Final version

An Approach to Sustainable Collaboration in Governmental Institutions

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Collaboration between:

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Comments:

- This thesis has been sponsored by Rijkswaterstaat (part of the Ministry of Infrastructure and Water Management), division: Water, Traffic, and Living Environment (originally in Dutch: Water, Verkeer en Leefomgeving), department: Knowledge Management.
- In consultation with both supervisors, some experiments are performed in Dutch due to the origin of Rijkswaterstaat, although the author of this thesis translated substantial elements into English.
- The author of this thesis is Alyssia Visser. During this research, the first -person plural is used with the aim of recognizing the valuable contributions of both internal and external supervisors, all the involved colleagues of Rijkswaterstaat, external partners of Rijkswaterstaat, and input from all the participants.

Status overview research

An overview of the research deliverables, statuses and dates are presented in Table 1. The start of this master project is on *6 October 2017*, and the completion of all mandatory deliverables is on *12 July 2018*. This study is interested in answering the following research question:

How can we ensure the sustainability of a corporate collaboration in a governmental organization?

Deliverable	Status	Date
Short proposal	Completed	Approved on 16 October 2017
Draft long proposal	Completed	December 2017 reviewed in January 2018
Final long proposal	Completed	January 2018
Colloquium 1e presentation	Completed	5 February 2018
Draft thesis	Completed	25 June 2018
Final thesis	Completed	5 July 2017
Colloquium 2e presentation	Completed	11 June 2018
Paper	Completed	5 July 2018
Final defense	Expected	12 July 2018

Table 1: Status overview deliverables of the study

Preface

This report is an MSc project that comprises a study of approximately 10 months of work and research on the development of an approach to implement a sustainable collaboration in the field of information systems (ISs). Prior to the start of the Master Business Informatics, I completed my studies in Business Administration. In that time, my field of interest was in improving business processes and designing smarter business processes to make them more reliable, effective, and efficient. My next move was to expand my knowledge; in my opinion, information and communication technology (ICT) is the most crucial element alongside individual knowledge to conduct a solid and successful organization. Since ICT was only a scant component of my bachelor studies, the Business Informatics study was the perfect link for my personal goals.

During my MSc studies, I was exposed to a wide variety of information and computer science elements: data analytics, business intelligence, software architecture, data mining, and so forth. During my studies, I discovered that my field of interest is mainly in the areas of enterprise architecture and knowledge management. When I had my first meeting with Rijkswaterstaat, at the department of knowledge management, I knew this would be an opportunity to develop myself further in the discipline that truly motivates me.

The intentional idea behind my project at Rijkswaterstaat was to implement a wiki that will contribute to knowledge management initiatives, such as sharing knowledge with external parties, storing the knowledge of experts who are retiring, or developing new knowledge with experts all over the world. Some major requirements of this wiki are that it needs to be solid and reliable, have a long-term existence, and contain high-quality content. It needs to be sustainable. Together with an external company that is specialized in implementing corporate wikis, I would create a method or approach, and during the second phase of my study, we intended to perform a pilot study. The plan unfortunately changed, and the collaboration with the external company was canceled. However, thanks to my colleagues, new ideas arose, and at the end of my study, we created an approach to implement a sustainable collaboration, and we evaluated this with the Wiki Support Tool—an example of the approach applied to a sustainable wiki.

On my first day at Rijkswaterstaat, on Wednesday, 6 September at 09:30 am, I really did not know what the outcome of this project would be. Now, 10 months later, I can look back on a great experience with many opportunities, challenges, and educational moments. I know that a company that is socially rather than economically driven will be a perfect fit for me as a person.

Alyssia Visser
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Acknowledgement

On this journey, I met many great people, and I would like to take this opportunity to thank several people in particular, starting with Marcela Ruiz, my first supervisor of the University of Utrecht. Thank you for your enthusiasm and support during all our meetings. You always gave me the energy and confidence to go a step further. I really appreciate your ideas and support throughout my entire thesis project. In addition to my first supervisor, I also want to thank Sietse Overbeek, my second supervisor. Thank you for your feedback from an objective perspective, it really helped to improve my thesis.

Moving on to my supervisors at Rijkswaterstaat. To my first supervisor, Martin Bos, thank you for the interesting meetings and your always honest and critical feedback. Thanks to your analytic skills, I was able to improve my approach from different business perspectives. I also want to thank my second supervisor at Rijkswaterstaat: Onno van Sandick. He helped me to understand Rijkswaterstaat, and he allowed me to participate in meetings for different projects. It afforded me additional perspective, which helped me to place my approach in the context of the company. Onno also helped me to build a solid foundation for my research. I also want to thank my direct colleagues at Rijkswaterstaat for their new ideas and suggestions. Thanks to all my colleagues, I had a pleasant environment in which to perform my study, and I felt welcomed and appreciated. Next, I am thankful to all the people who participated in my research; not only my colleagues at Rijkswaterstaat, but also external parties (RIVM, Deltares, HZ and so forth). Thank you for your contributions and honesty during interviews and/or experiments. Finally, I would like to thank my boyfriend, friends, and family for all their support during this journey; without you, I would not have achieved these results.

Thank you all for this great experience!

Abstract

Over the years, extensive studies have been conducted with knowledge management (KM) as the research subject, and they have even discovered the factors of success in a knowledge project. As an extension, this research focuses on sustainable collaboration in KM. Previous studies have already established that sustainable collaborations, such as wikis, can be sustainable, and they have identified the challenges in generating such a collaboration. The aim of our study is to amplify these challenges, and for this purpose, we design an approach to sustainable collaboration. Based on extensive problem investigations, the creation of the proposed design takes place, and it eventually forms the foundation of the approach to sustainable collaboration. The basic functions of a wiki are editing wiki pages, creating new pages, linking between pages, linking to external websites, and formatting the wiki page. Since we determine that the practical purpose of wikis and Wiki technology is equivalent to our idea of sustainable collaboration, it is important to obtain solid, basic knowledge about them. In essence, open editing is the functionality that characterizes a wiki, and a wiki is nothing more than a collection of various webpages with several collaboration features, which refer to the 12 wiki design principles. A wiki is highly effective for ad hoc problems with decentralized knowledge sources, although this can lead to problem in terms of quality of the content; therefore, there is a need for some kind of quality mechanism.

To shape the problem investigation part, we conduct an extensive literature review, semi-structured interviews with potential users of a wiki, and unstructured interviews with practitioners in the field of KM systems (KMSs). Chapter 3 is dedicated to answering the first RQ: what are the existing supports for sustainable collaboration and KM information systems (IS)? During the literature review, we reify the following three challenges: challenge 1, aligning manager and individual contributor expectations; challenge 2; content and flexibility; and challenge 3, positioning a wiki in an existing information ecology. We attempt to find the first principles for our treatment design. The input of the literature review is also used to create a questionnaire for the semi-structured interview with potential users. The main result from the literature review is that careful planning, involving both technological and cultural aspects, is needed. Also, user participation is a challenge that organizations need to overcome to achieve a successful wiki. An interesting aspect is how to improve people's enthusiasm. Other important elements are guidance, training, and clear governance. In addition to the literature review, the semi-structured interviews and unstructured interviews provided extra information to answer the sub-RQs: what is the current positioning of the information ecology of a governmental organization in relation to the organizational operations and culture, and how does one overcome barriers and pitfalls during the implementation of a collaborative tool/support in KM IS? The highlights we ascertain are in practice the complexities of organizations, such as different organizational culture, and specific expertise makes it challenging to implement IS integration, such as a wiki. To obtain a successful IS integration, it is important to equally involve the human and technical factors, such as the involvement of the user throughout the whole implementation process, and to ensure that the requirements and needs of all stakeholders are specified and understood by the people who are involved in the execution of the IS integration.

The aim of the development of the treatment design is to specify the purpose of the approach, the fundamental idea, followed by the design chunks in context, and how we developed such a design with

the support of the method engineering (ME) discipline and the ME lifecycle. Our treatment design essentially concentrates on the long-term sustainability aspect in KMSs integrated with one or more collaboration features. During the design of our approach, we use the fundamentals of situational ME—an ME discipline. The main idea of situational method composition is the selection and adjustment of artifact fragments with respect to a specific IS development situation. This composition process aims to configure a combination of multiple method chunks to create new constructional results.

Challenge 1—aligning manager and individual contributor expectations—contains the following two variables: (1) expectation of the wiki (from a stakeholder's perspective) and (2) organizational culture and style. The second challenge—content organization and flexibility—is also divided into two variables: (1) high variety in content, i.e., information need, and (2) suitable format for a wiki page. The final challenge—positioning a wiki in an existing information ecology and corporate culture—consists of three variables: (1) existing information ecology, (2) uncertainties regarding participation/contribution, and (3) maintenance quality. In the following paragraphs, we convert these challenges into three modules. The first module uses elements from the Stakeholder Theory, the Expectation-Confirmation Model/Theory (ECM/ECT), Enterprise Modeling, the Organizational Culture Assessment Instrument (OCAI) and the KM Assessment Instrument (KMAI). The second module focuses on the content per knowledge field, and it aims to create a wiki page that is suitable for the target group. The sub-activities of this module are based on the study by Haake, Lukosch, and Schümmer (2005), which is about the concept of wiki templates that allow users to determine the structure and appearance of a wiki page. Module 3 involves the integration of the wiki into an organization. This integration process focuses on the participation (and the uncertainties), the existing information ecology, and maintenance for quality purposes.

Throughout the years, researchers have commonly agreed that software development methods should be defined or adapted within a specific organization to determine whether the particular needs of the organization are met. To support this challenge, the ME disciple intends to provide solutions to efficiently deal with the definition and adaptation of methods, as well as to construct the supporting software tools. In our case, we created an approach to sustainable collaboration. To support the design, implementation, and execution of this approach, we implement our approach in an Intranet environment—the Wiki Support Tool. The general idea of this Wiki Support Tool is to create a type of wizard. The user goes through several steps, and he or she is also kept informed of the progress.

For the treatment validation, we conducted a single-case mechanism experiment. The researcher applied stimuli to a validation model and explained the response in terms of mechanisms that are internal to the model. In this case, we built the Wiki Support Tool in its intended context, and tested it with scenarios to observe its responses; this was done with the support of the Think Aloud Method and Retrospective Think Aloud. The general goal of the treatment validation was to evaluate the effects of implementing a sustainable collaborative approach regarding stakeholders' perceptions. In part I of this thesis, we established that sustainability means that a wiki page will have continuity for between 12 and 24 months. The expert opinion is an extension of the single-case mechanism, and it aims to validate the main objective of the study by means of analyzing the modules together. The total average task completion time was 36:43 minutes, with the fastest subject having a task completion time of 11:57 minutes, and the maximal duration time was 46:00 minutes. The effectiveness score (task

completing) was 96%, which means that only one subject did not complete one task; in this situation, the subject forgot to check-off the first task, which was to find the home page. To determine the extent to which the Wiki Support Tool can be used free from difficulty (objective measurement is perceived ease of use), we used the node error: when the subject made an error while executing the tasks. In total, two errors were made: task four, subjects S2 and S3. During the expert interview, the subject stated that, on the one hand, the approach is a complete list of elements with literature to support it and that it provides structure, guidelines, and concreteness. On the other hand, more studies and improvements are required in terms of the specification of the structure, accessibility, and utility, among other things. During the treatment validation of this study, we considered the four types of validity threats: (1) conclusion validity, (2) internal validity, (3) construct validity, and (4) external validity.

Keywords: knowledge management, sustainable collaboration, knowledge management systems, corporate wiki.

Tables of content

Common used abbreviations

Table 2 provides an overview of the commonly used abbreviations. In each part of this report, we will recur the whole term in each part.

Abbreviation	Term
ECM	Expectation-Confirmation Model
ECT	Expectation-Confirmation Theory
IS	Information system
IT	Information technology
ME	Method engineering
KM	Knowledge management
KMAI	Knowledge Management Assessment Instrument
KMS	Knowledge Management Systems
KQ	Knowledge question
OCI	Organizational Culture Inventory
OCAI	Organizational Culture Assessment Instrument
RWS	Rijkswaterstaat
RQ	Research question
TAM	Technology Acceptance Model
TRQ	Technical research question
UU	Universiteit Utrecht/ University of Utrecht

Table 2: List with commonly used abbreviations

PART I
Problem design

Chapter 1: Motivation

"Knowledge is power, but has little value unless it can be easily accessed and put into practice."
(Melany Gallant)

Knowledge is recognized as a primary commodity in the knowledge-based economy; therefore, this research considers that the key element is extracting valuable information from organizational knowledge (Zhang & Zhoao, 2006). In the literature, this concept is also known as the collaborative management discipline, knowledge management (KM): "the process of capturing, developing, sharing, and effectively using organizational knowledge" (Davenport, 1994). During this study, the researcher acknowledges that KM "involves the creation of value from an organization's intangible assets" (Rubenstein-Montano et al., 2001) and aims to make employees smarter, more innovative, and better decision makers (Patton, 2001).

Nowadays, organizations are confronted with various demographic changes that occur within the workforce. One of the main concerns is that the workforce ages; i.e., a group of knowledgeable employees retires within a few years (in Dutch, this translates as "vergrijzing"); therefore, the crux of the matter is that the knowledge must be captured and secured before it disappears (Calo, 2008; Dencheva, Prause & Prinz, 2011). Especially governmental organizations have the challenge of retaining the current knowledge therein; for instance, the book of Liebowitz (2012) even talks about the crisis in human capital in federal government: "At that time, Senator Voinovich indicated that more than half of the federal workforce would be eligible to leave (retire) in just four years." Also, concerns about securing human capital arise in an article initiated by the Dutch Minister of the Interior and Kingdom Relations[1]: "The government must take rapid actions to maintain the current knowledge."

In a knowledge-intensive business, it is essential to continuously preserve and share individual knowledge among workers, and KM helps to avoid redundant work, reduce employee training times, and adapt to changing environments (O'Leary, 1998). In addition, based on input from practice, the new business environment requires KM systems (KMSs) with specific information and greater freedom through open access. Some proof from the literature is the example of the research by Van der Brugge, Rotmans, and Loornbach (2005). This research about water management pointed out an interesting result: the transition of the water management project was not managed in the traditional way; instead, "it was managed in terms of stimulating new initiatives from frontrunners at the micro level, providing sustained room to develop these ideas." Knowledge sharing and collaboration are the purposes of the open-source software community, whose goals are to develop, distribute, redistribute, and share the source code of software that benefits individuals and organizations, with no discrimination and with restricted licensing (Lee et al., 2007). Such user collaboration is the main feature of Web 2.0. Wiki technology, which enables distributed users to collaboratively work towards the creation of online content by means of building and enhancing other users' contributions (Lykourentzou et al., 2011; Dencheva, Prause & Prinz, 2011). As a matter of fact, "Wikis provide a flexible platform for asynchronous collaboration to create content in general" (Louridas, 2006).

[1] http://www.slimmernetwerk.nl/

The interest of this study is in investigating the requirements to realize a sustainable collaboration with the use of Wiki technology. The study by Majchrzak, Wagner, and Yates (2006) established that a wiki is sustainable if it exists for approximately 12-24 months. According to their sample, beyond using a wiki on a project basis, organizations succeed at using it as a sustainable part of their collaborative work processes. This research will be conducted as commissioned by a Dutch government organization, Rijkswaterstaat (RWS), which is a division of the Dutch Ministry of Infrastructure and Water Management. The main responsibilities of RWS are to ensure a safe, sustainable, and accessible country, and to take care of the infrastructure of the Netherlands in the broadest sense, from roads to water and everything in between. In the context of the aging workforce, (i.e., the workforce that will leave the company within a few years), there is a demand from the employees to secure individual knowledge before it disappears, with the support of KM initiatives and KMSs.

1.1. Problem statement

The problem statement section provides more content about the general problem based on the preliminary investigation through a literature study, focusing on developments in the field of KM, KMSs, and the Wiki technology. Since this research is conducted in collaboration with RWS, some background information and challenges are provided to contextualize the research. Finally, the reasons for this research's interest in creating an approach to sustainable collaboration are briefly described.

1.1.1. Knowledge management, knowledge management systems development, and Wiki technology

Over the years, extensive studies have been conducted on KM, and the factors of success in a KM project have been discovered. However, the study by Alavi and Leidner (2001) concluded that there is no single optimum approach to KM and KMSs: "A variety of KM approaches and systems needs to be employed in organizations to effectively deal with the diversity of knowledge types and attributes." Furthermore, over the years, it seems that these KM success factors deliver new challenges; much research has been conducted about a company's culture, information technology (IT), information systems (ISs), and leadership (Yew Wong, 2005). In terms of KMSs, four main information elements could be derived: the staff—individuals with the correct knowledge and skills, (2) customers and clients—to support and serve, (3) methodologies and tools—to provide quality and consistency in an efficient and effective manner, and (4) practices and groups—to keep the information up to date (Chait, 1999; Lin & Huang, 2008). A "KMS is an IS developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application." (Alavi & Leidner, 2001).

From the IS perspective, knowledge is the top of the data-information-knowledge hierarchy, where information is meaningful. The combination of processed data and individual knowledge results in actionable information, which separates knowledge from information or data (Pfaff & Hasan, 2007). KM can save intellectual capital when employees leave the organization, if they become temporarily unavailable, or if they change to a different position. To support KM, a dynamic IS, such as a wiki system, can be deployed (Dencheva, Prause & Prinz, 2011). The most common way in which to use a wiki is as a collaborative tool (Hester, 2010), and essentially: "wikis provide a flexible platform for asynchronous collaboration to create content in general" (Louridas, 2006). Moreover, collaboration avoids bottleneck complications because of the constantly edited and refined content of a wiki page (Pfaff & Hasan, 2007). Knowledge can essentially be treated as either an object or a process. According

to the study by Lin and Huang (2008), the success of knowledge sharing depends on KMSs' knowledge contribution population, who are receiving content for reuse purposes. Although performing KM initiatives can be challenging, particularly in distributed environments, there is a need for a platform that can support effective, efficient collaboration among an often-large number of diverse stakeholders. The platform must account for the following challenges concerning stakeholders (Decker et al., 2007):

1. The different perspectives on the IS,
2. Background differences (communication challenges),
3. The various objectives of the stakeholders (different interests),
4. The numerous abilities to express the content and document them using a technical platform, and
5. Different involvements.

A corporate Wiki technology can enhance reputation and make work easier, and it helps to improve an organization's processes. However, research has demonstrated that the contribution to a corporate wiki in order to transfer knowledge can be slow due to the continuously pressing tasks and a chronic lack of spare time, as well as for motivational reasons. This indicates a problem because the wiki fails to achieve its purpose of collecting valuable knowledge, and over time, it becomes less attractive (Dencheva, Prause & Prinz, 2011). An important but challenging task is to establish and satisfy the business needs, which can be modest or voluminous, simple or complex, routine or novel, well specified or vague, stable or volatile, and of low priority or urgent (Holsapple & Joshi, 2002). It thus appears that paying attention to the needs and barriers of individual employees is an important factor.

Nevertheless, some literature stated that corporate wikis appear to be sustainable (Majchrzak, Wagner & Yates, 2006; Grudin & Poole, 2010). Based on the previous literature, we establish three dimensions that are essential to the successful implementation of a sustainable collaboration (Grudin & Poole, 2010; Bhatti, Baile & Yasin, 2011; Lykourentzou et al., 2011): alignment of manager and individual contributor expectations (expectations of the stakeholders and organizational culture/style), content organization and flexibility (differences in needs and requirements), positioning of a wiki in an existing information ecology and corporate culture (existing IS, missing reference/governance/guidance, limitations, and barriers). These three challenges are extended during the problem investigation section (see Chapter 3) while using three types of qualitive studies (a literature review, semi-structured interviews with potential users, and unstructured interviews with practitioners in the field of KMSs). The potential stakeholders for this study would initially be (Dutch) government institutions.

1.1.2. Research in context—about RWS

Since 1798, RWS has been responsible for the construction, management, and maintenance of rivers, canals, weirs, and polders, and these responsibilities have changed considerably over the centuries. Nowadays, RWS is the performing organization of the Ministry of Infrastructure and Water Management, and it is responsible for the management and development of the national highways/roads, the waterway/water network, and a sustainable living environment. Together with other parties, RWS protects the Netherlands from floods, and it aims to realize a "living environment"—an environment that is sufficiently green and that has sufficient and clean water. Rijkswaterstaat's intention is to attain a safe, sustainable, and accessible country (Rijkswaterstaat, 2017). The execution of the study is performed in cooperation with the water, traffic, and living

environment's (in Dutch: the "Water, Verkeer en Leefomgeving", abbreviated as WVL) organizational unit—the department of innovation—and KM. One of main responsibilities of WVL is to provide an overview of the required knowledge and information for RWS for today and in the future.

The knowledge horizon 2020 (RWS's strategic planning for 2016) consists of several knowledge indicators: the knowledge strategy, critical (knowledge) fields, sharing and managing knowledge, and a culture of learning. These knowledge indicators are established with the aim of ensuring and managing the necessary knowledge, so that RWS can provide the correct services and products in the future. In addition, it is important that knowledge is sharable, findable, and storable in an effective, efficient, and easy way.

One of the main challenges is to share and retain knowledge across the boundaries of projects and organizational units. The following indicators play an important role in addressing these challenges: community of practices (CoPs), guilds, and digital knowledge platforms. Corresponding to the emerging challenge about the aging workforce, the need for a knowledge tool is more relevant than ever. For RWS, a KMS is not a new concept; however, a sustainable wiki has not been successfully implemented yet. Alongside the significant contribution of a KMS to the organization, RWS also has some social importance due to its obligation to manage the weirs and since the Minister of Security and Justice has categorized the management of the water quantity as a "category A." In short, critical infrastructure can be defined as the products, services, and underlying processes that are essential for the daily lives of the majority of Dutch citizens. A situation in which critical infrastructure fails causes a large-scale social disruption (NCTV, 2017).

Despite the many studies that have been conducted about corporate wikis and a collaborative tool in general, this research deals with numerous stakeholders as well as internal (technical and business personnel) and external (market) people with different backgrounds; for example, expertise and specialism. RWS cooperates with a variety of specialized market parties, and it outsources the traditional tasks. One main concern of the stakeholders is to constantly realize a certain level of quality of the systems to provide a useful and usable tool. Therefore, it is important to establish the needs and requirements and to counteract requirement problems, such as organizational issues (for example, skills, culture, communication, and staff retention) and project and product issues (for example, documentation, measurement, quality, timescales, and development). Another commonly mentioned aspect in research is the importance of stakeholders' participation, which improves the requirement of the products, such as a wiki (El Emam, 1996).

1.1.3. Reasons for creating an approach to sustainable collaboration

Over the years, organizational knowledge can be seen as a critical business resource (O'Leary, 1998; Kankanhalli et al., 2003; Calo, 2008), and individual knowledge appears to be the basis for the competitive advantage of organizations (Argote & Ingram, 2000). Organizational knowledge relates to what people understand about the historical knowledge and experience inherent in the organization; for example, knowledge about products, services, processes, errors, and successes (Pfaff & Hasan, 2007). Many researchers and practitioners recognized the importance of knowledge as the most strategically significant resource for organizations (Grant, 1996). However, since the workforce drives the knowledge economy age, new challenges will emerge that will influence the dimension of the workforce of a business. These challenges consequently tend to have a major effect in the form of a

significant loss of valuable knowledge as older workers retire from the workforce (Calo, 2008). Performing KM initiatives can secure this valuable knowledge. Although there is no single definition of KM, knowledge can be seen from several perspectives: “a state of the mind, as an object, as a process, a situation of having access to information or even a capability” (Nonaka, 1994; Nonaka & Takeuchi, 1995). A KMS refers to any IT-based system that is “developed to support and enhance the organizational knowledge process of knowledge creation, storage, retrieval, transformation, and application” (Alavi & Leidner, 2001). Davenport and Prusak (1998) provided three reasons an organization should implement a KMS:

1. To enhance the visibility of knowledge in organizations, through the use of, for example, maps, hypertexts, yellow pages, and directories.
2. To build a knowledge-sharing culture; i.e., to create avenues for employees to share knowledge.
3. To develop a knowledge infrastructure that is not confined solely to technology, but also to create an environment that permits collaborative work.

These three reasons also align with the characteristics of an IS that uses Wiki technology (also known as a wiki). In Chapter 2, an elaboration on wikis and Wiki technology is provided.

1.2. Research method

This MSc project applies the design science methodology, as described in the book of Wieringa (2014): “Design science is the design and investigation of artifacts in context.” The major components of a design science project are the object of the study and the following two major activities: designing and investigating of the artifact. Artifacts are designed to interact with a problem context to improve something in that context. The aim of design science is to produce knowledge about the real world that does not make any unrealistic abstractions, and that has a scope of validity that is as large as possible. This study investigates how to deploy a sustainable collaboration so that KM initiatives could take place between both internal and external parties (for example, within RWS and externally with its partners and/or contractor). The following meaning of the term sustainability is used in this research: (1) the wiki will have continuity around 12-24 months—this requirement is based on the criteria of a sustainable wiki from the study by Majchrzak, Wagner, and Yates (2006)—and (2) the content of the wiki has an appropriate level of quality; it has sufficient utility and usefulness.

In the next paragraph, we discuss the object of the study of design science as well as the research problem and a framework in design science specified on this study.

1.2.1. Object of the study

The implementation and deployment of a sustainable collaboration with the Wiki technology involves three main challenges, established in Grudin and Poole’s (2010) study: (1) the alignment of manager and individual contributor expectations, (2) content organization and flexibility, and (3) the positioning of a wiki in an existing information ecology. For this research, the approach to sustainable collaboration is designed to include three main modules. The approach to sustainable collaboration and its modules is the artifact of this study.

The context comprises governmental organizations that are interested in creating and implementing a sustainable corporate wiki, which intends to offer specialized knowledge (for example, about issues and questions related to the national highways/roads, waterways/water network) and a sustainable living environment to internal employees and external parties, such as partners, the construction market, or other governments worldwide, as depicted in Figure 1.

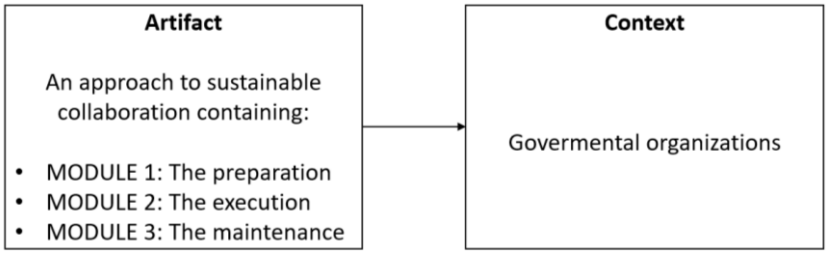

Figure 1: Depiction of artifact and context

The overall objective of this study is to design an approach to sustainable collaboration so that individuals who are interested in implementing a wiki in a corporate setting can create one. This eventually results in three modules that each separately contributes to the sustainability of a corporate wiki during the preparation, execution, and maintenance of the implementation. The main focus of this study is consequently on the interpretation of the modules to provide some structure and guidelines for implementing a sustainable collaboration with the use of Wiki technology. Therefore, this research designs an initial framework for that purpose.

1.2.2. Research problem

The two main components in design science are the problem design and problem investigation. These components corresponds to two types of research problems: (1) design problems (DPs) and knowledge questions (KQs); see Figure 2 for an overview of the design science project for an approach to sustainable collaboration.

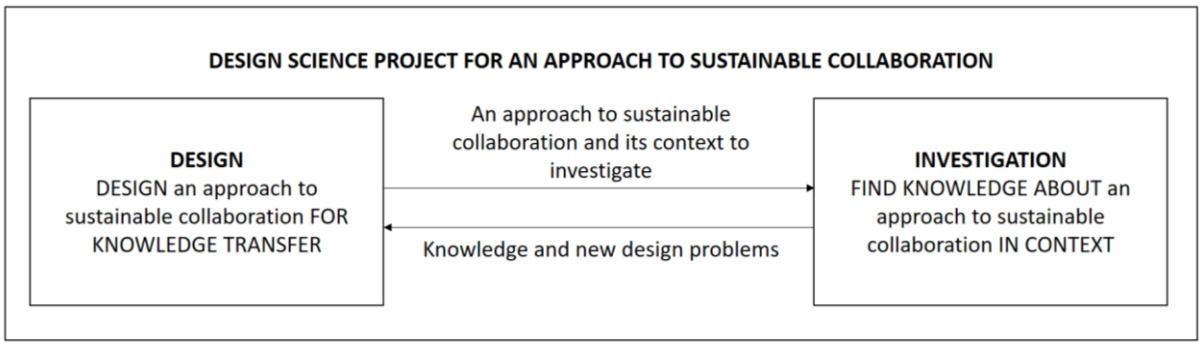

Figure 2: Design science project for an approach to sustainable collaboration

Design problems (DP) look for changes in the real world, and they require an analysis of an actual (organizational) goal, which is, in this case, to create a sustainable collaboration in order to transfer organizational knowledge. A solution is a design; in our case, it is a method that supports the sustainability of the system.

Knowledge questions do not refer to a change in the world but ask for the already available knowledge in the world (Wieringa, 2014). The DP is thus related to the design of deployment of a sustainable collaboration, whereas the KQs are related to finding knowledge about the interaction between the implementation methods and/or models for a collaborative tool and the context in which it is applied.

To answer the KQ, various propositions will be established. One of the goals of this research is to determine an objective solution that is not based on the individual goals of persons within RWS.

1.2.3. A framework for design science

Figure 3 is a depiction of the framework for design science, and it demonstrates our design science project as a whole. This framework contains the problem context of an artifact, the stakeholder of the artifact, and the knowledge used to design the artifact.

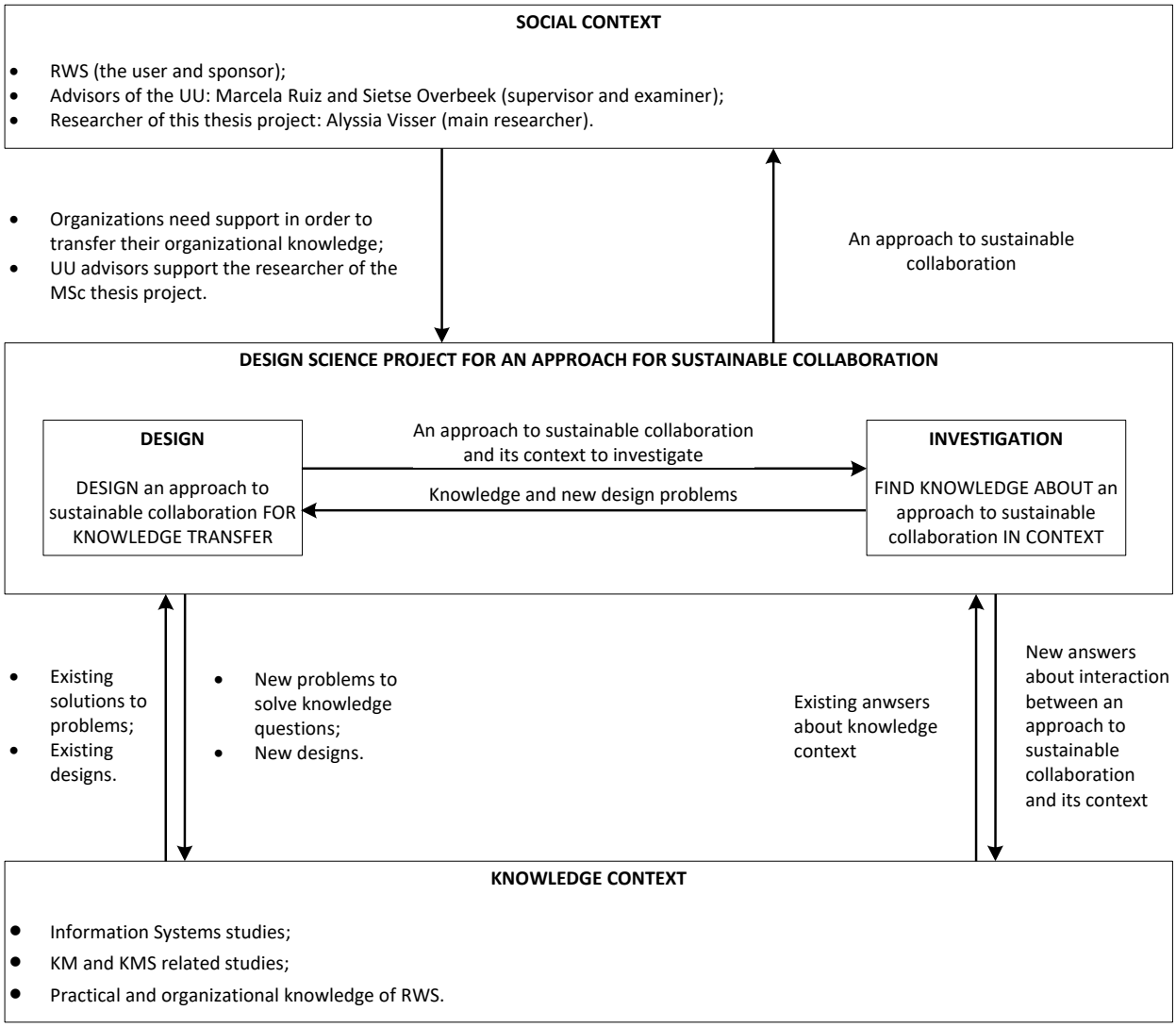

Figure 3: Framework for design science for an approach to sustainable collaboration

The *social context* is about the stakeholders who may affect or be affected by the project, such as the possible users, operators, or organization. In this case, the stakeholders are the Dutch government institution, RWS (the user and sponsor); the advisors at the University of Utrecht (UU), Marcela Ruiz

and Sietse Overbeek (supervisor and examiner); and the researcher of this thesis project, Alyssia Visser (main researcher).

The *knowledge context* is about the existing theories from science and engineering. The context of this research is IS studies, which are related to implementation in KM, such as requirement engineering, system adoption, content management, and quality maintenance. The practical and organizational knowledge of RWS consists of the following: strategic reports ("Kenniskoers 2020," translated: knowledge horizon 2020), meetings with the KM team and other stakeholders (manager, application advisor, and KM business consultants).

The framework presents the relationships between the project, social, and knowledge contexts, and together with the DP and KQs, it outlines the research goals and research question (RQ) of this study.

1.3. Research goal and RQs

Since design science studies highlight the inextricable link between designing and investigating, we decided to design the research goals and the knowledge goals in one overview.

1.3.1. Research goal

This research distinguishes between two different goals: the goal of the research and that of the (external) stakeholders (sponsor and users). Regardless of our motivation from a research perspective, the company and the researcher created a strong commitment to each other throughout the first phase of the process. The general desire is to improve the performance of ISs by providing an innovative and original solution, although the focus is primarily on the design science goals because of the exploratory characteristics of this research. Figure 4 illustrates an overview of the goal structure of this design science research project.

The approach to sustainable collaboration will be a result of an exploratory project. The lower levels of the figure present the knowledge goals and instrument design goals, which are about the related work on (corporate) wikis and other collaborative tools, and about the produced effect of our approach in context (G1 and G2). To answer G1 (the problem investigation), three types of qualitative research are conducted. To provide an answer to G2, we build an approach to sustainable collaboration (see the proposed design), and we develop an approach to support KM initiatives (G3 and G4). The design goal (G5) is the design for a sustainable collaboration, and the prediction goals are about the expected performance of the designed approach. Finally, the aim of the designed prediction goals, G6 and G7, is to generalize the results of the empirical exercise to any case of KM-related activities where the sustainable collaboration approach can be applied. These two goals would be achieved in the future, and they are not part of this study. Nevertheless, we describe G6 and G7 in this document because these prediction goals are part of the current goals' structure of the approach to sustainable collaboration.

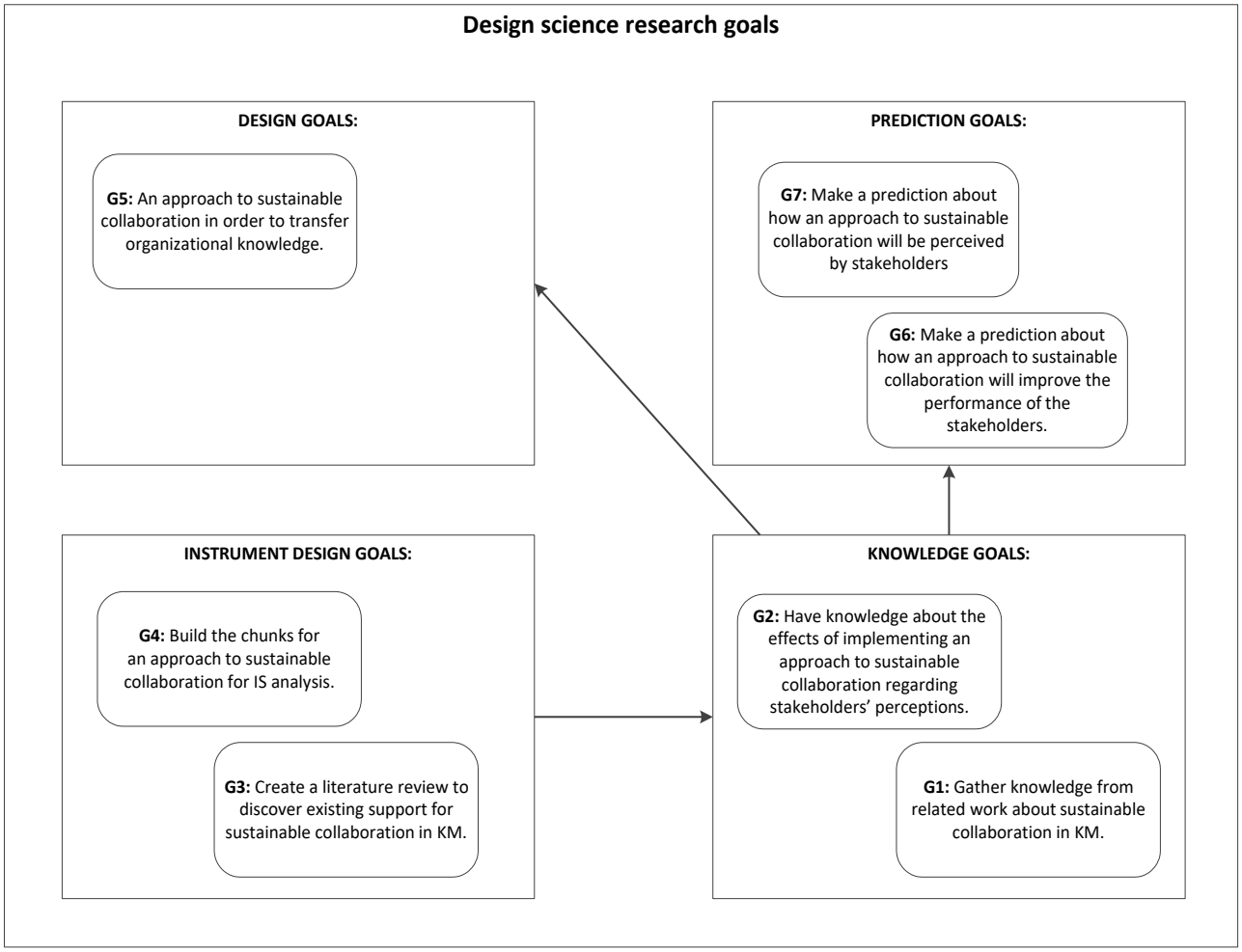

Figure 4: Goal refinement of the design science project for an approach to sustainable collaboration

1.3.2. Design problem

A DP is a problem regarding the design of an artifact so that it better contributes to the achievement of some goals (see Table 3). Based on the template for DPs, the researcher establishes the following main research goal: to successfully implement sustainable corporate collaboration in KM.

• Improve <continuity of corporate collaborations in KM>
• by <designing an implementation approach to sustainable collaboration>
• that satisfies <the needs and requirements of RWS, i.e., potential users>
• in order to <successfully implement sustainable collaboration for KM purposes>.

Table 3: Template for DPs (aka technical research questions)

Since this research is performed in collaboration with several parties, we must take into account the different stakeholders and their goals. However, apart from our motivation as researchers, we will strive for a strong commitment between both. We want to improve the way in which a collaborative tool performs within an organization. Below is a list of RQs derived from DPs—i.e., technical research problems (TRPs)—and KQs.

The central question is as follows: how can we accomplish an approach to sustainable collaboration in order to capture the valuable knowledge of the employees? One main objective of the stakeholders is to constantly maintain a certain level of quality of the systems to provide a useful and usable tool. Therefore, it is important both to establish the needs and requirements of the stakeholders and to counteract any requirement problems, such as organizational issues (for example, skills, culture, communication, and staff retention), or project and product issues (for example, documentation, measurement, quality, timescales, and development). Based on previous studies, the researcher establishes three dimensions: organizational changes, adjustment between the needs and new technology, and content management. This brings up various challenges that we need to overcome. These challenges lead to a main RQ and a set of sub-RQs.

