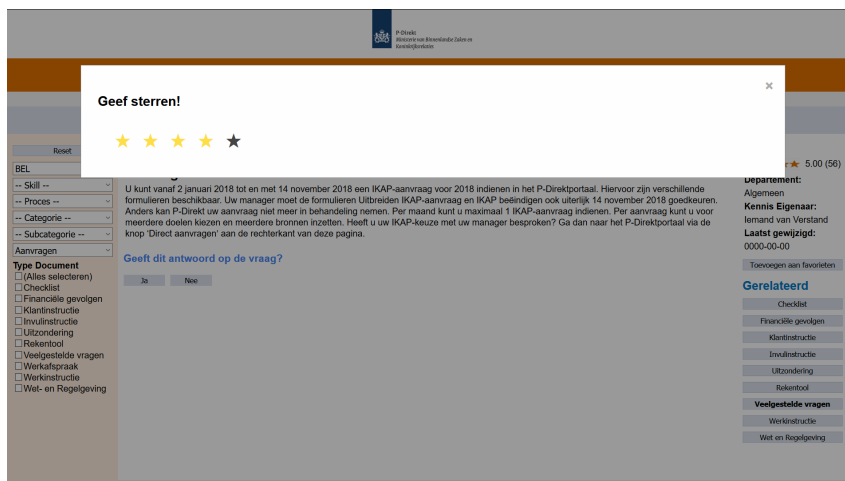


Figure 15: Feedback page of the TKS.

Metadata is important for the Traceability aspect of the system. Without knowing who is responsible for an article, it is hard to track the origin of that article and make the necessary changes to it. But also related content helps analyzing the impact of a change. When the metadata of an article is not visible or insightful, the traceability of the document cannot be trusted and is not ubiquitous (two of the challenges of Traceability). In the TKS, we choose to implement traceability by tagging the documents with a modification date, department, document type, process, process step and subcategory. With these tags and the limited information in the database, we can connect the articles to related content. In figure 16 we see the metadata on display at the top right side of the article page. In this block we can also find a button to mark the article as favorite and the links to related content. These links execute a search query for articles that are tagged with the same subcategory.

In the figure we also see that the filters and the search field are still present for direct access to a new search query.

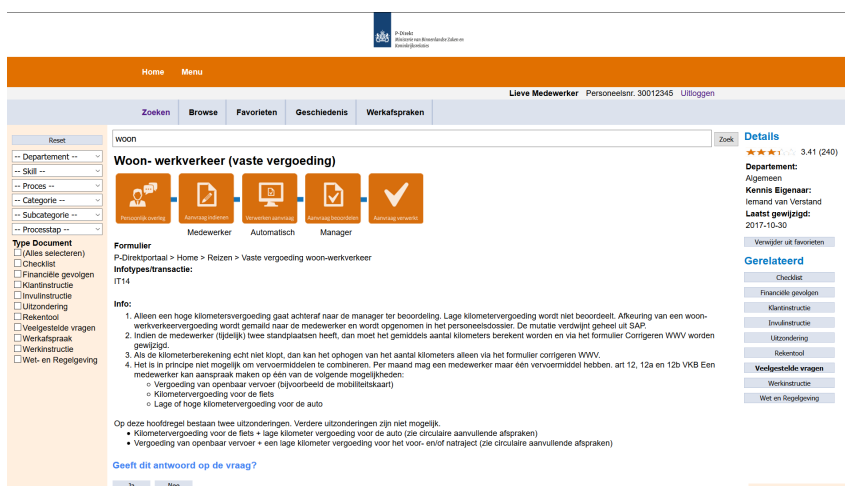


Figure 16: Article with metadata.

Other pages are the Favorite-page that lists the articles the user has marked as favorite (figure 27), History-page that list the recent search queries (figure 28), and the Work-agreement-page that list the work agreements (figure 29).

4.4 Design of the artifact

In this section we conclude how the challenges identified in chapter 3 lead to requirements that form the base of a new system. Together with the results of a small analysis in existing system, we can answer the research question state as followed:

RQ2: How to build a Traceability-based Knowledge System?

Before we answer the research question above, we first answer the subquestions.

RQ2.1: What are requirements of a Traceability-based Knowledge System?

For this research, we choose to write requirements in the form of User Stories. This is in line with the change from the Waterfall method to the Agile Scrum method. For each identified stakeholder of the new system and based on the challenges identified in the previous task (chapter 3), we formulated a set of User Stories. These User Stories can be grouped in the following categories:

- Search
- Feedback (giving and processing)
- Information presentation (UI)
- Drafting Knowledge Items
- Approval of Changes
- Automation and integration
- Authorization
- Technical requirements, such as operating system requirements, connections between existing systems, hosts, and standards.

Another activity in the Treatment Design Task is a state of the art review of existing KMS. For this research we made a small analysis of the portfolio of the current software suppliers. In this analysis, we mainly looked into the functionalities that can help P-Direkt to solve the challenges. This gives us an answer to the second subquestion stated as followed:

RQ2.2: What are the available tools to support a new system?

In the portfolio of the current software suppliers, we identified two systems. Genesys Knowledge Center provides open documentation about their KMS and functionalities. SAP on the other hand does not provide much insight in the functionalities since SAP is mostly custom made software. Functionalities that are known and related to the challenges are:

- Search
- Viewing recently asked questions
- Feedback (giving and processing)
- Browsing
- Favorites
- Set metadata

A comparison between both sets of functionalities gives the basic functionalities of a new KMS system, and the base for the designed artifact. This also gives an answer to the main research question of this task on how to build a Traceability-base Knowledge System.

The first step is to find the challenges in the current situation that need to be solved in the new system. Based on these challenges we form the requirements for the system. After this the organization can chose to find a software supplier that delivers a system conform the requirements, or the organization can develop a system themselves. For this research we decided to develop a web-based tool to validate that a new Traceability-based Knowledge System indeed solves the identified challenges.

The first step in the design of the new system is designing the User Interface. After that the basic functionalities are implemented and lastly data is entered into the system. Then the system is ready for the first round of testing and validation.

In the following chapter we evaluate how these functionalities can help overcome the frustrations and challenges of the current situation.

4.5 Summary

In the task Treatment Design, we specified User Stories based on the identified challenges in the previous task, and technical requirements based on informal interviews with the technical department of P-Direkt. The User Stories are divided into two perspectives. The work floor perspective identified User Stories about SEARCH, (giving and processing) FEEDBACK, INFORMATION PRESENTATION (as part of the User Interface), DRAFTING KNOWLEDGE ITEMS, APPROVAL OF KNOWLEDGE ITEMS. The future perspective identified User Stories about the user base expansion to include customers, automation and integration of systems, and performing analysis.

A second part of the Treatment Design is a review of the state of the art of KMSs. In this review we looked into the portfolio of the current software suppliers. Both Genesys and SAP provide software for Knowledge Management. Important functionalities in both these system are search, browse through topics, provide feedback, and set metadata.

In the last part of this task, we combined the User Stories and the results of the state of the art review to design the TKS. We choose to design an interactive website that supports the following functionalities:

- Searching articles by a search field.
- Filter options to reduce number of hits.
- Display Metadata.
- Multiple options to give feedback.
- Quick links to predicted frequently asked topics and related content.
- Browse through categories.
- Add favorite articles.

With these functionalities we are able to evaluate if the identified challenges are solved.

5 Treatment Validation

In this chapter we discuss the third and last task of the Design Cycle: Treatment Validation. In this task we answer the research questions stated as followed:

RQ3: What are the effects produced by the implementation of a Traceability-based Knowledge System in real world context?

As mentioned in the research design, this task consists of validating the feasibility of the TKS, testing the satisfaction criteria and evaluate the trade-offs of the TKS. This chapter concludes by answering the research question.

5.1 Validation method

Validation confirms that the designed artifact contributes to the stakeholders goals if implemented [42]. We choose to conduct an experiment to validate if the designed artifact is positively received and contributes to solving the identified challenges. The experiment is set up as an one-on-one session with an employee and an observer (see appendix I for the experiment protocol). The observer is tasked to take the participant on a walk-through of the TKS and observe the participant's reaction.

5.1.1 Environment

The experiment takes place in a secluded room where the participant is not disturbed by his surrounding and vice versa. The participant is also able to ask questions and the observer is able to patiently explain functionalities of the TKS and guide the participant in through the TKS.

The environment represents a normal work environment with a computer with two screens. One screen displays the TKS, the second screen displays the scenarios. Due to hosting difficulties a laptop is standby to switch to a locally hosted version of the TKS. Only when the normal website of the TKS is not responding, we switch to the local version for a smooth continuation of the experiment.

5.1.2 Participants

For the experiment we invited four employees, two male and two female, as participants of the experiment. The participants are selected based on availability and all have several years of work experience. The main characteristic for each individual participants is:

1. Has a lot of tacit knowledge and wants to answer the question without searching in the systems.
2. Reserved to actively try all aspects of the system.
3. Is customer oriented and tries to look at the system from a customer's perspective.
4. Focused on finding the correct information.

Each participant participate in an individual session that lasts 45 minutes.

5.1.3 Structure of experiment

The experiment consists of two parts (figure 17), a walk-through of the TKS and a short survey consisting of statements (see appendix J). Due to limited information in the TKS database and a limited search function, the observer guides the participant in using the correct keywords and articles. This way, the experiment does not experience any negative side effects based on the limited nature of the TKS. The main focus is on the different functionalities, not on the accuracy of matching a search query with correct information.

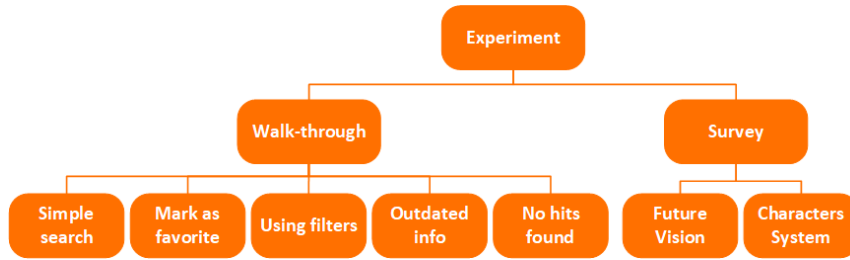


Figure 17: Composition of the experiment.

Walk-through

The walk-through consists of five scenarios. Each scenario represents a functionality in the TKS. The participant is free to browse through the TKS and to try available functionalities.

Scenario 1: A simple search.

This introduction scenario takes the participant through the homepage, how they can use the search box and how to select an article in the results. The participant is also guided to the browse page, where the participant is able to navigate through a familiar path to an article.

Scenario 2: Mark an article as Favorite.

In this scenario the participant is asked to mark an article as Favorite and to check if the action is successful.

Scenario 3: Using filters.

In this scenario, the participant experiences the ease of using filters. The observer selects a search query where the search results have multiple exceptions for departments. By using the department filter, the participant experiences how a long list can be reduced to the relevant hits.

Scenario 4: Outdated information.

In this scenario, the participant is triggered to look into the metadata. Especially the modification date. The observer has selected an article with a modification date of two year prior and notes that this information is changed throughout the years. The participant is then instructed to find a way to report this outdated article.

Scenario 5: No hits found.

In this scenario the participant performs a search query that results in zero hits. The participant is then instructed to report the result.

Survey

After the walk-through, the participant is asked to fill in a short survey of 14 statements. The statements are based on the identified challenge, the new functionalities, and a comparison between KDT and the TKS. For each statement, the participant indicates whether he agrees or disagrees with the statement and gives an explanation when disagreeing with a statement. If necessary, it is possible to select a neutral option, and explain their reasoning.

Comparison between KDT and TKS: These statements ask if the TKS provides an easier and quicker to find information and to give feedback, quicker to see if information is outdated, if it presents a more unified interface in comparison with the KDT, and find it convenient that all the information can be found in one place. With these statements we want to measure if the TKS improved the existing functionalities of the KDT.

New functionalities: These statements ask if the participant find it convenient to add articles to Favorite and to the homepage, see the search history, apply filters to a search query, see the rating of an article, see predicted frequently asked categories, and quickly navigate to related content. With these statements we want to measure if the new functionalities provide convenient features to improve the efficiency in finding answers.

The last statement ask if the participant sees potential in a similar new system with these functionalities. With this statement we measure if participants perceive the TKS as potential replacement of the KDT.

5.2 Results

In this section we first discuss the observations and comments of the participants per functionality. Secondly we discuss the result of the survey.

5.2.1 Observations and comments

Search

The participants mention how they have to change their work method. The current tool has multiple restrictions for searching. We notice that the participants' first wants to search in a familiar way by using the A-Z list on the browse page instead of using the search field. After explaining the possibilities of the search field, the participants were open to using this search method.

Mark as favorite

When asked to mark an article as favorite, the participants' first inclination is to go to the Favorite page instead of clicking on the button in the metadata-block. On first sight, it is not clear how to add a favorite. For the new system it is important to have a different, clearer visualization of this functionality.

Use filters

The focus of the experiment is on the department filter. This was positively received by the participants. They see value in splitting the large documents containing the exceptions into smaller articles and displaying only the relative articles. One participant even expressed the wish for this to be implemented in the current system.

Give feedback

There are several moments when the participant is able to give feedback. The question if the user has found what he was looking for, is visible at the bottom of the page after a search query. This question implies that this is only a relevant feedback option after a search query. The same concern applies to the question if the article gives an answer to the question visible at the bottom of an article. In the scenario of reporting outdated information, the last question can be misleading. For the new system it is important to evaluate how to ask the right question or give multiple options to give specific feedback.

We also observed that participants were searching for the familiar icon to give feedback. This indicates a need to change the work method of users in the new system.

General remarks

All participants gave a positive reaction on visual design of the TKSs. They also talked to colleagues that did not participate in the experiment about the system and its potential.

Remarkable is that two of the participants also mention that this can be a helpful system for customers.

Another suggestion of a participant was to add a section to display what articles recently have been changed.

5.2.2 Survey

The responses on the statements in the survey (see appendix K) are mostly positive. In some cases the participant was neutral or had a negative response. With four positive responses, the participants found that

- the interface looked more like other systems,
- it is convenient to add favorite articles and use multiple filters,
- it is easier to see if content is outdated,
- it is convenient not to be redirected to other sources,
- it is convenient to see favorite categories and predicted frequently asked categories on the homepage, and
- it is convenient to see links to related content.

The remaining of the statements received one neutral response. One participant responded due to the limited programmed content and functionalities, the search for information was not quicker in comparison with the current KDT. He does see the potential of the new system being quicker and more effective. Another participant mentioned that the swiftness to give feedback does not differ from the current speed in the KDT.

Other neutral statements are the convenience of looking into the search history and to see the rating of colleagues on an article. Both functionalities are nice additional functionalities in a system, but not the most important ones.

Overall the participants find that the TKS improves the existing functionalities of the KDT and that the new functionalities provide convenient features to improve their efficiency in finding answers.

As a conclusion of the survey, the participants were asked if they see potential in a new similar system. The participants responded with four positive confirmations. A new system with similar functionalities as the TKS has the potential to replace the KDT.

5.3 Checking challenges

In chapter 3 we identified challenges from empirical evidence and literature. In this section, we validate how selected challenges are solved with the functionalities in the TKS.

COMPLETENESS AND VALIDITY OF INFORMATION talks about how information needs to be complete and valid. QUALITY OF KNOWLEDGE talks about how knowledge should have a good quality. In the TKS we are only able to validate if the process of providing feedback is quicker and easier when the user notices incorrect or poor quality information. Based on the positive feedback in the experiment, we can conclude that the users are satisfied with the process of providing feedback to get complete, valid and high quality information. To keep and provide complete and high quality information is not measurable in the TKS since that process is a responsibility of a CONTENT MAKER and falls outside the scope of the TKS.