Main RQ: how can we ensure the sustainability of a corporate collaboration in a governmental institution?

RQ1. (KQ) What are the existing supports for sustainable collaboration and KM ISs? (We answer this question in Chapter 3.)

RQ 1.1: What is the current positioning of the information ecology[2] of a governmental institution in relation to the organizational operations and culture? *See Chapter 3.2.*

RQ 1.2: How does one overcome barriers and pitfalls during the implementation of a collaborative tool/support in KM ISs? *See Chapter 3.3.*

RQ2 (TRP): How should an implementation approach to sustainable collaboration be designed so that it supports stakeholders' activities in a KM context? See *Chapter 5.*

RQ3 (KQ): What are the effects of implementing a sustainable collaborative approach regarding stakeholders' perceptions? *See Chapter 7.*

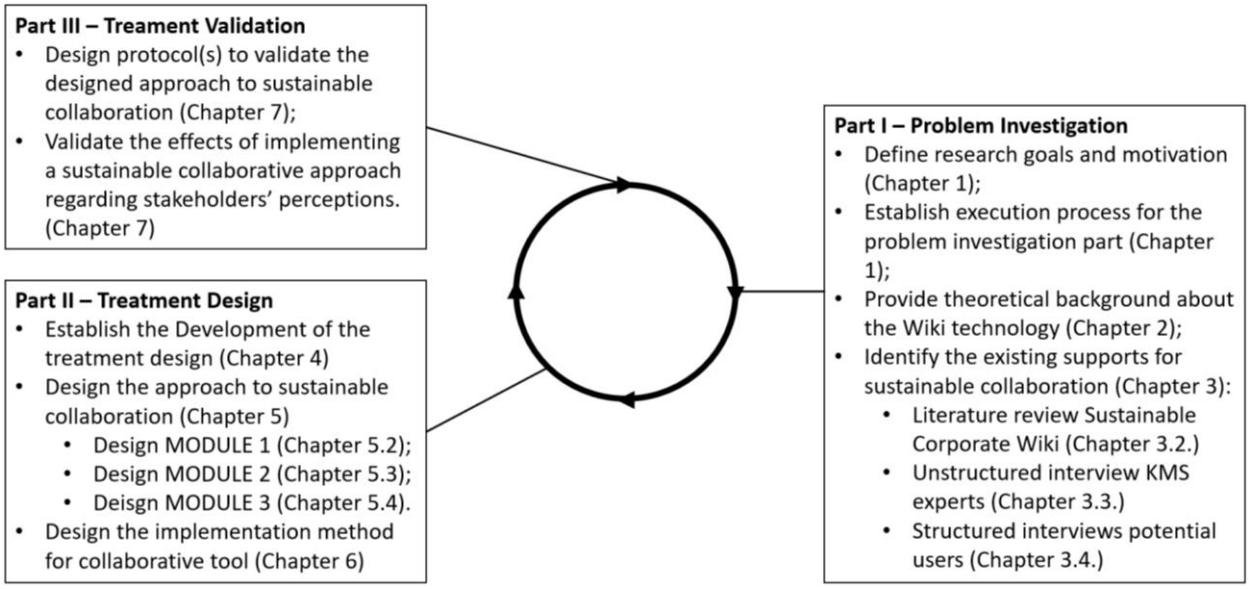

Figure 5: Design science cycle

[2] Current situation of the applications, systems and techniques within the organization.

The development of the approach to sustainable collaboration is in the frame of a design science project. As part of the design science cycle, we describe the activities of designing and investigating by means of three tasks: problem investigation, treatment design, and treatment validation (see Figure 5). During the treatment validation, the aim is to investigate the effect of the implementation approach to sustainable collaboration regarding stakeholders' perception with the support of a semi-case mechanism experiment and expert opinion (more elaboration is provided in Chapter 7).

1.4. The execution process of the problem investigation

In Chapter 3, we provide the problem investigation of this study. This section is dedicated to the execution component of that investigation. First, the justification for the used research method will be presented, followed by a brief description of the execution of our literature review. Thereafter, we provide the process for how we established the interview questions of the semi-structured interview, and a short description of the topic structure of the unstructured interview is included.

1.4.1. Justification for qualitative research

The aim of qualitative research is to preserve a chronological flow so that we can see which events lead to certain consequences. For example, we would like to investigate which human factors play a principal role in the sustainable collaboration approach. At the end, the qualitative data should derive fruitful explanations from the stakeholders. Furthermore, qualitative data provide well-grounded and rich descriptions of human processes for a problem investigation. Qualitative data focus on real situations to analyze naturally occurring, ordinary events in natural settings. These types of data are essential for KM initiatives because they deal with the complexity of human factors (Davenport, De Long & Beers, 1998), and more than simply delivering the correct information to the right people at the right time, we must take human factors into account (Thomas, Kellogg & Erickson, 2001).

Since KM and KMSs depend on human input, this qualitative analysis seems inevitable; the data were collected in close proximity to a specific situation, which is, in this case, the government institution. The emphasis is on a certain situation—a focused and bounded phenomenon embedded in its context (Miles, Huberman & Saldana, 2014). Furthermore, qualitative data are rich and holistic, with a string potential to reveal complexity, and they provide vivid descriptions that are nested in a real context. Miles, Huberman, and Saldana state that these types of data "have a ring of truth that has a strong impact on the reader." (2014). Qualitative data make up a thorough strategy for exploring a new area, which is an adjunct to our exploratory research.

1.4.2. The execution process—literature review

The literature review of the problem investigation is mainly based on a field search of papers from Google Scholar and the Association of Computing Machinery (ACM) Library. Concurrently with the field search, we used the snowballing method to extend and amplify our literature data. The selected papers were based on the title, abstract, (if necessary) introduction, and the expertise of the researchers. During the literature review, the Wiki technology seems to correspond to the aim of collaboration in KM, and to obtain the sustainability part, three commonly occurring factors are acknowledged: (1) adoption of the corporate wiki through aligning the expectations of managers and individual contributors; (2) content organization; and (3) maintenance of the system's quality, considering the

people's motivation, flexibility, and so forth (Grudin & Poole, 2010). Table 4 contains a non-exhaustive list of the search queries of the Google Scholar and ACM Library searches.

Keyword	Extension
Knowledge management	in organizations, in businesses, (business/organizational/corporate) culture, education/academia, government institution / public sector, projects, success, factors, barriers, IS, method, framework, limitations, way of working.
Knowledge management systems	collaborative, success factors, barriers, adoption, sustainable / long term, managing/managed.
Wiki	technology, way, in organizations, in businesses, success factors, barriers, adoption, sustainable / long term, motivation (factors).
Corporate wiki	Sustainable / long term, participation, (business/organizational/corporate) culture, education/academia, government institution / public sector, managing/managed, motivation (factors).

Table 4: List of search queries, literature review

1.4.3. The execution process—interviews

Complementary to the literature study, we conducted both semi-structured interviews with stakeholders from RWS and unstructured interviews with practitioners in the fields of KM and KMSs who are employees of external governmental institutions. The following subparagraph provides a general overview of the creation process of the questionnaire (semi-structured interview). Later on, we provide further details about the content of the interview questions and the created nodes.

Overview of the creation process of the questionnaire

Figure 6 depicts the process of the creation of the questionnaire for the structured interviews. Prior to generating the interview questions, we explored the problem statement together with the potential stakeholders (in this case, RWS) and UU advisors. Based on an internal (RWS documents/reports, the Intranet, and SharePoint) and external search (using the Google Scholar search engine and the ACM Library), we created an overview of the crucial factors for sustainable collaboration, and we amplify these factors through a literature review. Based on this review, we established a high-level baseline of the interview questions based on the study by Grudin and Poole (2010): (1) alignment of manager and individual contributor expectations, (2) content and flexibility, and (3) positioning of a wiki in an existing information ecology and corporate culture. Further intensification was obtained by means of a literature search of each factor. Thereafter, we selected the papers that genuinely contribute to the success factors in collaboration in KM and KMSs, resulting in a questionnaire that consists of 27 questions (see Appendix A). This questionnaire was reviewed by someone from RWS as well as from UU, and afterwards, the interview questions were finalized.

The interviews were conducted from weeks 46 to 49. Prior to the interviews, we held a short introductory session, wherein the participant had to sign an informed consent (see Appendix B), and we mentioned that the interview would be recorded for analysis purposes. Note that we conducted the interview in Dutch to reduce the language barrier and to gather as complete a picture as possible. In weeks 50 to 52, we processed and analyzed the qualitative data with tagging. To analyze our interview, we coded our data; "codes are labels that assign symbolic meaning to the descriptive or

inferential information compiled during a study." (Miles, Huberman & Saldana, 2013. p71). During this research, we used the fundamentals of qualitative data analysis from Miles, Huberman, and Saldana (2014); they consist of a method with two stages: the first cycle coding and the second cycle coding. For the first cycle coding, the data are coded based on the meaning of the data chunks, and the second cycle coding method generally works with the resulting first cycle codes themselves. We elaborate the execution of the first and second cycle coding after the creation of the interview questions.

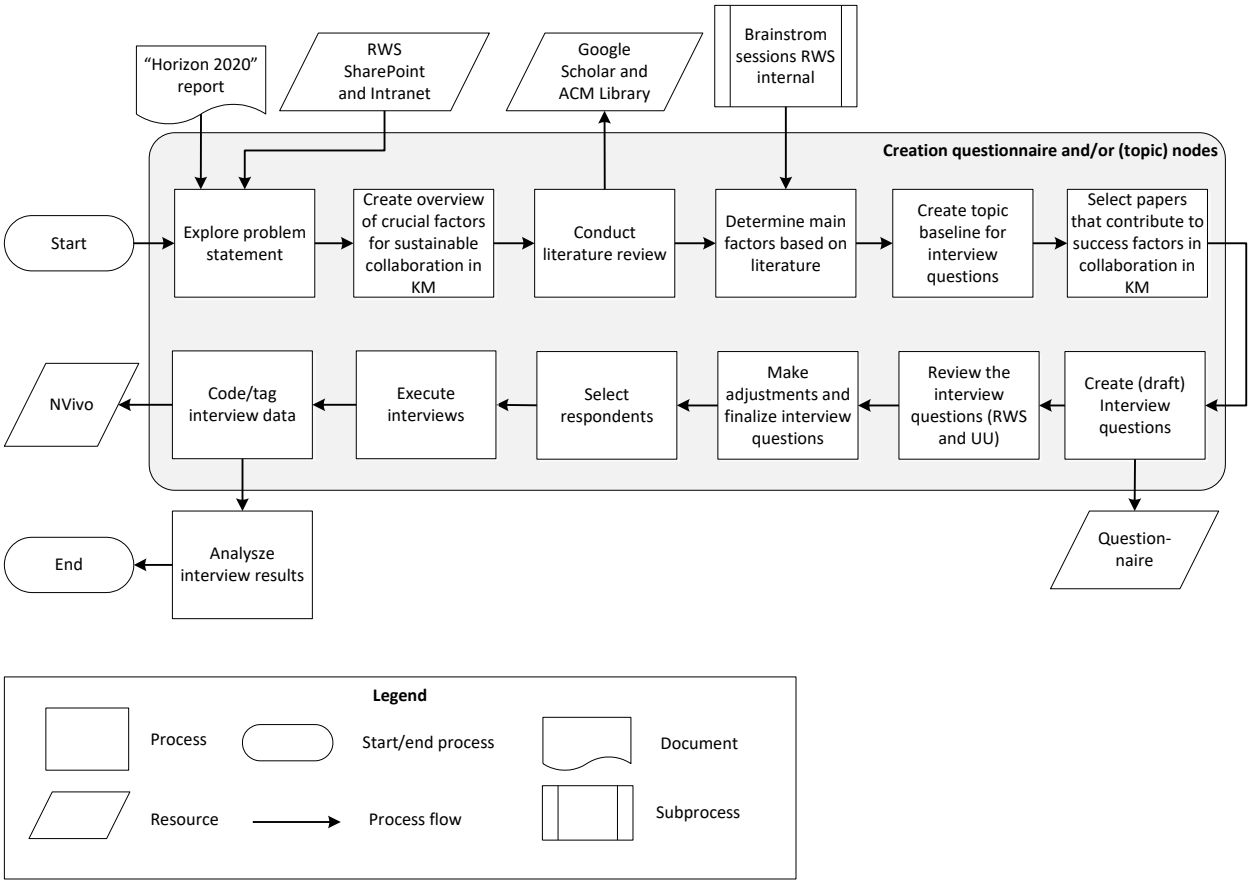

Figure 6: Creation process of questionnaire

Content interview questions

Figures 7, 8, and 9 illustrate an overview of how citations from several papers are converted into interview questions. Starting with the first topic—the adoption of the wiki system—which is established based on the first challenge of "aligning manager and individual contributor expectations" (Grudin & Poole, 2010), the questions are divided into the following subtopics (nodes): expectations (current idea of KM/KMSs, idea of KM in collaborative way, and expectations of system) and participation (both subtopics are related to the business culture). The second topic relates to content management, which is derived from the second challenge of "content organization and flexibility" (Grudin & Poole, 2010), which relates to both the information that the organization needs in the wiki and the technical aspect, such as editor contributions. The final topic is about maintenance quality, which is related to the third challenge of "positioning a wiki in an existing information ecology and corporate culture" (Grudin & Poole, 2010). The questions center around the current situation of a KMS within the organization, whether a new channel would disrupt the practice, the enthusiasm of the contributors, and how to motivate the employees.

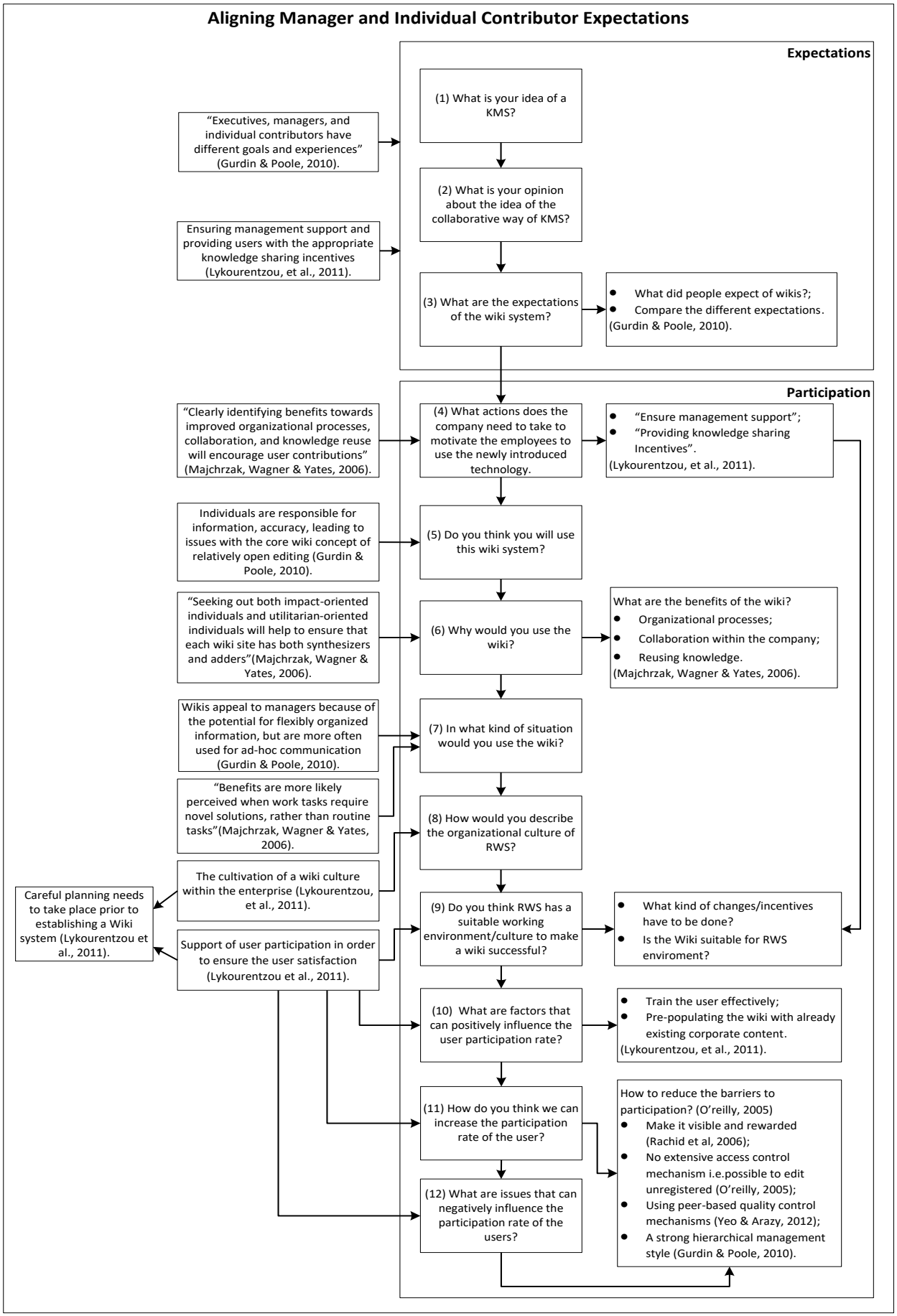

Figure 7 Interview questions for potential users, challenge 1

The unstructured interviews' topic list consists of two main nodes: best practices, which refer to what worked well, and poor practices, which refer to what went wrong. The aim of the unstructured interviews is to obtain an overview of the specific activities and lessons learned in the context of currently existing KMSs within government organizations. It is clear that the interview questions' main focus is on the implementation of Wiki technology, rather than on sustainable collaboration. As mentioned before, the characteristics, goals, and requirements of Wiki technology can be considered to be equivalent to those of the sustainable collaborative approach. Also, the sponsors of this research (RWS) seek to implement a wiki for KM purposes.

In Chapter 3, the results of the interview questions are described per respondent by means of a created code tree (see the next pages). In brief, the main diagnostic finding is that we amplify each challenge with the requirements, success factors, and findings from the literature and practices. These extensions attempt to provide a better foundation so that we can hopefully generate sustainable collaboration in KM.

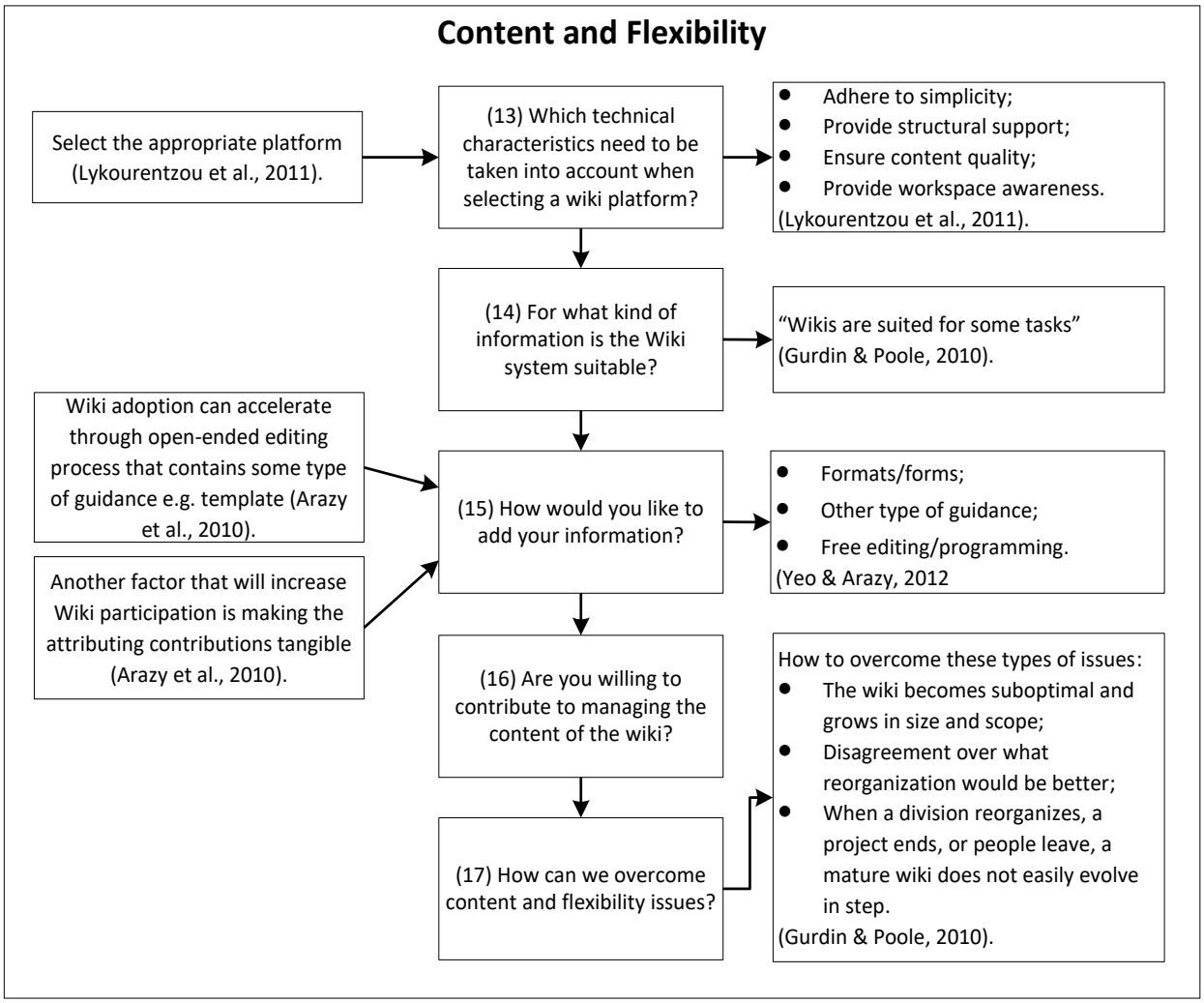

Figure 8: Interview questions for potential users, challenge 2

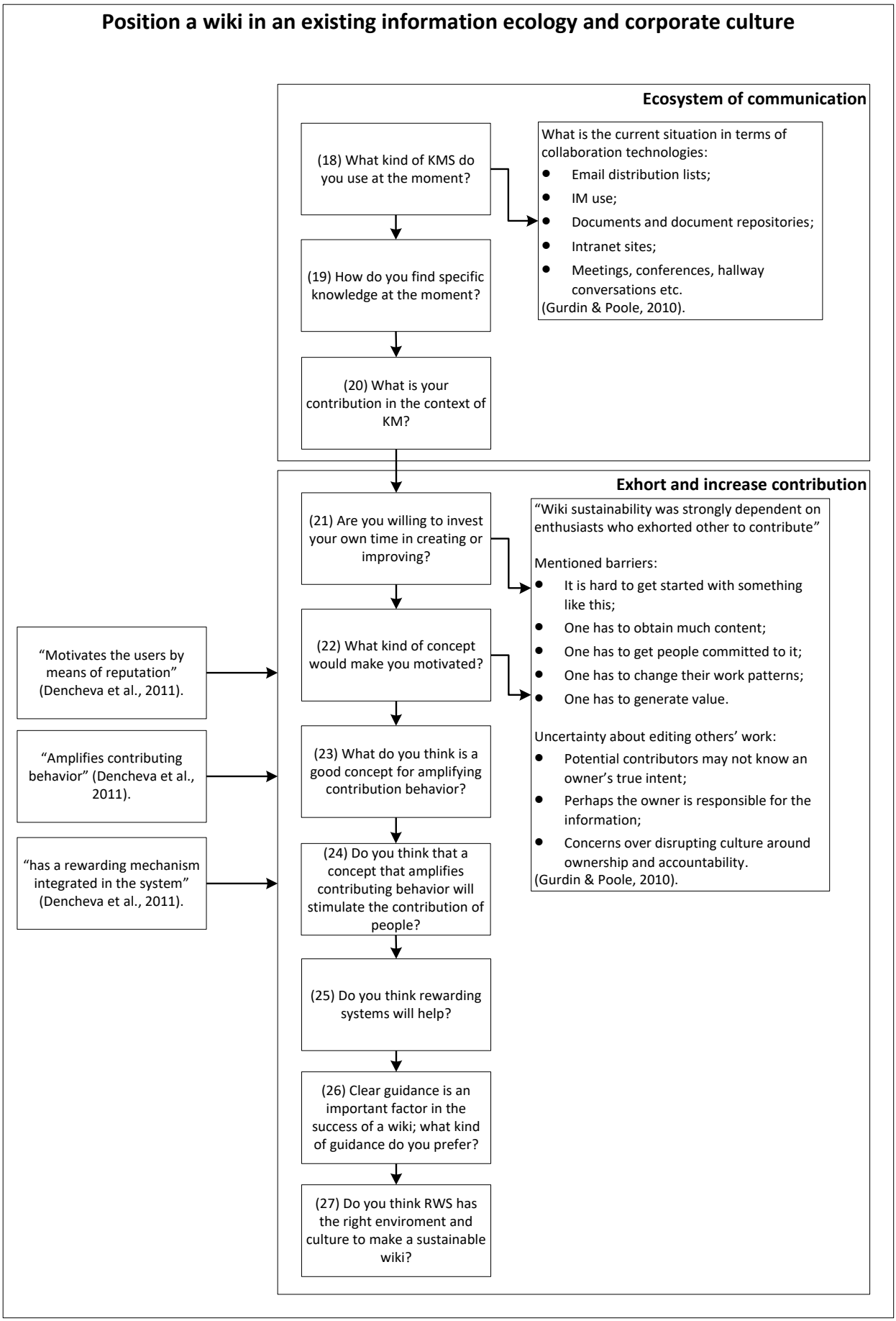

Figure 9: Interview questions for potential users, challenge 3

First cycle coding

During the first cycle coding, we performed descriptive coding; "a descriptive code assigns labels to data to summarize in a word or short phrase—most often a noun—the basic topic of a passage of qualitative data." For this long proposal, we created a code tree (depicted in Figure 10) to cluster our data in a specific node beforehand. Descriptive coding is especially useful for studies with a wide variety of data as well as for both unstructured and structured interviews. Since we have to extract data with high variety, descriptive coding is most suitable for this long proposal. During the first cycle, we extracted all passage codes to a certain node from various data of the interviews to compose a more detailed inventory of the cases and to construct a narrative that describes each defined node.

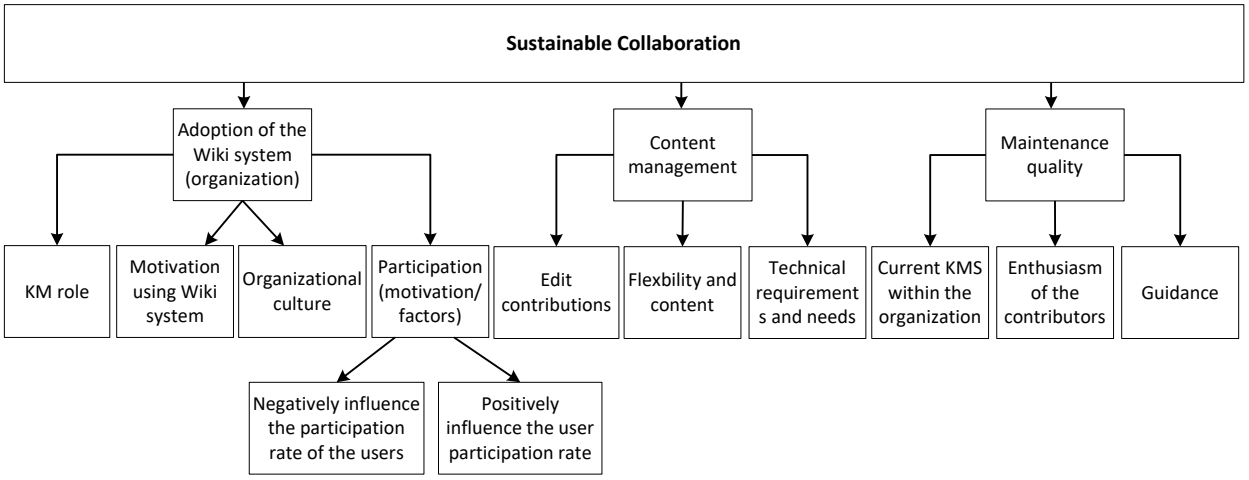

Figure 10: Code tree, first cycle coding

Second cycle coding

The second cycle coding involves pattern coding. It is a way of grouping the descriptions into a smaller number of categories (or nodes). Pattern codes are explanatory or inferential codes that identify an emergent theme, configuration, or explanation. In this way, the researcher gathers more meaningful and parsimonious units of analysis—some types of meta-code. After the first cycle coding, we began to analyze the qualitative data, and throughout this process, we adapted, merged, and removed nodes (based on the data). Figure 11 provides an illustration of the final code tree, which is also the structure for the results of the problem investigation (see Chapter 3.2.).

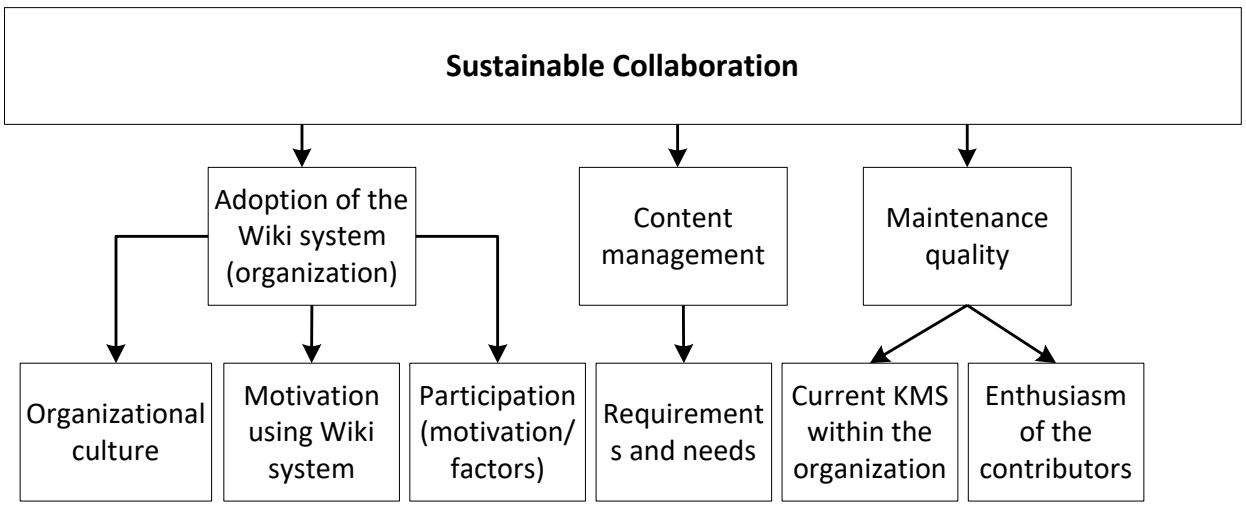

Figure 11: Code tree, second cycle coding

1.5. Means to achieve the main research goal

To achieve the main research goal and solve the RQs, we conceived the following three main means:

- *Expert views:* The research can be considered as expert in the field of KM due to the acquired knowledge during several master courses in that field. Alongside with essential courses to create and perform a solid design science project as well as to consider, inter alia, enterprise architecture, advanced research methods, method engineering (ME), software architecture, the strategic management of organizations and ICT, usability engineering, and user experiences. Furthermore, the research will be supported by supervisors from the UU and experts in the field of KM.
- *Collaboration with other organizations*: As a result of different collaborations with other organizations, new perspectives and ideas arose. We could participate in meetings regarding different KM-related projects or arrange a meeting with an individual to discuss their experience with KMSs.
- *Action research experiences:* To provide an example of how to implement the approach to sustainable collaboration, we created the Wiki Support Tool on the Intranet of RWS. The main advantage of this implementation is the potential to evolve our approach with the perspective of real-world conditions.

1.6. Proposed design—an approach to sustainable collaboration

The sustainable collaboration approach is an approach based on KM practices, and it is created from a fragmented architecture where various chunks can be assembled to solve the needs of KM. These chunks are established through qualitative research (see Chapter 3), although they would be refined throughout the treatment design (see Chapter 5) and validated during the treatment validation by means of a single-case mechanism experiment and expert opinion (see Chapter 7). The proposed design can be considered as the initial point and foundation of the approach to sustainable collaboration and the corresponding modules, namely the preparations, the execution, and the maintenance. See Chapter 5 for design chunks and the evolvement of the approach.

As previously mentioned, we establish that a collaboration with Wiki technology could be sustainable, although there are no guidelines, methods, or approaches to implement or develop a sustainable collaboration. To satisfy this approach, this research needs to (1) be formalized, including unambiguous descriptions; (2) be flexible, in the sense that it allows for situational adaption with different types of stakeholders/users; and (3) provide assembling processes for each situation. Figure 12 presents the foundation of the approach to sustainable collaboration, which consists of the baseline component and the component of the extensions. An approach is essentially a method without the validation to prove its efficiency in real scenarios/situations, and those extensions affix the three challenges for a sustainable wiki, as described in the study by Grudin and Poole (2010). They consist of requirements, factors, and concepts that are related to the successful implementation of a wiki within an organizational environment. In this case, those three aspects consist of planning criteria (Lykourentzou et al., 2011), implementation requirements and concepts (Voigt et al., 2011), requirements for the content template (Haake, Lukosch & Schümmer, 2005), factors to measure end users' perspectives (Bhatti, Baile & Yasin, 2011), and factors for a sustainable wiki (Arazy & Croitoru, 2010).

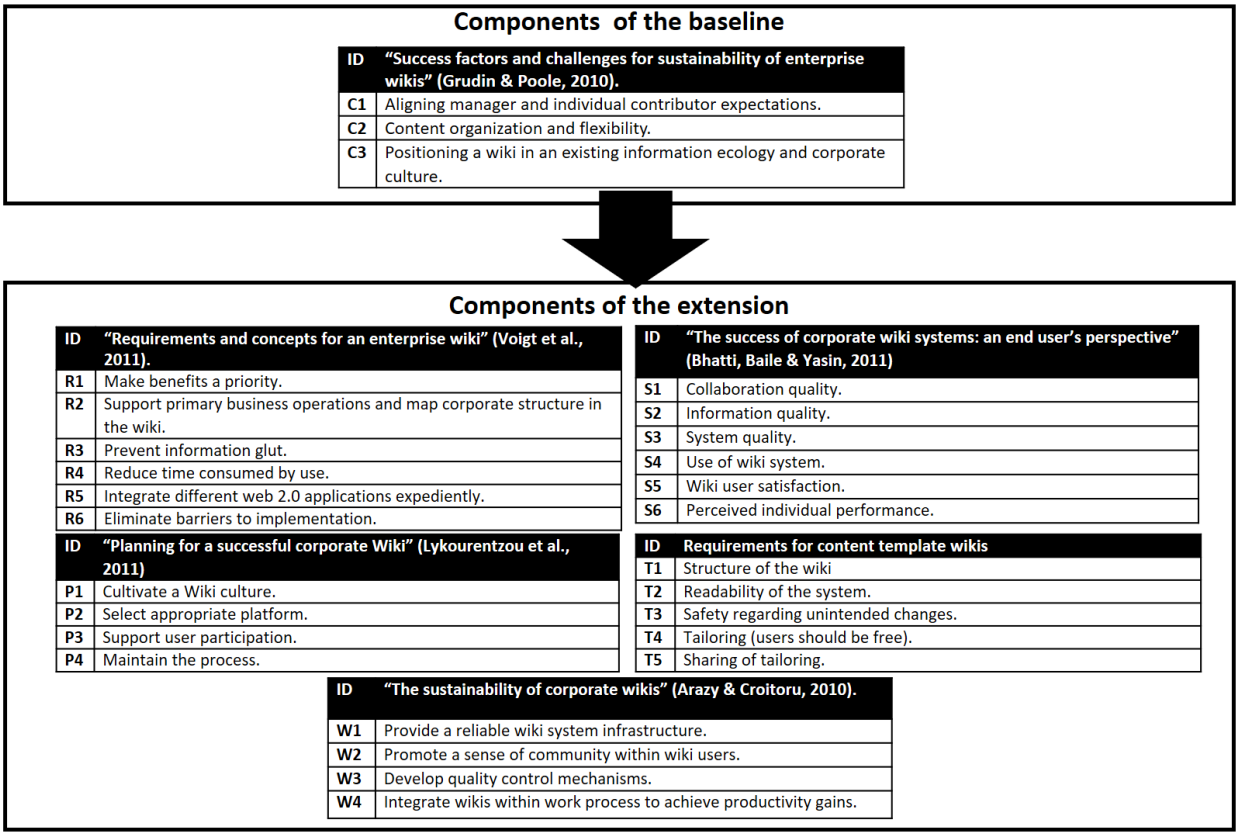

Figure 12: Overview of challenges extended with fragments from the literature and practice

Figures 13a and 13 provide an overview of the elements of the approach in a process deliverable diagram (PDD). These elements would be defined; for example, a protocol or a form throughout the research process. In short, a PDD, which is related to the ME discipline, is a meta-modeling technique based on UML standards, consisting of two diagrams. The left-hand side is the process view activity flow, based on the UML activity diagram, and the right-hand side is the deliverable view, based on the UML class diagram (Weerd & Brinkkemper, 2009). See Chapter 4.4. for a more in-depth explanation of the PDD in context.

The approach fragments of sustainable collaboration consist of three so-called modules, which can be seen as the main activities of this approach, and each main activity has certain sub-activities. This paragraph provides a brief explanation of each module. The first module aligns manager and individual contributor expectations; it involves the preparation of collaboration in KM, and it also includes the initiation component, wherein the stakeholders, sponsors, goals, first requirements, and needs are established. The second module involves the content's organization and flexibility, based on the activities related to the requirements for the content templates of wikis. The final module relates to maintenance and quality management (positioning a wiki in an existing information ecology and corporate culture), and it focuses on successes from an end user's perspective and the past sustainability of a wiki. The design of this PDD model is based on the results of Chapter 3; the phases are based on the baseline founded in the literature review (see Chapter 3.2.), and the sub-activities are created based on the literature review as well as the semi-structured and unstructured interviews (see Chapters 3.2., 3.3. and 3.4.).