SHARING KNOWLEDGE talks about how the user has to be motivated to share knowledge. A successful system motivates users to participate in sharing knowledge. In the TKS knowledge can be shared by providing feedback on incorrect or insufficient information in articles and search queries. This experiment can only measure how the user perceived the way in which he can provide feedback. For a successful completion of sharing knowledge, the submitted feedback needs to be processed by another role. This falls outside the scope of the TKS. With the positive feedback on the feedback function, this is a begin to solve this challenge.

SEARCHABLE INFORMATION talks about how information can be found in various ways and how the correct information is visible on a search query. This challenge is solved by providing multiple ways to access the information (through a search query and the browse-page), by extending the search algorithm with keywords and synonym search, and to expand the search range to include searching in the content of the article. Based on the positive feedback of how the participants can easier and quicker search for information, we can conclude that this challenge is satisfied in the TKS.

SCALABLE talks about how the system should be scalable to support omni-channel communication and expand the user base. This challenges cannot be tested since the TKS is developed for one role and is not tested in a fully productive setting. It is noteworthy to say that the participants of the experiment see the potential of expanding the user base to customers, and therefore has the system the potential to satisfy this challenge.

TRACEABILITY talks about how the links between knowledge fragments should be valued, trusted, ubiquitous, scalable and configurable. In KM is traceability between knowledge fragments important. In the TKS each article is tagged with various categories that can be linked to each other. These tags are linked to the filters and to the related content links on the article's page. This is only a simple form of traceability and for a full effectiveness more connections between articles and system need to be made. But the positive feedback on the related content indicates a good start to visualize traceability for an employee.

5.4 Conclusion Treatment Validation

In this section we conclude how the designed artifact in chapter 4 is received in a real world context. Based on the observations from the experiment and an analysis of satisfied challenges, we can answer the research question state as followed:

RQ3: What are the effects produced by the implementation of a Traceability-based Knowledge System in real world context?

There is a learning curve for employees on how the work with the new functionalities of the system. Most participants of the experiment reverted to their old habits in searching for information. In this behavior, we see the need for change management and workshops for employees to fully understand and use the new system.

After an introductory course in the system, it is expected that most of the current frustrations employees have in the KDT, are solved. So can the system search for keywords in the content itself, giving the users relevant results to their search query and leave irrelevant hits out. This way the user is not overwhelmed with information or disappointed in the lack of results.

The user is also able to quickly navigate to predicted frequently asked questions, their favorite articles and to related content. This saves the user time so he becomes more productive.

A negative effect is the process of getting the traceability right and insightful. This could be a longer process with trial and error, before the optimal network is established. Even then, continuous improvements must be made to keep the ever-changing information up-to-date and relevant.

A positive effect is the prediction of the participants of the experiment to expand the user base to include customers. This indicates that the participants not only see the system being used by themselves, but that it is helpful for customers. This results in fewer contact moments for smaller and easy to explain questions and therefore less work pressure and more time for harder to explain and in-depth questions.

The overall effect is that employees look forward to work with a Traceability-based Knowledge System and are enthusiastic to their colleagues about this system.

5.5 Summary

In the task Treatment Validation, we validated the artifact designed in previous task by conducting an experiment with four employees. Each employee participated in a 45 minute walk-through of the TKS. In this session, the participant was guided through five scenarios, each scenario representing a different functionality. After the session, the participants were asked to fill in a survey containing 14 statements.

The participants all gave positive feedback on the designed TKS and see the potential of the new system to replace the current KDT. They agreed that the advanced search possibilities with filtering options are an added bonus in a system. New functionalities such as fast links to related content and predicted frequently asked topics, and favorite and history are welcome.

In this experiment, we also noticed a learning curve on changing the work method of the employees. We noticed participants looking for familiar icons and search options. By providing workshops and explanations to help the employees find their way in the new system.

6 Discussion

The main goal of this research was formulated as followed:

Translating the current system to a new Traceability-based Knowledge System.

To reach this goal, we executed three main tasks: Problem Investigation, Treatment Design and Treatment Validation. The first step in the task Problem Investigation was to identify the frustrations in the current system, an Excel-based tool. The formulated challenges to overcome these frustrations are based on a survey among employees, management staff interviews and a literature review. The identified challenges are: Completeness and validity of information, Searchable information, Usability, Analyzable, Scalable, Sharing knowledge, Learning and innovation, Quality of knowledge and Traceability.

Based on these challenges, we formulated requirements and User Stories for the design of the TKS in the second task Treatment Design. The User Stories are divided in a work floor perspective, containing elements as search, feedback, information presentation, drafting and approval of knowledge items, and a future perspective, containing elements as expanding user base, automation and integration of systems. The technical perspective contains technical requirements of the system.

Together with the common functionalities identified in a state of the art review of current software suppliers, this forms the base of the design of the TKS. The first step in building the TKS is to change the nature of the tool from Excel-based to web-based. This change automatically satisfies the User Stories about searching in text and finding content in one place. The focus of the TKS is on the role of Employee.

The second step is building an interface. As UI we choose to unify the systems and build an UI based on the existing P-Direktportaal. Then we implemented the basic functionalities that solves some of the challenges. So is the search functionality expanded to reduce the frustration about too much, too little or even no information to be found on a search query. This expansion included synonym search, splitting the search query into individual keywords, search in the content itself, and filter hits on criteria. Giving feedback is possible in multiple ways, as textual feedback when information is missing or incorrect or as a rating of the quality of an article. Together with the insight in metadata, the completeness and validity of information can be checked and guaranteed. Fast links to predicted frequently asked topics and related content are helped by Traceability. Browsing through topics is expanded by integrating existing systems as P-Direktportaal and CRM system as browse categories. Additional functionalities are marking favorite articles and see the search history.

The last task is Treatment Validation, in which we validated the artifact by conducting an experiment with four employees. The experiment consisted of a walk-through in the system to show and experience the functionalities followed by a survey with 14 statements about the TKS and their experience in it.

It is expected that a workshop helps the employees to experience the full functionalities and find new and more efficient methods to search and access information.

Overall the participants were enthusiastic about the possibilities of the system and see its potential as replacement of the current tool. By walking through the three tasks, we identified the challenges in the current system and translated these to how a new system could solve these challenges.

6.1 Limitations

There are some limitations to this research. The scope of this research is limited to one organization. This makes it harder to generalize the results without further research. Some of the challenges identified are confirmed by other literature sources, such as searching and knowledge quality. Also the content, structure and layout of the TKS are developed for P-Direkt and therefore are not suitable for other companies. The concept of developing a prototype such as the TKS is suitable when the structure and layout is adaptable to the environment of the organization.

Another limitation is limited programmed content and search algorithm of the TKS. This prototype of the TKS is only suitable to showcase the functionalities of a KMS and give an indication of the potential, and not to measure the difference in efficiency. The participants of the experiment were not able to do a full search with matching results and could only believe in the future capabilities of a similar TKS.

6.2 Future research

This research only looked into the basic functionalities of a KMS from an employee's perspective. To fully evaluate the impact of a KMS the effects on other roles in the organization, such as Knowledge Owner, need to be researched. This can also be in a setting similar to this research by developing a quick interactive website to demonstrate functionalities focused on that role. Interesting in this line of research would also be the impact of a prototype to help the transition to a new system and how it is designed.

In a long-term perspective, a research direction is to identify the long term effects of the transition from an Excel-based tool to a web-based system. Not only to identify the changes in the organizational culture, but also how change management is implemented and what challenges the chosen system solves and possible new challenges it creates. In addition it would be interesting to see what metrics can be implemented to measure the systems performance and how that data can help in improving the system.

Since this research is only conducted at one organization, it is also interesting to see if the identified challenges occurs in other companies to see if we are able to generalize our results.

In a Traceability perspective, it would be interesting to see how articles could be linked so that an impact analysis can be conducted, but also to effectively suggest related content. Another direction is to investigate how Traceability can be visualized in a KMS. We could also link traceability to the search queries. A good question in this direction is to ask how the search results can be optimized by combining a search query with an article that is tagged as helpful for that question.