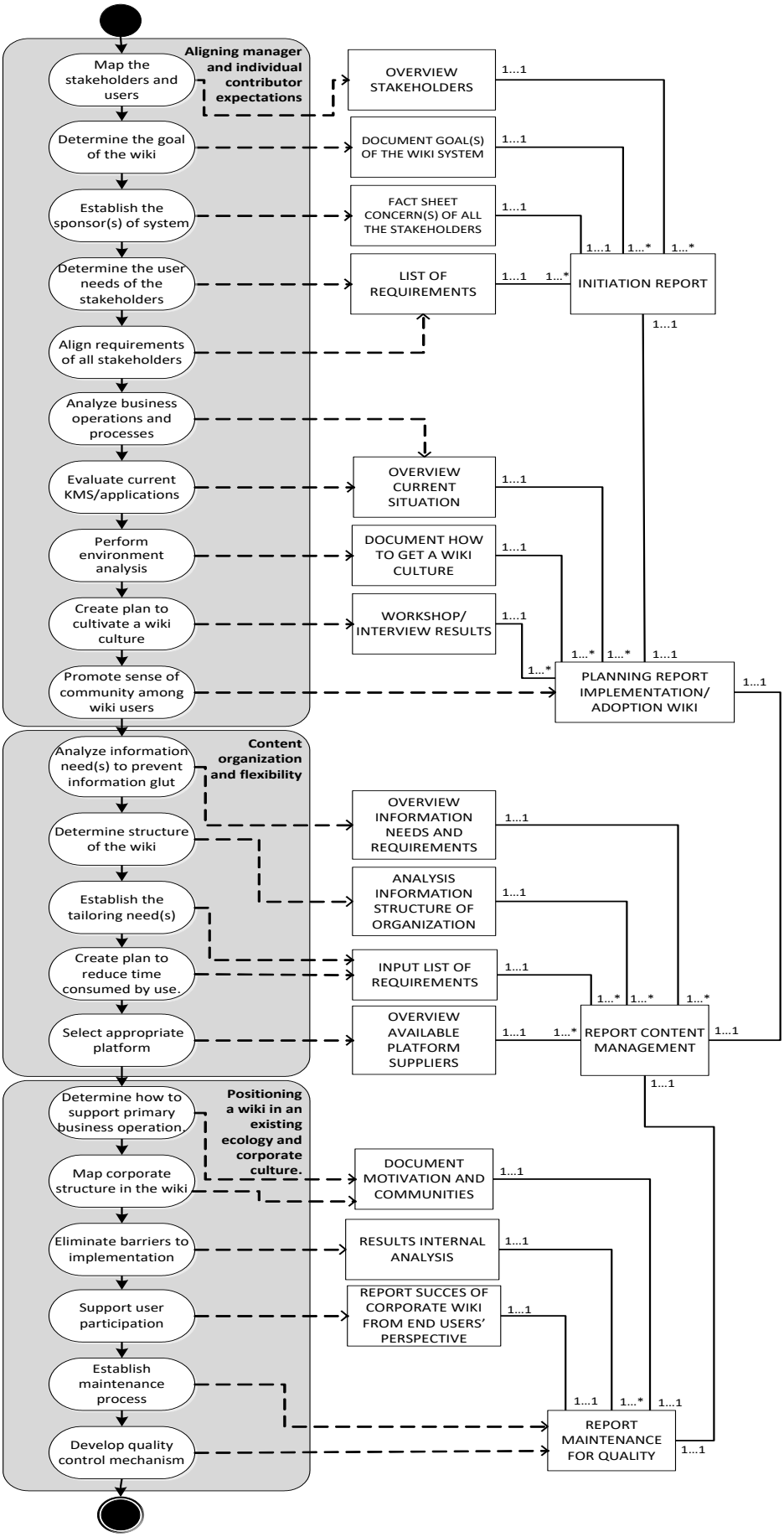

Figure 13: Overview of sustainable collaboration approach

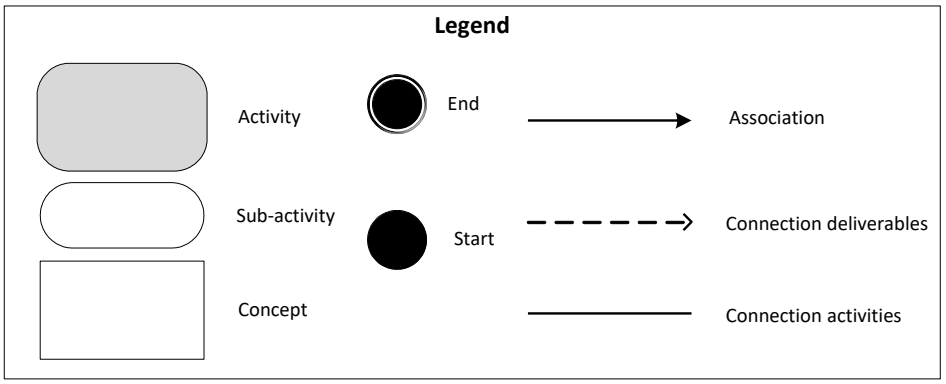

Figure 13a: Legend for the overview of sustainable collaboration approach

1.7. Outline of the thesis

The structure of the thesis is organized as follows:

Part I: Problem investigation

This part consists of **Chapter 1**, **Chapter 2**, and **Chapter 3**. In **Chapter 1.1.** the problem statement and research context are discussed, followed by **Chapter 1.2.,** the used design, which presents design science and the determination of the research goal and RQs. Since we establish the problem design not only with a literature review, but also with semi-structured interviews with potential users of a wiki and unstructured interviews with practitioners of KMSs, we define and describe the execution process and their elements briefly in **Chapter 1.3.** In the final section, **Chapter 1.4.**, the proposed design based on the problem design is described. The proposed design contains the first principals of our treatment design. **Chapter 2** provides the results and further understanding of the problem design. We begin with the motivation—why wiki technology is employed instead of other KMSs (**Chapter 2.2.**). Thereafter, a brief explanation of a wiki and Wiki technology is presented in **Chapter 2.3.** We continue with the state of the art in **Chapter 3.**, with the results and perceptions from the literature review (**Chapter 3.2.**), semi-structured interviews (**Chapter 3.3.**), and unstructured interviews (**Chapter 3.4.**). All the results of the problem design are summarized in **Chapter 3.5.**

Part II: Treatment design

This part spans across **Chapter 4** to **Chapter 6**. **Chapter 4** is concerned with the development of the treatment design. The aims of this chapter are to provide the reader with a better understanding of how we designed the approach to sustainable collaboration and to provide information about the fundamental idea (**Chapter 4.2.)**; the design chunks in the research context (**Chapter 4.3.**); the used method, namely the situational ME (**Chapter 4.4.**); and finally, more in-depth information about the ME cycle (**Chapter 4.5.**). **Chapter 5** itemizes all the method design chunks per module. Each activity or a combination of activities is related to one or more literature studies on the following: the Stakeholder Theory, the Expectation-Confirmation Model (ECM), the Expectation-Confirmation Theory (ECM), Enterprise Modeling, the Organizational Culture Assessment Instrument (OCAI), the KM Assessment Instrument (KMAI), and different concepts from different studies. **Chapter 6** contains an example of how organizations can use the approach to sustainable collaboration, namely the Wiki Support Tool. Organizations that might be interested in this approach would be those that seek to create a sustainable corporate wiki.

Part III: Treatment validation

The treatment validation consists of Chapter 7. During the treatment validation part, we performed an evaluation study. In Chapter 7.2., we first provide the user with an overview of the evaluation study, which is comprised of a single-case mechanism experiment and expert opinion. Chapter 7.3. is dedicated to that experiment (using the Think Aloud method), which consists of the experimental setup and experimental process, followed by the first phase of an evaluation study. This first phase relates to definition and planning, and it contains explanations of the following: the goal, research items, subjects, objects, experimental tasks, and instrumentation. Then, the second phase—the execution of the experimental process—provides a description of the preparation, operation, data validation, analysis of the subjective data, analysis of the objective data, and finally the results of the single-case mechanism experiment. Chapter 7.4. is about expert opinion; it describes the goal, subject and object, instrumentation, preparation and operation, data validation and data analysis, and finally the result of the expert opinion interview. The final section, Chapter 7.5., is dedicated to the validation component of the treatment validation.

Part VI: Discussion and conclusion

The final part, **Chapter 8**, is the final section of this thesis report. It includes the following elements: the discussion, conclusion, limitations of the study, and future work.

Chapter 2: Theoretical background

"And Knowledge Management is a means, not an end"
(Bill Gates)

2.1. Introduction

This chapter provides further theoretical context for Wiki technology, based on the literature study. Since Chapter 1 established that the practical purpose of wikis and Wiki technology is equivalent to our idea of sustainable collaboration, it is important to begin with sufficient basic knowledge of Wiki technology and wikis in general. First, we start with the motivation, which answers the following question: why the support of Wiki technology rather than other KMSs? This is followed by an overall view of Wiki technology and the way in which a wiki generally works, and finally, a comparison between a wiki and its characteristics.

2.2. Motivation – the Wiki technology

The main challenge is to efficiently use individual employee intelligence through a machine-facilitated understanding of the collected individual corporate knowledge, this in order to develop the employees collective intelligence (collaboration in KM) with the support of technology systems (Yeo, 2012). Also, in the education discipline, collaborative learning can add value with Web-based learning systems: "In Web-based systems, cross-platform environments, hyperlink networks, and synchronous or/and asynchronous communication are all appropriate functions that provide students with more equal opportunities" (Liaw et al., 2008). The motivation for selecting an IS that uses Wiki technology rather than other groupware or KM tools is because wikis allow users almost complete freedom. This means that there are (almost) no restrictions during the content development process; there are no rigid workflows, access restrictions, or predefined structures, all of which limit a user (Schaffert, 2006). Users essentially do not need to adapt the practice that is dictated by the system; instead, they are allowed to use their own practices to define the structure of a KMS. This is important because different domains often have different types of workflow. For example, based on the semi-structured interviews in Chapter 3.3., it appears that RWS must deal with a wide variety of expertise; each knowledge domain has its own process, procedures, and rules. In the study by Schaffert (2006), the following purposes of a wiki were identified: encyclopedia systems, software development, project KM, personal KM, collaborative writing, and knowledge base. Moreover, wikis take into account the concerns mentioned in Chapter 1.1.1; they provide support for the different IS perspectives, background/communication, objectives/interests, content/documents, and involvements. Furthermore, collaboration in KM can enhance reputation and make work easier, and it helps to improve the processes of an organization. The concept of a wiki was originally intended for knowledge work on the open Internet—the most successful wiki technology is the well-known Wikipedia.

Despite the success of various wikis in the public domain, it is still not clear whether wikis can succeed in corporate settings, since there seems to be an inherent tension between wikis' affordances and the nature of knowledge work in organizations (Yeo, 2012). An often-mentioned aspect is that the participation of the stakeholders can have a major influence on the success of a wiki (Dencheva, Prause & Prinz, 2011; Yeo, 2012). Therefore, the interest of this study is in finding a solution to ensure the

sustainability of a corporate wiki, although to provide an appropriate answer, more understanding about corporate wikis in general is needed.

2.3. Intention behind the Wiki technology

In 1995, Ward Cunningham developed a collaborative tool—nowadays known as wiki—for use on the Internet. Wiki is a derivative of the Hawaiian word wikiwiki, which means quick/fast, in reference to the speed at which content can be created (Wagner, 2004; Ebner, 2008). It is important to note that there is a difference between the term Wiki (uppercase W) and wiki; the former addresses the technology concept, and the latter refers to an application/system. The first wiki was called the "PortlandPatternRepository," which was initially created to communicate specifications for software design. The functionality that the wiki characterizes is essentially that it is open editing, meaning that the user of the wiki can visit, read, reorganize, and update the structure and content of a wiki page, following the principles of universal access; "the basic idea behind this term is access to information by everybody" (Ebner, 2008).

A wiki system is an online platform, and it provides mark-up languages based on simplified HTML elements in order to offer the editors an easy way in which to create online content. This type of system was originally developed as an easy-to-use KMS for effective and efficient online collaboration. For this purpose, a wiki can demonstrate great potential as an online collaboration tool, due to the fact that a user needs to read and edit the wiki in a web browser (Augar, 2004; Ebner, 2008). This brings us to the most important asset of wiki systems: they are free and easy to access for every user. During this study, the following definition is used: "a wiki is a set of linked web pages, created through the incremental development by a group of collaborating users" (Wagner, 2004), with the following key characteristics (based on Wikipedia[3] and an online encyclopedia): (1) documents can be authored in a collective way, (2) it provides the user with a simple make-up scheme (HTML), and (3) new web pages appear when a user creates a hyperlink that refers to a page that does not already exist. Wagner's study mentioned another key characteristic of a wiki: "wiki content is not reviewed by any editor or coordinating body prior to its publication" (2004). During this research, these key characteristics are partly discarded because of the confidentiality of certain information of a company. Ward Cunningham formulated 12 principles[4] for designing a wiki (provided in Table 5). For this research, some adaptions will be made due to the fact that this wiki will be initialized by a governmental institution.

Design principles	
Simple	Due to the wide variety of users (different types of specialism), it has to be easy to use with a simplified HTML markup.
Open	In this case, there has to be a balance between universal open access and the level of control for quality assurance. Every user should have the possibility to create, edit, revise, and extend the content, although the content of the wiki must be reliable and precise.
Incremental	Pages can cite other pages, including pages that have not been written yet.
Organic	The structure and text content of the site are open to editing and evolution.
Mundane	A small number of (irregular) text conventions will provide access to the most useful page markup.

[3] www.Wikipedia.org
[4] http://wiki.c2.com/?WikiDesignPrinciples

Universal	The mechanisms of editing and organizing are the same as those of writing, so that any writer is automatically an editor and organizer.
Overt	The formatted (and printed) output will suggest the input required to reproduce it.
Unified	Page names will be drawn from a flat space so that no additional context is required to interpret them.
Precise	Pages will be titled with sufficient precision to avoid most name clashes, typically by forming noun phrases.
Tolerant	Interpretable (even if undesirable) behavior is preferred to error messages.
Observable	Activity within the site can be watched and reviewed by any other visitor to the site.
Convergent	Duplication can be discouraged or removed by finding and citing similar or related content.

Table 5: wiki design principles, Ward Cunningham

A wiki consists of a collection of various webpages with several collaboration features, which reflect the 12 design principles. The software of a wiki is open source (most of the time), such as the popular MediaWiki[5], which is a free, open-source software Wiki package written in PHP, and it was originally used for Wikipedia. Although MediaWiki currently acts as a foundation for many other wikis, other similar wiki software packages are PHP Wiki and PMWiki. Despite the different implementations, all these software packages apply the Wiki design principles, and they only differ in their additional features.

Creating and editing activities correlate with the mundane and universal principles. The user can enter his/her contribution through web-enabled form fields with plain text or a simplified mark-up language. Creating hyperlinks is a fundamental aspect of KM with wiki systems, and it corresponds to the open principle. Furthermore, hyperlinks connect topics and create context. In a Wiki design, creating hyperlinks is an easy task because the user does not have to create URLs, but can use CamelCase (multiple words capitalized and concatenated) instead. Multi-user technology is one of the characteristics that makes a Wiki distinct. The next principles, namely incremental and organic, correspond to the several features that a wiki incorporates to simplify multi-user web page creation and manipulation. Important features are the provisions for multi-user access and features to avoid conflict or inconsistencies that arises from multi-user editing. Due to the fact that multiple people work on a Wiki, it can be difficult to track and connect the existing pages meaningfully. This means that a directory function is important for a wiki system. A directory presents all orphaned pages, which are pages without links to them. Administrators and/or contributors can consult this directory to organize the existing knowledge more cohesively and to create more context. As mentioned before, wikis allow users to modify the content of other users' web pages (on a certain level), which leads to the challenge of keeping prior versions of any web page (this relates to the observable principle). A way in which to address these challenges is to keep prior versions in memory and enable rollback, comparison, difference identification, and similar functions.

From a KM perspective, wikis have the ability to address specific knowledge needs; they tend to be most effective for ad hoc problems with decentralized knowledge sources. However, a wiki system is not limited to this area. To explore the knowledge needs, a distinction will be made between knowledge users and knowledge creators due to their different needs. With regard to knowledge users, the knowledge is ad hoc, meaning that these users are likely unable to specify knowledge needs

[5] https://www.mediawiki.org/wiki/MediaWiki

as a priori. To counter this, a tool that incorporates fast question answering is needed. The next concern is finding the knowledge, which is a major challenge for KMSs. Users need to easily find the correct knowledge in the system; this means that they require a tool that is “search (engine) friendly” and hence keyword oriented, hyperlinked, and indexed. Complementary to the previous need is filtering knowledge from noise. This means that the user would like to find relevant knowledge effectively.

The final established need relates to the quality of the source. In this case, it is necessary for the KMS to have an incorporated quality assurance mechanism, including the tracking of the sources. From the knowledge creator’s perspective, different concerns and needs are determined. The first concern relates to dynamically changing knowledge, since it is exceedingly difficult to manage knowledge when it changes rapidly. For this purpose, the technology needs to support the distribution of knowledge creation activities to as many participants as possible.

Another concern is that the knowledge is distributed, since collective knowledge is superior to the knowledge of any individual. Despite the fact that knowledge is well defined, no one can possess all knowledge. Even when there are a few key experts, they may be unable to record all their knowledge or state it in ways that are meaningful to everyone else. Therefore, the KM tool should be able to seamlessly combine the knowledge of multiple experts. Next, with regard to errors and recovery (in the context of quality assurance), an inevitable problem is that the content/knowledge will be incorrect at some points in time—it can either contain incorrect facts or omit relevant knowledge. Therefore, it is important that the tool has a self-correcting mechanism that quickly corrects any errors in the KMS. The final principle is the publication overt, which requires that message representation and posting on a shared knowledge repository be fast, easy, and secure. The basic functions of a wiki are (1) editing wiki pages, (2) creating new pages, (3) linking between pages, (4) linking to external websites, and (5) formatting the wiki page.

The first function, namely editing wiki pages, allows users to add, delete, and modify the content of the wiki directly, which means that every page has a link to “edit this page.” The user of a wiki can click on this link and edit his/her contribution in an already existing page of plain text, and at the end, he/she can click the “save” or “update” function. The new content will automatically be published in Web format, as long as it satisfies the possible regulations. Second, creating new wiki pages enables users to make new wiki pages to develop a logical flow. The next function involves linking between wiki pages within the wiki environment; this is a type of citation function for other pages. Furthermore, users can create links to external websites by clicking on the external link icon, where he/she can place the URL link. The final aspect entails formatting, such as bold, underline, or cursive (Raman, Ryan & Olfman, 2005).

2.4. Summary

The theoretical background was created to provide the reader with additional understanding of Wiki technology in general. Since we determine that the practical purpose of wikis and Wiki technology is equivalent to our idea of sustainable collaboration, it is important to obtain solid basic knowledge about Wiki technology and wikis. In essence, the functionality that characterizes a wiki is open editing, and a wiki is nothing more than a collection of various webpages with several collaboration features, which align with the 12 wiki design principles. A wiki is highly effective for ad hoc problems with

decentralized knowledge sources, although this can lead to problems in terms of the quality of the content; therefore, there is a need for a quality mechanism. The basic functions of a wiki are editing wiki pages, creating new pages, linking between pages, linking to external websites, and formatting the wiki page.

Chapter 3: The existing supports for sustainable collaboration

"Knowledge Management is a bit like Travel Insurance – You only wish you had it when it is too late."
(O'Neil, 2009)

3.1. Introduction

To shape the problem investigation, we conducted three types of qualitative studies (Figure 14 provides a depiction of these studies). We began with the literature review to explore the field of collaboration in KM and the sustainability component—for example, KMSs in general, collaborative KMSs, and Wiki technology—to provide an overview of state-of-the-art sustainable collaboration. Based on the same input of the literature review, we created a questionnaire for the semi-structured interviews with potential users of a wiki. The final study involves unstructured interviews with practitioners in the fields of KM and KMSs who are employees of external governmental institutions. Both types of interviews exemplify the literature review in practice through evaluations of practitioners, i.e., lessons learned. According to Patton (2001), a "high-quality lesson learned is knowledge that can be applied to future actions and derived from screening according to specific criteria." During our problem investigation, we used the following criteria: the wisdom and experience of practitioners, experience reported by program participants (past events), and expert opinions. This whole chapter is also dedicated to the following RQ:

RQ1: What are the existing supports for sustainable collaboration and KM ISs?

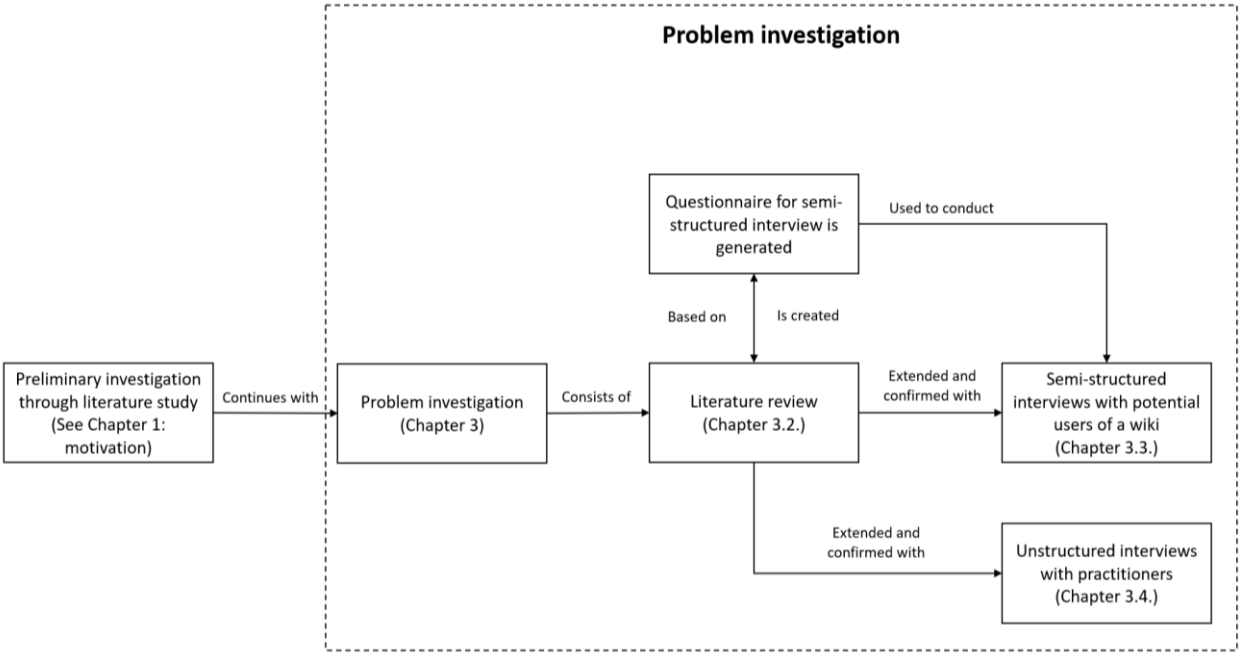

Figure 14: Overview of the structure of the problem investigation

3.2. Literature review—state of the art

In the past, many studies were conducted regarding the critical factors in the successful implementation of KM (Davenport, De Long & Beers, 1998; Chait, 1999; Choi, 2000; Hasanali, 2002; Alazmi & Zairi, 2003) and KMSs (Akhavan, Quaddus & Xu, 2005; Jafari & Fathian, 2006); however, KMS-related studies mainly focused on the set of critical success factors (CSFs) that support KM adoption and/or diffusion. There are even studies that combined the external factors, such as the organizational culture and knowledge sharing (Ismail Al-Alawi, Yousif Al-Marzooqi & Fraidoon Mohammed, 2007), and research that specified the CSF's per organization size or type, such as small- and medium-sized enterprises (Yew Wong, 2005), or temporary organizations (Lindner & Wald, 2011). Despite the extensiveness of the conducted studies about wikis and Wiki technology, none of them investigated the ways in which to make a corporate wiki sustainable. The paper of Majchrzak, Wagner, and Yates (2006) has concluded that a wiki appears to be sustainable, and it only provides a brief overview of the sustainability aspect of the system. The study by Grudin and Poole (2010) has established three main challenges that will contribute to a sustainable wiki, as previously stated. The aim of this literature review is to gain further understanding of those challenges by exploring each one individually in order to design our proposed approach.

3.2.1. Challenge 1—aligning manager and individual contributor expectations

The first challenge relates to the expectations of the different stakeholders of a corporate wiki: "Many executives and managers supported the idea in principle and envisioned how wikis could be useful, but their visions did not align with the ways that even successful wikis were used by the individual contributors who contributed most content" (Grudin & Poole, 2010). Alongside the mismatch between the vision of the management team and individual contributors, the culture within an organization can add another layer of complexity; therefore, it can be seen as an important point of concern. Since we are focusing on the sustainability aspect of a collaboration in KM, we define the following measurement for sustainability: (1) the length of time in existence, (2) the number of lurkers, (3) the number of contributors, and (4) the frequency with which pages are accessed (Majchrzak, Wagner & Yates, 2006). For the first challenge, we established the following three main concerns: implementation/planning with respect to the technological and cultural aspects, implementation, and contributor participation.

Careful planning involving both technological and cultural aspects

The study by Lykourentzou et al. (2011) has stated that the effective implementation of a wiki within an organization depends on various factors, which involve both technological and cultural aspects. It is essential that management supports both aspects to create the basics for a sustainable collaboration implementation. Based on a number of non-successful cases, it turns out that careful planning needs to take place prior to establishing a wiki system. To create such planning, the following key factors that affect the success of a corporate wiki are established: cultivating a Wiki culture within the enterprise, selecting the platform that meets the business needs, supporting user participation, and maintaining the wiki.

The first factor, related to culture, states that the success of a wiki system depends on the open, knowledge-sharing culture of an enterprise. Therefore, two main prerequisites are involved: ensuring management's support and providing users with the appropriate knowledge-sharing incentives. To

ensure management's support, it is important to satisfy the need for a non-hierarchical, open, and bottom-up knowledge-sharing culture. Furthermore, management must actively urge users to share their knowledge, and promote interaction, dialogue, and feedback among the prospective wiki users. The following four knowledge-sharing initiatives tend to have the most impact: (1) incorporating the wiki into the daily routine of the workforce, (2) recognizing the users that provide contributions, (3) creating a safe-to-contribute environment, and (4) motivating and creating team spirit.

With regard to the second factor, the following issues need to be taken into account when selecting the platform that meets the business needs: the level of complexity, structural support, quality assurance, and workspace awareness that the platform provides.

The third factor involves user participation to ensure user satisfaction. To obtain user satisfaction, the following two activities are important: training the user effectively and pre-populating the wiki with already existing corporate content.

The final factor is the maintenance factor. It is important to constantly monitor, evaluate, maintain, and enhance results to ensure that the platform will produce long-term value for the organization by observing a user's activity history and the wiki platforms in a textual or visual way or by applying social network analysis to analyze and measure the activity levels inside the wiki. These factors help to familiarize stakeholders at various organizational levels (managers, experts, CoPs, and other employees) with the particularities that the use of the Wiki technology most commonly presents. Furthermore, these factors support the future implementation and sustainability of more successful corporate wiki stories.

The essential elements of KM using a KMS are the technical, legal, social, and management concerns. First, the technical concerns relate to the technical support to install the corporate wiki and maintain the overall quality of the wiki. Next, the legal concerns relate to several issues such as copyright and legal liability, which will increase the social responsibility of the users as time progresses. Furthermore, a corporate wiki contributes to redefining the social constructs of the organization because it places the users on the same level as management, meaning that there is no discrimination among participants, which opens development to diverse knowledge (Awazu & Desouza, 2004; Pfaff & Hasan, 2007).

Implementation requirements

In addition to the second challenge in Grudin and Poole's (2010) study, the implementation requirements for a corporate wiki, as described in Voigt et al.'s (2011) study, could be valuable extensions. During this study, requirements and concepts are investigated in SMEs, and we determine the following six implementation requirements: (1) make benefits a priority, (2) support primary business operations and map corporate structures in the wiki, (3) prevent information glut, (4) reduce time consumed by use, (5) integrate different Web 2.0 applications expediently, and (6) eliminate barriers to implementation.

Contributors' participation

Wikis are essentially designed to promote and encourage group collaboration rather than individualism—the different pages are not associated or linked to a single author. It is even difficult to

assess the individual authors' contributions (Arazy et al., 2010). Another factor that will increase Wiki participation is making the attributing contributions tangible. From research on another collaboration platform, it has been found that users tend to contribute more when their contribution is visible and rewarded (Rachid et al, 2006). To attract more participants and increase the size and diversity of the user/author group, the majority of external wiki systems do not have an extensive access control mechanism (for example, possibility to edit unregistered); they use "the wisdom of the crowds." One of the key factors that leads to the success of Wikipedia is reducing the barriers to participation (O'reilly, 2005) and therefore using the collective intelligence of a diverse expert/author set, resulting in higher-quality content (Yeo & Arazy, 2012). However, unregistered and anonymous authorship are usually undesirable in corporate settings because of the accountability principle. The participants in the sample of a study by Yeo and Arazy (2012) stated that they did not have a preference regarding unregistered editing, nor did they believe that this would result in higher participation in a wiki in a corporate setting.

3.2.2. Challenge 2—content and flexibility

The second challenge, as mentioned in the study by Grudin and Poole (2010), is concerned with early deployment choices: "Contributors to team wikis mentioned time and again that seemingly arbitrary choices of how to organize information at the outset became suboptimal as a wiki grew in size and scope." Content management is the process of creating, managing, and revealing the content of a system. Adding further structure to a wiki system can help the user to state and answer the right questions in order to understand and communicate a specific subject. However, it is important to maintain a healthy balance between a proposed structure and the potential freedom to express oneself, which is defined in two strategies: (1) Wiki users should be free to combine less structured parts with structured parts according to their needs, using gradually increasing structured documents, and (2) wiki users should be able to tailor the structure to their needs (Haake, Lukosch & Schümmer, 2005).

Wiki technology can be used in both Internet and corporate settings, although it seems that KM practices differ substantially from Internet wikis (for example, Wikipedia). Different from the norms of Wikipedia, corporate wikis have to deal with other editing norms. The main idea of a wiki is that it can be edited in an unconstrained manner and therefore provides much flexibility, although this also causes uncertainty regarding the expectations for use. A user in a corporate setting is accustomed to receiving training on new technology. However, wikis are normally deployed in many corporations from the ground up, with little (or even no) training. If no guidance is provided, it can result in detrimental effects. The lack of norms that indicate knowledge sharing across organizational boundaries can be an impediment to the adoption of a wiki. To counteract this situation, the alternative approach to guiding users who are modifying Wiki technology is through the use of standard templates (also mentioned in the second challenge), constraints placed on wiki pages, or the use of ontologies to ensure consistent structure and terminology (Yeo & Arazy, 2012).

In summary, wiki adoption can accelerate through an open-ended editing process that contains some type of guidance, for example, templates; therefore, collaborative authoring norms will increase the participation of the wiki users. The study by Haake, Lukosch, and Schümmer (2005) investigated a better support for the editing of structured wiki pages, and it established the following template requirements for a wiki:

- *Structure*—the users of a wiki want to create well-structured content, although some guidance is needed for untrained users in order to create a sound structure.
- *Readability*—to support the user to concentrate on editing the content rather than struggling with layout aspects, structure and presentation should be separated.
- *Safety regarding unintended change*—the wiki system should provide some notification to users to make them aware of the changes they apply in order to prevent unintended departure from the proposed format of structuring content.
- *Tailoring*—all the users should be free to use different content structures. In cases where users feel the need to create a new structure, they should be able to add this structure to the wiki as a tailored template for later reuse.
- *Sharing of tailoring*—the build structures should be easily shared with other users to help them to solve comparable tasks.

3.2.3. Challenge 3—position a wiki in an existing information ecology

The final challenge is that introducing a new channel/system could disrupt the already existing practices to some extent, especially those that have a fundamentally different method of operation. In addition, the sustainability of a wiki depends on people's enthusiasm and the way in which they exhort others to contribute. Another concern within this challenge is the absence of a reference—a single place that contains information about how to use each system, per situation. The last concern we established for this challenge relates to end users' perspectives; for example, people are hesitant to edit someone else's work (they are not certain about the intention of their work).

People's enthusiasm

The lack of knowledge exchange within a community is one of the main factors that influences the quality of a wiki. The success of wiki systems such as Wikipedia is rare. Of the approximate 6,000 installations of the MediaWiki software, not every second one has eight users or more. The reasons for a low knowledge transfer in corporate wikis are as follows: continuously pressing tasks, a chronic lack of spare time, and motivational reasons. Furthermore, the consequence of the main challenge is that all the wiki users must make personal efforts and invest their own time in order to create and improve content. Moreover, a wiki with little content and/or poor articles fails to support KM activities, since there is no information to consume. The wiki is thus not useful, and the few users who contribute become increasingly demotivated, as they feel that nobody else is contributing. In this case, the wiki fails to collect knowledge, with the result that it becomes less attractive over time.

A way in which to increase the contribution quantity (article count and size) and quality (readability and timeliness) is a concept that (1) motivates users by means of reputation, (2) amplifies contributing behavior, and (3) has a rewarding mechanism integrated into the system (Dencheva, Prause & Prinz, 2011). Another factor with regard to motivation is that KM practices cannot be directed from the top down; instead, motivation must come from the bottom up (Pfaff & Hasan, 2007; Dencheva, Prause & Prinz, 2011). To achieve effective KM, motivation should be internal and intrinsic, and not something that an organization decides. To stimulate KM sharing, an organization must provide places and opportunities to their employees that encourage them to exchange their knowledge and ideas. The open source concept, such as wiki systems, can be seen as an informal knowledge exchange practice (Awazu & Desouza, 2004). As mentioned before, knowledge can be explicit or tacit. The main challenge is to capture tacit knowledge in a KMS. For this purpose, the organization must clearly define the task

of complex tacit knowledge, and an environment that supports and rewards knowledge sharing is also necessary (Lee et al., 2007).

Wikis often lack centralized governance; therefore, peer-based quality control mechanisms could impede a wiki project's success. Based on experience from online communities, it has been found that peer oversight is only effective as expert quality control. However, such rating of a wiki only has limited impact for wiki users because there is a relative lack of risks; for example, vandalism. Nevertheless, this feature can be useful when opening wiki participation to external parties (Yeo & Arazy, 2012).

Guidance, training, and references/governance

To increase the use of a wiki system, it is important that the wiki is easy to use and provides recognizable advantages over previous technologies. Furthermore, to positively influence the ease of use, adequate training in Wiki technology is desirable. In addition, it may be beneficial for management to spend time educating employees on the advantages of using wikis. An increase in adoption and usage may be facilitated by targeting users to serve as champions who make their wiki usage visible and encourage others to participate. To identify these champions of Wiki technology, a short survey that evaluates users and their personal innovativeness in IT should be conducted (Hester, 2010). Even though a wiki system facilitates knowledge creation, this does not imply that knowledge appears out of nothing. "Wiki Scaffolding" is an aid to stimulate knowledge creation. In essence, scaffolding provides three benefits. First, "Scaffolding facilitates wikis to be better aligned with the organization's strategy," since a lack of strategy might result in no clear guidelines. ''Wiki Scaffolding'' forces one to consider these concerns from the beginning. Second, "Scaffolding promotes user engagement." In an organization, a wiki page might require some permissions (for example, be subject to a deadline, belong to some wiki categories, or follow a given template). Wiki Scaffolding permits this frame to be available by the time the user starts editing. Finally, the third benefit is "Scaffolding as a wiki map." It is important that a wiki is easily accessible to new users; therefore, Wiki Scaffolding can provide a README page with some textual description of the practices (Díaz & Puente, 2012).

The end user's perspective

Prestige and power relationships can act as stressors, making the users of a wiki system reluctant to expose edits prematurely. One of the reasons could be that people are afraid of presenting incorrect statements/content, or they do not feel confident enough about the content of their contribution, resulting in editing anxiety. This phenomenon might result in a lower adoption rate and hence lower maintenance of the wiki because editing contributions fail to appear. To counter this issue, the bar for drafting could be lowered with the use of Wikinote, which is an extension of MediaWiki's Visual Editor, with the draft mode. This extension will reduce wiki editing anxiety (Arellano, Díaz & Azanza, 2015).

Arazy and Croitoru (2010) have investigated the extent to which corporate wikis are sustainable, and they have proposed the following four aspects to ensure sustainability: (1) provide a reliable wiki system infrastructure, (2) promote a sense of community among wiki users, (3) develop quality control mechanisms, and (4) integrate wikis into the work process to achieve productivity gains. As a part of maintenance, it is important to measure the success of the wiki, also focusing on the end user's perspective. Bhatti, Baile, and Yasin (2011) have utilized a model that attempts to present a framework for the analysis of the direct and indirect effects of explanatory levels to describe the benefits of a wiki. The theoretical construct of the model consists of three levels, each with subdivided variables. Level 1

relates to perceived wiki success, and it contains the following elements: collaboration quality, which is the process of working together to achieve a common goal; information quality, which is a combination of the satisfaction of the end user and the quality of text created by the collaborative efforts of the contributors; and system quality, a measurement that consists of the technical operations, performance characteristics, functionality, and usability. Level 2 is the process level, and it is about the use of the wiki and user satisfaction. The final element, level 3, relates to the perceived net benefits—perceived individual performance.

3.3. Semi-structured interview—potential user

The aim of the semi-structured interview is to exemplify the literature review in practice. As a result, we gain insight into the concerns and needs of the potential users, combined with their organizational environment, using the code tree structure (see Figure 15). The next paragraph is dedicated to the following related question:

RQ 1.1: What is the current positioning of the information ecology of a governmental institution in relation to the organizational operations and culture?

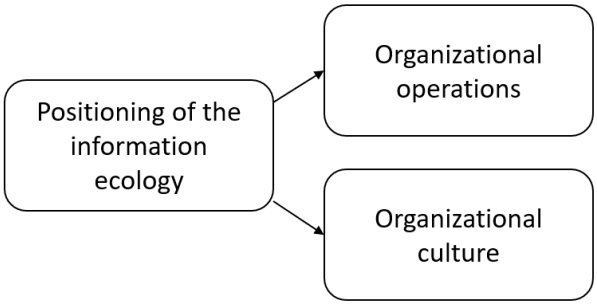

Figure 15: The code three structure

We start by conducting semi-structured interviews with potential end users (employees at RWS). Each respondent differs in terms of his/her department and/or role within the organization, and all participants are senior advisors with different responsibilities, from water control, roads, and geotechnics to road design and a general specialist. Together with the supervisor of the company, three different types of participants are established to gather diverse insight into the potential users' concerns and needs. The first participant role is that of the end user, who utilizes the knowledge; this person is not directly related to KM activities within RWS (i.e., KM is not mandatory for their official function). Second is the knowledge provider—someone who is constantly involved in one or more KM activities, such as knowledge sharing through the delivery of workshops and presentations or the writing of articles or blogs. Finally, the chief knowledge field is a person who is responsible for the knowledge within a knowledge field. For this study, we interviewed two end users, two knowledge providers, and one chief knowledge field. Note that some participants have some overlap in their roles. For the sake of anonymity, the respondents are unrecognizable throughout the research (respondents are indicated as A, B, C, D, and E). The results of the semi-structured interviews, which always begin with an overview table containing all the highlights per node, are described below (see Figure 16).

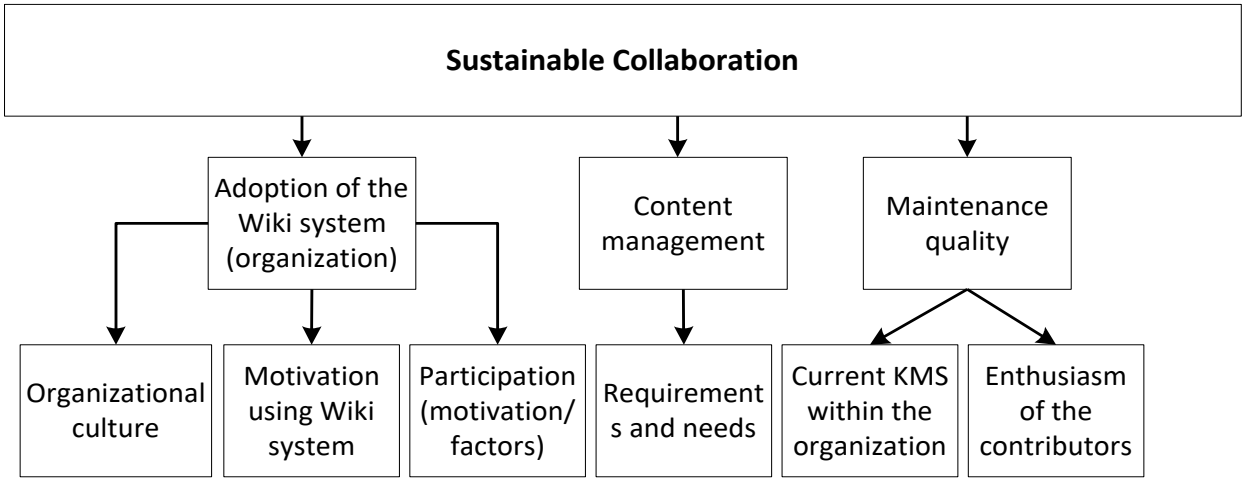

Figure 16: Code tree for sustainable collaboration

3.3.1. Adoption of the wiki system

Table 6 summarizes the main highlights of the first challenge: aligning manager and individual contributor expectations.

Node	Highlights
Organizational culture and KM role	• No single organizational culture is defined within RWS. • There is a high level of diversity among employees; differences in expertise, specialism, and type. • People who focus on performance vs. people who explore new developments. • The organization's structure adds another layer of complexity. • The complexity of the organization makes the company cumbersome, and it is difficult to institute changes. • Within RWS, there are people who are emotionally invested in the business. • There is a lethargy between (not within) the departments. • Rijkswaterstaat has a short-term vision. • A pitfall of the RWS culture is that people tend to start too early in a process, instead of considering who the target group of a certain project is. • People within RWS have the tendency to create something new, rather than looking to the already available knowledge. • People within RWS have a useful strategic and tactical way of thinking.
Motivation using wiki system	• Finding the right knowledge. • Adding value/contributions in KM. • Identifying and correcting mistakes more easily. • Ensuring interaction between users and administrators of the knowledge. • Providing easy access to and from the market. • Having efficiency in the way of working (avoid reinventing the wheel).
Participation/motivation factors	• Unreliability of the wiki. • Forgetting to contribute because of high workloads. • The reward system can demotivate people. • The time-consuming aspect and the accessibility are barriers. • Should be easy to use and have easy access. • A newsletter is not the desired medium. • Making the wiki compulsory can demotivate people and make them defensive. • Displaying personal details could be a barrier for people. • User-friendliness needs much attention.

	• Implementing/offering it in a fun way (for example, workshops and plenary sessions). • Bring the knowledge/information to the people through push notifications (only based on their interests/needs, and not too frequently). • Support of corporate level is needed (including capacity and financial support). • Create clear explanations (clearly define the aim and purpose, and create a balance between generalists and specialists). • Create logbook functions (history, saving articles, and the possibility to share articles). • The wiki should be a part of currently existing ecosystems (for example, CoPs). • Only focus on the groups that are willing to participate (including the market).