In an analytical perspective, it would be interesting to see how performance data can be tracked and analyzed to improve the system and prevent the emergence of new challenges.

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A Interview Protocol Management Interview

Doelgroep: Management

Tijdsbestek: 1-14 november 2017

Begroet de geïnterviewde en begin met uitleg van de context van dit interview, gevolgd door de volgende informatie: Het interview is geheel vrijblijvend, en kan zonder consequenties gestopt worden. Met toestemming wordt het interview opgenomen. Audio-opnames worden na afronding van het project vernietigd.

Het interview is verdeel in twee secties. Eerst wil ik het hebben over de huidige situatie er nu uitziet. Dus nog niet over hoe het KDT zou moeten werken of wat de ideale situatie moet zijn. Maar hoe er nu mee gewerkt wordt en waar eventueel problemen zijn. Het tweede gedeelte gaat over de visie waar het KDT naartoe moet gaan.

Huidige situatie

1. Werkt u met het KDT?
 - (a) Zo ja: Waar liggen de frustraties als u hem gebruikt?
 - (b) Zo niet: Waarom niet?
 - (c) Komt u er in andere opzichten mee in aanraking?
2. Bent u tevreden hoe de CC medewerkers met het KDT werken?
 - (a) Wat zijn de frustraties en ontevredenheid die u hoort?
 - (b) Wie komen er nog meer in aanraking met het KDT?
3. Zou u het KDT aanraden aan andere mensen of organisaties (buiten de organisatie)?
4. Hoe deelt u uw kennis met de CC medewerkers of mensen om u heen?
5. Hoe denkt u dat de CC medewerkers kennis met elkaar delen?

Ideale situatie

1. Waarom is het belangrijk dat er een nieuw systeem komt?
2. Wat zijn de karakteristieken van een nieuw KDT in een ideale wereld? *Denk bijv. ook aan functionaliteiten.*
3. Met welke andere systemen zou hij samen moeten werken?
4. Zou hiermee ook de tevredenheid en gebruik omhoog gaan?
5. Heeft u nog andere vragen en/of opmerkingen?

Afsluiting. Bedankt de geïnterviewde voor zijn/haar tijd.

B Classifications Management Interview

Here a list of main points from the management interview.

Stakeholders

- 1e en 2e lijn.
- Klachten team
- Kwaliteitsteam
- Team opleiden
- MW CC
- Proces eigenaren (PE)
- Proces ondersteuner(PO)

Knowledge sharing with employees

- Vertellen
- Overleg
- Ervaring
- Bila's
- Mail
- Nieuwsberichten
- Blog
- Dagstart
- Veel mondeling
- Wiki (DVS)
- G-schijf

Knowledge sharing between employees

- Vraagbaak
- Sparren met elkaar
- Dagstart
- Werkafspraken over de mail (observatie)
- Voor 2e lijn werkt het iets anders, we zijn nu wel aan het proberen om het recht te trekken met ook werkafspraken te sturen. Zo weten we hoe ze via PEs en experts aan informatie moeten komen. Maar werken nog niet echt met het KDT.

Positive points about the KDT

- Ziet er fancy uit
- Hij staat centraal
- Nieuwe stijl gaat meer met processen mee.
- Goede tool als opstart

Frustrations

1. Search function:
 - (a) Zoeken is niet flexibel.
 - (b) Moet kennis van zaken hebben.
2. Knowledge not available or insufficient
 - (a) Kan het zelf niet vinden
 - (b) Kennis/inhoud niet op orde.
 - (c) KSM functioneert alleen als er goede info instaat
 - (d) Team kwaliteit: lange doorlooptijd voordat antwoord door PE/vraagbaken gegeven wordt
 - (e) Lange tijd voordat nieuwe info wordt verwerkt.
 - (f) Issues die lang open blijven staan
 - (g) Het staat er niet.
3. Internal Knowledge
 - (a) Ik weet het al, dus ik hoef het niet op te zoeken.
 - (b) Sparren met elkaar, staat het dan ook in het KDT en hoe gaan ze hem dan meer gebruiken.
 - (c) KDT heeft functioneel zijn beperkingen.
4. Content management
 - (a) Er zit geen beheersysteem plan omheen
 - (b) Het beheer van info
 - (c) Content beheer zit niet in het systeem
 - (d) Niet veel mensen begrijpen Excel, dus kwetsbaar

Characteristics of the new system

1. Snel
2. Gebruiksvriendelijk
3. Herkenbaar
4. Uitnodigend
5. Zelflerend
6. Core van het kennismanagement
7. Leuk zijn om mee te werken, verliefd worden op het systeem
 - (a) Gamification
8. Mobiel toegankelijk
9. Schaalbaar
10. Robuust
11. Veilig
12. Stabiel
13. Voorbereiding om nieuwe technologie
 - (a) Chatbots
 - (b) Pauline
14. Casuïstiek
15. Ondersteunend al voordat gebruiker belt
16. Ondersteunend voor MW bij vragen waar ze weinig kennis van hebben
 - (a) Meer mensen breder inzetbaar door goede ondersteuning
17. Up-to-date houden van MW moet niet teveel tijd kosten.
 - (a) Makkelijk te onderhouden/beheren

Functionalities of the new system

1. Goede zoekfunctie
 - (a) Makkelijk vindbaar
2. Ondersteuning
 - (a) Spraak ondersteunen
 - (b) VPA/VCA die gegeven kan ophalen uit systemen
 - (c) Robotiseren, automatiseren, Kunstmatige intelligentie.
 - (d) Goede integratie andere systemen
 - i. Open structuur
 - (e) Automatische impactanalyse
 - i. Signalering Functie
3. Toegankelijk voor MW
 - (a) Medewerker moet nog wel zelf denken, dus niet alles wordt voorgekauwd.
 - i. Medewerker geeft antwoord, systeem controleert of punten naar voren zijn gekomen.
 - (b) Handvat voor verdieping
 - (c) Verzamelen waar het over zou kunnen gaan en dat presenteren aan medewerker.
4. Toegankelijk voor klant
 - (a) Info gericht op klant, gebruikersperspectief
 - (b) Klant voor informeren. Veel vragen vooraf al afvangen.
 - i. Dynamisch top 10 van vraag/antwoord geven
5. Content beheerproces
 - (a) Kennis uit mails, chat transcripties, beleidsdocumenten
 - (b) Omgaan met gestructureerde en ongestructureerde informatie
 - (c) Gestructureerd vanuit de processen
 - i. Geïntegreerd met primaire processen
 - (d) Terugbrengen van aantal kennisbronnen
 - (e) Update content vanuit tool
 - (f) Content maken in tool
 - (g) Ranken op kwaliteit
 - (h) Veel soorten content herbergen
 - i. Filmpjes
 - ii. Rekensheets

Integration with other systems

- Genesys
- SAP CRM
- portaal
- SAP UI5
- p-direkt.nl
- Rijksportaal
- Rapportages
 - Hoe vaak wordt het gebruikt
- Chatbot
- Standaarden (rest APIs) en semantisch (DVS)

Starting point for a new system

- Kennis op orde
- Zoeken en dan presenteren van info
- Stap om vooraf mogelijke vragen en antwoorden te geven
- Zoekfunctie
- Waarde van alle kennis bepalen

C Survey "Frustraties in het KDT"

Voor mijn masterscriptie ben ik bezig om onderzoek te doen naar een nieuw kennissysteem voor P-Direkt. Voordat er een nieuw systeem kan komen, wil ik eerst het oude systeem (het KDT) analyseren. Met deze enquête wil ik identificeren wat de meest voorkomende frustraties zijn bij het gebruik van het KDT en/of waarom hij niet of weinig gebruikt wordt. Met jouw antwoorden kan ik gaan kijken waar de grootste problemen liggen en waarop gelet moet worden bij het kiezen van een nieuw systeem, zodat deze goed aansluiten op de wensen van het contact center.