Table 6: Overview of highlights for challenge 1—adoption of the wiki system

Organizational culture

The culture of a company is the most accurate reflection of why certain aspects of that organization work or not (Schwartz & Davis, 1981), and it can be considered as one of the important aspects during organizational adaption. Therefore, it is important to provide both an overview and a description of the patterns and behavior used within the organization, adjusting to the environments (Miles et al.,1978): "but the complexity of the adjustment process can be penetrated: by searching for patterns in the behavior of organizations, one can describe and even predict the process of organizational adaptation."

Respondent A—old patterns are fixed within people's heads

RWS is a large and complex organization with diverse expertise, specialists, and disciplines: "it is a complex world, with a lot of opinions and visions." This was also stated by respondents D and E; therefore, it is not possible to establish one business culture. Based on the interviews, we can distinguish three color types: blue, yellow, and green. The people who are labeled as 'blue' focus on performance, stability, and working in a structured way, with a high degree of procedures and standardization. 'Yellow' and 'green' refer to people who tend to be highly critical and who explore new developments. The distinctive difference between these two types of people is that 'yellow' focuses on the ratio between sociability and the normative rather than pragmatic part, and 'green' is more social in that sense.

During the interview, the researcher noticed that old patterns are fixed within people's heads, such as creating something new rather than looking to the already available knowledge: "If someone asks me a question, I start thinking: what is a possible solution? I totally forget to check whether this information is already available." "I think we are also selected because of our strategic and tactical way of thinking," although this is coherent with the specialist work they do; therefore, they frequently work on their own and sometimes simply forget to share their knowledge. In addition, respondent B stated that people consciously do not share their knowledge because either they are afraid that others might misuse that information or they want to protect their reputations: "I am the expert." There is a need to change people's attitudes to achieve a level of willingness to share knowledge. On the other hand, RWS employees are willing to share their knowledge; however, it is difficult to create a legal base of the knowledge of different parties.

Respondent B—the need to be responsible for something

This behavior could be a consequence of the enhanced sense of responsibility, answered by respondent B: "That is really a thing within RWS. Everyone feels the need to be responsible for something;" therefore, it is important that employees within RWS are connected to the right knowledge domain. However, one respondent stated that "people do not feel a part of a bigger picture." Multiple respondents stated that RWS has a short-term vision; therefore, it might not be the ideal organization in which to manage a wiki system on a long-term basis, as respondent C mentioned: "I don't think RWS has the right attitude to perform the activities to manage a wiki in the future."

Respondent D—a deal is a deal

The people of RWS are emotionally invested in the business, and they would like to operate in the best possible way: "We want to have clear and unambiguous advice." However, because of the current work processes of RWS, people experience high pressure; therefore, they often focus on strict frameworks and documents. Due to the complexity of the organization, it is difficult to implement changes: "Change is very difficult to implement; you have to describe it in detail and find the right people to support this" (commentary from respondent E). Furthermore, the employees of RWS are fundamental people; "A deal is a deal. They really like rules, and a deal is a deal. If something is secured in a framework document, then you can expect that everyone works according to that procedure" (also stated by respondent E).

"Everyone has a very positive way of thinking… fraternal, willing, but also rigid." (respondent E)

Respondent E—there is an open culture

The complexity of the organization refers to the structure of the organization. In spite of the fact that we would like to have one organization, there are still departments on their own; there are still separate islands. The lethargy is between the islands." Based on a complementary comment from respondent A, it can be seen that complexity also depends on the way in which people work: "People are used to a certain way of working. This will be a different way of working, which can also give resistance from the organization." In addition, respondent A stated that this issue also has to do with the wide variety of expertise, with the side effect "…that everyone knows better how to do their job; I am doing this my own way… and if you, as the organization, want to do it another way, there is some resistance…" Additionally, with regard to the structure of the organization (as stated by respondent B), this organization has to deal with shifting work tasks through many reorganizations. This influenced not only the way of working but also the workplace itself. In spite of the island culture, there is an open culture with a CoP within the department. Furthermore, respondent D stated, "we are getting people together to discuss knowledge developments." Also, there is an open culture between RWS and external parties: "There is a very open culture, also between RWS and the market. They pursue an open discussion. You do not have to deal with mutual competition… They really discuss in an honorable way. That is really a positive thing… More often people find their network in an informal way," and a respondent was also positive about the company's communication, stating that "We are very good in the way we communicate… Making the translation (answered by respondent B). This is a very good point in our culture. I think we are unique in that."

Different KM roles (respondents' answers combined)—everyone is involved in KM

As mentioned before, the each of the three types of participants offers different contributions in the field of KM. In this node, we provide an overview about the official and unofficial KM activities. The chief knowledge field aims to obtain a realistic view of the current state of knowledge, to determine the current relevant developments, and to put forward prospective options through assessing the required knowledge and making an internal inventory. This is a continuous process where the people's capacity and quality are examined. The end users of the wiki system have different roles and responsibilities; for example, one could be an administrator of the architecture of the framework process, while another person could play a more technical role, being responsible for all the specifications that are related to the roads. The end users are also contributors to the wiki, adding and developing new knowledge and translating the knowledge into hard and soft elements. The agreements, framework documents, and guidelines are the hard elements, while the soft elements relate to how to use the knowledge. "I try to secure knowledge; I am talking to the chief knowledge fields, and I also give presentations and try to involve other people at RWS." Another important KM activity is knowledge development and the community in relation to the market: "I am a bit the driving force for knowledge development and knowledge communities within RWS in relation to the market." Overall, also derived from the business culture, some people are willing to contribute to KM by setting up knowledge communities, conducting research about several knowledge aspects, and encountering problems in the field of KM: "I don't have an official role; I am technical adviser. However, in my field, I encounter some problems in the field of KM."

Motivation for using wiki systems

During this node, we tend to assess the respondent's motivation for using the wiki system. We mainly examine the main feature of wiki, namely open editing for multiple users, so that the users can visit, read, reorganize, and update the content and structure of a Wiki page.

Respondents A, B, C, and D (combined)—do not reinvent the wheel multiple times

Respondent A's main idea is that a wiki makes the search for the correct information more efficient. Respondent C tends to use this wiki not only to find knowledge but also to add contributions. Another motivation to use the wiki is that it involves end users' knowledge, which respondent D considered to be added value: "You involve the knowledge of the end users, which can add value. Because, knowledge is knowledge, but you also have to deal with experience. With this tool, you can get some feedback, if knowledge is applicable in some situations;" furthermore, end users can easily identify and correct mistakes. The wiki will be a place where one can ask various questions, such as guideline questions and KQs. Respondent D deems the interaction between users and administrators (of the knowledge) to be valuable, and a wiki will also be an easy point of access for the market so that they can ask questions. Respondent E expects that people are going to use it and that the system provides relevant and up-to-date knowledge, and he/she hopes that it will be an actively used and growing product. Similarly to the motivation of respondent A, respondent B hopes for efficiency—"We reinvent the wheel multiple times, and that is a pity. That is about efficiency"—and effectiveness, which relates to the way in which RWS manages the large and complex amount of information.

Participation

This node assesses factors that can (1) negatively and (2) positively influence the participation rate. The participation rate includes all types of end users.

1. Negatively influence the participation rate of the users

According to respondent A, reliability is an important factor in why people will use the wiki. If there is noise in the system, then the wiki becomes unreliable; as a consequence, nobody will use it anymore. According to respondents A and B, we must also consider the high workload of RWS employees; people will be evaluated on their liabilities and basically forget to contribute to the wiki.

Respondent A—uncertain about a reward system

This respondent is uncertain about the reward system because it also has negative aspects: "A reward system can be a motivation, although it can also be seen as a penalty system, if you have not enough points." Respondents B and E agree that a reward system demotivates people because they already receive too much information/newsletters: "In a meeting, we talked about getting an overview, and the newsletter is not the desired medium."

Respondent D—make it accessible

Respondents A, D, and E mentioned that the barrier relates more to the time-consuming aspect and accessibility; the wiki should be easy to use, and it should have easy access. In addition, respondent A stated that making it compulsory to contribute to the wiki can lead to negative effects. Instead of enabling motivated people to contribute, people will take a defensive position. Another risk is the storage of the questions/reviews; if this information will always be stored on the wiki and viewed by all the users, then it could be a barrier to contribute. In addition, providing personal details, such as names and telephone numbers, can be a barrier for some employees.

Respondent E—easy way to contribute

Also, the user-friendliness needs much attention, according to respondent E, so that people will want to work in the wiki instead of another internal system or document. The editing process also needs to be easy so that no programming is needed.

"Another thing that annoys me is the frequently asked questions because my question is never in there. And I think that a lot of people have that." (respondent B)

2. Positively influence the user participation rate

Respondent A—gain knowledge in a fun way

The user requirement can make the wiki interesting for regular use. For example, respondent A suggested that instead of making the wiki compulsory, make it fun: "Make it fun. Just sit down with a few colleagues and update the content of the wiki in an afternoon." Another way in which to increase user participation is to provide insights into the consequences of not capturing people's knowledge; i.e., demonstrate the cruciality of this wiki: "There needs to be an urgency." Respondent C also mentioned making the wiki attractive and pleasant to use. The final aspect is about a trigger or push notifications: "In that way, you bring the information to the people. I think this will motivate people to use the wiki—that you get some alert when there is new information."

"I think that everyone finds it important to be connected to the correct knowledge domain." (respondent B)

Respondent B—specify the content on your target group

It is necessary to arrange the implementation and operation on a corporate level: "Ensure that the corporate level supports this initiative." Furthermore, a well-established governance will increase the participation rate. Also, there is a need for some type of support, such as a point of support or someone who has the time and the capacity to operate the wiki. Another factor, which respondent E mentioned, that will increase user participation is breaking down the old system, and then making the wiki a central point where one can find knowledge. Another suggestion was to make the content and aim of this wiki clear: "Formulate the expectation clearly," as respondents C and E stated. Therefore, we establish the aim of the information per knowledge page. Furthermore, respondent B considers two ways in which to implement the wiki: (1) launch the wiki when it is completely finished or (2) make it clear that the wiki's information is limited, and specify what is and is not in the wiki, otherwise people's expectations and needs will not be met, and they will think the wiki is tedious. It is important that when employees do not find the knowledge they need, there is a reference to an email address or other options.

Another consideration about the content is the target group—the specialist versus the generalist: "I think you have to consider two target groups, the casual passer, searching for more general information, and the other one, the real specialist." It is also important to not overload users with information, but to only provide them the information they need: "I only want to receive information that is interesting to me." The frequency depends on the knowledge field because for some knowledge fields, this only means receiving push-notifications once per year, or perhaps embedding some boxing lists per interest so that users can check and uncheck their interest fields. Another mentioned feature is the suggestion of interesting topics, based on previous interest: "(…) people who read this article, also read this and this article. Although, I do not want to receive it every week. That is really annoying." A logbook function is also something that could increase user participation. Users can create a logbook, which allows them to revisit the topics they read; they could also share the logbooks with other users or even gain permission to access someone's profile. Another barrier is complex logins. For internal use, it is desirable to use the RWS login data. Furthermore, respondent A believes that an effective search option will increase user participation—to be able to find the right knowledge and/or people, and that knowledge providers receive the questions in their expertise field: "That you can reach the people who are interested in your expertise."

Respondent C—demonstrate the connection between the other systems

Together with respondent D, respondent C mentioned the following important aspect: "In line with the intelligibility, we have to make clear why this system is necessary for people and how it differs from the currently existing systems, and provide insight into the difference." and "you have to show the connection between the other systems, rather than show it as something new… This is a real challenge, it is really hard to manage this." Furthermore, it is important to take the contributions and feedback seriously, "otherwise people will think this wiki is useless, and the whole idea will be ended very quickly." Furthermore, the respondent stated that the wiki should be a part of the organization's Intranet because different layers could create a barrier: "The wiki should be a part of our daily work, rather than something extra" (also stated by respondent E). In terms of design, it should be simple and intuitive, similar to the "Wikipedia design." The wiki should consist of knowledge in context rather than technical information, as respondent D also mentioned. It is also wise to focus only on the group of people who are willing to participate rather than on everyone within the organization (also mentioned by respondent E).

Respondent D—the wiki needs to be reliable and valid

Rijkswaterstaat only has to take the first step and extend it step by step; during this process, it should focus not only on the end users but also on the market. Following the adaptive approach, respondent D recommends starting small and then extending the wiki per knowledge topic or chapters and also making it familiar amongst the people with the support of knowledge communities (also mentioned by respondent E). If RWS makes the information more accessible, then employees will have a better overview of the coherence between knowledge. Also, a distinction between the wiki and guidelines must be made. They are presented on the same webpage, but the wiki provides the most important elements in a way that is simple to understand. From a systems perspective, the knowledge of the wiki needs to be reliable and valid, and the system needs to be rapid. Furthermore, there needs to be a possibility to navigate quickly through the pages, with possible navigation in the system and the inclusion of a sufficient "thesaurus" that could connect words.

Respondent E—it is important to communicate knowledge

This respondent mentioned the importance of communication through, for example, technical articles, symposiums, and the CoPs of RWS. Another factor that could increase a user's participation is the creation of standard formats. For the sake of findability, every element or knowledge page should have an owner/author, whose name and phone number are presented, but only for internal RWS staff: "But this can also be considered as a barrier, people get extra responsibility. Yes, but you only have to deal with the users. If you place something on the Intranet, everyone can see this. Now you are only limited to the users. This will lower the barrier to place something. And finally, just keep it professional because you have to deal with a lot of technical people."

3.3.2. Content management

This subsection relates to the second challenge: content and flexibility. We converted the results into a list of requirements per respondent. Table 7 contains an overview of these results.

ID	Requirements and needs	Stated by
RN01	A system where external parties can cooperate (internationally).	A, C
RN02	A news and facts page, avoiding mixing opinions with facts (definition list).	A, B, E
RN03	A dictionary explained in (business) language, understandable language.	A, D
RN04	Library with valid information about the frameworks, (knowledge) documents, and guidelines; also, find a way to validate this knowledge/information.	A, B, C, D
RN05	A display of the actual status of the data.	A
RN06	An encyclopedia containing the reasoning with the knowledge context.	A
RN07	A way to find knowledge about certain goals (in network), finding the right person within two seconds	A
RN08	The explanation of the business processes.	B
RN09	Open access to main pages for everyone, and only authorization needed for underlying pages (external/internal).	B, C, E
RN10	Certain location/sites to be unchanged for approximately 10 to 25 years in terms of URLs.	B
RN11	A reliable infrastructure.	B, C
RN12	A dynamic rather than a static wiki.	B
RN13	Clear ownership/governance for each process, such as validating the reviewing or editing process.	B, D, E

RN14	The ability for external people to contribute to the wiki.	B
RN15	Clear guidelines for how to use and interpret the wiki (e.g., disclaimer: documents of RWS are the exact requirements).	B, D
RN16	A function so that people can ask questions.	B
RN17	A community among this wiki (CoPs).	B, E
RN18	An option so that people can receive only the information they need or are interested in, also with the frequency following: one per week, month, or year (subscribe).	B, C
RN19	Easy uploading, for example, of images.	B
RN20	Utilization of the same structure as where the information is retrieved… and if something is changed in that structure, other information that is connected within that structure also changes.	C
RN21	Connection between projects, systems, framework documents, and knowledge.	C
RN22	Avoidance of forms with double information.	C
RN23	Different search options (table of contents, search engine).	C, E
RN24	Some navigation options for users to see where they are located and to make it easy to find their way back (table of contents).	C, E
RN25	One place to present the information; perhaps it is even possible to extract information from other sources.	C
RN26	Technical support (service point, course, presentations).	D
RN27	To be as friendly as Word and Excel (also a copy function).	D, E
RN28	An option so that external people can provide feedback (preferably on the same page).	D
RN29	Storage/presentation of the feedback (temporary or even only for the owner).	D
RN30	A distinction between KQ and advice questions (different channels).	D
RN31	A unique ID for each page, and the ability to assemble it.	D
RN32	Standardized formats.	D
RN33	Possibility of adding information.	B
RN34	Multiple wikis, but with the interface of one system.	A, B, C
RN35	A logbook function (with a share function).	B
RN36	Option to grant someone permission to access someone else's profile.	B
RN37	The ability for the wiki to be used on other devices.	D

Table 7: Challenge 3—content and flexibility—requirements and needs of potential users

3.3.3. Maintenance quality

This section summarizes the highlights of the third and final challenge, namely positioning a wiki in an existing information ecology and corporate culture (see Table 8).

Node	Highlights
Current KM	• Finding knowledge via an open online search engine (Google, and not via the internal Intranet of RWS); • Finding knowledge via own social network; • Using social media, such as Twitter and LinkedIn, to find their knowledge; • Finding new knowledge with Connect or VPR (internal KMS); • Sharing knowledge through presentations from specialists; • Providing knowledge through email (answers and questions); • Missing a single architecture; • Missing a central list/point with all the framework documents; • Finding new knowledge through the address directory and RWS guidelines;

	• Providing knowledge via the central number of the WVL office (data is stored in TopDesk); • Gathering knowledge on personal/department knowledge page on Intranet.
Enthusiasm of the contributor	• People within RWS are somewhat skeptical about motivation concepts; • There is a need to create a trigger such as the poll from the RWS Intranet; • A rewarding system could lead to counter productivity.
Guidance	• Guidance or other explanations via video is desirable; • Presentations could also be useful methods for instructing people.

Table 8: Overview of highlights for challenge 3—maintenance quality

Current KM

The current KM and KMS node examines the way in which the people of RWS contribute to KM and the type of KMS they currently use.

Respondent A—the medium should never be considered as the aim itself

Knowledge management and KMSs are two different aspects—KM and the system behind KM: "knowledge is 'IXEXSXA'," where 'I' stands for the knowledge, frameworks, solidified knowledge, knowledge models. A wiki is certainly a fulfilment for 'I.' The 'E' and 'S' stand for experience and skills. You need those skills to apply the 'I.' You need the experience in case 'I' does not fit. So, you can also handle exceptional situations. And finally, 'A' is about attitude and behavior—the attitude, the curiosity, and the willingness to share knowledge. And also, able to escalate when the knowledge does not fulfil the actual goal. Have the right attitude; I am not going to work in this system anymore, I am going to quit this process. This is the basics of my knowledge profile." A KMS focuses on the "I" through capturing knowledge in models, frameworks, and guidelines. A wiki is essentially a medium, and the medium should never be considered as the aim itself.

> "We also have very old framework documents; some of them are outdated. Why don't we throw away that old document? That is because, in that old document, a lot of knowledge is captured."
> (Respondent A)

This respondent finds knowledge via an open, online search engine, Google, and not via the internal Intranet of RWS because it is difficult to find the right knowledge; supplementary to this, respondent B also conducted a survey about findability, and there were a few colleagues who did not search in the internal system but Googled their information: "Our knowledge area is not really a good search engine." Another way in which to find knowledge is via employees' own networks due to the fact that RWS has an open culture (also to external parties): "There is a very open culture, also between RWS and the market. They pursue an open discussion. You do not have to deal with mutual competition… They really discuss in an honorable way. That is really a positive thing… More often people find their network in an informal way," stated respondent D. Additionally, some employees find their information via social media, such as Twitter and LinkedIn, while others can use Connect or VPR (an internal KMS).

Respondent B—capture knowledge in a physical way

The department has much specialist knowledge in its knowledge field, and it shares this knowledge through presentations. However, it has the need to capture its knowledge in a physical way because people currently ask for knowledge through different communication channels, which is time consuming. The department of respondent B has a point of support, who helps them with repetitive

activities. Respondent B normally provides knowledge through email and shares it with other knowledge providers: “If I receive an email with a question, and I know another colleague who is also active in that field, then I add him in the CC. At a certain moment, you created a group with the answers;” this was also mentioned by respondent C.

Respondent C—do not look at the limitations only

A KMS should serve the underlying needs of the users: “RWS tends to look at the limitations of the systems we have, and we have to make our information accessible, working from the employee’s perspective.” RWS has been defining its business processes and establishing its framework documents and guidance, and it has knowledge about its object data. This is not the problem; however, it would be a problem if each system has a different architecture. At the moment, there are some parts that have a specific architecture; however, it is often unclear what the relationships between architectures are. Also, there is a need for framework documents that are connected to bridge type X. This is not currently the case because there is no central list. The way in which respondent C finds knowledge is through the address directory and RWS guidelines.

Respondent D—keep the knowledge up to date

At the moment, there are different systems with various login data and different ways of working. Each time, the user has to figure out how each system works. Even though RWS has approximately 800 framework documents, which are managed by coordinators, the plan-do-check-act cycle is not always conducted. The result is that certain documents are difficult to find because the document is in a different location and/or system. The content of RWS’s KMS consists of functional, process, and criteria documents. At the moment, RWS receives questions and input from its 0800-number or via the WVL office, and the data are stored in TopDesk, followed by a follow-up action so that people receive an answer within three days. Another way in which to gather knowledge is via RWS’s Intranet, the knowledge place, RWS guidelines, and the personal/department knowledge page on the Intranet. It is always a challenge to keep the knowledge up to date in order to share it among colleagues.

“We reinvent the wheel multiple times, and that is a pity. That is about efficiency.” (respondent E)

Respondent E—way of working in 2017

At the moment, within RWS, knowledge sharing occurs in a fragmented manner. “Not the way of working in 2017. For example, we have multiple software packages for document management systems. Also, we often reinvent the wheel multiple times, and that costs extra time.” However, RWS has one of the better KMSs; i.e., an Intranet with complete content: “I think RWS is one of the better ones. They spent a lot of time on their Intranet. The information that I can find on Intranet is complete, most of the time.” However, one component that is missing on the RWS Intranet is a general definition list. Another KM need that respondent E mentioned is to discard the design guidelines and store them in one system instead of the separate files that RWS currently has. Also, the respondent E’s department has a knowledge page on the Intranet with its guidelines.

Enthusiasm of the contributor

Here, I asked about motivational factors, such as a reward system, as mentioned in the paper of Dencheva, Prause, and Prinz (2011). Respondents A, C, and D are skeptical about this concept, and they will not be motivated by a reward system. Another factor that could influence the motivation to

use the wiki is that people are busy, and they forget to perform actions such as adding knowledge to a KMS. Also, since they are assessed on their product, they need to deliver. However, respondent C mentioned that something such as an interesting article once per month or the poll we know from the RWS Intranet could be an added value for the organization. Respondent D subsequently believes that some motivational concepts that are based on reputation could help, although motivational concepts based on a reward system could be counterproductive. The RWS employees prefer a simple wiki: "Simply keep it professional… You have to deal with a lot of technical people." Respondent C stated that people are sometimes encouraged to perform a project beyond the rules and find a creative solution: "Sometimes you stay invisible if you are performing according to the rules" (respondent C).

Guidance

Respondents A, B, and D believe that a video can be a useful instrument; however, as much as possible, it should remain within the application, as also stated by respondent C. Respondent D mentioned that a presentation is also a useful way in which to present videos to the people. Respondent E is somewhat skeptical about the usefulness of videos—perhaps not for the wiki, but for the Intranet.

In Appendix C the tagged texts of the semi-structured interviews are provided.

3.4. Unstructured interviews—best practices and lessons learned

The researcher conducted unstructured interviews with experts and people who have experience in the field of KMSs at four different organizations. These organizations are presented in Table 9, along with a short description about each organization and a link to its KMS (in the results, respondents are indicated as A2, B2, C2, and D2). For this qualitative analysis, the researcher defines two nodes: best practices and poor practices. In this case, best practices refer to the lessons learned in terms of what works in this situation, and poor practices are related to lessons learned in terms of what did not work and what actions need to be performed to overcome this either partly or as a whole. This subsection is dedicated to the following question:

RQ 1.2: How does one overcome barriers and pitfalls during the implementation of a collaborative tool/support in KM ISs?

Organization	KMS	Short description of the organization	Website (KMS or organization)
Rijksoverheid/ government (Bodem+)	Bodem Richtlijn	The Recovery and Management (water) Soil Quality Directive discloses relevant information in the area of soil and sediment management.	www.bodemrichtlijn.nl
Deltares	Internal KMS	Deltares is an independent institute for applied research in the field of water and subsoil.	www.deltares.nl
HZ	Delta Expertise	The DeltaExpertise site unlocks expertise about life in a delta. Research results and knowledge come together at this location and provide a source of information for education and (future) professionals.	www.deltaexpertise.nl
RIVM	Internal KMS	"RIVM works to prevent and control outbreaks of infectious diseases. We promote public health and consumer safety, and we help to protect the quality of the environment. RIVM collects and collates	www.rivm.nl

		knowledge and information from various sources, both national and international." (RIVM, 2017)	

Table 9: Overview of organizations and KMSs

Similarly to the semi-structured interviews, the respondents are anonymized throughout the whole research (respondents are indicated as A2, B2, C2, and D2). The results of the unstructured interviews also begin with an overview table containing all the highlights, followed by a description per respondent. Tables 10 and 11 illustrate an overview of the main best and poor practices per respondent.

Best practices	Respondent
• An agreement is created with the sponsor.	A2
• The KMS is constantly running.	A2
• The KMS is accessible—also to different stakeholders (different people, countries, and languages).	A2, B2
• The credibility and reliability of the content of the KMS is important.	B2, D2
• The knowledge in the KMS is useful (monitoring the usability).	B2
• The KMS is independent.	A2, B2
• The focus is on the people/users rather than the system (working in a community and have the wiliness to share knowledge together).	C2, D2
• The system is implemented in people's daily work.	C2
• There is continuity in the way of working rather than being project-based.	B2
• The KMS is kept simple in a way that satisfies the goals and creates a basal system rather than a custom-made system.	C2

Table 10: Overview of best practices per respondent

Lesson learned	Respondent
• There must be a sponsor (time and money) for the KMS.	A2
• Do not only focus on system (and the limitation of that).	D2
• Do not proceed with the system in the hope that people will use it.	C2
• Do not make tacit knowledge explicit.	C2, D2

Table 11: Overview of poor practices per respondent

Respondent A2—the need for a sponsor

The employees of an organization need to have the capacity (time and money) to contribute to the wiki on a long-term basis, otherwise nothing will happen, and the KMS will not succeed. There is a need for a sponsor who arranges this capacity. In addition, respondent B2 always works with a sponsor before the project starts (by creating an agreement). The accessibility of a KMS is another factor that contributes to the system's success. For an organization, it is crucial that the KMS is running constantly; for example, if the system is not accessible somewhere in Europe, it should still be possible to use it via a different server. Also, changing the website (URL) can negatively influence the accessibility of a KMS. Another important aspect is that the KMS is accessible for different countries by adding a translation button—seeing the knowledge as an export product. Furthermore, according to respondent D2, the credibility and reliability of the content of the KMS are also important.

A KMS needs to be smart in terms of management and the technical environment around the system; the suggestion is to not repeatedly reinvent the wheel, but to connect the knowledge elements with each other, and also add some kind of revision control function. In addition, with regard to the content, respondent B2 measures the usability of the system with some type of societal impact analysis to avoid useless knowledge. This means that instead of only publishing a scientific report or paper, it could be

made more accessible and understandable for society using infographics or through a connection to a societal context. The KMS has to be embraced by all important stakeholders (for example, clients, provinces, municipalities, government, and the boards). It is interesting to notice that this respondent also managed another collaborative tool (different from a KMS), wherein specialists can discuss certain issues/questions. This collaborative tool tends to be successful and can be seen as an opportunity for a wiki system. However, this can lead to certain risks. Furthermore, the respondent mentioned a pitfall regarding the "ownership" of the content of the KMS—people went off with someone else's knowledge. In this case, one can prevent this by creating an impartial KMS—one that is in the government's design, but without the organizational logo. This also applies to respondent B2's KMS, which is even legally independent.

Respondent B2—create useful knowledge only

The project results mostly become public, except when they are confidential due to national security. Moving on to the managing process of a KMS, respondent A2's KMS is only managed by one specialist (often outsourced to the market), while that of respondent B2 has its own department with approximately 40 employees exploring and developing new knowledge. This department scans the web for relevant documents pertaining to the following question: "So, what happens in the news or in Twitter and all social media?". A "smart filter" categorizes this information into certain themes, and it is interiorized by a specific person. It is important to notice that the KMS of respondent A2 is only about one specific knowledge field, whereas that of respondent B2 is related to the entire organization. The KMS of respondent A2 consciously did not create a discussion platform due to the so-called "mudslinging" of people. To increase the usability of a KMS, some type of investigation is necessary, such as finding the search behavior of the visitors and adapting those criteria to the taxonomy. Another consideration is that the KMS conforms to the web guidelines[6].

To keep the KMS data up to date, KQs need to be answered, which will be conducted/answered during a project, as respondent A2 also stated. However, this respondent's KMS provides knowledge about the current state of technology and/or policy: "We cannot anticipate. There are other sites for that. This is really how it is now. The intention, that it reflects the current state." According to this respondent, the success factors are to be independent, contemporary, and impartial: "Success factors, having expertise. So that it turns out that you are up to date, and whether we claim that the world is flat, but everyone else thinks that the world is round, then we did not do our work correctly." Furthermore, if there are new insights due to new technology or methods, they should be explicitly mentioned in the KMS.

Respondent C2—focus on the people rather than the system

Respondent CS, together with respondent D2, stated that this organization focused on the people because these respondents work in a community and have the willingness to share knowledge: "learning from practice, you can create a system. If the people do not use it in their daily work, then the model is just worthless; the wiki is just worthless." Additionally, respondent D2 also considered the different worldviews: "It is not a single approach, there are different world views… You cannot simply use technology somewhere without it being compatible with people's world. Essentially, the first step is to determine the mutual goal. The next step is the business process and organization; what

[6] See (Dutch) web guidelines on: www.digitoegankelijk.nl

are the agreements? What type of roles do we have? And how often do we meet each other? And after this process, you will analyze which technique is suitable. Wiki is just the medium." This was also stated by respondent D2.

Another important aspect is the continuity. The current way of working is based on a project; if the project ends, then people stop working on that knowledge, and there is no continuity. To keep the knowledge/information up to date, respondent C2 states that a community is required, not necessarily to keep the information updated, but to find the knowledge together: "I think it will be a kind of network… To develop it together." Also, respondent C2 recommends taking it slowly, step by step, and observing what happens: "Do not run forward with the system, in the hope people will use it. It really does not work that way." Another way in which to transfer knowledge is through workshops, although these are limited to the people who are present.

The basic idea is to keep it simple to satisfy the goals and create a basal system rather than a custom-made system; however, it is a difficult to manage such a system. Furthermore, a target group must be defined that can also consist of multiple target groups with their own methods of extracting knowledge, i.e., differences in goals and levels of knowledge, manners of writing, and ways of thinking, for example, the different perspective of a policy maker vs scientists. Respondent C2 stated that it is quite difficult to determine the goal of a KMS: "What do they need? They find it hard to define." Sometimes, an application articulation phase has lasted for 1.5 years, and even then, it is not completely clear because there are still iterations. Therefore, it is necessary to deepen each other's fields of expertise and to create a community with agreements among the wiki, otherwise there is no overview of the completeness of the KMS's content: "And the culture is to add things. I think that works. Without those expectations, but with the hard agreements. Because when you are without obligations, then I do not see it working, because it is not complete. Some people use the KMS, other people do not. If under 80%-90% of the people participate, then the system is unreliable." It would also be helpful to make it easier for people to perform KM: "Yes, but if I have to look up everything, if I have to actively take KM continuously to make sure the rest is going well, then that will not work."

Respondent D2—do not make tacit knowledge explicit

Respondent D2 uses the data, information, knowledge, and wisdom pyramid, which divides knowledge into two areas: (1) knowing-that knowledge, which is semantic and conceptual knowledge that allows one to ask questions related to what, who, and where, and (2) knowing-how knowledge, which refers to action knowledge and insertion patterns (tacit knowledge). It is not possible to make tacit knowledge explicit; however, insight can be gained into that knowledge. The knowing-that and knowing-how knowledge are connected to each other, and they comprise many different variations in terms of the best practices approach: "a best practice is a collection of activities that are coherent with each other, which thus generates this synergy in a given situation."

In Appendix D the transcribed texts of the unstructured interviews are provided (in Dutch).

3.5. Discussion and outcome—a focus on the human factor

To obtain an effective implementation of a wiki within an organization, it is important to take into account not only the technological aspect but also the (organizational) culture aspect. Therefore, the support of management, who seeks both aspects, is a crucial factor for the sustainability of a corporate

wiki. To ensure this support, the ideal situation is to have a non-hierarchical, open, and bottom-up knowledge-sharing culture, although this is not always the case within an organization. Within RWS, it is not possible to define one organizational culture due to a wide variety of expertise in the field. In terms of Handy's typology (Machado & Carvalho, 2008), the RWS environment can be established as a task culture, which is project-oriented. Also, the core way of working is another challenge to withstand. A focus on the human factor rather than on technical aspects was also confirmed as a challenge in the unstructured interviews. Therefore, it is important for RWS to first shift the organizational culture in a more open way and to create a safe-to-contribute environment. Furthermore, management must actively urge users to share their knowledge and to promote the interaction between different knowledge parties. For potential users, finding the right knowledge efficiently, accessing the market easily, and managing large amounts of information are added values. Furthermore, the content management component, which relates to the balance between the proposed structure and potential freedom in expressing oneself, is also a challenge, as mentioned during the interviews with the potential users. These users would like to have a basic structure (based on existing framework documents), with underlying pages where people can contribute freely. The basic idea mentioned during the expert interviews is to keep the KMS simple to ensure that it satisfies the stakeholders' goals and creates a basal system rather than a custom-made system. Finally, maintenance for quality purposes is a main challenge; KMSs tend to fail because of a low participation rate as a result of continuously pressing tasks, a chronic lack of spare time, and motivational reasons. Based on the interview with potential users, the researcher established that some types of reward systems are not suitable for the RWS environment and can even have a counterproductive effect. It is important to incorporate the wiki into the business process and to define concrete agreements, roles, and activities. Based on the results of the problem investigation, we amplify the already existing challenges / success factors for a sustainable corporate wiki as input for our approach.

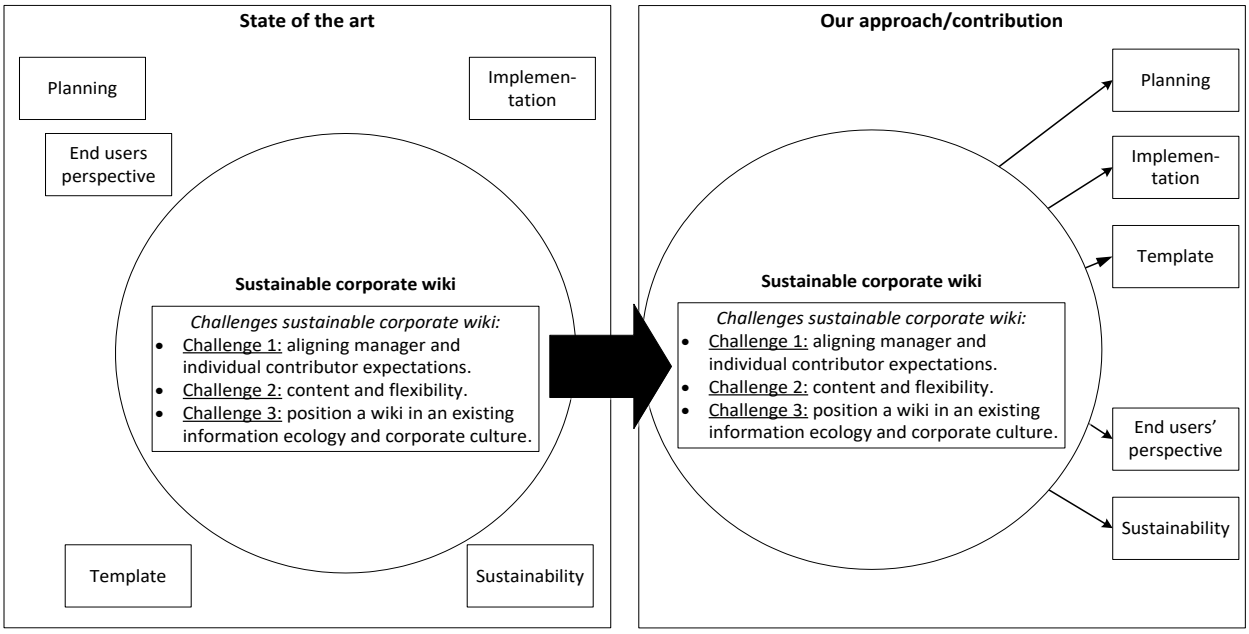

Figure 17: Current situation vs. proposed approach

As mentioned before, our design is an extension of the three main challenges stated in Grudin and Poole's (2010) study, with specific activities established from our problem investigation (see Figure 17). Note: see Chapter 1.6. proposed design for the meaning of the codes, for example R1 of W4 (see

Table 12). The approach to sustainable collaboration amplifies the already existing challenges / success factors for a sustainable corporate wiki.

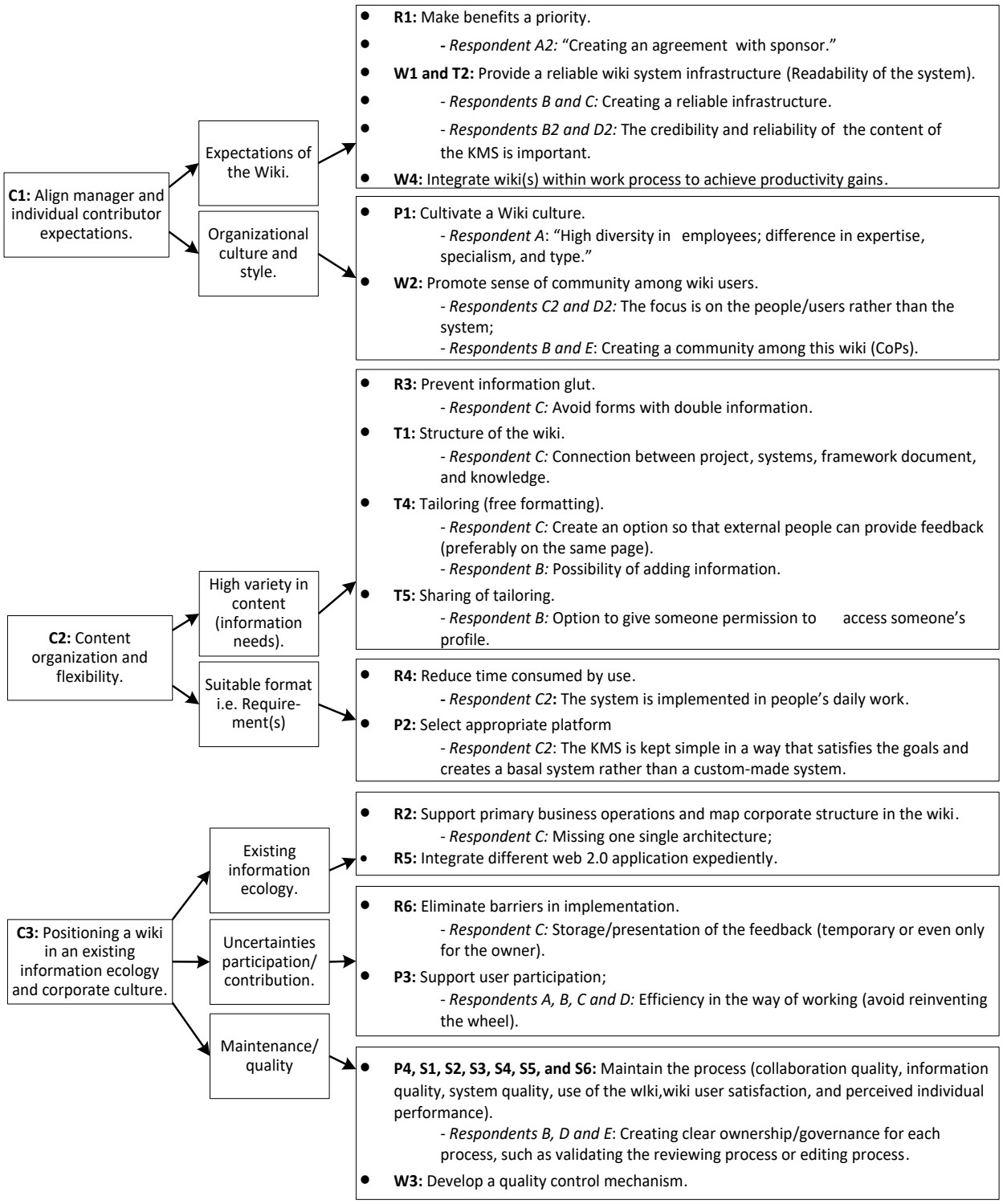

Figure 18: Overview of challenges extended with fragments from the literature and practice

The fragments that make up the sustainable collaboration approach support the sustainability component of collaborative KM(Ss)—see Figure 18. In short, our proposed design/approach could be reinforced with the requirement and concept established in the study by Voigt et al. (2011) and the activities to plan for a successful corporate wiki. Furthermore, templates could form a sufficient way

in which to structure the content/information of a wiki within a governmental institution. Finally, the two studies of Bhatti, Baile, and Yasin (2011) and Arazy and Croitoru (2010) contain useful chunks to create our proposed design. See Chapter 1.6. for the overview of all the components per study. From this overview of challenges, we integrated all elements in the proposed design to investigate which elements are truly contribute the sustainability part in collaborations. However, we have to deal with overlap during realization of the proposed design. At the end, one challenge and one variable are mitigated throughout this study. This is about (C3) positioning a wiki in an existing information ecology and corporate culture, and the variable, existing information ecology. We did not completely omit the elements, but integrated these elements in other challenges, for example, corporate culture and existing information ecology is inextricably related to the first challenge (C1) align manager and individual contributor expectation. The remaining challenges are a part of this thesis, and it would be interesting to explore them in depth in future research.