De enquête kan op elk moment worden ingevuld en verstuurd worden. Het is ook mogelijk om hem meerdere keren in te vullen.

Alvast bedankt voor je medewerking.

Algemeen

1. Wat is je naam?
Deze vraag is alleen bedoeld om op een later moment contact met je te zoeken voor een uitgebreidere uitleg over jouw gegeven antwoorden.
2. Bij welk team zit je?

<input type="checkbox"/> K&U	<input type="checkbox"/> Kwaliteit	<input type="checkbox"/> Verlof & Verzuim
<input type="checkbox"/> Bonnenadministratie	<input type="checkbox"/> O&F	<input type="checkbox"/> Ondersteuning CC
<input type="checkbox"/> Greenfield	<input type="checkbox"/> P&S	<input type="checkbox"/> Anders...
<input type="checkbox"/> IDU	<input type="checkbox"/> Taakaccenten	
3. Welke locatie?

<input type="checkbox"/> Den Haag	<input type="checkbox"/> Zwolle	<input type="checkbox"/> Bonaire
-----------------------------------	---------------------------------	----------------------------------
4. Gebruik je het KDT?
 Ja. *Ga door naar vraag 7.* Nee, niet of heel weinig.

Niet gebruiken van het KDT

Je hebt aangegeven dat je niet of weinig gebruikt maakt van het KDT.

5. Waarom maakt je geen/weinig gebruik van het KDT?
6. Zitten aan jouw redenen frustraties verbonden?

Top 5 van frustraties

Geef hier aan welke frustraties er bij jou opkomen bij het gebruiken van het KDT. Dit kan alles zijn wat met het KDT te maken heeft.

7. Wat is de frustratie?
8. Waar komt de frustratie op?
9. Wanneer komt de frustratie op?
10. Waarom komt de frustratie op?
11. Heb je een idee om deze frustratie op te lossen?
12. Heb je nog meer frustraties

Afsluiting

Bedankt voor je medewerking.

13. Heb je nog een positief puntje over het KDT?
14. Heb je verder nog opmerkingen of toevoegingen?

D Classifications Employee Survey

Categories	# of mentioned
Access	0
Analysis	0
Availability	11
Content Management	7
Contribution	3
Internal Knowledge	4
Names	2
Quality	7
Reward	0
Search	5
Storage	8
Support	2
System	7

Table 2: Overview of categories mentioned in the literature.

E Classifications Literature Review

Categories	Literature						
	Akhavan	Alavi	Ali	Hahn	Joo	Ko	Tseng
Access				✓	✓	✓	✓
Analysis	✓	✓					✓
Availability		✓		✓			
Internal Knowledge				✓		✓	✓
Quality		✓	✓	✓	✓	✓	
Reward	✓		✓	✓			
Search				✓	✓		✓
Storage	✓	✓		✓	✓	✓	✓
Support	✓	✓	✓	✓		✓	✓

Table 3: Overview of categories mentioned in the literature.

F List of User Stories

Table 4: List of User Stories

ID	User Story
U1	As a User I want to see a list of people and roles with just one click, so I can easier and faster communicate with the right people about the process (4).
U2	As a User, I want to be assigned a role so that I can not see and execute tasks that I do not have permission to do.
E1	As an Employee, I want to receive the same information with different search terms, so that I do not have to search for the right search terms to get the right information (2).
E2	As an Employee, I want the department and role of the Customer to be entered automatically in the search fields so that I can find the right information more quickly (3).
E3	As an Employee, I want to be able to search for a specific word in the text on a page with information, so that I can access the relevant information more quickly (2).
E4	As an Employee, I want to select a ministry when searching, so that I can exclude information that is not intended for me (2).
E5	As an Employee, I want to select a team/department within P-Direkt when searching, so that I can exclude information that is not intended for that department (2).
E6	As an Employee, I want to select a type of document / information so that I can exclude information that does not apply to my question.
E7	As an Employee I want to see a page with FAQs about the searched / selected topic, so that I can quickly answer a frequently asked question (2).
E8	As an Employee I want to see a keyword list / topics overview (2).
E9	As an Employee I want to search from one point, so that I can find all information from one point (2).
E10	As an Employee, I want to be the first to see the main points of the article in the selected article, so that I can find the main points of my question in one view and then ask for more in-depth information (2).
E11	As an Employee, I would like to be able to request a more extensive explanation of the main points after I have seen the main points, so that I can give an in-depth answer to the Client (2).
E12	As an Employee I want to go to related topics in the selected article, so that I can request additional and related information (2).
E13	As an Employee, I want to indicate whether the information shown helped me to answer the question asked, so that the Knowledge Owner and other Employees know that this is good knowledge (2,3).
E14	As an Employee, I want to see how knowledge has been assessed by other Employees, so that I know that I can pass on high-quality knowledge to the Customer (2,3).
E15	As an Employee, I want to provide feedback and additional information on articles, so that I can help to update missing and / or outdated information and share my experiences.
E16	As an Employee, I want to indicate when my requested question does not produce any hits or does not answer the question asked, so that the missing knowledge can be composed.
E17	As an Employee, I would like to receive feedback / feedback about my provided feedback / and additions / suggestions, so that I know it is being processed.
E18	As an Employee, I want to see which information has recently been changed, so that with my knowledge I am also up-to-date (2.5).
E19	As an Employee I want to see a number of personal, frequently used processes on the homepage, so that I do not have to retrieve / search for them every morning via various channels.
E20	As an Employee, I want to see a top of predicted frequently asked topics on the homepage, so that I can find an answer to a predicted question more quickly.
E21	As an Employee, I want to see several important dates quickly, so that I cannot miss a deadline.

ID	User Story
CM1	As a Content Maker, I want to draft a text for new information, so that this information can be approved (1).
CM2	As a Content Maker I want to draft a text for a change of information, so that this change of information can be approved (1).
CM3	As a Content Maker, I want to see an overview of feedback from Employees about my knowledge items, so that I can quickly see what has to be done (1).
CM4	As a Content Maker I want to be able to respond to feedback from Employees about my knowledge items, so that the Employee knows what is being done with his feedback.
CM5	As a Content Maker I want to get a signal if I take too long to process feedback, so that the Employee also knows where he stands and to avoid a long lead time.
CM6	As a Content Maker I want to give a signal to the Knowledge Owner / Content Specialist / people involved to approve knowledge, so that they know they have a task (1).
CM7	As a Content Maker I want to get a signal when I have to approve knowledge, so that a long lead time is prevented (4).
CM8	As a Content Maker, I want to get a signal if a text to be approved is not approved after a certain time, in order to prevent a long lead time.
CM9	As a Content Maker, I want to see an overview of outstanding texts that have yet to be approved, so that I know where I stand and to avoid long lead times.
CM10	As a Content Maker, I want to run an impact analysis so that I know where the bottlenecks are when changing information (3).
CM11	As a Content Maker, I want to see the rating of Knowledge items, so I know what Knowledge Items need to be improved for the better quality.
CM12	As a Content Maker, I want to set metadata for the knowledge, so that Users can search and select information more easily and quickly, and can see who the persons involved are.
CS1	As a Content Specialist, I want to publish accredited information in the system so that Users can read this information (1).
CS2	As a Content Specialist, I want to link knowledge to the right channel, so that the User can see the correct information per channel (1).
CS3	As a Content Specialist, I want to print an overview of the taxonomy, so that I can analyze it more quickly (1).
CS4	As a Content Specialist, I want to schedule the publication date of the knowledge at a chosen time, so that certain information can only be seen from a certain moment and time-sensitive information cannot be forgotten.
CS5	As a Content Specialist, I want to put an end date on published knowledge, so that from that moment on, selected information is no longer visible to Users.
CS6	As a Content Specialist, I want to get a signal when planned information is almost published, so that I can check whether the information is still correct.
KO1	As a Knowledge Owner, I want to carry out a periodic review, so that I can verify outdated and correct information (1).
KO2	As a Knowledge Owner, I want an overview with a periodic review of all processes, so that I know which processes have not had a review for a long time.
KO3	As a Knowledge Owner, I want an overview of processes that are currently being reviewed by my colleague Knowledge Owner, so that I do not start a periodic review process that is already being reviewed at that time.
KO4	As a Knowledge Owner, I want an overview of the processing time of processes that are currently being reviewed, so that I can intervene on time if the processing time threatens to go outside the Service Level Agreement (SLA).
A1	As Analyst, I want to analyze business processes so that processes can be optimized (1,2).
A2	As Analyst, I want to analyze information flows, so that I know who the users are and how they work in the system to improve efficiency (1).
A3	As Analyst I want to see an overview of KPIs, so that I know how the KPIs are progressing and what needs to be managed more (1).
A4	As Analyst, I want to place the predicted most frequently requested topics for that day / week on the homepage, so that these topics can be accessed more quickly.