3.6. Summary

To shape the problem investigation, we conducted an extensive literature review, semi-structured interviews with potential users of a wiki, and unstructured interviews with practitioners in the field of KM(S). Chapter 3 is dedicated to answering the first RQ: what are the existing supports for sustainable collaboration and KM ISs? During the literature review, we reify three challenges. Challenge 1 involves aligning manager and individual contributor expectations, while challenge 2 is about content and flexibility, and challenge 3 relates to positioning a wiki in an existing information ecology. We attempt to find the first principles for our treatment design, and the input of the literature review is used to create a questionnaire for the semi-structured interview with potential users. The main results collected from the literature review reveal that careful planning involving both technological and cultural aspects is needed. Also, user participation is a challenge that organizations need to overcome to build a successful wiki. An interesting aspect is how to improve people's enthusiasm, while guidance, training, and clear governance are other important elements. In addition to the literature review, the semi-structured interviews and unstructured interviews provided extra information to answer the following sub-RQs: what is the current positioning of the information ecology of a governmental institution in relation to the organizational operations and culture, and how does one overcome barriers and pitfalls during the implementation of a collaborative tool/support in KM ISs? The highlights we ascertain are, in practice, the complexity of the organizations, such as different organizational cultures, and specific expertise, both of which make it challenging to attain IS integration such as a wiki. To obtain a successful IS integration, it is important to equally consider the human and technical factors, such as the involvement of the user, throughout the whole implementation process, and to ensure that the requirements and needs of all the stakeholders are specified to and understood by the people who are involved in the execution of the IS integration.

Part II
Treatment design

Chapter 4: Development of the treatment design

"All knowledge is connected to all other knowledge. The fun is in making the connections."
(Arthur Auferheide)

4.1. Introduction

As Chapter 3 concluded, to achieve an effective implementation of a wiki within an organization, it is important to take into account not only the technological factors but also the culture (i.e. human) factors. In the previous chapter, we introduced the first impression of our proposed design (Chapter 1.6.) to generate a sustainable wiki-based collaboration in knowledge management (KM). This chapter is devoted to the development process of the approach to obtaining sustainable collaboration, and further evolvement of our approach's design will take place with the support of the method engineering (ME) discipline: "Method engineering is the engineering discipline to design, construct, and adapt methods, techniques, and tools for the development of information systems" (Brinkkemper, 1996). The aim of the development of the treatment design is to specify the purpose of the approach—the fundamental idea—followed by the design chunks in context and how we developed such a design with the support of the ME and the ME lifecycle.

4.2. The fundamental idea—the approach to sustainable collaboration

Before starting with the fulfillment of the approach's treatment design, we first establish the fundamental idea of our approach for the sake of clarity. Our treatment design essentially concentrates on the long-term sustainability aspect of KM systems (KMSs) integrated with one or more collaboration feature. Figure 19 provides an overview of the metrics of composition we would like to achieve with our treatment design.

The sustainability part is equivocal because it focuses on the quantity as well as the quality of the wiki. Quantity refers to the length of time that the KMS has been in existence and the frequency with which pages are accessed, and the quality component measures the quality of the content of all the wiki pages through metrics that are dedicated to the contributors and participants—for example, the number of contributors, the number of lurkers, and the level of expertise (Majchrzak, Wagner & Yates, 2006; Kane, 2011). Additionally, with regard to quality, the study by Kane (2011) suggests that a critical mass of contributors and participants is needed to reach a base level of collaborative success, although additional contributors and/or participants tend to have little impact on the success of the collaboration once the critical mass is reached. Therefore, it is important to establish the minimal level of collaboration per situation.

Then, regarding the collaboration component, as mentioned before, this part of our approach refers to the comparable Wiki technology features. A wiki characterizes itself by its open editing functionality, which means that the user of the wiki can visit, read, reorganize, and update the structure and content of a wiki page.

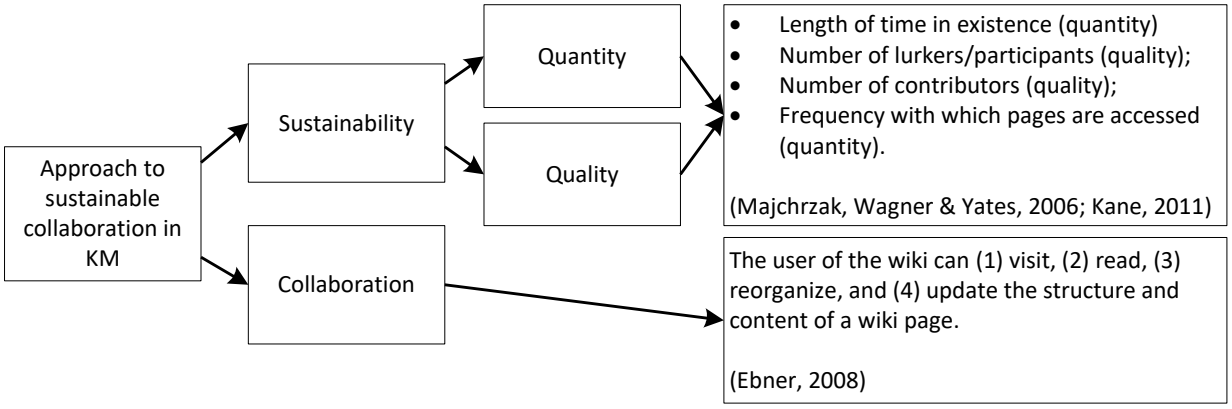

Figure 19: Overview of composition metrics of the approach

4.3. The design chunks in context

Figure 20 presents an overview of the sustainable collaboration approach's chunks and its research context: KM, KM effectiveness, KMSs, and our design's sustainable collaboration and extension components. Below, we will discuss the research context and the design of our approach. For further details about the extension components, see Chapter 1.6. and Chapter 3.

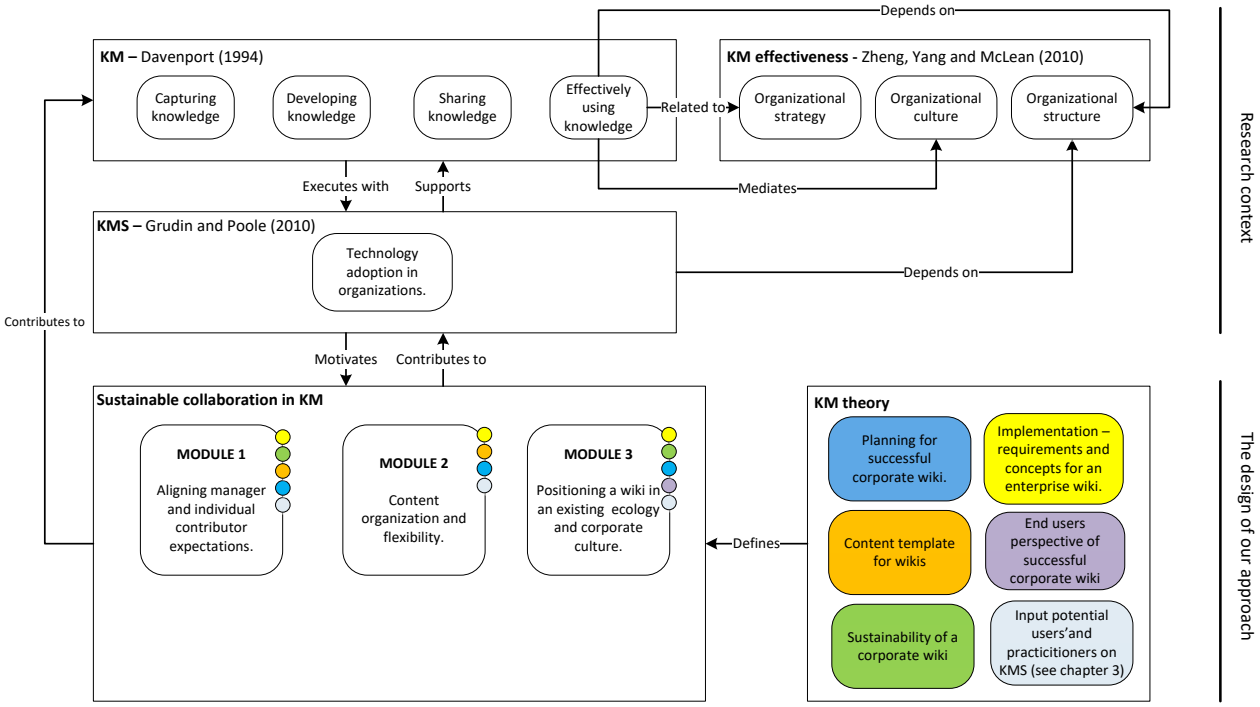

Figure 20: The research context of the sustainable collaboration

4.3.1. Research context

Over the years, many frameworks dedicated to KM processes have been developed. During the development of our design, we will mainly focus on solutions that include the four KM processes that have received the most consensus in literature: capturing, developing, sharing, and effectively using organizational knowledge (Davenport, 1994; Gold, Malhotra & Segars, 2001).

First, *knowledge capturing* refers to the creation of novel organizational knowledge by means of the application of available knowledge within an organization. This entire process requires substantial effort and a high degree of recognizing and capturing novel knowledge. Second, *knowledge developing* is the process in which organizations create, accumulate, and acquire knowledge from external and internal sources. The third KM process, *knowledge sharing*, which is also known as knowledge transfer or knowledge diffusion, is the process by which knowledge is transferred from one individual and/or group to another individual and/or group. Finally, *effectively using knowledge* depends on the alignment of the organizational strategy, culture, and structure (Zheng, Yang & McLean, 2010). In this case, organizational strategy refers to "the current set of plans, decisions, and objectives that have been adopted to achieve the organization's goals" (Draft, 2006). According to Schein (1990), the organizational culture refers to shared assumptions, values, and norms. Over the years, empirical studies have demonstrated that organizational culture is a key factor in organizational effectiveness, and it can be seen as a source of sustained competitive advantage. The organizational structure indicates "an enduring configuration of tasks and activities" (Zheng, Yang & McLean, 2010). In addition, the study by Zheng, Yang, and McLean (2010) suggests that there is empirical evidence of the connection between KM and organizational effectiveness: "this study suggests that knowledge management could be an intervening mechanism between organizational context and organizational effectiveness." The result of this study concludes that KM is more than just an independent managerial practice; it is also a central mechanism that leverages a company's cultural, structural, and strategic influence on organizational effectiveness.

During the KMS part, we mainly focus on the *technology adoption in organizations*, since adoption is a key factor for a successful sustainable collaboration. Repeatedly identified problems during technology adoption in organizations are the lack of management support, data that are difficult to find and/or out of date, and software usability problems (Grudin & Poole, 2010).

4.3.2. Approach design

The emphasis of this study is on generating a *sustainable collaboration in KM* (as described in Chapter 4.2.), which consists of the three previously mentioned main challenges established in Grudin and Poole's (2010) study. These three challenges are converted into three modules (see Chapter 5 for the creation and development of these modules). During our problem investigation, we extend these three challenges with the *KM* theory, which contains the requirements, concepts, and success factors of studies related to successful wiki implementations: *requirements and concepts for an enterprise wiki* (Voigt et al., 2011), *planning for a successful corporate wiki* (Lykourentzou et al., 2011), *end users' perspective of successful corporate wikis* (Bhatti, Baile & Yasin, 2011), wiki concepts—*content template for wikis* (Haake, Lukosch & Schümmer, 2005)—and contribution to sustainable corporate wiki—*the sustainability of corporate wiki* (Arazy & Croitoru, 2010). The input of the KM theory, combined with the results of our semi-structured interviews with potential users and unstructured interviews with practitioners of KMSs, is the starting point of our design (see proposed design in Chapter 1.6.). To further evolve our design, we continue with a literature search to find theories and concepts to fulfil our design of a feasible approach. In the next paragraph, we will discuss the sub-activities per challenge, amplified by theoretical support.

4.4. Situational method engineering

During the design of our approach, we will use the fundamentals of situational ME—the ME discipline. The main idea of situational method composition is the selection and adjustment of artifact fragments with respect to a specific information system (IS) development situation. This composition process aims to configure a combination of multiple method chunks to create new constructional results (Harmsen, Brinkkemper & Oei, 1994; Bucher et al., 2007; Weerd & Brinkkemper, 2009). The ME discipline is a reaction to the growing complexity and size of IS development projects. Situational ME is essentially a way in which to improve the effectiveness of a method by taking into account the uniqueness of the project situation. This is done by constructing an optimized method for every system design situation, and it involves reusing parts (also known as method fragments) from existing methods. During this study, we will use the following definition of ME: "Method engineering is the engineering discipline to design, construct, and adapt methods, techniques, and tools for the development of information systems" (Brinkkemper, 1996). Moreover, the situational method refers to an IS development method that is tailored for the situation of the project at hand. For the situational ME approach, four generic steps are established:

1. Analyze the project situation and identify needs;
2. Select candidate methods that meet at least one aspect of the identified needs;
3. Analyze candidate methods and store relevant method fragments in a method base;
4. Select useful method fragments, and assemble them in a situational method by using a route map configuration to obtain situational methods.

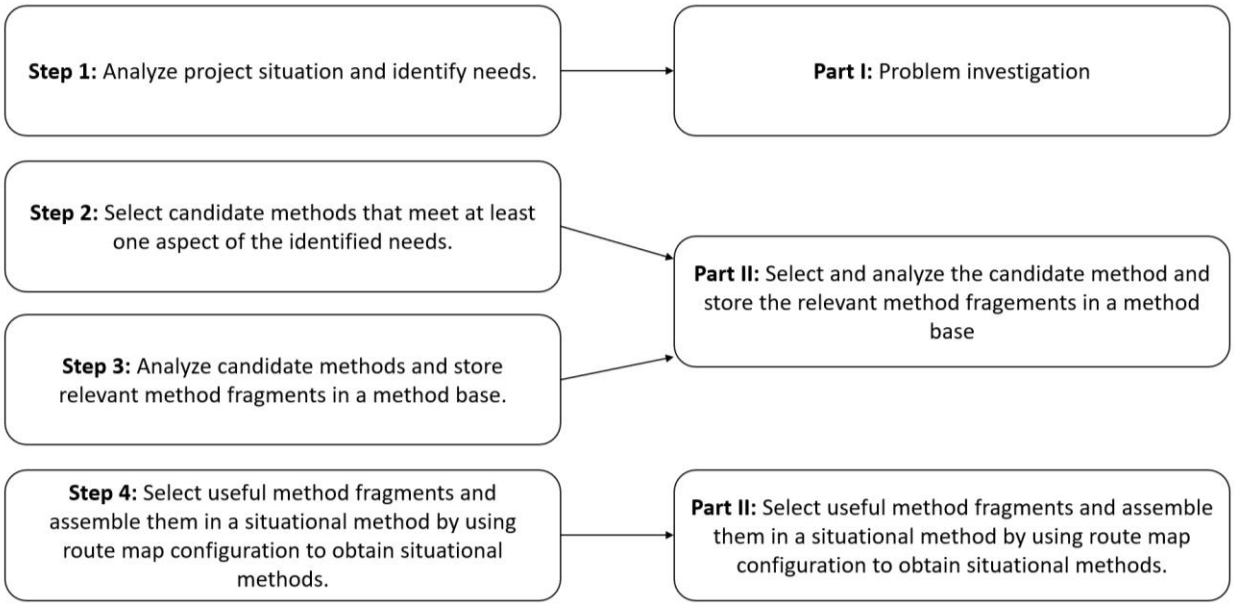

Figure 21: Overview of situational ME approach steps and converted steps

Steps 3 and 4 are supported by the meta-modeling technique; therefore, during this study, we will use the technique: process-deliverable diagram (PDD). This technique is used to analyze, store, select, and assemble the method fragments, so that we can ultimately create a method that is suitable for a certain IS development. The PDD consists of two integrated diagrams. On the left-hand side, there is the process view based on a UML activity diagram. An activity is "a diagram that shows the flow from activity to activity; activity diagrams address the dynamic view of a system." (Weerd & Brinkkemper, 2009). An activity diagram contains activities and transitions. Furthermore, the activities can be

modified into sub-activities when necessary, and the creation of a hierarchical activity decomposition consequently appears. The transitions are used to demonstrate the control flow from one activity to another by means of a simple arrow. On the left-hand side, based on a UML class diagram, the deliverables of a certain process are given, and they consist of a concept diagram. In Part I: Problem investigation, we analyzed the project situation (for example, the research context and state-of-the-art sustainable collaboration). The next chapter (Chapter 5) is dedicated to the creation process of the treatment design. The remaining three generic steps for the situational ME approach will be executed per method (fragment), and to avoid redundant information, we combined steps 2 and 3 into one step (see Figure 21).

4.5. The method engineering lifecycle

As a starting point, we used the requirements, concepts, and model elements from our proposed design mentioned in Chapter 1.6. We adjusted this starting point to include elements from several literature studies that are related to sustainable collaboration or the successful implementation of collaboration. Thereafter, those elements were reshaped and reformed into a substantial approach to achieve sustainable collaboration within an organization. This approach is a model-driven approach that makes intensive use of model-driven engineering techniques, such as metamodeling, model transformations, and models at runtime, to support the design, implementation, and execution of methods. A model-driven ME is a paradigm for ME where models play a key role in the design, construction, and adaptation of methods, techniques, and tools for the development of ISs (Cervera et al., 2015). See Figure 22 for the depiction of the three phases of the ME lifecycle applied to the approach to sustainable collaboration.

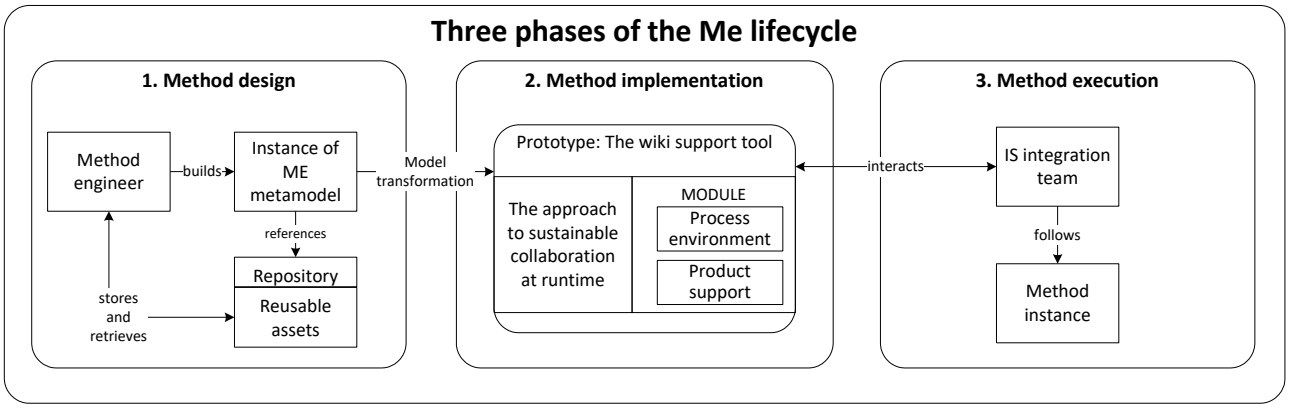

Figure 22: Three phases of the ME lifecycle

The ME lifecycle is used in the following sections, where the method design refers to the reusable assets—design chunks—from the literature study. For the method implementation, we provide an example of how one could use the approach to sustainable collaboration by means of the Wiki Support Tool, which we created (see Chapter 6). The method execution takes place with the support of the Wiki Support Tool through experiments using the Think Aloud method and expert opinion (see Part VI, Chapter 7).

4.6. Summary

The aim of the development of the treatment design is to specify the purpose of the approach—the fundamental idea—followed by the design chunks in context and how we developed such a design

with the support of the ME and the ME lifecycle. Our treatment design essentially concentrates on the long-term sustainability aspect in KMSs integrated with one or more collaboration features. During the design of our approach, we will use the fundamentals of situational ME—the ME discipline. The main idea behind situational method composition is the selection and adjustment of artifact fragments with respect to a specific IS development situation. This composition process aims to configure a combination of multiple method chunks to create new constructional results.

Chapter 5: Method design chunks

"Sharing knowledge is not about giving people something or getting something from them. That is only valid for information sharing. Sharing knowledge occurs when people are genuinely interested in helping one another develop new capacities for action; it is about creating a learning process."
(Peter Senge)

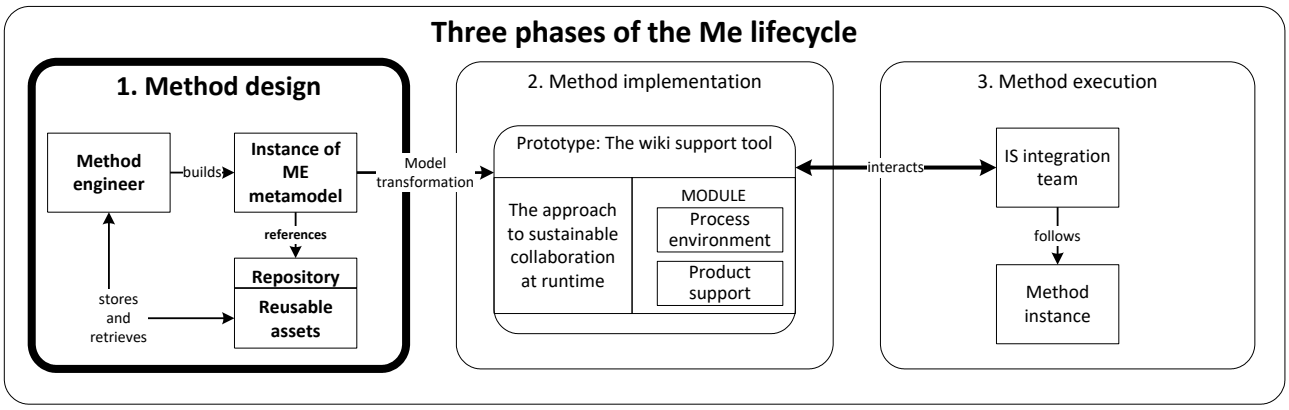

Figure 23: The method design, ME lifecycle

5.1. Introduction

In this chapter we discuss the method design chunks (see Figure 23), which are established based on the outcomes of Chapter 3. Challenge 1—aligning managers and individual contributor expectation—contains the following two variables: (1) expectation of the wiki (from a stakeholder's perspective) and (2) organizational culture and style. The second challenge—content organization and flexibility—is also divided into two variables: (1) high variety in content, i.e. information need, and (2) a suitable format for a wiki page. The final and third challenge—positioning a wiki in an existing information ecology and corporate culture—consists of three variables: (1) the existing information ecology, (2) uncertainties regarding participation/contribution, and (3) maintenance quality. In the following paragraphs, we convert these challenges into three modules. As mentioned before, we will use the ME approach steps per method fragment. Each module begins with an overview of all defined activities and selected methods. Thereafter, a more in-depth discussion per selected method fragment is presented in the section titled "Selection and analysis of the method fragments," followed by a PDD with an explanation table in the following section: "Selection and concatenation of the useful method fragments."

5.2. MODULE 1—aligning manager and individual contributor expectations

As established earlier in Chapter 3, we can subdivide this challenge into two variables: (1) expectations of the wiki and (2) organizational culture and style. Figure 24 provides an overview of the variables connected to the sub-activities (as described in Chapter 1.4.), and these sub-activities are amplified by several theories to support and extend each sub-activity as defined in our proposed design. In the next subparagraphs, we will discuss each sub-activity in more detail, reifying it with one or multiple of the following theories (or a part of one single theory): the Stakeholder Theory, the ECM or the ECT, Enterprise Modeling, the OCAI, and the KMAI.

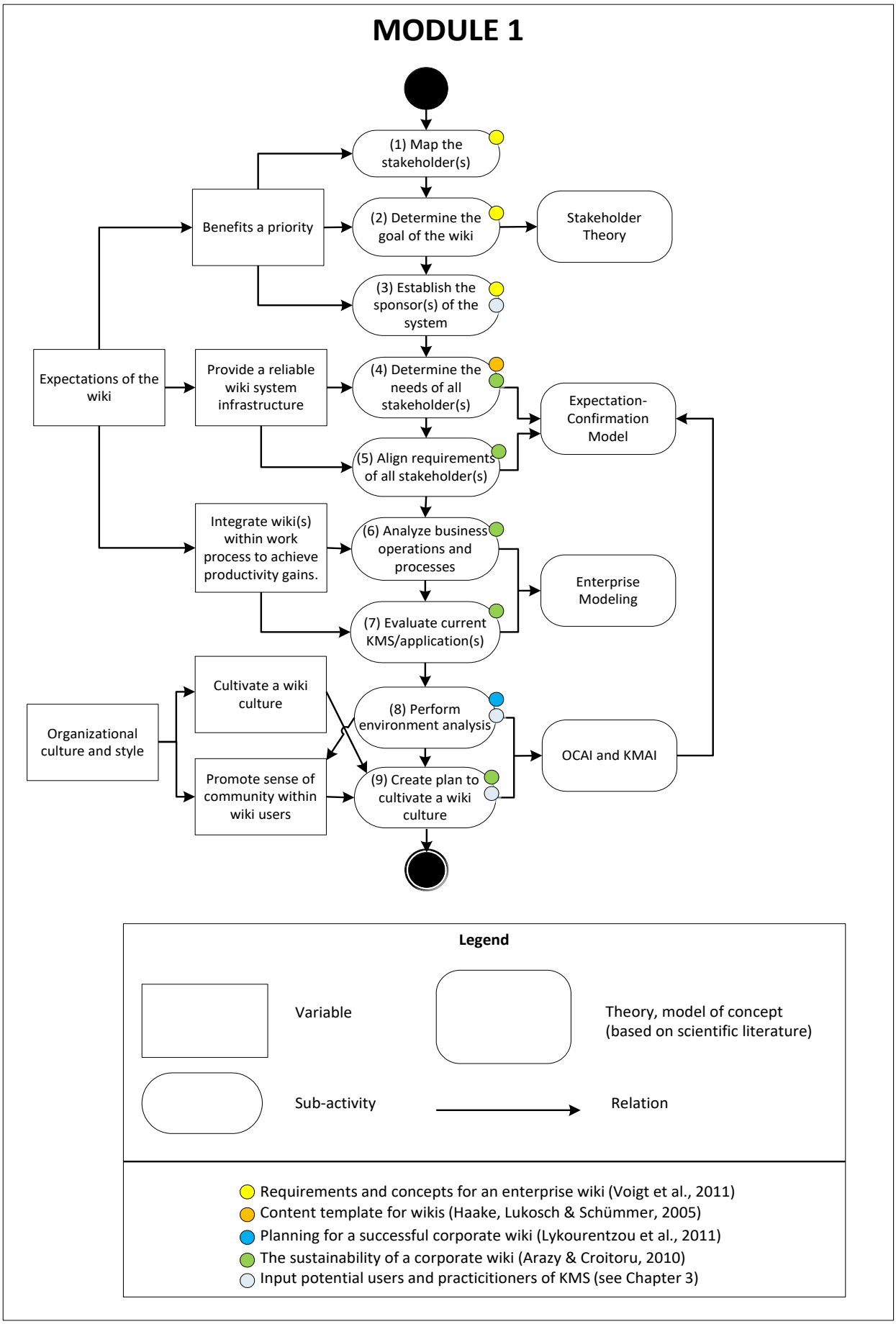

Figure 24: Overview of MODULE 1

5.2.1. The Stakeholder Theory—selection and analysis of the method fragments

The sub-activities (1) map the stakeholder(s) and user(s), (2) determine the goals of the wiki, and (3) establish the sponsor(s) of the wiki system (see Figure 25) are dedicated to the establishment of the stakeholders: "Stakeholders are persons or groups with legitimate interest in procedural and/or substantive aspects of corporate activity. Stakeholders are identified by their interests in the corporation, whether the corporation has any corresponding functional interest in them" (Donaldson & Preston, 1995).

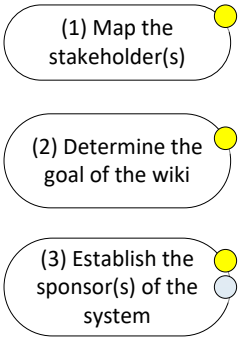

Figure 25: Sub-activities 1, 2, and 3—the Stakeholder Theory

Before defining the expectations of the wiki from a stakeholder's perspective, it is important to identify these stakeholders. To sufficiently map the stakeholders and their goals, we will use some elements from the Stakeholder Theory: "Stakeholder theory begins with the assumption that values are necessarily and explicitly a part of doing business" (Parmar et al., 2010).

In general, the Stakeholder Theory can be identified as a descriptive, instrumental, and normative theory to help in understanding and classifying the different facets of the Stakeholder Theory (Pouloudi, 1999). It is descriptive because it provides a model description of the concerning organization. According to Donaldson and Preston (1995), the Stakeholder Theory describes the organization as a constellation of operative and competitive interests possessing intrinsic value; however, this theory does not only describe existing situations or predict causes and effects; "It does not simply describe existing situations or predict cause-effect relationships; it also recommends attitudes, structures, and practices that, taken together, constitute stakeholder management"(Donaldson & Preston, 1995). The Stakeholder Theory is also instrumental because it establishes a framework for examining the connections between the practices (of the stakeholder) and the achievements of the organizational performance goals. The final consideration is that it is a normative aspect, which can be seen as the core of the Stakeholder Theory. This aspect exemplifies how the justifications for favoring the Stakeholder Theory over other management theories ultimately rely on normative arguments (Pouloudi, 1999).

These three aspects can be illustrated as nested circles, as depicted in Figure 26. The notion of stakeholders has been used in many different ways, although it tends to reflect a primarily descriptive or instrumental perspective (Pouloudi, 1999), especially when a more holistic view of stakeholders is needed so that it reflects the current multi-faceted concerns of IS development. The study by Pouloudi (1999) makes an important point that these three aspects are often intertwined and mutually supportive. The Stakeholder Theory is primarily used as a tool for examining the external organizational environment, and it explores how an organization can manage multiple stakeholder relationships. The basics of this theory are concerned with the following question: what brings the core

stakeholders together? Managers need to articulate the shared sense of the value they create within an organization, and this theory pushes them to be clear about their vision for the way in which a business should be conducted as well as the different relationships that are required to meet stakeholders' needs.

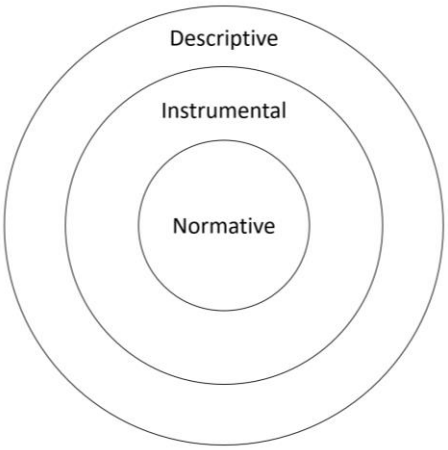

Figure 26: Aspects of Stakeholder Theory (Donaldson and Preston, 1995)

Furthermore, the Stakeholder Theory also provides a deeper understanding of the following three interconnected business problems: (1) the problem of understanding the creation and sharing of value, (2) the problem between the connection of ethics and capitalism, and (3) the problem of supporting managers to manage in such a way that the two previous problems are addressed. Parmar et al. (2010) mentioned that "Stakeholder theory suggests that if we adopt as a unit of analysis the relationships between a business and the groups and individuals who can affect or are affected by it, then we have a better chance to deal effectively with these three problems." This can be managed to understand the relationships within an organization—how they work and how they change over time.

Managers face the challenge of shaping these relationships to create as much value as possible for stakeholders and to manage the distribution of that value. In cases where stakeholder interests cause conflicts, the manager needs to find a way to revise the problems so that the needs of a broad group of stakeholders are addressed, and to the extent that this is done, even more value may be created for each stakeholder.

Parmar et al. (2010) also mentioned another interesting point of view; they state that the Stakeholder Theory is a type of living "wiki"—something that is constantly evolving "as stakeholder theorists attempt to invent more useful ways to describe, redescribe, and relate our multiple conceptions of ourselves and our institutions such as business" (Parmar et al., 2010). We will mainly use the elements from the stakeholder engagement framework to gain further understanding of stakeholder alliances and stakeholder value creation. The framework for stakeholder engagement consists of four dimensions, based on the study by Freeman (2017). The first dimension involves examining stakeholders' relations, with the aim of understanding the relational factors in stakeholder engagement. This dimension focuses on how value can be created with and for stakeholders. The second dimension is about communication with stakeholders, and it focuses on the communication with and between stakeholders from several perspectives and contexts. The third dimension examines

learning with and from stakeholders by means of using criticism, suggestions, and feedback as value-creation opportunities in stakeholder engagement. The fourth dimension combines all inputs and examines integrative stakeholder engagement. Figure 27 provides an overview of the framework for stakeholder engagement, inspired by a study conducted by Freeman (2017).

In addition, to determine the stakeholder interest or perspective, we will use the following elements, retrieved from Freeman's (2010) book: (1) define stakeholders (list of all people who are involved in a certain project or task, divided into internal and external stakeholders), (2) determine stakeholder importance by rating one's stakeholder by importance, (3) determine the stakeholder knowledge (area/specialism and the level of knowledge), and (4) evaluate stakeholder decision, which relates to the stakeholders who are a part of the decision-making process.

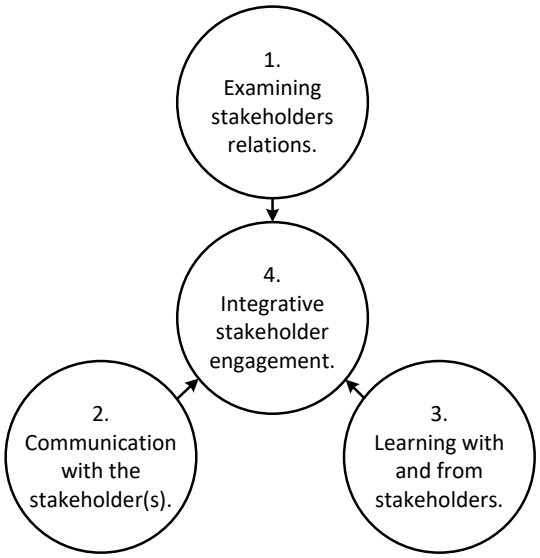

Figure 27: Stakeholder Theory—framework for stakeholder engagement

Despite the above-mentioned framework, there is still a challenge in immediately identifying the different perspectives of all the stakeholders; therefore, Pouloudi (1999) suggests that IS development and implementation benefits from the study of multiple stakeholder viewpoints. This implies that the extension of other theories is desirable. We will thus use some extensions from Pouloudi's (1999) study, which provides an overview of instrumental uses of the stakeholder concept in the strategic management literature; this overview consists of two main contributions: (1) use stakeholders to assist with planning and decision making and (2) use stakeholders to examine the external organizational environment in order to assist strategic planning and control.

An example of the first main contribution is using a stakeholder analysis as an element to integrate into a business planning process. Examples of the second main contribution are gathering insight into different conceptions of strategy (including stakeholder analysis), which can help managers during problem solving activities in different contexts, and performing a stakeholder analysis, which can complement scenario planning to enable organizations to assess stakeholders' reactions to certain organizational (strategical) changes. For our study, we will use several elements from both main contributions. Pouloudi's (1999) study also mentions that the most common instrumental approaches to stakeholder analysis in the field of ISs address one of the key issues of IS practice, namely the

development of an IS strategy and its alignment to the business strategy. A stakeholder analysis can be used to assist IS development and implementation, although the main challenge is to meet the expectations of all stakeholders. To manage conflicting stakeholder interests during the implementation of IS, it is important to consider key stakeholders when developing an IS.

The study by Lacity and Hirschheim (1995) describes the mismatch of and obstacles to the alignment of ISs and business strategies due to the conflicting expectations and perceptions that different organizational stakeholders have of ISs (Pouloudi, 1999). For example, senior management is mainly concerned with cost, whereas users are mostly concerned with service, and the IS managers sit in between. These managers face the challenges of creating an agreeable environment and justifying the compromises that must be made between the former two groups.

The study by Ruohonen (1991) more specifically establishes three key stakeholder groups within each organization: (1) top management, (2) user management, and (3) IS management groups. His point of view is that strategic IS planning should take into account the dynamics of these groups as well as the intragroup and inter-group relations. Finally, Pouloudi's (1999) study mentions a seven-step stakeholder analysis approach derived from the study by Benjamin and Levinson (1993). This approach, which is presented in Figure 28, supports management during change, enabled by IS, and it will help the organization to determine whether the change is feasible.

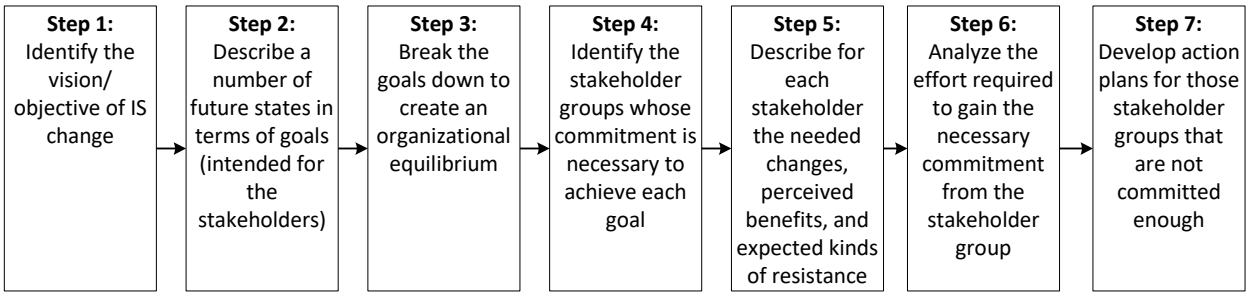

Figure 28: Seven-step approach, Benjamin and Levinson (1993)

5.2.2. The Stakeholder Theory—selection and concatenation of the useful method fragments

Based on the selection and analysis section, we created the PDD presented in Figure 29, followed by an explanation of the (sub-)activities in Table 12 and Table 13. Specify the stakeholders' goals.