ID	User Story
A5	As Analyst, I want to analyze the missing hits for searches, so that I can notify Content Maker that items are missing or incorrectly labeled.
C1	As a Customer, I want to see customer-oriented information about my question / topic so that I cannot see any unnecessary and incomprehensible information (3).
C2	As a Customer, I want to find my information from one place so that I can quickly find my answer without going to different sources.
C3	As a Customer, I want to be guided to the appropriate channel if I want to ask a question, so that I can find an answer to my question in the quickest way.
C4	As a Customer, I want to see the top 10 FAQs about my subject / question, so that I can get a quicker and easier answer.
C5	As a Customer, I want to quickly see various important data, so that I cannot miss a deadline
Un1	As [Role] I want to assign a role to a User, so that the User can only access permissioned functionalities.

G User Stories linked to Evidences and Literature

Table 5: Overview of categories mentioned in the literature.

ID	Literature	Literature Challenge	Empirical Challenge	Survey Category	Interview Category	Work floor	KDT
U1	[7] [8] [36]	Traceability, Usability		Content Management	Content Management	✓	✓
U2	[7] [25]	Usability				✓	
E1	[7] [8] [25]	Traceability, Usability	Searchable Information	Search	Search		
E2	[7]				Integration, Automation		
E3	[7] [8] [25]	Usability	Searchable Information	Search	Search		
E4	[7] [25]	Traceability, Usability	Searchable Information	Search	Search		
E5	[7] [25]	Traceability, Usability	Searchable Information	Search	Search		
E6	[7] [25] [36]	Traceability, Usability	Searchable Information	Search	Search		
E7						✓	✓
E8						✓	✓
E9				Storage			✓
E10	[36]	Usability	Completeness and Validity of Information	Availability		✓	
E11	[36]	Traceability, Usability	Completeness and Validity of Information	Availability		✓	
E12	[25]	Traceability					
E13	[15] [33] [36]	Quality of Knowledge	Completeness and Validity of Information	Quality			
E14	[15] [33] [36]	Quality of Knowledge	Completeness and Validity of Information	Quality			
E15	[15] [33] [35] [36]	Sharing Knowledge					✓
E16	[15] [33] [35] [36]	Sharing Knowledge					✓
E17	[15] [35]						E*
E18	[7]		Completeness and Validity of Information	Content Management	Content Management		
E19	[25] [36]						
E20	[7]						
E21						✓	
CM1	[7] [25] [35] [38]		Completeness and Validity of Information	Content Management	Content Management		
CM2	[7] [25] [35] [38]		Completeness and Validity of Information	Content Management	Content Management		
CM3	[36] [38]	Quality of Knowledge					E*

ID	Literature	Literature Challenge	Empirical Challenge	Survey Category	Interview Category	Work floor	KDT
CM4	[38]	Quality of Knowledge					E*
CM5	[38]						
CM6	[38]						
CM7	[38]						
CM8	[38]						
CM9	[38]						E*
CM10		Traceability, Analysis	Analyzable		Impact Analysis		
CM11	[33] [36] [38]	Quality of Knowledge					
CM12	[25] [25] [36] [38]	Traceability			Search		
CS1	[38]						√
CS2	[25] [38]	Traceability	Scalable		Expansion		
CS3	[7] [38]	Traceability					
CS4	[38]						
CS5	[38]					√	
CS6	[38]						
KO1	[25] [38]	Quality of Knowledge					
KO2	[25] [38]	Quality of Knowledge					
KO3	[38]	Quality of Knowledge					
KO4	[38]	Quality of Knowledge					
A1	[25] [35] [36] [38]	Traceability, Analysis	Analyzable		Impact Analysis		
A2	[25] [35] [36] [38]	Traceability, Analysis	Analyzable		Impact Analysis		
A3	[25] [38]	Analysis	Analyzable		Impact Analysis		
A4	[38]						√
A5	[25] [38]	Analysis	Analyzable		Search, Impact Analysis		
C1					Accessible for Customer		
C2					Accessible for Customer		
C3		Traceability			Accessible for Customer, Expansion		
C4	[7]				Accessible for Customer		
C5					Accessible for Customer		
Un1	[25]	Usability					

* Functionality is placed in an external system.

H Technical Requirements

Technical requirements formulated based on informal interviews with the technical department.

1. The functionality of the system must be available in the form of APIs.
2. The system can call on APIs from other software solutions.
3. The system must communicate with open standards such as HTTPS, REST and SOAP.
4. The system must communicate with SAP and Genesys until 2025/2030.
5. The user interface of the system must run on the DWR-Next workstation;
6. The server components of the KMS must work on the SSC-ICT ODC infrastructure (Windows 2012 / Windows2016 / RHEL 7.4 / MSSQL / PostgreSQL on Linux).
7. The system must meet the requirements of the General Data Protection Regulation (AVG) when it concerns content that contains sensitive information.
8. The system must be set up in accordance with the Civil Service Information Security Baseline (BIR) 2017.
9. Systems running on exotic frameworks are not allowed.

I Protocol Experiment

Tijdsduur: 45 minuent

Observerder/begeleider: S. van Dalen

Begroet de participant en begin met uitleg van het doel van deze demonstratie, welke functionaliteiten het systeem bevat en de beperkingen van het systeem.

De demonstratie is verdeel in twee secties. Eerst lopen we door het systeem door aan de hand van een vijftal scenario's. Elk scenario licht een bepaalde functionaliteit van het systeem uit. Daarna heb ik nog een aantal statements over het systeem.

Walk-through

Scenario 1

In dit scenario hebben we een vraag gekregen over hoe woon-werkverkeer kan worden aangevraagd. De opdracht is om naar het juiste artikel te gaan om deze vraag te beantwoorden.

De participant kiest zelf de manier waarop hij naar een artikel kan gaan. Nadat de participant het artikel gevonden heeft, wordt er ook gewezen op de andere manier van zoeken.

Scenario 2

In dit scenario stellen we dat we heel veel vragen over dit artikel krijgen, dus willen we snel toegang tot dit artikel hebben. De opdracht hier is om het artikel in de favorieten te zetten.

Als de participant vastloopt kan er gewezen worden op waar hij de knop 'Toevoegen aan favoriet' wel kan vinden.

Scenario 3

Er wordt een zoekopdracht met 'IKAP aanvragen' klaargezet. Deze zoekopdracht heeft veel uitzonderingen per departement.

Met dit scenario willen we laten zien hoe we met behulp van filter sneller en specifiekere resultaten kunnen krijgen op een zoekopdracht. Stel je voor dat er een klant van de Belastingdienst belt met een vraag over het aanvragen van IKAP. De opdracht hier is om de resultatenlijst zoveel mogelijk te reduceren.

Scenario 4

Er wordt een artikel klaargezet met een datum laatst gewijzigd van twee jaar terug en informatie met een datum van twee jaar terug.

Als je het artikel leest zien we dat er oude data in staan. Het is logisch om te denken dat deze informatie verouderd is. De opdracht is om een manier te zoeken om dit te rapporteren.

Scenario 5

Er wordt een zoekopdracht klaargezet die geen resultaat oplevert.

Met dit scenario willen we laten zien hoe we nog feedback kunnen geven over de zoekopdrachten en de verwachtingen hiervan. De opdracht hier is om feedback te geven over de missende resultaten van de zoekopdracht.

Als afsluiten is de participant vrij om het systeem verder te onderzoeken naar functionaliteiten en is vrij om hier ook vragen bij en over te stellen.

Enquête

Als laatste heb ik nog een paar statements over hoe je het systeem hebt ervaren. Als je het niet eens of neutraal bent met het statement, geef dan aan waarom.

Afsluiting: Vraag of de participant nog verdere vragen en/of opmerkingen heeft en bedank hem voor zijn input en medewerking

J Survey "Demo Nieuw Kennissysteem"

1. Ik kan informatie makkelijker vinden in vergelijking met het huidige KDT.
2. Ik kan informatie sneller vinden in vergelijking met het huidige KDT.
3. Ik kan sneller zien wanneer informatie oud is in vergelijking met het huidige KDT.
4. Ik kan sneller feedback geven op een artikel in vergelijking met het huidige KDT.
5. De website lijkt meer op bestaande schermen (interfaces) in vergelijking met het huidige KDT.
6. Ik vind het handig om Favorieten op te slaan.
7. Ik vind het handig om in mijn Geschiedenis te kijken.
8. Ik vind het handig dat ik niet wordt doorverwezen naar andere systemen voor informatie (zoals bijv. Rijksportaal of p-direkt.nl).
9. Ik vind het handig om meerdere filters in te voeren.
10. Ik vind het handig om te zien hoe collega's informatie beoordelen.
11. Ik vind het handig om mijn favoriete categorieën op de homepagina te zien.
12. Ik vind het handig om veelgestelde categorieën op de homepagina te zien.
13. Ik vind het handig om gerelateerde onderwerpen/artikelen te zien.
14. Ik zie potentie in een vergelijkend nieuw systeem.

K Responses to experiment survey

Statement	Positive	Neutral	Negative
1	4	0	0
2	3	1	0
3	4	0	0
4	3	1	0
5	4	0	0
6	4	0	0
7	3	1	0
8	4	0	0
9	4	0	0
10	3	1	0
11	4	0	0
12	4	0	0
13	4	0	0
14	4	0	0

Table 6: Overview of categories mentioned in the literature.

L Screenshots of TKS

The screenshot shows the search results for the query "hoe vraag ik woon-werkverkeer aan?". The page features a navigation bar with "Home" and "Menu" on the left, and "Lieve Medewerker", "Personeelsnr. 30012345", and "Uitloggen" on the right. Below the navigation bar are tabs for "Zoeken", "Browse", "Favorieten", "Geschiedenis", and "Werkafspraken". A search bar on the left contains the query, and a "Zoek" button is on the right. The search results are displayed in a list format, with each result including a title, a brief description, a rating (stars), and a count of results. The results are:

- Woon-werkverkeer corrigeren** (Algemeen): Voor het corrigeren van vaste vergoeding woon-werkverkeer, voor- natraject en/of fiets, corrigeren incidenteel woon-werkverkeer en corrigeren incidentele fietsvergoeding. 3.18 (206)
- Woon- werkverkeer (vaste vergoeding)** (Algemeen): Voor het aanvragen van vaste vergoeding woon-werkverkeer (reiskosten). 3.41 (240)
- Kan een stagiaire een vaste vergoeding wwv aanvragen?** (Algemeen): Ja, als de stagiaire zelf inloggegevens heeft voor het P-Direktportaal. Anders een opdracht van de manager of HRO. 3.29 (224)
- Ik ben op arbeidstherapeutische basis weer aan het werk. Hoe vraag ik opnieuw mijn reiskostenvergoeding aan?** (Algemeen): U kunt uw eigen woon-werkvergoeding weer aanvragen vanaf de eerste dag van de volgende maand nadat u (gedeeltelijk) beter bent gemeld. 2.44 (321)
- Man een medewerker die in het buitenland woont en werkt een vergoeding voor wwv**

Figure 18: Search results.

The screenshot shows the search results for the query "ikap". The page layout is identical to Figure 18. The search results are:

- Aanvragen van IKAP** (Belastingdienst): Bij de Belastingdienst kan in het kader van IKAP voor bedrijfsfitness een vergoeding worden toegekend. De Belastingdienst heeft bepaald welke fitnessbedrijven gelden per vestiging. Zie de lijst met fitnessbedrijven die voor de Belastingdienst gelden. Zie ook de Personele Uitvoeringsbepalingen Belastingdienst (PUB) Hoofdstuk Belonen en Vergoeden, onderdeel 5 IKAP. 3.14 (7)
- Aanvragen van IKAP** (BZ) Buitenlandse Zaken: De Tijdelijke uitvoeringsregeling IKAP BZ uit 2008 is begin 2014 komen te vervallen. Daarnaast faciliteert BZ de telewerkplek thuis niet. Daarvoor zijn telewerkcontracten nodig en die kent BZ niet. Vanuit de toememende werkvorm van Het Nieuwe Werken zal telewerken bij BZ ook niet worden ingevuld. 3.14 (7)
- Aanvragen van IKAP** (terW) Infrastructuur en Waterstaat: 3.14 (7)
- Aanvragen van IKAP** (MinFin) Financiën: Financiën(*) beschikt over een inpassende bedrijfsfitness in het pand Korte Voorhout 7 te Den Haag. Alleen de contributie van deze inpassende bedrijfsfitness komt in het kader van de fiscale regels rondom IKAP en bedrijfsfitness in aanmerking voor inzet als doel in IKAP. (*) Hieronder vallen DGBel, DGFZ, DGRB, GT en alle onderdelen binnen het SG-cluster. De Belastingdienst – de uitvoeringsorganisatie – heeft een eigen regeling voor IKAP/bedrijfsfitness. 2.00 (2)

 At the bottom of the results, there is a section "Heeft u gevonden wat u zocht?" with "Ja" and "Nee" buttons.

Figure 19: Search without filtering.

The screenshot shows the search results for the query "ikap" with filtering applied. The page layout is identical to Figure 19. The search results are:

- Aanvragen van IKAP** (Algemeen): U kunt vanaf 2 januari 2018 tot en met 14 november 2018 een IKAP-aanvraag voor 2018 indienen in het P-Direktportaal. Hiervoor zijn verschillende formulieren beschikbaar. Uw manager moet de formulieren Uitredend IKAP-aanvraag en IKAP beëindigen ook uiterlijk 14 november 2018 goedkeuren. Anders kan P-Direkt uw aanvraag niet meer in behandeling nemen. Per maand kunt u maximaal 1 IKAP-aanvraag indienen. Per aanvraag kunt u voor meerdere doelen kiezen en meerdere bronnen inzetten. Heeft u uw IKAP-keuze met uw manager besproken? Ga dan naar het P-Direktportaal via de knop 'Direct aanvragen' aan de rechterkant van deze pagina. 5.00 (56)
- Aanvragen van IKAP** (Belastingdienst): Bij de Belastingdienst kan in het kader van IKAP voor bedrijfsfitness een vergoeding worden toegekend. De Belastingdienst heeft bepaald welke fitnessbedrijven gelden per vestiging. Zie de lijst met fitnessbedrijven die voor de Belastingdienst gelden. Zie ook de Personele Uitvoeringsbepalingen Belastingdienst (PUB) Hoofdstuk Belonen en Vergoeden, onderdeel 5 IKAP. 3.14 (7)

 The "Heeft u gevonden wat u zocht?" section is also present.

Figure 20: Search with filtering.