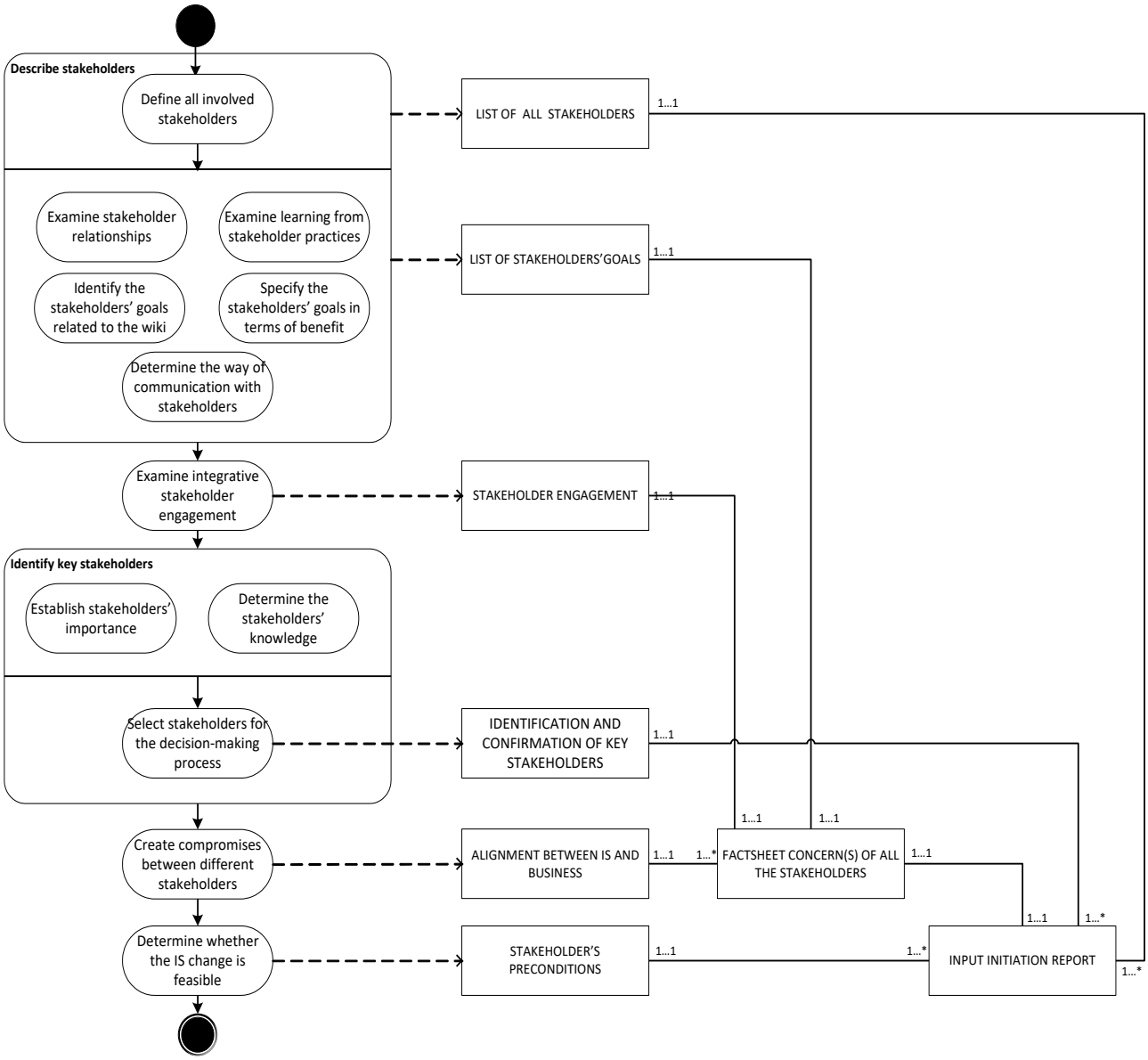

Figure 29: THE PDD of sub-activities 1, 2, and 3—the Stakeholder Theory

Activity	Sub-activity	Description of (sub-)activity
Describe stakeholders	Define all involved stakeholders	During this sub-activity, all involved parties will be identified, and the stakeholders' characteristics will be specified (their relationships, communication, and experience). The outcome of this activity is a LIST OF ALL STAKEHOLDERS, containing information about the stakeholders involved in a certain project or task, divided into internal and external stakeholders.
	Examine stakeholders' relationships	Another important step is to identify the relationships between the different stakeholders, primarily to examine and gain a deeper understanding of the relational factors in stakeholder engagement. It is about improving intelligibility regarding how value can be created with and for stakeholders.

		For example, in this step, one would examine whether there are similarities/connections in the knowledge field and whether departments cooperate in connecting projects.
	Identify the stakeholders' goals related to the wiki	The next step is to identify the goals of all the stakeholders, related to the wiki. This sub-activity is input of the concept: FACT SHEET CONCERNS OF ALL THE STAKEHOLDERS.
	Specify the stakeholders' goals in terms of benefit	In addition, each goal needs to be specified in terms of benefit, such as knowledge sharing or developing new knowledge.
	Determine the way of communication with stakeholders	This sub-activity results in a COMMUNICATION AGREEMENT between the stakeholders about communication. It mainly focuses on the several perspectives and contexts that the stakeholders have.
	Examine learning from stakeholder practices	This sub-activity is concerned with stakeholders' experiences: learning from previous practices through the use of criticism, suggestions, and feedback as value-creation opportunities in stakeholder engagement.
	Examine integrative stakeholder engagement	This sub-activity combines the input from the first activity—"Describe stakeholders"—and it examines integrative stakeholder engagement, which results in a STAKEHOLDER AGREEMENT.
Identify key stakeholders	Establish stakeholders' importance	During this sub-activity, the importance of the stakeholders will be established through the rating of each stakeholder by importance.
	Determine the stakeholders' knowledge	In the "Describe stakeholders" activity, we already identified their involvement in projects or tasks. This sub-activity provides more in-depth information about the knowledge area and/or specialism and the level of that knowledge.
	Select stakeholders for the decision-making process	Based on the "Establish stakeholders' importance" and "Determine the stakeholders' knowledge" sub-activities, the key stakeholders who will participate (partly or wholly) in the decision-making process will be selected, which results in a CONFIRMATION OF KEY STAKEHOLDERS.
	Create compromises between different stakeholders	Conflicting expectations and perceptions during IS implementation causes mismatches in and obstacles to the alignment of ISs and business. These mismatches can be established by justifying the compromises between stakeholders and/or creating a hostile environment. At the end of this sub-activity, an ALIGNMENT BETWEEN ISs AND BUSINESS is established.
	Determine whether the IS is feasible	This sub-activity will be performed with the support of the seven-step approach: 1. Identify the vision/objective of IS change; 2. Describe a number of future states in terms of goals; 3. Break down the goals to create an organizational equilibrium; 4. Identify the stakeholder groups whose commitment is necessary to achieve each goal;

		5. For each stakeholder, describe the needed changes, perceived benefits, and expected type of resistance; 6. Analyze the effort required to gain the necessary commitment from the stakeholder group; 7. Develop action plans for those stakeholder groups that are not committed enough. At the end of this sub-activity, the STAKEHOLDER'S PRECONDITIONS are established.

Table 12: Activity table of PDD of sub-activities 1,2, and 3

Concept	Description of concept	Cardinalities
LIST OF ALL STAKEHOLDERS	The LIST OF ALL STAKEHOLDERS is a list of all the involved individuals, such as users, manager, members of the CoP. A stakeholder could also be a department or a community. That list provides further understanding of the business environment. Note: in the proposed design this concept is called: OVERVIEW STAKEHOLDERS.	It is possible to have one or more lists (concept: LIST OF ALL STAKEHOLDERS, but there is only one initiation report (concept: INPUT INITIATION REPORT)
LIST OF STAKEHOLDERS'GOALS	The LIST OF STAKEHOLDERS'GOALS is the results of the sub-activity "identify the goals of all the stakeholders related to the wiki." This concept contains the goals of all the different stakeholders, including the desired results. Note: in the proposed design this concept is called: DOCUMENT GOAL(S) OF THE WIKI SYSTEM.	For sake of clarity, there is only one LIST OF STAKEHOLDERS'GOALS in the FACTSHEET CONCERN(S) OF ALL THE STAKEHOLDERS (which is also the only factsheet in the initiation report).
STAKEHOLDER ENGAGEMENT	The STAKEHOLDER ENGAGEMENT is a document or an overview of the type of communication, relationships, and situations whereby we can learn from practice.	It is possible to have one or more stakeholder engagements (concept: STAKEHOLDER ENGAGEMENT), although there is only one FACTSHEET CONCERNS OF ALL THE STAKEHOLDERS.
IDENTIFICATION AND CONFIRMATION OF KEY STAKEHOLDERS	Based on the stakeholders' importance and knowledge, along with the decision-making process, a list of key stakeholders will be determined in the following concept: IDENTIFACTION AND CONFIRMATION OF KEY STAKEHOLDERS.	There is only one overview of the key stakeholders (concept: IDENTIFICATION AND CONFIRMATION OF KEY STAKEHOLDERS) in the initiation report (concept: INPUT INITIATION REPORT). Contrary, there is only one initiation report.
ALIGNMENT BETWEEN ISs AND BUSINESS	The "create compromises between different stakeholders" activity results in the ALIGNMENT BETWEEN ISs AND BUSINESS by mapping all the stakeholders' expectations and perceptions and creating synergy.	There could be one or more alignments (concept: ALIGNMENT BETWEEN ISs AND BUSINESS), but there is only one FACTSHEET CONCERNS OF ALL THE STAKEHOLDERS.

STAKEHOLDER'S PRECONDITIONS	After the stakeholders are described and identified, a determination is made as to whether the IS integration is feasible. This results in the following concept: PRECODITION STAKEHOLDER.	It is possible to have one or more STAKEHOLDER'S PRECONDITIONS, but there is only one initiation report (concept: INPUT INITIATION REPORT).
FACTSHEET CONCERNS OF ALL THE STAKEHOLDERS	The concept FACTSHEET CONCERNS OF ALL THE STAKEHOLDERS is a collection of: • LIST OF STAKEHOLDERS'GOALS; • STAKEHOLDER ENGAGEMENT; • ALIGNMENT BETWEEN IS AND BUSINESS.	• There is only one factsheet (concept: FACTSHEET CONCERNS OF ALL THE STAKEHOLDERS), and one initiation report (concept: INPUT INITIATION REPORT). • Other cardinalities are described in previous concepts.
INPUT INITIATION REPORT	The concept INPUT INITIATION REPORT is a collection of inputs of MODULE 1. Note: in the proposed design this concept is a combination of INITIATION REPORT and INPUT PLANNING REPORT IMPLEMENTATION/ADOPTION WIKI.	See previous concepts for the description of the cardinalities.

Table 13: Concept table of PDD sub-activities 1, 2, and 3

5.2.3. Expectation-Confirmation Model—selection and analysis of the method fragments

The perceived success and usefulness of an IS is subjective, based on multiple views and goals: in some cases, managers' perceptions versus the individual contributors' perceptions do not match. Staples, Wong, and Seddon (2002) state that managing user expectations is an important consideration for successfully implementing a new IS. Their study suggests that it would be in management's best interests to develop strategies that ensure that these expectations in particular will be maintained at a realistic level. To amplify sub-activities 4 and 5 (see Figure 30), we will use elements from the ECM, which is comparable with the technology acceptance model (TAM) formulated in the study by Davis, Bagozzi, and Warshaw (1989). The TAM adapted the theory of reasoned action from the social psychology literature to postulate a model of IS acceptance, and the ECT was adapted from the consumer behavior literature to propose a model of IS continuance (Bhattacherjee, 2001). We start with a brief explanation of the theoretical background of the ECT next, followed by the formation of the sub-activities in our design with extended ECT elements from the literature.

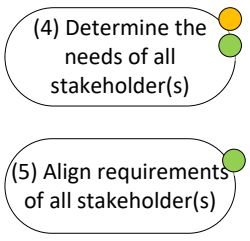

Figure 30: Sub-activities 4 and 5—the ECM

Theoretical background: the Expectation-Confirmation Model/Theory

A hurdle within organizations is that CIOs still consider unknown or unrealistic expectations on the part of the employees; therefore, Brown, Venkatesh, and Goyal (2012) studied expectation confirmation in technology, which is based on the assimilation-contrast model and prospect theory. The above

described situation suggests that both the model and the theory are needed to account for the magnitude and direction of the deviations between experiences and expectations. For this purpose, the primary construct of the TAM is used: perceived usefulness. The has been applied to IS users' continuance decisions because researchers postulate that they are similar to consumers' repurchase decisions (Chou, et al., 2010). The ECT is intentionally used from the customer behavior literature to study customer satisfaction, post-purchase behavior, and service marketing in general. The predictive ability of this theory has proven itself over a wide range of product repurchase and service continuance contexts (for example in the context of the repurchase of automobiles and camcorders as well as photographic, restaurant, and business professional services. Figure 31 contains the original ECT with the key constructs and relationships.

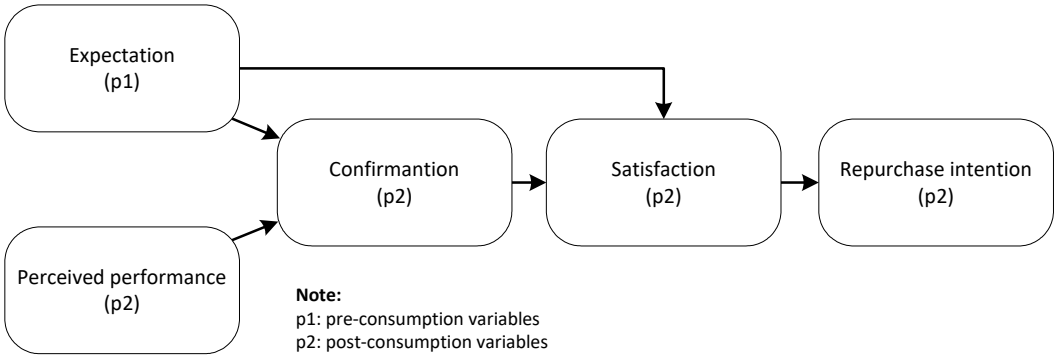

Figure 31: Original ECT, based on the study by Bhattacherjee (2001)

To gain a better understanding of the ECT, we constructed Figure 32 based on the paper by Bhattacherjee (2001) and Hossain and Quaddus (2012), and we illustrate the process of the ECT framework by which consumers reach repurchase intentions.

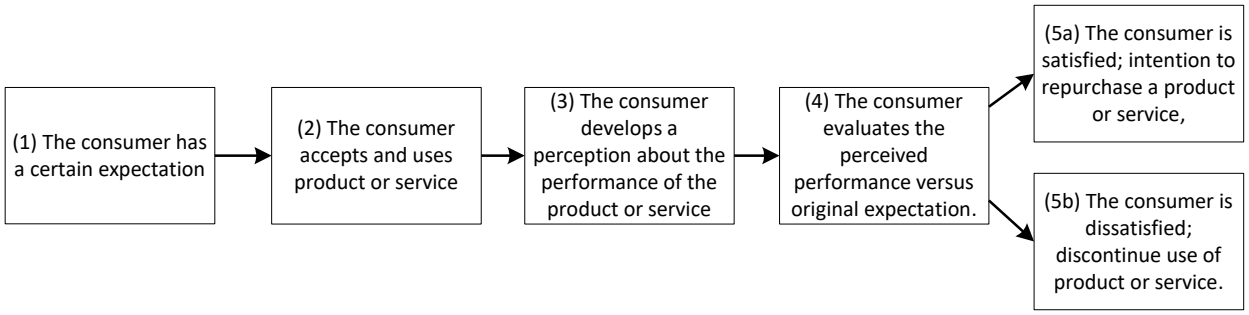

Figure 32: The process of the ECT framework, based on Bhattacherjee (2001) and Hossain and Quaddus (2012)

The first step refers to the period before the consumer purchases a product or service; he/she has a certain expectation about the specific product or service based on prior and existing experiences as well as through interactions with different members of the communication channels, such as mass-media channels through which customers acquired information about the product or service (for example, advertisements, package information, media reports, and media interviews).

Another method of communication is an interpersonal communication channel, for example: personal selling, feedback from prior users, advice from opinion leaders, and formal or informal discussions among peer consumers. It is possible that for the same product, the expectation may vary across

consumers, since it depends on the quality and reliability of the communication channel and information source. For example, if a customer receives incorrect or misleading information and has a lack of product knowledge, then this situation can cause him/her to have unrealistic expectations, which would influence the perceived performance of a product. In the second step, the consumer accepts and will use that product or service, followed by a period of initial consumption. During this period, he/she will develop a perception about the performance of the product or service—this is the extent to which the customers expectation is confirmed (confirmation or disconfirmation). The third step involves an evaluation of the perceived performance versus the original expectation. The consumer establishes the extent to which his/her expectation is met. This means that when a product performs better than expected, the perceived performance is greater than the expectation, and we then talk about a positive disconfirmation. On the other hand, we talk about a negative disconfirmation when the customer assesses the product performance to be lower than expected—perceived performance is lower than the expectation. The final option is when the perceived performance matches the expectation, which is called a simple confirmation. The fourth step refers to the degrees of satisfaction or affect based on information from the previous step. The last step is about whether the consumer is satisfied; it assesses whether there is an intention to repurchase a product or service or whether a consumer is dissatisfied and will thus discontinue its subsequent use. Appendix E contains a more elaborate illustration of the process steps of the ECT framework.

The ECT states that consumers' intentions to repurchase a product or continue with service use are determined primarily by their satisfaction with prior use of that product or service. Satisfaction is considered to be the key to building and retaining a loyal basis of long-term consumers. Bhattacherjee mentions the following definition of satisfaction: "the summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer's prior feelings about the consumption experience" (2001). The basic principles are as follows: lower expectations and/or better performance lead to greater confirmation, which positively influences customer satisfaction and continuance intention, and in contrast, higher expectations and/or poorer performance cause disconfirmation, dissatisfaction, and discontinuance intention.

"The aim of ECM is to model the individual intentions to continue using IT/IS"
(Thong, Hong & Tam, 2006)

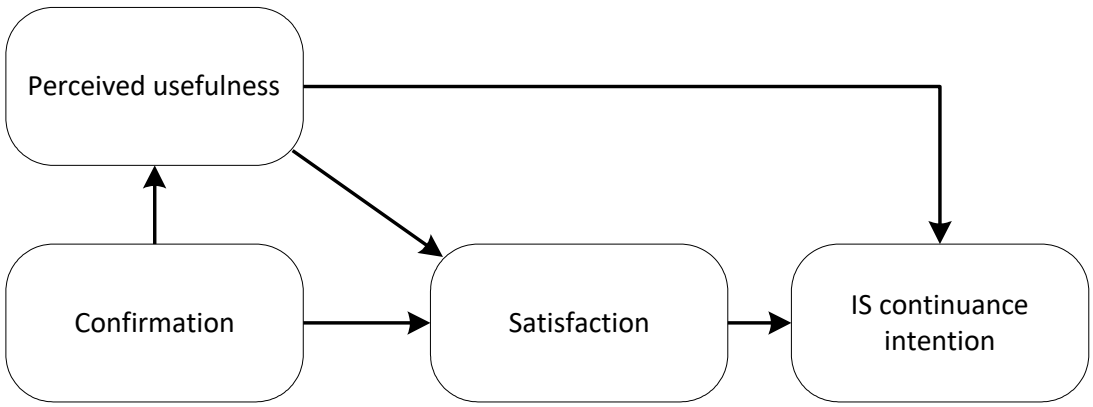

Figure 33: A post-acceptance model of IS continuance, based on Bhattacherjee (2001)

Throughout our literature search, we also encounter the term ECM, which is a model based on the ECT concept. It includes the following three dimensions (see Figure 33) of a user's intention to continue accepting IT: (1) perceived usefulness, (2) confirmation of expectation, and (3) satisfaction. The difference between the ECT and the ECM is related to the constructs of post-acceptance. The ECT mainly focuses on pre- and post-consumption factors (indicated by p1 and p2 in Figure 31), whereas the ECM examines the effect of post-consumption expectations rather than that of pre-consumption expectations. Furthermore, the ECM can be viewed as an improvement on the ECT through its consideration of perceived usefulness. The ECM essentially states that an individual has an intention to continue using an IS after developing expectations about the IS. The ECM is a model for investigating IS continuance (Thong, Hong and Tam, 2006; Chen, Liu & Lin, 2013).

On the one hand, the ECM only focuses on post-acceptance variables due to the fact that the effects of any pre-acceptance variables are already captured within the confirmation and satisfaction constructs. On the other hand, the ECT only examines the effect of pre-consumption (ex ante) expectations, but not post-consumption (ex post) expectations. Ex post expectations are especially important for products or services where expectations may change with time, which is a common case in IS use (Bhattacherjee, 2001).

Formation of sub-activities with expanded ECT/ECM elements

Sub-activities 4 and 5 involve the determination of the stakeholders' needs. These needs can be divided into technical and non-technical needs. Note that technical needs differ from technical requirements, as we know from IS/IT. During our study, we define technical needs as the elements that are related to and/or have influence on the technical aspect of a system, for example, the need for breadcrumb trails in order to improve the findability of the data. Non-technical needs are basically the remaining aspects, for example, the need for system training.

Bhattacherjee (2001) states that the ECT can serve as a useful theoretical framework for explaining IS continuance behaviors. Since our research focuses on an approach that contributes to sustainable collaboration in KM, we use different extensions than those in literature that is focused on the long-term sustainability part of the ECT. For example, the study by Bhattacherjee (2001) extended this theory with prior IS use research to theorize a model of IS continuance—users' intentions to continue using a certain IT system. This same study concludes that the post-acceptance usefulness perception continues to influence users' continuance intentions, and user satisfaction with prior use has a relatively stronger effect on the dependent variable (see Figure 34 for the ECT and IS continuance constructs).

Note that since perceived usefulness, confirmation, and satisfaction are the recurring basics of ETM, these three elements will be omitted in the next constructs / item tables. Only the constructs marked in gray in the corresponding figures will be explored in this chapter, and the confirmation question will be discussed in Chapter 5.4.

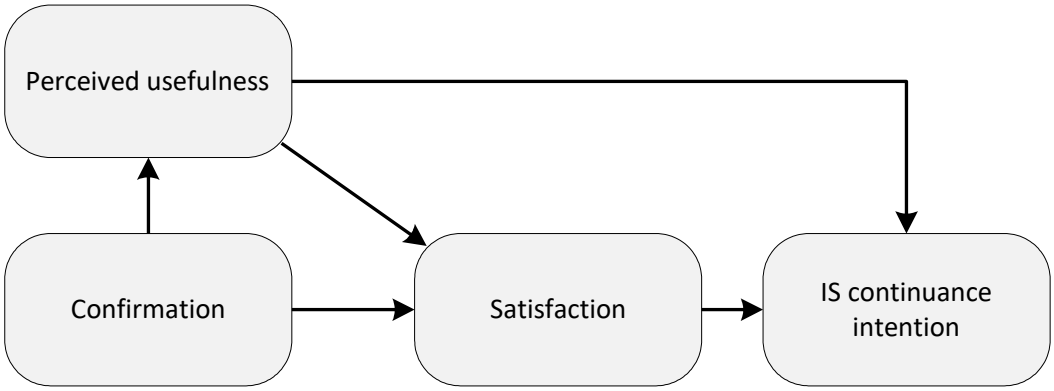

Figure 34: The ECM, Bhattacherjee (2001)

The study by Halilovic and Cicic (2013) aims to contribute to a better understanding of the salient antecedents of IS continuance intentions and to determine how they influence the decisions of IS users; therefore, they use two models: the ECM of IS continuance and the extended ECM of IS continuance. Based on a confirmatory factor analysis, they examined the following extended construct: the condition of support. The condition of support examines whether the supporting personnel are competent and easily available to support users with a certain IS system. See Figure 35 for the depiction the ECM.

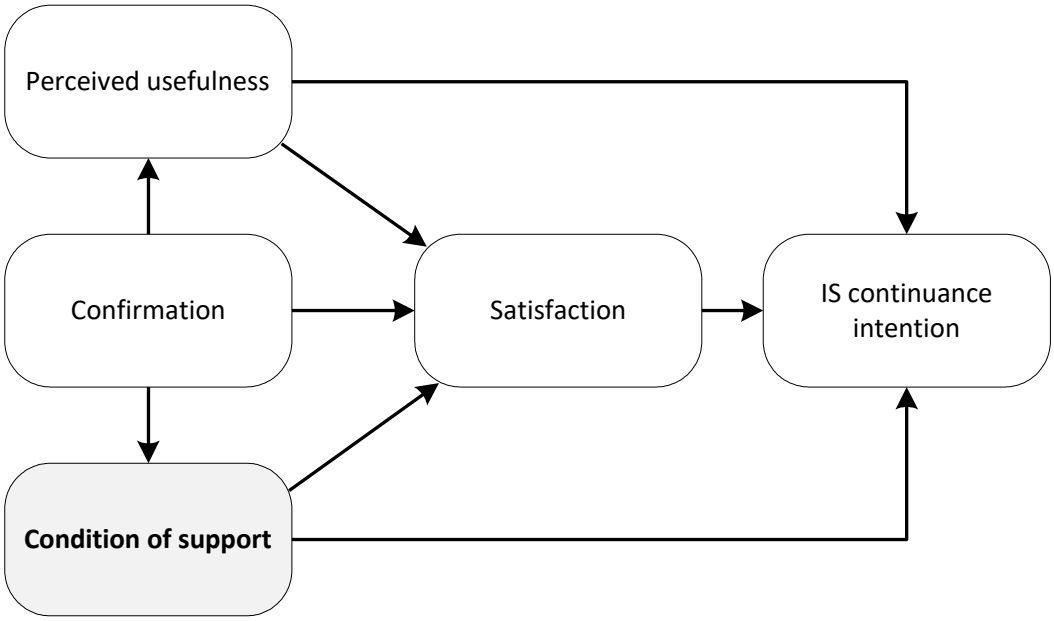

Figure 35: The ECM extended with the condition of support

In the research by Thong, Hong, and Tam (2006), attempts were made to expand the set of post-adoption beliefs in the ECM to extend its application beyond an instrumental focus, incorporating the post-adoption beliefs of perceived ease of use and perceived enjoyment. Perceived ease of use takes into account an important user perception; it explains IT adoption and usage behavior:" The inclusion of perceived ease of use in the ECM also enables us to better understand the role of the complex nature of an IT as a boundary condition in explaining user behavior in the continued IT usage context" (Thong, Hong & Tam, 2006). Perceived enjoyment is another important factor that can lead to

successful IT usage: “a hedonic IT, which provides a pleasurable experience such as fun, emphasizes perceived enjoyment” (Thong, Hong & Tam, 2006). This same study also states that some studies confirm the saliency of perceived enjoyment in explaining IT acceptance, and apparently, there have been fun aspects related to IT use. Perceived enjoyment has been found to be significant and even more important than perceived usefulness as a determinant of IT usage. The aim of this research was to investigate continued ISs and the influence of usage behavior. See Figure 36 for the illustration of Thong, Hong, and Tam’s (2006) research model.

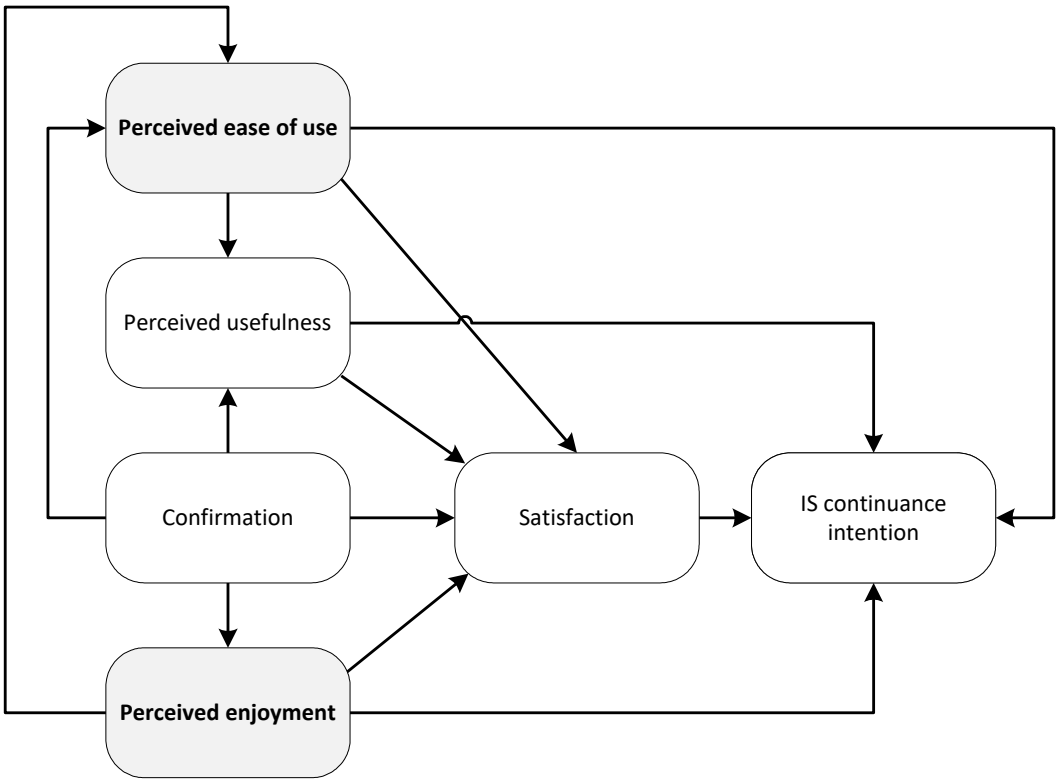

Figure 36: The ECM extended with perceived ease of use and perceived enjoyment (Halilovic & Cicic, 2013).

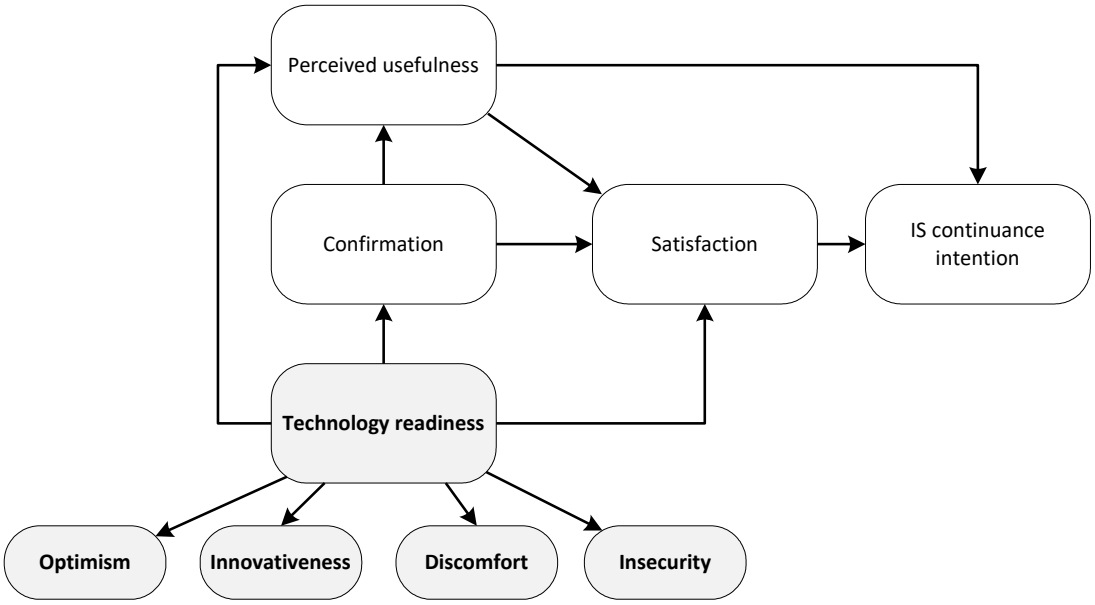

Figure 37: The ECM extended with technology readiness

Next, we explore an extension that focuses on integrating technology readiness into the ECM in order to explain individuals' continuance in the context of mobile data service usage (Chen, Liu & Lin, 2013). To measure the readiness, we use a questionnaire with the following items: optimism, innovation, discomfort, and insecurity. Since we have to deal with a wide variety in different background types of people (as mentioned in Chapter 3.2.1.), these constructs can provide surplus value for mapping the level of readiness of the people within a certain organization. See Figure 37 for a depiction of the model.

In addition, in the field of mobile devices, Oghuma et al. (2016) present a systematic approach to gain further understanding of a user's continuance intention to use mobile instant messaging platforms (for example, WhatsApp or Facebook messenger). Despite the context of this research in relation to our research, the research by Oghuma et al. (2016) has interesting findings regarding the constructs that significantly affect user satisfaction and the continuance intention to use. Therefore, they incorporate the following additional constructs in order to extend the ECM: perceived service quality, perceived security, and usability (of the user interface of the IS). Concluding from this study, it seems that perceived service quality and perceived usability significantly affect user satisfaction and the continuance intention to use. See Figure 38 for the extensions of the ECM IS continuance.

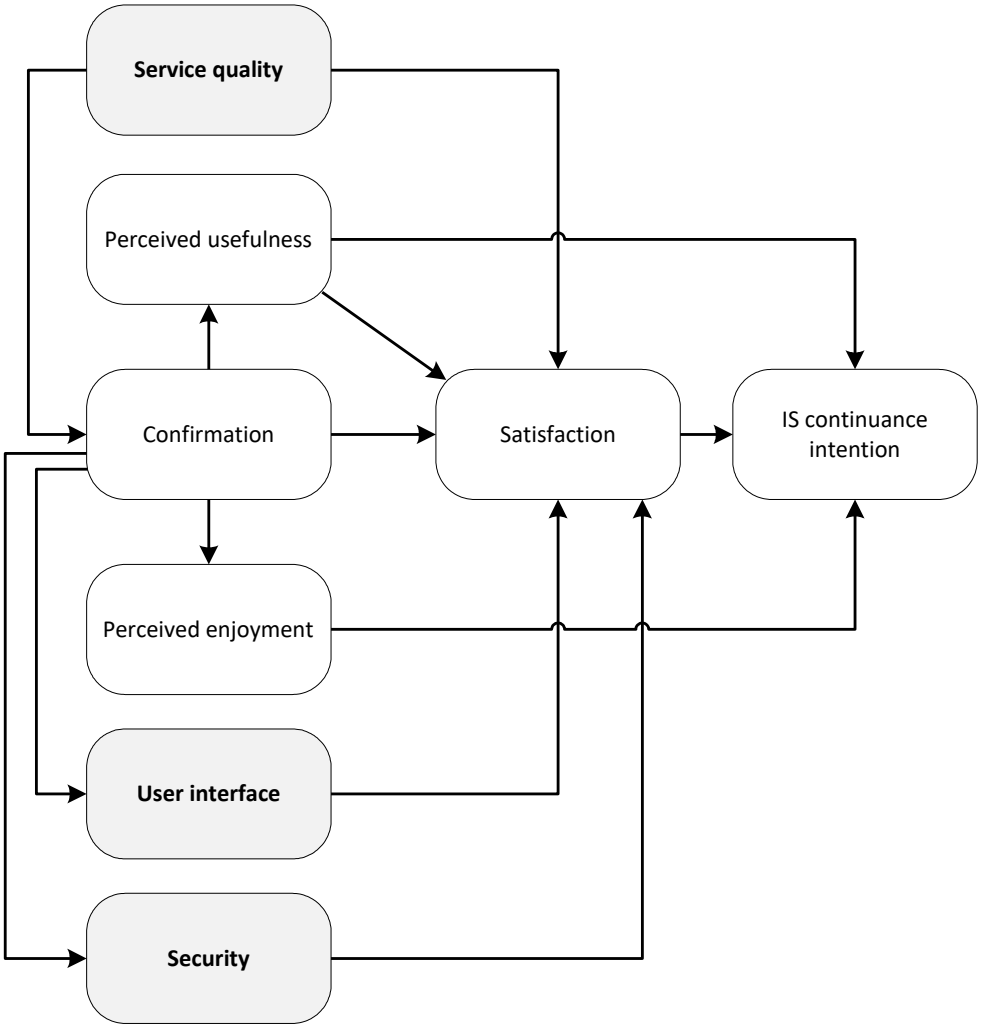

Figure 38: The ECM extended with service quality, user interface, and security

Also, in the field of e-learning, there is a challenge to increase the intention to continue using such a system. The study by Lee (2010) demonstrates that the item satisfaction has the most significant effect on users' continuance intention, followed by perceived usefulness, attitude, concentration, subjective norm, and perceived behavior control as significant but weaker predictors. Attitude can be seen as the degree of a person's unfavorable evaluation or appraisal of the behavior in question—when a person cultivates a positive attitude towards e-learning, he/she will have a stronger intention to adopt it and hence be more likely to use it. Concentration can be seen as another important construct of a person's flow experience: "For users to be in a flow state, they must first concentrate on their activities" (Lee, 2010).

Therefore, when a person performs multiple tasks simultaneously and is not able to focus on a limited field, it is not possible for him/her to reach a state of flow. A subjective norm refers to the normative beliefs about other people's expectations. The final construct is the perceived behavioral control, which refers to ''people's perception of ease or difficulty in performing the behavior of interest" (Lee, 2010)—despite the fact that a tool can be useful and efficient, users must still have basic IT/Internet skill to use it. Table 14 lists the constructs and their corresponding elements, and Figure 39 depicts these constructs.

Construct	Items
Attitude	A1: Using [x] is a good idea.
	A2: I have fun using [x].
	A3: It is desirable to use [x].
Concentration	C1: The [x] provides the service I need.
	C2: I feel comfortable in using the functions and services provided by [x].
	C3: The [x] provides complete information.
	C4: The [x] provides information that is easy to comprehend.
Subjective norm	People important to me support my use of [x].
	People who influence me think that I should use [x].
	People whose opinions I value prefer that I use [x].
Perceived behavioral control	Using [x] was entirely within my control.

Table 14: The ECT according to the study by Lee (2010)

Lin, Wu, and Tsai (2005) investigated the integration of perceived playfulness into the ECM within a web portal context, as illustrated in Figure 40. They conclude that to create web portal loyalty, it is necessary to focus on the user experience; i.e., provide the user with an interesting and enjoyable surfing experience. Therefore, playfulness can play a role. Researchers suggest that higher playfulness can result in an immediate subjective experience, such as a positive mood and satisfaction, which can result in continuance intention.

The study by Lin, Wu, and Tsai (2005) is based on the following idea: "once users are satisfied with a website, they will become loyal to it," and the researchers state that perceived playfulness is a crucial consideration in the design of websites. However, perceived usefulness was not found to significantly impact satisfaction; it was significantly associated with the intention to continue using a web portal. When users perceive a web portal to be less useful, it is highly unlikely that they will return to it. This

study concludes that perceived playfulness, in combination with confirmation of satisfaction, and perceived usefulness all contribute to the intention to reuse a website. The study provides better insight into continued use in the web portal context. The revised model can be used to guide research on post-acceptance behavior. Additionally, this same research also suggests that a better understanding of the measures of perceived playfulness is valuable in design in a diversified World Wide Web context.

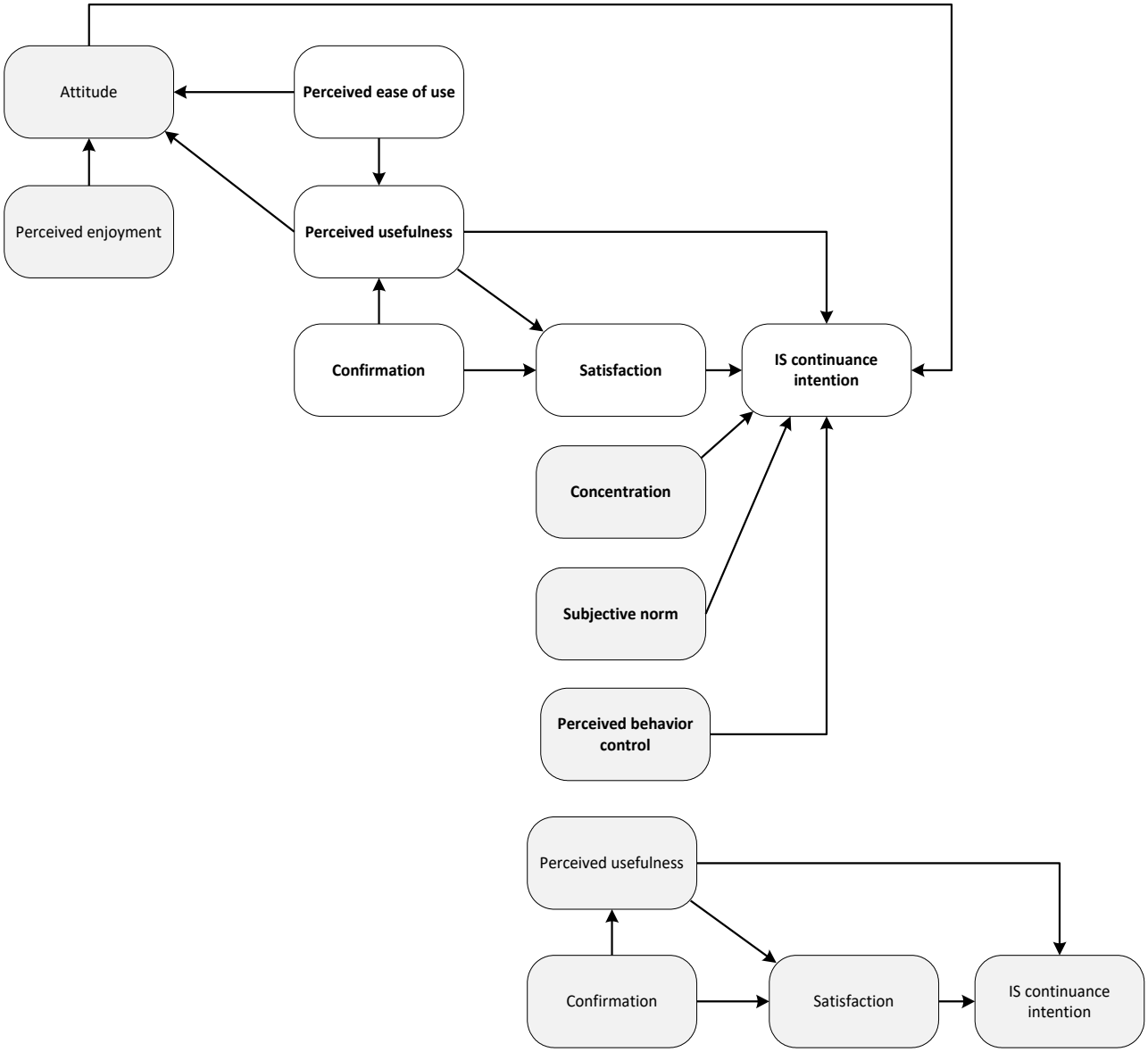

Figure 39: Depiction of constructs of the ECT according to the study by Lee (2010)

Figure 40: An overview of and relations between the ECT extended with perceived playfulness

Chou et al. (2010) suggest that the content of knowledge and the continuance of knowledge contribution are the salient factors for virtual communities, such as wikis. Due to the sustainability part of our approach, that research contributes substantially to determining sub-activities 4 and 5, which are related to establishing the stakeholders' needs. The study is also in line with one of the purposes of a wiki, namely knowledge creation: "Knowledge creation aims to develop new content or replace existing content of individuals' tacit and explicit knowledge" (Chou, et al., 2010); see Table 15 and Figure 41.

The study by Chou et al. (2010) provides some additions to the ETC (including the variable IS continuance) in the context of knowledge creation and satisfaction. These two variables tend to be affected by their perceived identity verification (PIV), which plays a key role in knowledge creation and social interaction between members of a virtual community as well as performance expectancy in an online community. Perceived identity verification can be seen as a perceptual construct, which consists of a twofold reasoning. First, PIV considers the individual's perceptions of others' assessments to be more important than how the individual's salient referents are actually perceived. The second reason is the importance of perceived confirmation from others.

Construct	Items
Perceived identity verification	PIV1: In this community, I am … (you can write down facts, roles, or emotions. There are no wrong answers).
Performance expectancy	PE1: The community is useful for improving my job performance.
	PE2: Participating in the community enables me to accomplish tasks more quickly.
	PE3: Participating in the community increases my productivity.
	PE4: If I participate in the community, I will increase my chances of getting better competence.
Knowledge creation	In the community, I have the continuance intention of performing the following activities:
	S1: Converting the existing knowledge into new knowledge with the help of mentors in the community.
	S2: Brainstorming.

	S3: Finding an expert who is able to help me with the conversion of tacit knowledge into comprehensive forms.
	S4: Making creative inferences from collaborating with other members.
	E1: Modeling based on analogies and metaphors.
	E2: Capturing and transferring experts' knowledge.
	E3: Finding an expert who is able to help me with conversion of tacit knowledge into comprehensive forms.
	E4: Making creative inferences from collaborating with other members.
	C1: Integrating best practices.
	C2: Communicating with other members and diffusing information and ideas among members.
	C3: Using a systematic approach to analyzing and evaluating information.
	I1: Learning by doing.
	I2: Gaining insights from other members' actions and practices.
	I3: Learning by observations.
	I4: Identifying the job-related knowledge by reading or listening to others' stories.

Table 15: The ECT constructs based on the paper of Chou et al. (2010)

Performance expectancy also consists of a twofold reasoning. First, performance expectancy is defined as the degree to which an individual believes that using the system will help him/her to attain gains in job performance. These expectations are related to several factors: perceived usefulness, extrinsic motivation, job fit, and outcome expectation. These factors are salient to an intention and behavior; performance expectancy exerts the strongest influence and remains significant at all points of measurement in both voluntary and mandatory settings (Chou, et al., 2010). The aims of the study were to identify the salient determinants of continuance intention regarding knowledge creation in an online environment and to gain a better understanding of how these determinants influence the dependent variable. The results of this study demonstrate that both post-acceptance performance perception and PIV affect participants' continuance intention regarding knowledge creation.

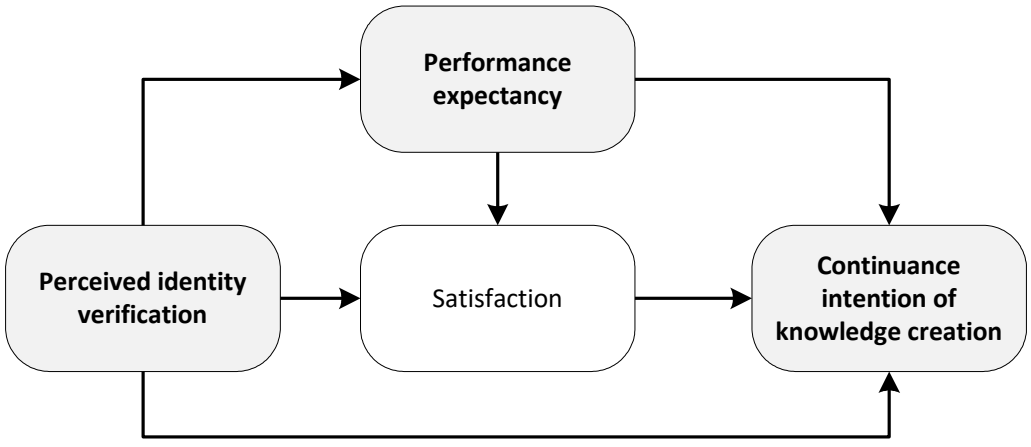

Figure 41: The ECT based on the paper of Chou et al. (2010)

For the continuance intention regarding knowledge creation, Nonaka's (1994) socialization, externalization, combination, and internalization (SECI) model is used. This model views knowledge creation as involving a continual interplay between the tacit and explicit dimensions of knowledge. The aim of SECI is to create, share, and enlarge knowledge. The socialization dimension involves the conversion of tacit knowledge to new tacit knowledge through social interactions and shared

experiences from individuals within an organization. The next dimension is the combination mode, which refers to the creation of new explicit knowledge by merging and synthesizing existing explicit knowledge (for example, data regarding water quality or quantity). Externalization involves converting tacit knowledge into new explicit knowledge, and finally, internalization refers to the creation of new tacit knowledge from explicit knowledge.

As mentioned before, the ECT is a widely used theory in consumer behavior literature to study customer satisfaction, post-purchase behavior (for example, repurchase and complaining), and service marketing in general: the "ECT holds that consumers' intention to repurchase a product or continue service use is determined primarily by their satisfaction with prior use of that product or service" (Bhattacherjee, 2001).

5.2.4. Expectation-Confirmation Model—selection and concatenation of the useful method fragments.

Figure 42 is a depiction of the PDD of sub-activities 4 and 5. This figure is followed by an explanation of the (sub-)activities in Table 16 and the concepts in Table 17.

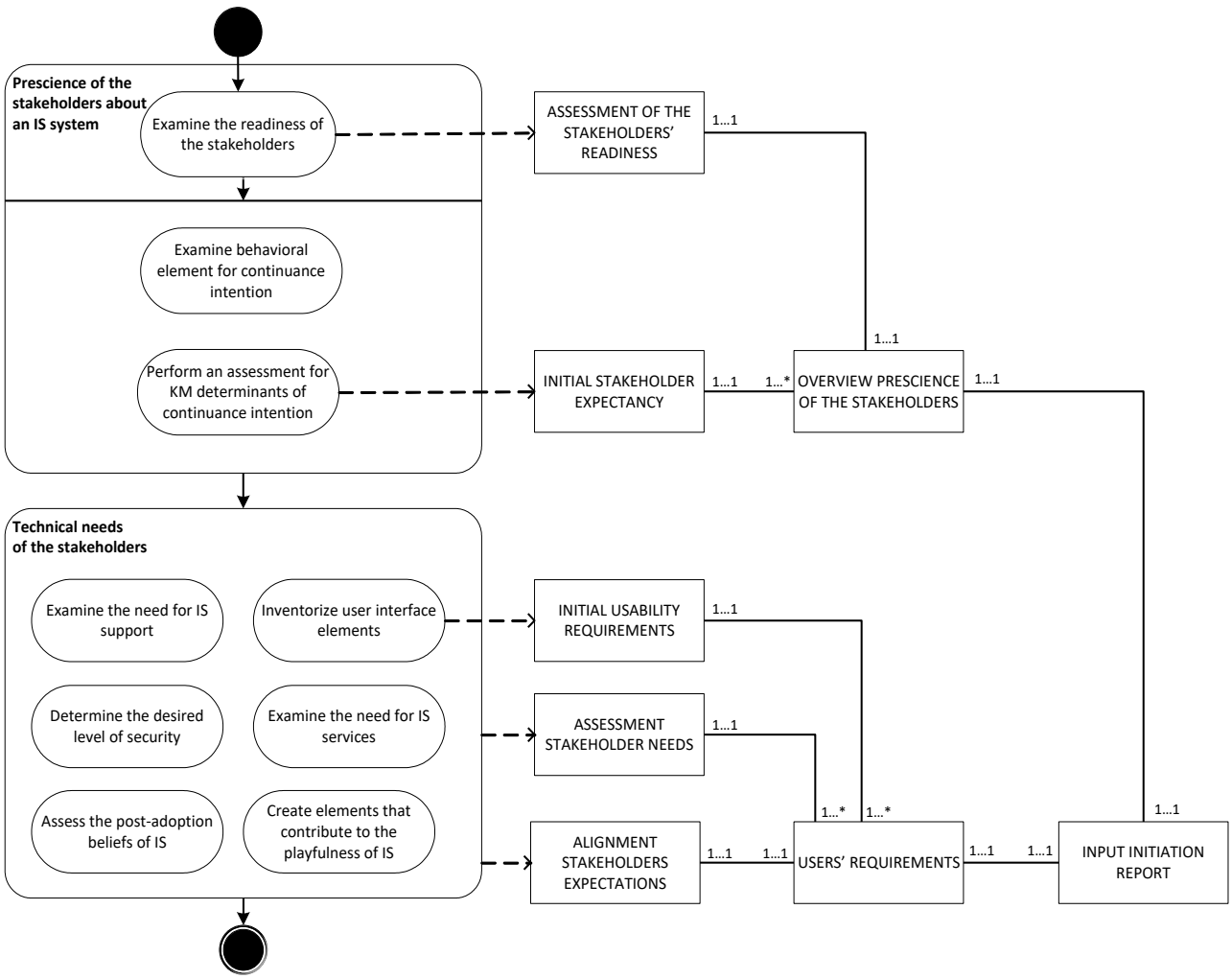

Figure 42: The PDD of sub-activities 4 and 5—ECT/ECM

Activity	Sub-activity	Description of (sub-)activity
Prescience of the stakeholders about an IS system	Examine the readiness of the stakeholders	Before establishing stakeholders' needs, it is valuable to assess their readiness, which refers to stakeholders' perceptions of ISs. To measure readiness, the following items will be examined: optimism, innovation, discomfort, and insecurity, all of which results in the concept of the ASSESSMENT OF STAKEHOLDER'S READINESS.
	Examine behavioral element for continuance intention	This sub-activity is based on the significant effect on users' intention to use an IS. Examined in the study by Lee (2010). It consists of the following four items: (1) attitude, (2) concentration, (3) subjective norm, and (4) perceived behavioral control. These items combined are INPUT FOR AN ORGANIZATIONAL CULTURE INVENTORY (OCI) ASSESSMENT, which is a component of sub-activities 8 and 9.
	Perform an assessment for KM determinants of continuance intention	During this sub-activity, we assess the determinants as described in the study by Chou et al. (2010): perceived identity verification, performance expectancy, and knowledge creation. The knowledge creation component will be performed with the support of the SECI model, which provides an explanation of how tacit and explicit knowledge are converted into organizational knowledge.
Technical needs of the stakeholders	Examine the need for IS support	The condition of support examines whether the supporting personnel are competent and easily available to support users with a certain IS system. In this sub-activity, we attempt to establish the required level of support.
	Inventorize user interface elements	With this sub-activity, we map the desired interface elements that contribute to sufficient usability for all stakeholders. This eventually results in the concept of INITIAL USABILITY REQUIREMENTS.
	Determine the desired level of security	This sub-activity does not only examine the required level of security, since in most organizations, this is already defined in their IT policy; it is more about the stakeholder's experience/perception of using the IS with enough confidence and trust.
	Examine the need for IS services	The need for IS services relates to the degree to which the IS serves the stakeholder/user, from the user perspective. This sub-activity can be seen as an enlargement of the "Inventorize user interface elements" sub-activity.
	Assess the post-adoption beliefs of IS	The assessment of post-adoption beliefs consists of two elements: perceived ease of use and perceived enjoyment. The first element takes into account an important user perception, and it explains IT adoption and usage behavior. It appears that the second element, perceived enjoyment, is another important factor that leads to successful IT usage.

	Create elements that contribute to the playfulness of IS	Researchers conclude that to create web portal loyalty, it is necessary to focus on the user experience. To provide an interesting and enjoyable surfing experience, we need to concentrate on perceived playfulness. Researchers suggest that higher playfulness can result in an immediate subjective experience, such as a positive mood and satisfaction, which can result in continuance intention.

Table 16: Activity table of PDD of sub-activities 4 and 5

Concept	Description of concept	Cardinalities
ASSESSMENT OF STAKEHOLDERS' READINESS	Before establishing the expectations and needs, an assessment of the stakeholders' technological readiness must be performed because this readiness influences the IS continuance intention.	There is only one ASSESSMENT OF STAKEHOLDERS' READINESS in the OVERVIEW PRESCIENCE OF THE STAKEHOLDERS (which also contains only one assessment of stakeholders' readiness).
INITIAL STAKEHOLDER EXPECTANCY	Based on the SECI model, the stakeholders' expectancy will be established. That model consists of the following dimensions: socialization, externalization, combination, and internalization.	It is possible that there are one or more expectancies of the stakeholders (concept: INITIAL STAKEHOLDER EXPECTANCY), although there is only one OVERVIEW PRESCIENCE OF THE STAKEHOLDERS.
OVERVIEW PRESCIENCE OF THE STAKEHOLDERS	At the end of the "Prescience of the stakeholders about IS system" activity, an overview document of stakeholders' IS and IT prescience is provided.	There is only one OVERVIEW PRESCIENCE OF THE STAKEHOLDERS in the initiation report (concept: INPUT INITIATION REPORT).
INITIAL USABILITY REQUIREMENTS	This concept is concerned with the technical needs of the stakeholder in terms of the user interface elements. For example, navigation via a breadcrumb trail. Basically, the first usability requirement of the IS will be investigated.	There are one or more usability requirements (concept: INITIAL USABILITY REQUIREMENTS), but there is only one overview of users' requirements (concept: USERS' REQUIREMENTS).
ASSESSMENT OF STAKEHOLDER NEEDS	When completing the "Technical needs of the stakeholders" activity, the assessment of the stakeholders' needs is completed.	It is possible to have one or more assessments of the stakeholder needs (concept: ASSESSMENT OF STAKEHOLDER NEEDS), although it only refers to one overview of users' requirements (concept: USERS' REQUIREMENTS).
ALIGNMENT OF STAKEHOLDERS' EXPECTATIONS	At the end of the "Technical needs of the stakeholders" activity, the needs of all stakeholders are aligned. Not that this process is iterative and can therefore change over time.	There is only one ALIGNMENT OF STAKEHOLDERS' EXPECTATIONS (to provide clearness) and only one overview of users' requirements (concept: USERS' REQUIREMENTS).

USERS' REQUIREMENTS	This concept refers to the end of this module, and it provides a document with all the needs (established on the ECT/ECM) of the stakeholders. Note: in the proposed design this concept is called: LIST OF REQUIREMENTS.	There is only one overview of users' requirements (concept: USERS' REQUIREMENTS) and only one initiation report (concept: INPUT INITIATION REPORT).
INPUT INITIATION REPORT	See Table 13.	See previous concepts for the description of the cardinalities.

Table 17: Concept table of PDD of sub-activities 4 and 5

5.2.5. Enterprise Modeling—selection and analysis of the method fragments

The aim of sub-activities 6 and 7 (see Figure 43) is to establish the architecture of an organization so that the organization has the correct knowledge to implement a sustainable collaboration. For this study, we will use the following definition of architecture: "Architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principle guiding its design and evolution" (Lankhorst, 2009). Our approach focuses on only the operations, business processes, current KMS, and applications; therefore, we consider Enterprise Modeling to be a suitable technique to analyze the organizational architecture. The purpose of modeling itself has always been at the core of both organizational design and IS development. These models provide decision makers with more understanding and thus enable them to filter out the irrelevant complexities of the real world. This means that efforts can be directed towards the most important parts of the system (Giaglis, 2001).

In short, Enterprise Modeling is the process of producing abstractions—constructing models about the enterprise business functions, business data, and business cycles as well as any other models that are useful in describing the states of the enterprise. A model is "a purposely abstracted and unambiguous conception of a domain" (Lankhorst, 2009).

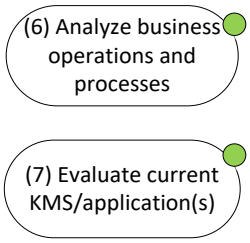

Figure 43: Sub-activities 6 and 7—Enterprise Modeling

Next, we will discuss the theoretical background of Enterprise Modeling, followed by the formation of Enterprise Modeling for our design. At the end, sub-activities 6 and 7 are illustrated in a PDD with their corresponding tables.

Theoretical background: Enterprise Modeling

Enterprise models can play a key role in IS integration; they contribute to a better design for organizations by analyzing their performance and managing their operations (Fox & Gruninger, 1998).

An enterprise model can be seen as a computational representation of the organization structure, activities, processes, information, resources, people, behavior, goals, and constraints (Ghidini et al., 2009). For our study, we will only focus on the following aspects of an organization: operation, process, and systems (KMS and applications). Enterprise Modeling is used for the definition, analysis, redesign, and integration of business processes, process data and knowledge, software applications, and ISs within an organization. With this information, the organization can achieve marked advancements in terms of overall organizational performance (Lim, Juster & Pennington, 1997). The study by Lim, Juster, and Pennington (1997) provided seven key aspects of Enterprise Modeling and integration: drivers, goals, domains, types, modeling, scales, and issues. The reason the various topics are classified under these seven key aspects is because they could be directly related to common queries that are usually made with regard to Enterprise Modeling and integration, namely the whys, whats, and hows. Table 18 contains an overview of the seven aspects and their corresponding queries.

Aspect	Measurement	Query
Drivers	The reasons a certain enterprise integration is required within an organization.	Why
Goals	More concrete ideas about what the organization aims to achieve with the application of the enterprise integration.	What
Domains	The main domains and components that must be integrated to achieve enterprise integration.	What
Types	The different kinds of enterprise integration.	How
Modeling	The process of producing abstractions about the elements relating to the operation of a business in order to understand the complexities of implementing enterprise integration.	How
Scale	The level of complexity involved in the implementation of enterprise integration.	What
Issues	The barriers limiting the implementation of enterprise integration.	What

Table 18: The seven key aspects of Enterprise Modeling

These seven key aspects of Lim, Juster, and Pennington (1997) are briefly described below.

Drivers

As mentioned before, the drivers refer to the motivation for a certain integration. In many cases, the driver behind an integrated enterprise depends on the need for enterprises to provide timely availability of data and information to both internal participants (for example, different departments) and external partners (for example, sub-contractors and suppliers). With the provision of these elements, it is possible to define the backbone of effective communication of the data as well as the interaction between the involved people. We can divide the drivers into four categories: (1) the integration of enterprise business processes, (2) the integration of enterprise ISs, (3) the facilitation of effective communication and integration among enterprise participants, and (4) the provision of support for sound decision making.

Goals

Goals can be defined as tangible or non-tangible, and they can be driven by external factors. Tangible goals are the most common type, for example increased flexibility or automatic process monitoring and control, while non-tangible goals are, for example, consumer satisfaction. An example of an external factor is the external environment related to government policies or changing customer wishes.

Domain
The aim of the domain is to scope the domains and elements that should be integrated during the IS integration. It creates a better view of the context of the IS integration.

Types
We can establish two commonly described Enterprise Modeling types: intra-enterprise and inter-enterprise integration. On the one hand, intra-enterprise integration is mainly concerned with the IS integration of locally distributed business units (internal); on the other hand, inter-enterprise integration, focuses on the integration of customers, sub-contractors, suppliers, and geographically distributed business units.

Modeling
A way in which to manage and capture the complexity of an organization structure is through modeling. The aim of modeling is to produce meta-models of an organization; therefore, these models could be utilized to help to integrate business processes, software applications, physical resources, and enterprise models.

Scale
The way in which the IS integration takes place depends on the size, operation, and complexity of the organization. The scale of an IS integration can vary accordingly. At the end, having an understanding of this scale will provide indicators of, inter alia, the time frame, cost, and resources that are required. This will eventually lead to better project management. During this study, we recognize the following seven scale categories:

1. Small or large enterprises;
2. Manufacturers of simple or complex items;
3. Manufacturers that produce items in low or high volumes;
4. Enterprises based on discrete or continuous processes;
5. Enterprises that are locally or transnationally grouped;
6. Manufacturers that produce single or multiple products, and
7. Enterprises that manufacture or assemble items.

Issues
For this study, we classify the issues as follows: (1) technical, (2) people-oriented, (3) economic, and (3) organizational concerns. Technical issues refer to technological matters such as manufacturing infrastructure, shared knowledge bases, and ISs. People-oriented issues relate to the customer and the supplier as well as people and business teams. Economic issues are about organizational costs, and finally, organizational issues relate to, for example, management, resources, responsibilities, and business processes.

5.2.6. Enterprise Modeling—selection and concatenation of the useful method fragments.

Figure 44 is an illustration of a PDD of sub-activities 6 and 7. This is followed by an explanation of the (sub-)activities in Table 19 and the concepts in Table 20.

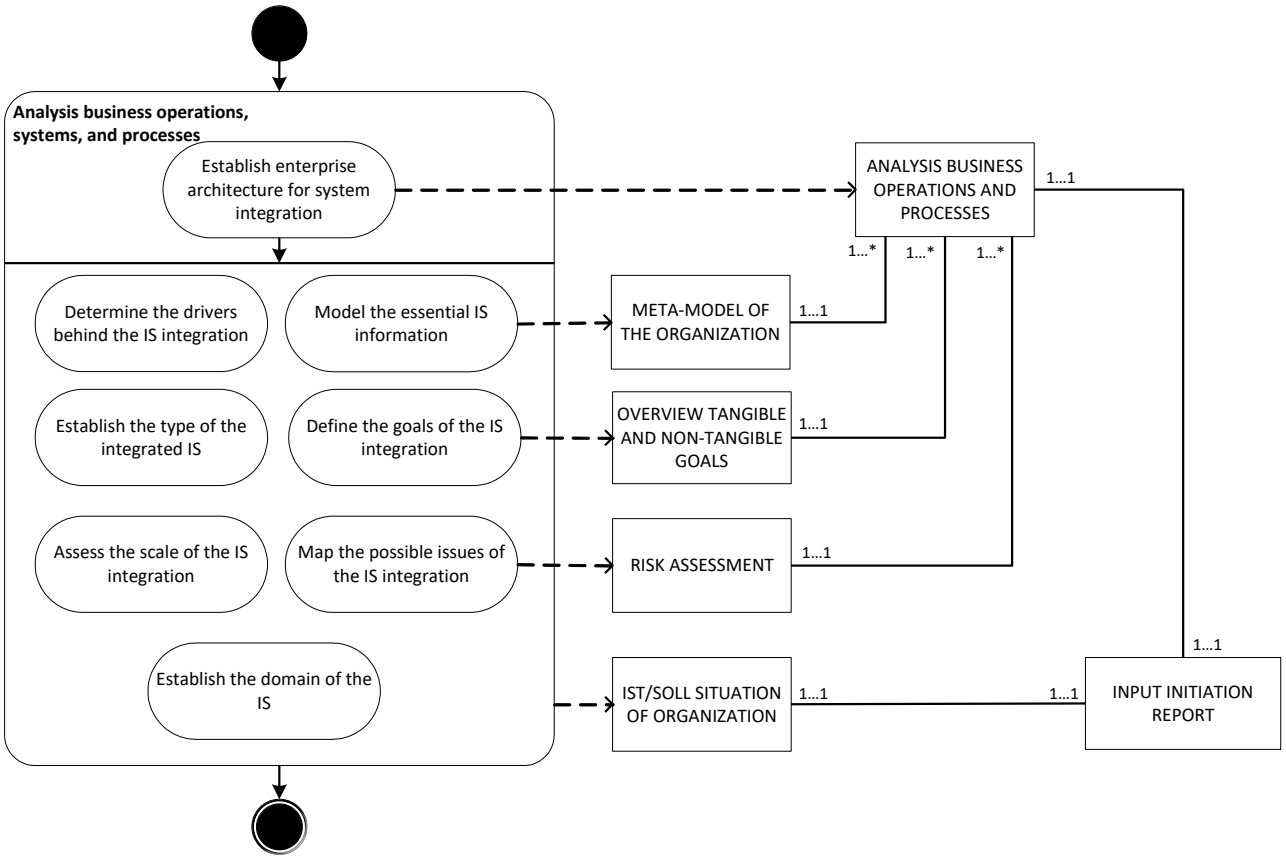

Figure 44: PDD of sub-activities 6 and 7—Enterprise Modeling

Activity	Sub-activity	Description of (sub-)activity
Analysis of business operations, systems, and processes	Establish enterprise architecture for system integration	This sub-activity results in the following concept: ANALYSIS OF BUSINESS OPERATIONS AND PROCESSES. It is necessary for gaining a better understanding of the structure of an organization. This information is crucial for locating the IS integration.
	Determine the drivers behind IS integration	The aim of the drivers is to establish the motivation for a certain IS integration. This sub-activity can be divided into four categories: (1) the integration of enterprise business processes, (2) the integration of enterprise ISs, (3) the facilitation of effective communication and integration among enterprise participants, and (4) the provision of support for sound decision making.
	Model the essential IS information	In this sub-activity, we capture the complexity of the organizational structure. The aim of modeling is to produce meta-models of an organization.
	Establish the type of integrated IS	This sub-activity consists of two types of integration: intra-enterprise and inter-enterprise integration. The former refers to concerns related to the IS integration of locally distributed

		business units (internal), while the latter is mainly focused on the integration of customers, sub-contractors, suppliers, and geographically distributed business units.
	Define the goals of the IS integration	Defining the goals results in tangible or non-tangible goals, both of which can be driven by external factors.
	Assess the scale of the IS integration	This sub-activity contributes to better project management. There are seven scale categories established: (1) small or large enterprises, (2) manufacturers of simple or complex items, (3) manufacturers that produce items in low or high volumes, (4) enterprises based on discrete or continuous processes, (5) locally or transnationally grouped enterprises, (6) manufacturers that produce single or multiple products, and (7) enterprises that manufacture or assemble items.
	Map the possible issues of the IS integration	The issues of IS integration are divided into the following concerns: (1) technical, (2) people-oriented, (3) economic, and (3) organizational.
	Establish the domain of the IS	This sub-activity aims to scope the domain and related elements for IS integration. It creates a better view of the context of the IS integration.

Table 19: Activity table of PDD of sub-activities 6 and 7

Concept	Description of concept	Cardinalities
ANALYSIS OF BUSINESS OPERATIONS AND PROCESSES	Before implementing the IS integration, it is necessary to have a clear view of the business operations and processes. This concept is the final document/report, which receives input from the subsequent sub-activities.	• There is only one overview of analysis of business operation and processes (concept: ANALYSIS OF BUSINESS OPERATIONS AND PROCESSES), and there is only one initiation report (concept: INPUT INITIATION REPORT) • See next concepts for the description of the other cardinalities.
META-MODEL OF THE ORGANIZATION	The sub-activity titled "Model the essential IS information" aims to collect all the core elements and operations of the organization, which results in the following concept: META-MODEL OF THE ORGANIZATION.	It is possible to have one or more meta-models of the organization (concept: META-MODEL OF THE ORGANIZATION). However, there is only one overview of analysis of business operation and processes (concept: ANALYSIS OF BUSINESS OPERATIONS AND PROCESSES)

OVERVIEW OF TANGIBLE AND NON-TANGIBLE GOALS	Another input for the ANALYSIS OF BUSINESS OPERATIONS AND PROCESSES is formed by the goals of the IS integration. It is important to remain critical regarding the types of goals that a wiki page meets.	There are one or more overviews of tangible and non-tangible goals (concept: OVERVIEW OF TANGIBLE AND NON-TANGIBLE GOALS), but there is only one overview of analysis of business operation and processes (concept: ANALYSIS OF BUSINESS OPERATIONS AND PROCESSES).
RISK ASSESSMENT	It is also ideal to take into account the issues (or risks) beforehand so that they can be eliminated, minimized, or recognized.	It is possible to perform one or more risk assessments (concept: RISK ASSESSMENT), although there is only one overview of analysis of business operation and processes (concept: ANALYSIS OF BUSINESS OPERATIONS AND PROCESSES).
THE IST/SOLL SITUATION OF ORGANIZATION	With the IST and SOLL situation, we can establish the possible gap to achieve IS integration. Note: in the proposed design this concept is called: OVERVIEW CURRENT SITUATION.	There is only one IST and SOLL situation of the organization (concept: THE IST/SOLL SITUATION OF ORGANIZATION), and there is only one overview of analysis of business operation and processes (concept: ANALYSIS OF BUSINESS OPERATIONS AND PROCESSES).
INPUT INITIATION REPORT	See Table 13.	See previous concepts for the description of the cardinalities.

Table 20: Concept table of PDD of sub-activities 6 and 7

5.2.7. The OCAI and KMAI—selection and analysis of the method fragments

Since the effective implementation of a wiki and both technological and cultural aspects are inseparable, we can conclude that organizational culture plays a crucial role in the successful implementation of a KM collaboration; see corresponding sub-activities 8 and 9 in Figure 45. The study by Lykourentzou et al. (2011) states that to implement a successful wiki, an organization must cultivate a wiki culture, which is "a bottom-up phenomenon based on the assumption that users of any given product are like the proverbial blind men feeling an elephant. Their knowledge is far greater than the sum of its parts" (Taylor & Masters, 2005). To cultivate a wiki culture, two steps must be performed: (1) ensure management's support and (2) provide knowledge-sharing incentives. Our first intention was to use the OCI as an instrument to profile the culture of an organization: "The Organizational Culture Inventory was designed as part of a self-scoring, multilevel diagnostic system for individual change and organizational development" (Cooke & Rousseau, 1988). This study concludes that OCI has important advantages for organizational development interventions and other programs directed toward system-wide change. In essence, the OCI™ is the most widely used and thoroughly researched tool for measuring organizational culture in the world; however, since it is a commercial tool of Human Synergistics International, we cannot use it or its questions without permission. Also, since organizational culture is not the main priority of this research, we will use alternatives: the OCAI and the KMAI.

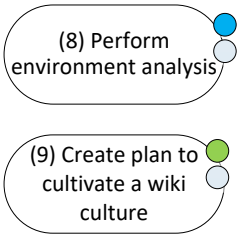

Figure 45: Sub-activities 8 and 9—OCAI and KMAI

Theoretical background: the OCAI and KMAI

Organizational culture and KM are genuinely related to each other. In Lawson's study, the relationship between organizational culture and KM were examined, and it seems that organizational culture indeed has a positive correlation with KM. This was also the case in the study by Chin-Loy and Huizenga (2003), whose results demonstrate that there is a positive relationship between organizational culture types and KM programs. To assess the organizational culture and KM initiatives within an organization, the following two instruments are used: the OCAI and the KMAI. The OCAI, validated by Cameron and Quinn (1999), is an instrument to assess organizational culture with the use of a five-point Likert scale. The OCAI consists of six key dimensions, which address various components of organizational culture: (1) an organization's dominant characteristics, (2) organizational leadership, (3) management of employees, (4) organizational glue, (5) strategic emphases, and (6) an organization's criteria of success. Each dimension comprises four statements that can be answered with a five-point Likert scale. At the end of the OCAI, four types of organizational culture can be established: clan, adhocracy/developmental, market/rational, and hierarchy (Chin-Loy & Huizenga, 2003), as presented in Figure 46[7]. Note that the OCAI is a public-domain document, and no permission was consequently necessary to utilize this instrument.

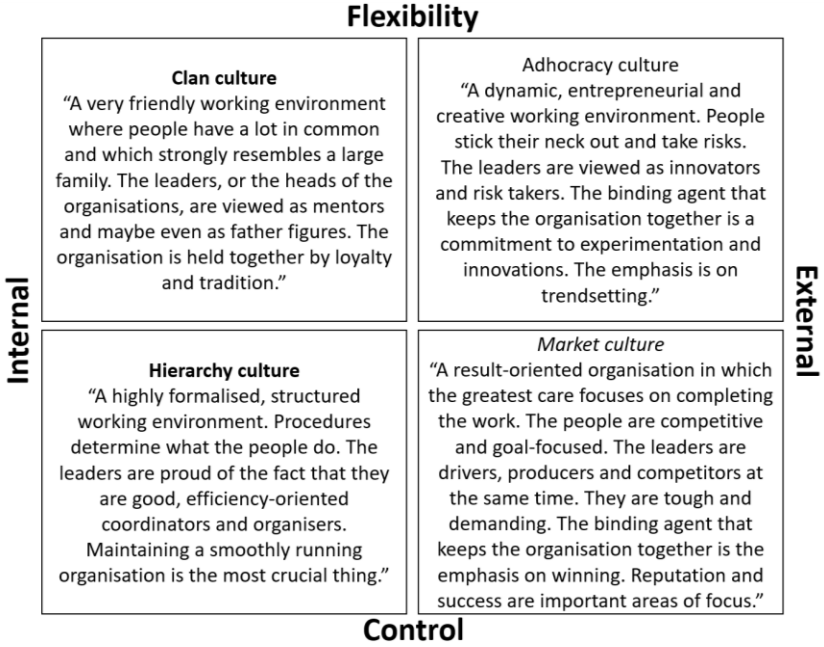

Figure 46: Quinn's culture types

[7] The content of the figure is derived from: https://www.quinnassociation.com/en/culture_typology

The KMAI is an instrument created by Lawson (2002) to measure the KM activities within organizations. The KMAI adapts the six-process KM cycle, consisting of (1) knowledge creation, (2) knowledge capture, (2) knowledge organization/coding, (3) knowledge storage, (4) knowledge dissemination/publishing, (5) accessing knowledge, and (6) knowledge application. “An organization that is actively implementing a strategic advantage must be utilizing all six processes to varying degrees depending on its environment.” (Lawson, 2002). The KMAI consists of six questions; each question represents a KM process and contains four descriptive statements (utilized with a five-point Likert scale) to assess the level of activity within the KM cycle. Lawson (2002) states that the hierarchy culture type does not successfully support the implementation of KM, whereas the market culture does support KM initiatives. With regard to group and developmental culture types, the results were inconclusive. Park, Ribière, and Schulte (2004) established critical attributions of organizational culture that promote knowledge sharing and KM technology implementation success.

Laweson (2002) states that KM technologies include elements that support KM within a certain organization. According to many studies, the main barrier to success is that the failure of KM initiatives posited that of organizational culture. Other challenges that influence the launch of KM initiatives are (i) encouraging cultural adoption of KM, (ii) encouraging people to share, and (iii) managing information. Another aspect that is constrained by organizational culture is the efficient use and acceptance of IT tools that are designed for the facilitation of knowledge creation, capture, storage, and distribution. Therefore, practitioners realized that the focus on human factors is as important as the focus on KM IT applications. The study by Davenport and Prusak (1998) also mentions that managers should not expect software to solve knowledge integration problems. In addition, the study also suggests that when managers spend a third or more of their energy and money on technology, they are neglecting the important organizational factors, including organizational culture.

Changing the culture within an organization is a major challenge; it is a time-consuming and often frustrating process. The success of changes is low in situations where employees do not understand or accept the purpose of the culture change. A way in which to achieve cultural change is through a strong communication campaign. According to Laweson (22), it seems to be more effective to enable cultural evolution than to implement radical change. Besides, it has also been posited that is it more rewarding to align the KM system with the organizational climate rather than to attempt to change the organizational culture. We can conclude that the success of KM technology implementation is mediated by human behavior.

Park, Ribière, and Schulte (2004) identified the following cultural attributes that have a positive correlation with the success of KM technology implementation: supportive of employees, trust, sharing information freely, working closely with others, and team-oriented work. Before an organization begins to implement KM technology initiatives, it should first assess and comprehend the attributes of the organizational culture in terms of a technology profile. In short, implementing KM strategies and technologies yields tangible benefits from knowledge sharing.

5.2.8. The OCAI and KMAI—selection and concatenation of the useful method fragments.

Figure 47 provides a PDD of sub-activities 8 and 9, supported by an explanation of the activities and concepts in Table 21 and Table 22.

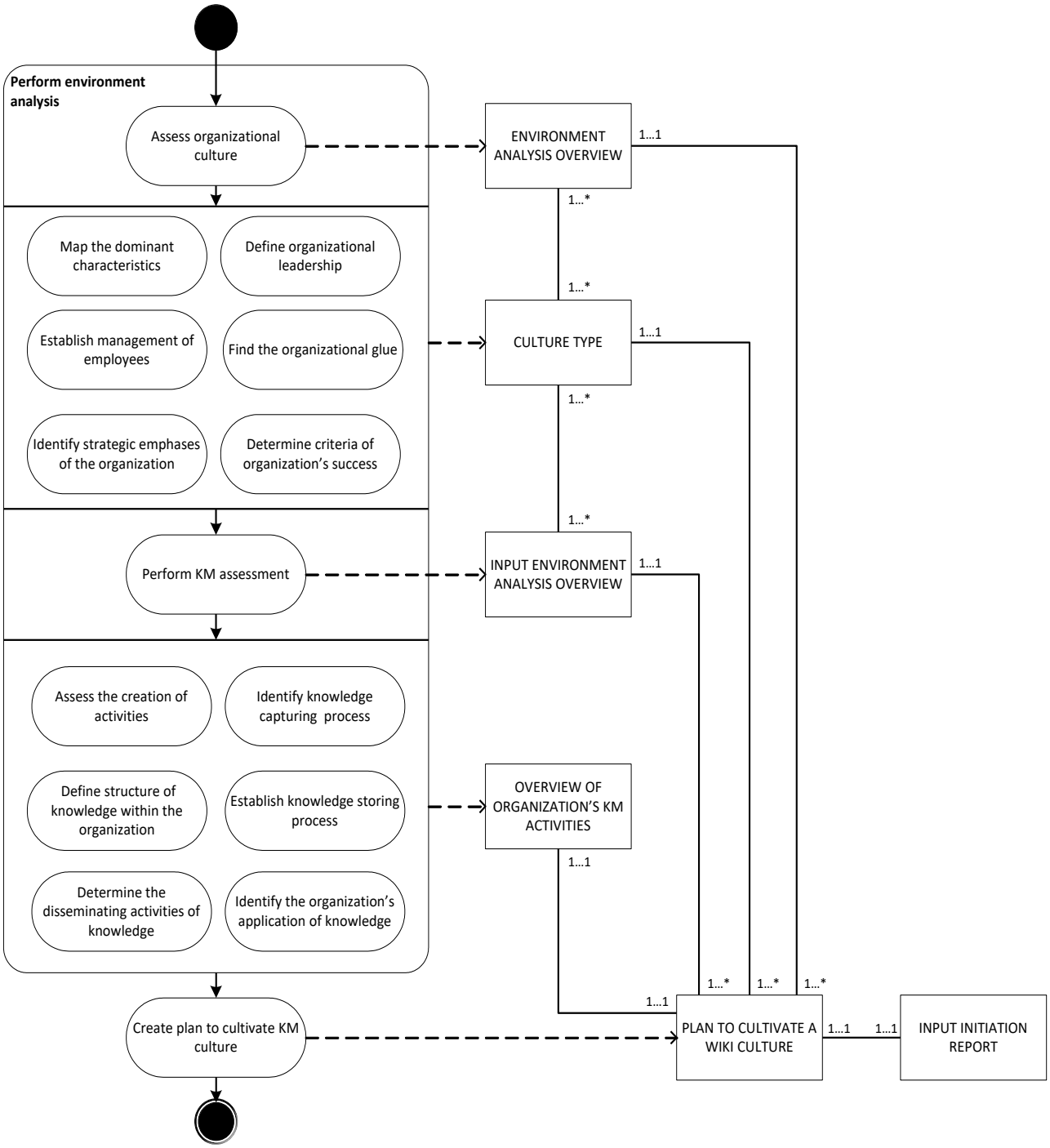

Figure 47: The PDD of sub-activities 8 and 9—OCAI and KMAI

Activity	Sub-activity	Description of (sub-)activity
Perform environment analysis	Assess organizational culture	Based on literature, we could establish that before an organization launches a KM technology initiative, it should assess its organizational culture and KM technology profile. Therefore, an assessment will be conducted with both elements. The organizational culture assessment consists of six elements (see the subsequent six sub-activities): domain characteristics, organizational leadership, management of employees, organizational glue, strategic emphases, and criteria of success.
	Map the dominant characteristics	This sub-activity consists of four statements (five-point Likert scale) that will establish the characteristics of an organization.
	Define organizational leadership	To define the organizational leadership, four statements are provided that need to be answered with a five-point Likert-scale score.
	Establish management of employees	This sub-activity measures the management style within an organization. It also consists of four statements that use a five-point Likert scale.
	Find the organizational glue	The organizational glue refers to the norms and values of the organization (also provided with four statements using the five-point Likert scale).
	Identify strategic emphases of the organization	This sub-activity assess the strategic emphases of the organization. For example, it examines whether the organization focuses on human development or on competitive actions (provided in four statements using a five-point Likert scale.
	Determine criteria of organization's success	The assessment (four statements using a five-point Likert scale) of this sub-activity focuses on the way in which an organization defines its success, for example, success based on the development of human resources or on efficiency.
	Perform KM assessment	This part of the assessment is concerned with the KM activities of an organization. It consists of six elements divided into four statements each (using a five-point Likert scale). The level of each KM activity will be assessed.
	Assess the creation of knowledge activities	This sub-activity measures the level of knowledge creation, for example, whether the organization encourages or rewards knowledge creation.
	Identify knowledge capturing process	The capturing of knowledge is identified through this sub-activity. It measures the way in which an organization contributes to methods for capturing knowledge, such as different types of documentation.
	Define structure of knowledge within the organization	This sub-activity relates to the organization of KM activities, such as the existing policy or KM-related mechanisms.