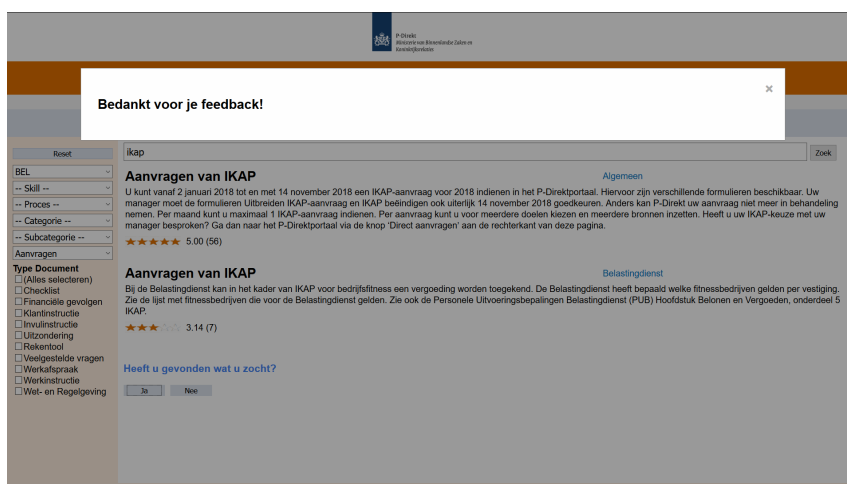


Figure 21: Feedback on correct hits.

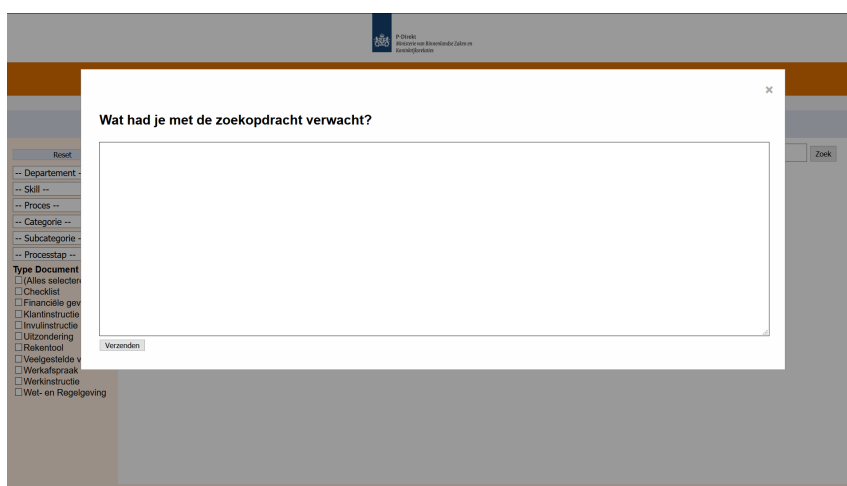


Figure 22: Feedback on no hits.

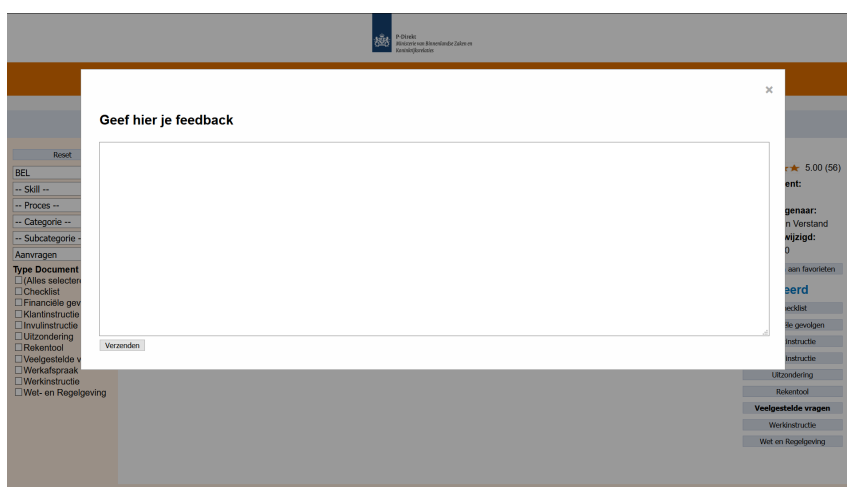


Figure 23: Feedback on article.



Figure 24: Browse-page using A-Z list.

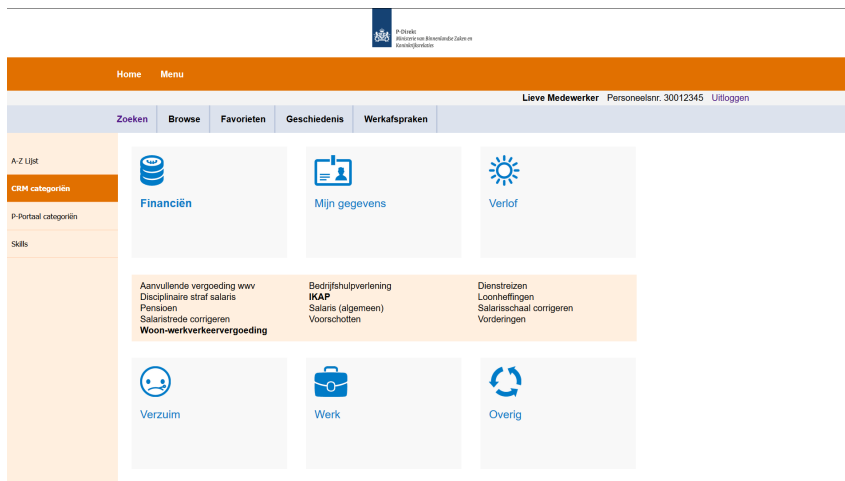


Figure 25: Browse-page using CRM categories.

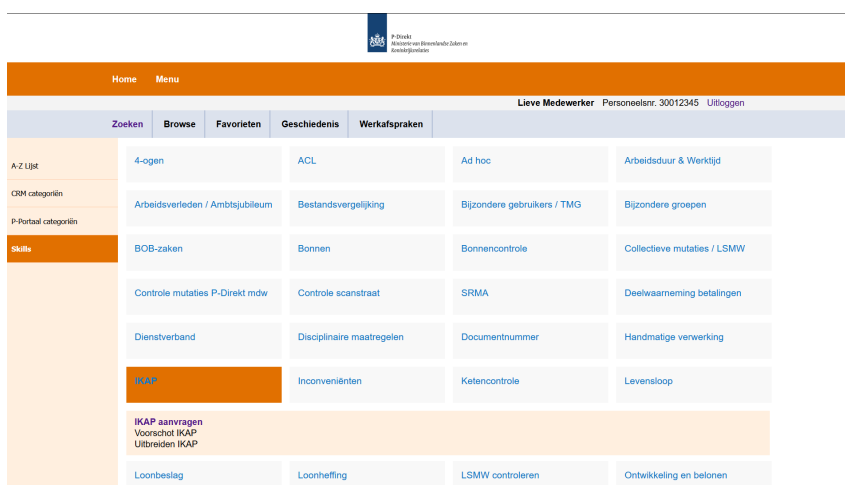


Figure 26: Browse-page using Skills.

Figure 27: Favorite page.

Datum	Zoekopdracht
2018-05-24 16:55:50	Hoe verwerk ik een aanvraag nieuwe medewerker?
2018-05-24 16:55:28	Kan ik met zwangerschapsverlof?
2018-05-24 16:55:02	Hoge kilometer vergoeding
2018-05-24 16:54:35	IT007
2018-05-24 16:54:22	Inconvinienten
2018-05-24 16:54:02	VOG declaratie stagair
2018-05-24 16:53:00	Hoe kan ik een favoriet toevoegen?
2018-05-24 16:51:46	Werkafspraken
2018-05-24 16:51:34	Werkafspraken 15 juni
2018-05-24 16:51:09	Wat is stoffering?
2018-05-24 16:50:52	langdurig ziek reiskosten vergoeding
2018-05-24 16:50:19	Hoe moet ik een contract van een stagair verlengen?
2018-05-24 16:49:40	ov-chipkaart wwv
2018-05-24 16:49:15	Belastingdienst ikap aanvragen
2018-05-24 16:48:51	salaris verhoging
2018-05-24 16:48:45	hoe vraag ik woon-werkverkeer aan?

Figure 28: History page.

Figure 29: Work agreements page.