	Establish knowledge storing process	This sub-activity is about the method of storage. For example, it asks whether the organization has databases or devices to store its knowledge.
	Determine the disseminating activities of knowledge	The dissemination of knowledge is considered in the context of the findability and accessibility of the knowledge.
	Identify the organization's application of knowledge	This sub-activity involves the application of the knowledge. It asks the following question: are there methods or mechanisms for KM?
	Create a plan to cultivate KM culture	This sub-activity is based on input from the "Perform environment analysis" activity

Table 21: Activity table of PDD of sub-activities 8 and 9

Concept	Description of concept	Cardinalities
ENVIRONMENT ANALYSIS OVERVIEW	The environment analysis analyzes two different components: the organizational culture and KM activities within an organization.	• There is only one PLAN TO CULTIVATE A WIKI CULTURE, but it is possible to have one or more overviews of environment analyses (concept: ENVIRONMENT ANALYSIS OVERVIEW). • It is possible to have one or more culture types (concept: CULTURE TYPE), and it is possible to have one or more overview of environment analyses (concept: ENVIRONMENT ANALYSIS OVERVIEW).
CULTURE TYPE	Based on the results of the six related sub-activities, one culture type will be established.	• There is only one PLAN TO CULTIVATE A WIKI CULTURE, but it is possible to have one or more culture types in this plan (concept: CULTURE TYPE). • It is possible to have one or more inputs of the environment overview (concept: INPUT ENVIRONMENT ANALYSIS OVERVIEW), and it is possible to have one or more culture types (concept: CULTURE TYPE). • See concept: ENVIRONMENT ANALYSIS OVERVIEW.
INPUT ENVIRONMENT ANALYSIS OVERVIEW	Apart from the culture type, other important input will be captured in one report.	• There is only one PLAN TO CULTIVATE A WIKI CULTURE, but this plan can have one or more inputs of the overview of

		the environment (concept: INPUT ENVIRONMENT ANALYSIS OVERVIEW). • See CULTURE TYPE.
OVERVIEW OF KM ACTIVITIES OF ORGANIZATION	The result of the KM assessment is an overview of the organization's KM activities.	There is only one OVERVIEW OF KM ACTIVITIES OF ORGANIZATION, and one PLAN TO CULTIVATE A WIKI CULTURE.
PLAN TO CULTIVATE A WIKI CULTURE	At the end, based on all input, a plan to cultivate a wiki culture could be produced. Note: in the proposed design this concept is related to the following concepts: DOCUMENT HOW TO GET A WIKI CULTURE and WORKSHOP/INTERVIEW RESULTS.	• There is only one PLAN TO CULTIVATE A WIKI CULTURE, and only one initiation report (concept: INPUT INITIATION REPORT). • See previous concepts for the description of the cardinalities.
INPUT INITIATION REPORT	See Table 13.	See concept: PLAN TO CULTIVATE A WIKI CULTURE.

Table 22: Concept table of PDD of sub-activities 8 and 9

5.3. Module 2—content organization and flexibility

A major issue of a wiki is its loose content structure. Despite the fact that the open editing nature of wiki technology facilitates informal sharing, collaboration, and innovation creation, it also tends to produce unstructured knowledge content. This essentially results in difficulties in navigation and querying, as well as in the insertion and retrieval of useful information. However, enforcing a strict information structure is also not desirable, since it limits creativity and collaboration capabilities (Lykourentzou et al., 2011).

This second module focuses on the content per knowledge field, and it aims to create a wiki page that is suitable for the target group. The sub-activities of this module are based on the study by Haake, Lukosch, and Schümmer (2005), which is about the concept of wiki templates that allow users to determine the structure and appearance of a wiki page. The idea of this approach is to offer the possibility to customize each page. See Figure 48 for the overview of all the sub-activities and selected method fragments.

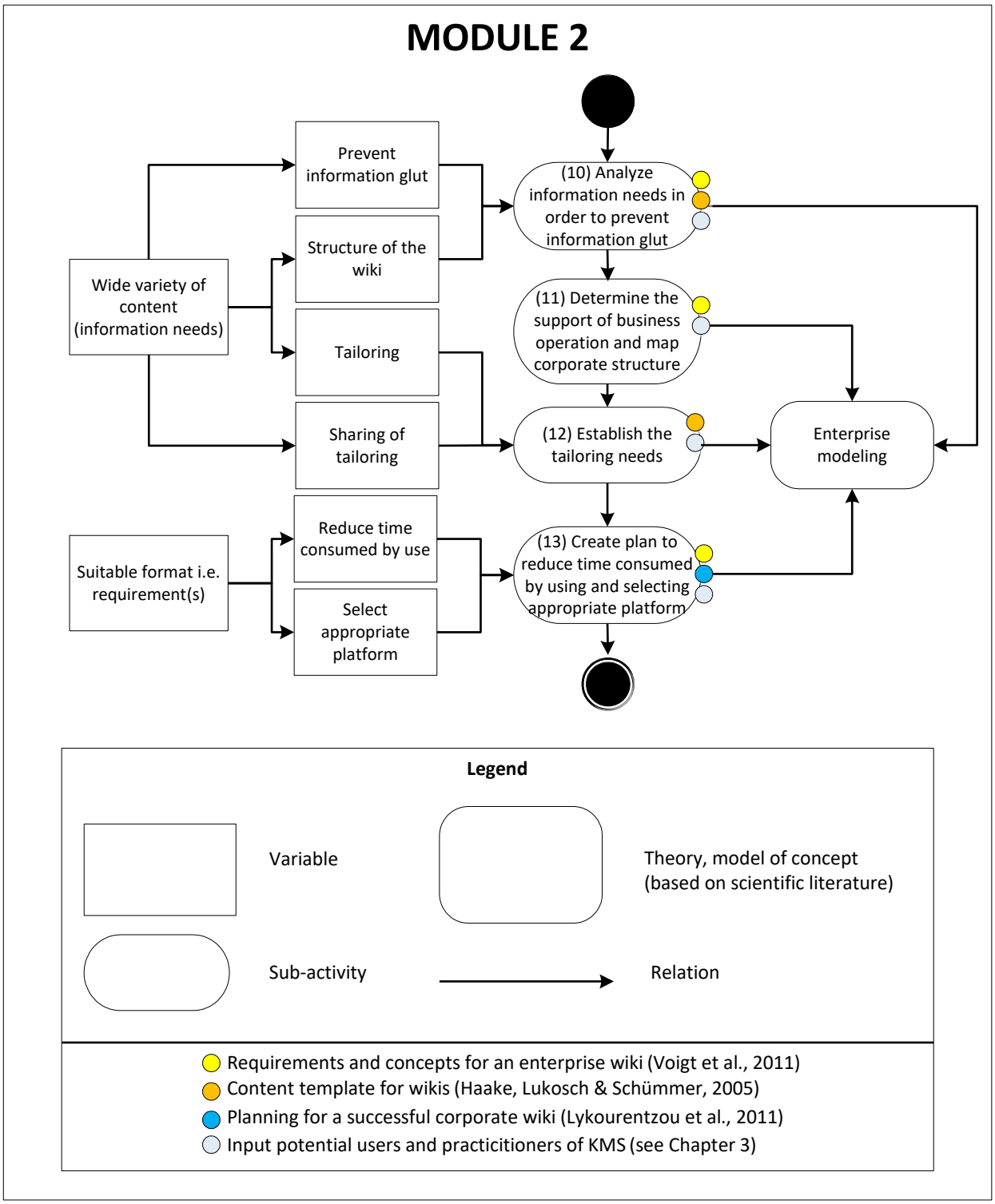

Figure 48: Overview of sub-activities of MODULE 2

5.3.1. Enterprise Modeling—selection and analysis of the method fragments

Employees have to deal with a vast amount of information, which they constantly filter for relevance. For example, common problems within several organizations are email inboxes full of irrelevant information and attempts to find relevant information on the Intranet. In this sense, a wiki is another information medium that could lead to another source of potential information flows. Voigt et al. (2011) executed a survey, which concluded that potential information glut can be identified as a

serious barrier to the implementation of Web 2.0 applications within organizations. A system that uses Wiki technology can be considered to be a Web 2.0 application. Therefore, it is imperative that an IS with Wiki technology supplies information based on the need of the users; i.e., it achieves a balance between having an up-to-date wiki on the one hand and simply another vast source of information on the other hand. See Figure 49 for sub-activities 10 and 11.

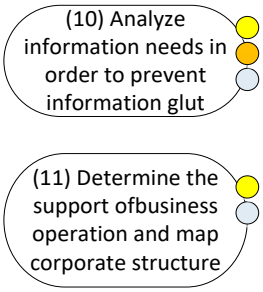

Figure 49: Sub-activities 10 and 11—structure of the wiki

The main idea of sub-activity 10 is to prevent information glut. Voigt et al. (2011) created a wiki engine to compile the requirements for a wiki knowledge and collaboration platform. To prevent information glut, the following features will be deemed relevant (for integration into wiki engine ICKwiki): the structure of the organization; a graphical representation of the most important (knowledge) domains; and (automatic) linking of information objects, connected by metadata and automatic listing. Since the structure is one of the major factors, we add some elements from the study by Haake, Lukosch, and Schümmer (2005), which is about wiki templates that allow users to determine the structure and appearance of a wiki page. Therefore, the following requirements are established: structure, readability, safety regarding unintended changes, tailoring, and sharing of tailoring. The last two requirements will be discussed in sub-activity 12 because they are more relevant to personal preferences than to general IS requirements.

The first requirement is to define the structure. Users will create a wiki template to represent structural patterns for organizing their content. For this purpose, the user identifies types or entities, and he/she models the attributes thereof. This action is comparable to identifying classes and attributes in an object-oriented analysis. Second, maintaining the readability involves securing a well-arranged wiki; i.e., retaining the readability of the system. There are two options for returning the fields of a page: (1) view methods return the field's content either in a formatted or in a plain text representation or (2) manipulation methods return the input fields in which the authors can specify content (Voigt et al., 2011). The final requirement is safety—to prevent unintended structural changes to the document. Here, users are presented with the input field of the created structure, and to prevent unintended changes, they are only allowed to change the content of a wiki page; if they want to change the structure, they must edit the wiki template. To accommodate the above-mentioned goals and objectives, a model must be capable of providing various information elements to its users, such as answers to the following questions: what types of activities comprise the process, who performs these activities, when and where are these activities performed, how and why are they executed, and what kinds of data elements or information are manipulated? To answer these questions, modeling techniques can be used. These techniques differ in the extent to which their constructs highlight the information that answers these questions. Giaglis (2001) established the following so-called process

perspectives: (i) the functional perspective (represents the process elements/activities that are being performed), (ii) the behavioral perspective (represents when and the sequence in which activities are performed), (iii) the organizational perspective (represents where and by whom activities are performed, the communication mechanism, media, and storage location), and (iv) the information perspective (represents both the informational entities/data that a process produces or manipulates and their relationships.

Continuing with sub-activity 11, which is about gaining further understanding of a wiki's contribution to business purposes so that users have insight into the value of the system. The users must see the utility of the IS integration; therefore, it is important to gain insight into how a wiki or certain wiki page could support specific business operations. Apart from creating an overview with information regarding how a knowledge page could support certain business operations, information about the communication and negotiating roles is vital. The lack of effective communication is one of the chief barriers to collaboration (Naismith, Lee & Pilkington, 2011).

5.3.2. Enterprise Modeling—selection and analysis of the method fragments

Figure 50 illustrates a PDD of sub-activities 10 and 11, and it is supported by explanation tables of the (sub-)activities and concepts in Table 23 and Table 24.

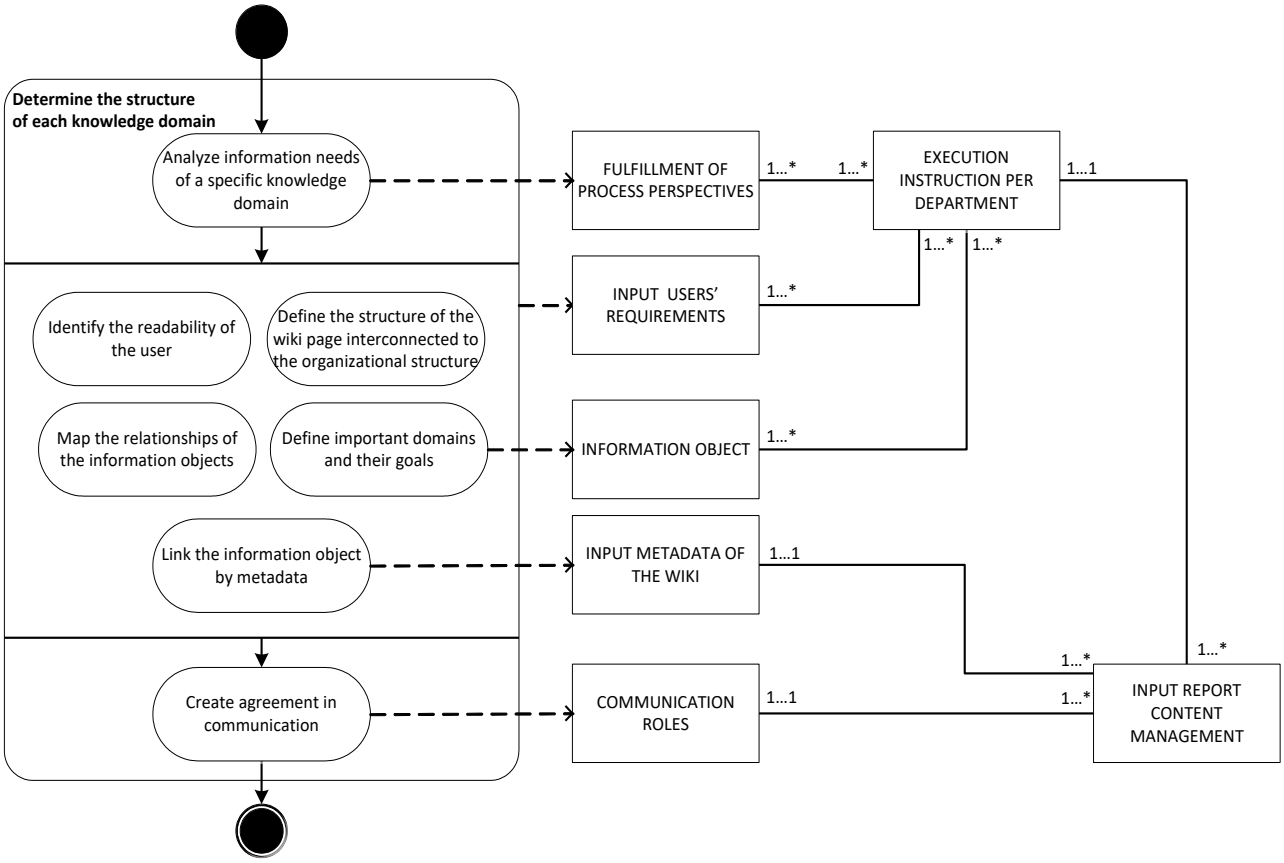

Figure 50: The PDD of sub-activities 10 and 11—structure of the wiki

Activity	Sub-activity	Description of (sub-)activity
Determine the structure of each knowledge domain	Analyze information needs of a specific knowledge domain	To retain the content flexibility and still take into account the user's need per domain (i.e., per wiki page/domain), we will establish the information needs per domain. This sub-activity is an iterative process and is interconnected with the concept of USERS' REQUIREMENTS mentioned in module 1.
	Identify the readability of the user	Within organizations with a wide variety of specialism and experts, the needs hence the representation of the content differ. For example, technical personnel require a platform to share their knowledge to external parties. Their knowledge consists of real case experience supported by graphical elements (such as pictures and technical drawings). Another example is an advisor who requires an overview of the regulations and guidelines of a project plan. This information consists of standardized elements that can be combined and extracted from the system. Therefore, we need to determine the readability per knowledge domain.
	Define the structure of the wiki page interconnected to the organizational structure	Despite each knowledge domain having its own structure, goals, and users, it is imperative to connect the information objects to the organizational structure. At the end, the knowledge domains are connected and part of one wiki network.
	Map the relationships of the information objects	To conserve the findability of the information object, one large network should be created, rather than individual wikis.
	Define important domains and their goals	Also, in the context of retaining the findability, it is crucial to define and establish the important organizational domains and their goals and target groups.
	Link the information object by metadata	Another important sub-activity that impacts the findability and accessibility of wiki content is to link the information object by metadata. Without this sub-activity, there is a risk of some knowledge domains becoming untraceable and therefore useless.
	Create agreement in communication	Lack of communication is a chief barrier in collaboration; therefore, it is important to deliberate a communication agreement. In this agreement, not only are the connection between wiki content and business operations made, but also the roles of all people who are involved in the process, for example the users, admin, or project team of a certain knowledge page.

Table 23: Activity table of PDD of sub-activities 10 and 11

Concept	Description of concept	Cardinalities
EXECUTION INSTRUCTION PER DEPARTMENT	At the end of this activity, a personalized instruction/report per department or knowledge domain will be generated.	• It is possible to have one or more fulfillments of the process perspectives (concept: FULFILLMENT OF PROCESS PERSPECTIVES), and there are one or more execution instructions per department (concept: EXECUTION INSTRUCTION PER DEPARTMENT). • The execution instruction per department can have one or more inputs of the users' requirements (concept: FULFILLMENT OF PROCESS PERSPECTIVES), and there are one or more execution instructions per department (concept: EXECUTION INSTRUCTION PER DEPARTMENT). • It is possible to have one or more information objects (concept: INFORMATION OBJECT), and it is possible to have one or more execution instructions (concept: EXECUTION INSTRUCTION PER DEPARTMENT). • There is only one planning report content management (concept: INPUT REPORT CONTENT MANAGEMENT), and it is possible to have one or more execution instructions per department (concept: EXECUTION INSTRUCTION PER DEPARTMENT).
FULFILLMENT OF PROCESS PERSPECTIVES	This concept provides more understanding about the process perspectives (input for the USERS' REQUIREMENTS, module 1).	See concept: EXECUTION INSTRUCTION PER DEPARTMENT.
INPUT USERS' REQUIREMENTS	This concept is a replenishment of the USERS' REQUIREMENTS mentioned in module 1. The aim of this concept is to provide further understanding of the process perspectives, users' needs per knowledge domain, and information objects and their goals and relationship. Note: in the proposed design this concept is related to the	See concept: EXECUTION INSTRUCTION PER DEPARTMENT.

	following concepts: OVERVIEW INFORMATION NEEDS AND REQUIREMENTS and INPUT LIST OF REQUIREMENTS.	
INFORMATION OBJECT	Each knowledge domain could consist of multiple information objects (with each being another goal). For the sake of clarity, it is necessary to identify all these information objects beforehand.	See concept: EXECUTION INSTRUCTION PER DEPARTMENT.
INPUT METADATA OF THE WIKI	The sub-activity "link the information object by metadata" results in new input relations for the metadata of the whole wiki. Note: in the proposed design this concept is called: ANALYSIS INFORMATION STRUCTURE OF ORGANIZATION.	There is only one report content management (concept: INPUT REPORT CONTENT MANAGEMENT), but this report can have one or more inputs of metadata of the wiki (concept: INPUT METADATA OF THE WIKI).
COMMUNICATION ROLES	In an agreement, a short report containing the communication roles is established. It specifies who is responsible for specific communication actions, and also serves to update the responsibilities of stakeholders/people who are involved.	It is possible to have one or more descriptions of the communication roles (concept: COMMUNICATION ROLES), but there is only one report content management (concept: INPUT REPORT CONTENT MANAGEMENT).
INPUT REPORT CONTENT MANAGEMENT	The concept INPUT REPORT CONTENT MANAGEMENT is a collection of inputs of MODULE 2.	See previous concepts for the description of the cardinalities.

Table 24: Concept table of PDD of sub-activities 10 and 11

5.3.3. Concept for providing a suitable format—selection and analysis of the method fragments

One problem that could arise when using a structured representation of information is that the structure may be too inflexible. This occurs particularly in creative contexts, where the problem domain is hazy and not (always) well understood. For this reason, we need to create a format that is clear, understandable, and easy to implement on the one hand, and that offers users enough freedom on the other hand. Sub-activities 12 and 13 (see Figure 51) aim to provide a suitable format for users.

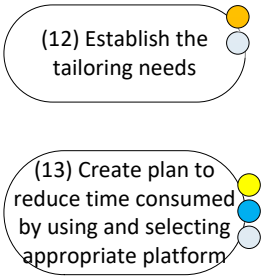

Figure 51: Sub-activities 12 and 13—provide a suitable format

Tailoring needs

Sub-activity 11 consists of two elements: (1) tailoring and (2) sharing of tailoring. Tailoring refers to the fact that users should be free to employ different content structures when desirable. Haake, Lukosch, and Schümmer (2005) state, "In cases where the users feel the need to create a new structure, they should be able to add this structure as a tailoring to the wiki in order to reuse it later on." In this same research, they argue that users should have the possibility to tailor the structure parallel to the editing process. It is important that users are constantly encouraged to reflect on emerging structures. Haake, Lukosch, and Schümmer (2005) identified template evolution as an important aspect when allowing authors to change the structure/template at runtime. Sharing of tailoring refers to the ability to share each structure with others.

Reduce the time it takes to use and select the appropriate platform

With regard to sub-activity 12, "Create plan to reduce time consumed by using and selecting appropriate platform," Voigt et al. (2011) identified two important, similar barriers: the platform is too time consuming, and it distracts employees from their actual work, which can lead to stress or higher workload. For this purpose, there is a need to counter these barriers to establish an application that integrates applications into an operation to such an extent that no additional stress is produced. This can be achieved by creating a tool that is easy to use and that demands hardly any additional time. Another step towards a successful wiki implementation involves selecting a platform that is most suitable for the users' needs. The following issues must be taken into account to facilitate this selection: (i) the level of complexity, (ii) structural support, (iii) quality assurance, and (iv) and workspace awareness provided by the platform (Hasan & Pfaff 2006; Lykourentzou et al., 2011).

In addition, simplicity and customization are other important elements for the selection of a wiki platform. Simplicity refers to the selection of the simplest possible wiki platform, which still meets the users' requirements. The idea is that a simple, core platform can later be extended to include the exact additional functionalities that the organization needs. Lykourentzou et al. (2011) state that "many organizations seem to prefer selecting a simple, usually open-source platform and to customize it to fit the needs of their own enterprise setting, rather than using a ready-to-use solution." An example of a typical customization process is extending a core wiki platform to support more complex file formats, compared to simple text, such as tables, spreadsheets, executable code, as well as enterprise simulation models. Also, according to Richter and Koch (2008), "Our biggest lesson learned of this project was: A platform cannot be simple enough."

5.2.2. Concept of providing a suitable format—selection and concatenation of the useful method fragments.

Figure 52 provides a PDD of sub-activities 12 and 13, supported by an explanation of the activities and concepts in Table 25 and Table 26.

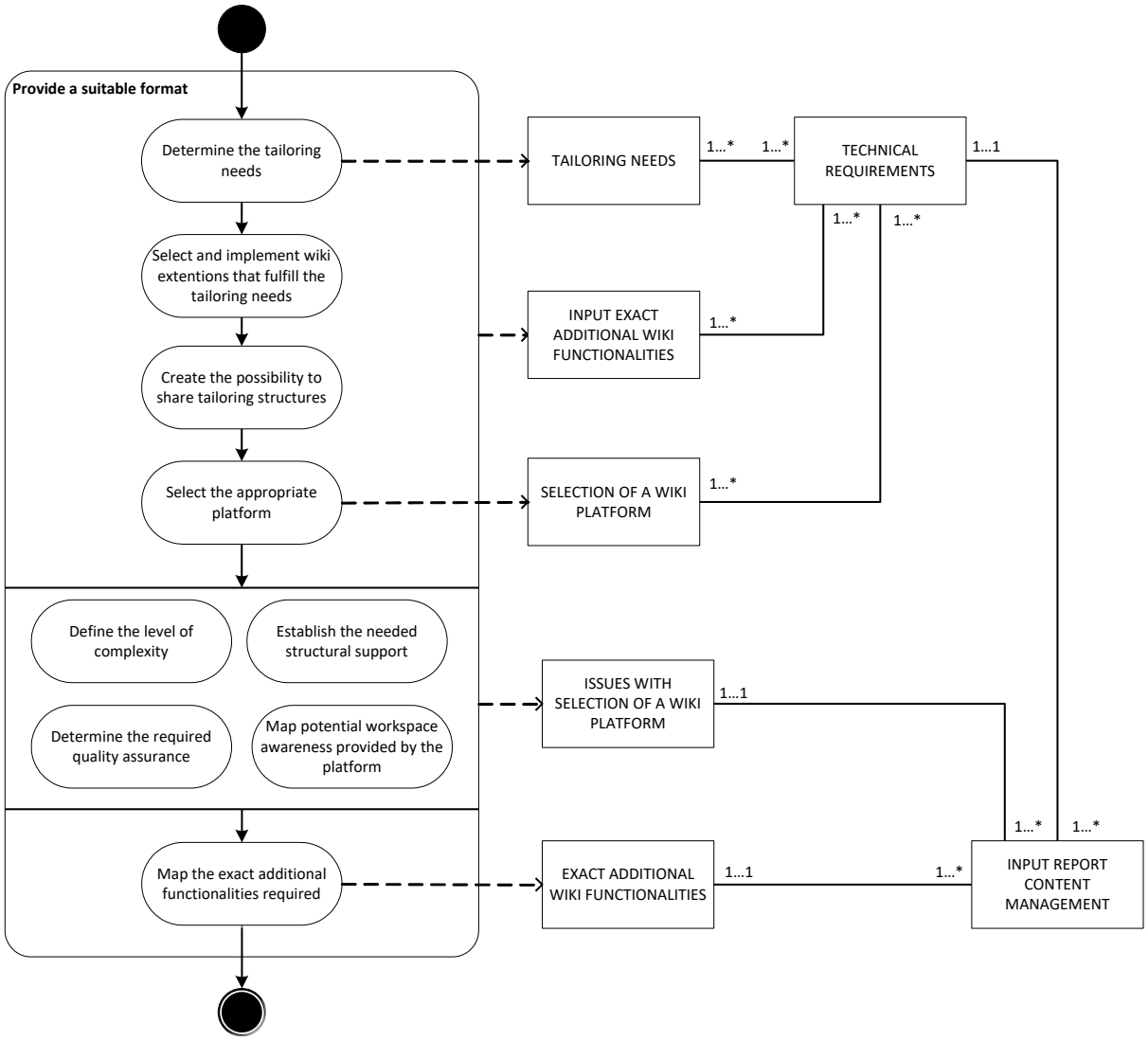

Figure 52: The PDD of sub-activities 12 and 13—provide a suitable format

Activity	Sub-activity	Description (sub-)activity
Provide a suitable format	Determine the tailoring needs	This sub-activity is part of the content of the concept TECHNICAL REQUIREMENTS. Through this sub-activity, we would like to assess the need for freedom versus structure in the structure of a knowledge page. It is possible that each type of user has different tailoring needs.
	Select and implement wiki extensions that fulfill the tailoring needs	Based on the previous sub-activity, a selection of possible wiki extensions must be analyzed, and later on, one or multiple extensions must be implemented into the IS system.

	Create the possibility to share tailoring structures	This depends on the tailoring needs of the users. However, as an organization, it is possible to provide two options, such as creating the structure with free templates and fixed ones.
	Select the appropriate platform	Before selecting the most suitable platform, one needs to analyze and establish the level of complexity, structural support, quality assurance, and workplace awareness (see subsequent four sub-activities).
	Define the level of complexity	This refers to the level of complexity that the platform provides. Based on previous input, the required level of complexity must be considered.
	Establish the required structural support	In this sub-activity, the following questions are asked: What kind of structural support is desirable? Is a page dedicated to FAQs enough, or do users need a notification/information button per knowledge page or even per information object?
	Determine the required quality assurance	For organizations, it is important to have a KMS with reliable and current information as well as personal experiences. The latter type of information could be more subjective. An idea is to "mark" each information object with some indication of the level of quality assurance—for example, "not verified" or "verified by expert."
	Map potential workspace awareness provided by the platform	This sub-activity maps the information object to certain projects or business operations so that workplace awareness will be created.
	Map the exact additional functionalities required	As mentioned before, it is better to start with a platform that is as simple as possible, and later on, add exact wiki functionalities based on the needs of the users.

Table 25: Activity table of PDD of sub-activities 12 and 13

Concepts	Description concepts	Cardinalities
TECHNICAL REQUIREMENTS	The TECHNICAL REQUIREMENTS concept is basically a report with all the input of the sub-activities related to the "Provide a suitable format" activity. Based on this report, the project team could establish and implement the required technical requirements.	• It is possible to have one or more overviews of the TAILORING NEEDS and there are one or more overviews of the TECHNICAL REQUIREMENTS. • It is possible to have one or more input of the exact additional wiki functionalities (concept: INPUT EXACT ADDITIONAL WIKI FUNCTIONALITIES), and it is possible to have one or more overviews of the TECHNICAL REQUIREMENTS. • It is possible to have one or more selections of a wiki platform (concept:

		SELECTION OF A WIKI PLATFORM), and it is possible to have one or more overviews of the TECHNICAL REQUIREMENTS. • There is only one report content management (concept: INPUT REPORT CONTENT MANAGEMENT), and this report can have one or more overviews of the TECHNICAL REQUIREMENTS.
TAILORING NEEDS	There are many possibilities for structuring the content of a wiki; for example, by providing a high degree of freedom versus a fixed format. The project team must establish the degree of freedom/structure that is desirable.	See concept: TECHNICAL REQUIREMENTS.
INPUT EXACT ADDITIONAL WIKI FUNCTIONALITIES	The first input for additional wiki functionalities will be identified during the first four sub-activities of the following activity: "Provide a suitable format." Note: in the proposed design this concept is a part of concept: OVERVIEW AVAILABLE PLATFORM SUPPLIERS.	See concept: TECHNICAL REQUIREMENTS.
SELECTION OF A WIKI PLATFORM	Based on the input of the ISSUES WITH SELECTION OF A WIKI PLATFORM, the SELECTION OF A WIKI PLATFORM will be performed.	See concept: TECHNICAL REQUIREMENTS.
ISSUES WITH SELECTION OF A WIKI PLATFORM	The concept of ISSUES WITH SELECTION OF A WIKI PLATFORM is a result of an analysis of the identified issues during the platform selection process.	It is possible to have one or more ISSUES WITH SELECTION OF A WIKI PLATFORM, but there is only one report content management (concept: INPUT REPORT CONTENT MANAGEMENT).
EXACT ADDITIONAL WIKI FUNCTIONALITIES	Based on additional input, it is possible to establish specific needs to implement EXACT ADDITIONAL WIKI FUNCTIONALITIES within a wiki.	It is possible to have one or more EXACT ADDITIONAL WIKI FUNCTIONALITIES, but there is only one report content management (concept: INPUT REPORT CONTENT MANAGEMENT).
INPUT REPORT CONTENT MANAGEMENT	See Table 24.	See previous concepts for the description of the cardinalities.

Table 26: Concept table of PDD of sub-activities 12 and 13

5.4. MODULE 3—positioning a wiki in an existing information ecology

MODULE 3 (see Figure 53) involves the integration of the wiki into an organization. This integration process focuses on the participations and uncertainties, the existing information ecology, and the wiki's maintenance for quality.

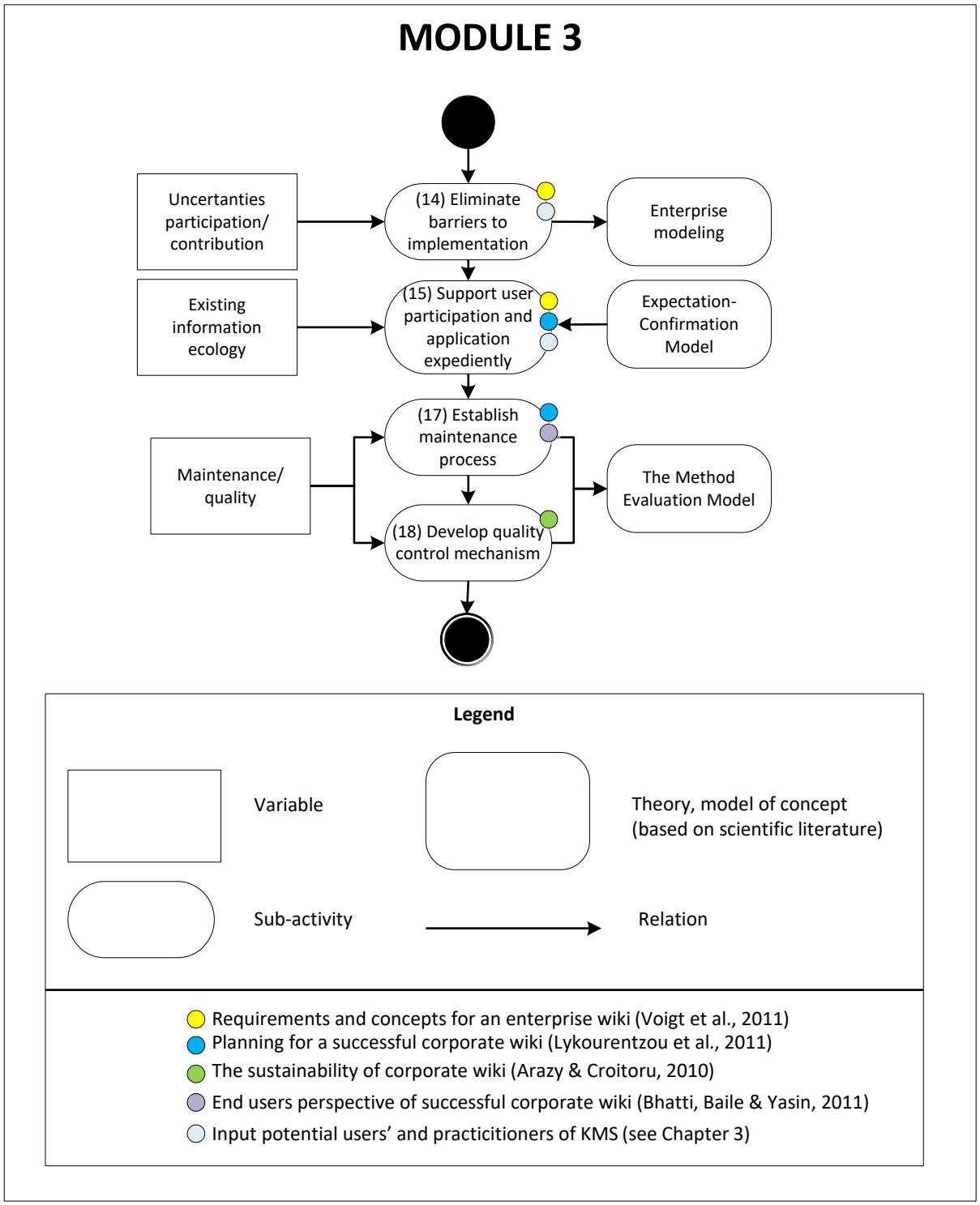

Figure 53: Overview sub-activities of MODULE 3

5.4.1. Concept of eliminating barriers—selection and analysis of the method fragments

In the previous modules, we established an effective wiki sharing culture inside the organization, and we also selected the wiki platform that best suits the organizational needs. The next step in a successful wiki implementation is to ensure satisfactory user participation and the quality of information (Lykourentzou et al., 2011) by eliminating barriers. The barriers to Web 2.0 application are mainly related to economic and organizational culture contexts—for example, preventing information glut (mentioned in module 2) and establishing benefits of the stakeholders (MODULE 1).

According to Voigt et al. (2011), "The applications must be easy to use (time-saving) and may not constitute an additional information glut. Instead their use must replace or consolidate information and communication channels." Based on this, clear requirements for a corporate wiki can be derived. These technical and non-technical requirements are already established in modules 1 and 2. See Figure 54 for a depiction of sub-activities 14 and 15.

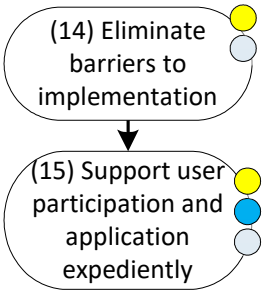

Figure 54: Sub-activities 14 and 15—participation, contribution, and uncertainties

Eliminate barriers to implementation and support participation

Since sub-activities 14 and 15 are interconnected, they will be discussed as one. The analyses in previous modules are intended to reduce existing barriers to implementation. Voigt et al. (2011) provided examples of barrier elimination: performing a management game that facilitates active assessment of work with the wiki or a role playing game to increase the understanding of other colleagues' work and operations.

Furthermore, supporting communication also contributes to eliminating existing barriers. Other activities to reduce the barriers include management training, identification of postulated benefits, short references to the wiki with the most important functions, or wiki posters for internal marketing. In addition, Lykourentzou et al. (2011) mentioned that support of user participation influences a successful wiki implementation. To obtain such user participation, two activities must be executed: (1) effectively train the users and (2) pre-populate the wiki with already existing corporate content. User training is reported to be a highly significant factor for a successful wiki, and the guidance regarding such training should consist of both cultural and technological aspects.

On the one hand, the aim of the cultural aspect is to introduce potential wiki users to the knowledge-sharing culture so that they will be motivated to share their experiences and ideas with colleagues, thereby resulting in an open environment. This type of environment is necessary for the wiki platform

to create value for the organization. On the other hand, the technical aspect aims to familiarize users with the use of the system itself. It introduces the user to the interface of the system and its different functionalities, such as the navigation mechanisms or the content development syntax. These trainings can be performed both prior to the launch of the wiki, through introductory sessions and workshops, and during its use, through the provision of guidelines, help pages, and training areas.

Pre-populating the wiki is the next activity to achieve a successful implementation. Users are less likely to see future value in and thus contribute to an entirely blank knowledge page on the wiki; therefore, it is necessary to provide some examples. The content for the pre-population can be retrieved from various sources that are potentially used within the organization, such as e-mail, Intranets, documentation databases, or discussion platforms (Yammer). Lykourentzou et al. (2011) state that wikis or other Web 2.0 applications only reveal their true value when their strengths are combined and integrated. A prime example of this is a wiki that is not only used to collect organizational content, but that also simultaneously facilitates employee social networking, which can be supported by social media platforms (Yammer or LinkedIn).

In addition, it is important to support synchronous communication about content (such as instant messaging) when possible. Kittur, Suh, and Chi (2008) enumerate a number of risks associated with the use of Wikipedia:

1. Accuracy—it is difficult to distinguish accurate content from inaccurate content, which is often aggravated by a lack of references;
2. Motives—the motives of the authors are unknown, and risks such as subjectivity could appear;
3. Expertise—the expertise field and level of expertise of an author is unknown;
4. Stability—the stability of an article and how much it has changed since the last viewing is unknown;
5. Coverage—this risk refers to the coverage of the topics of a wiki's content in general;
6. Sources—the cited articles on the knowledge pages may originate from hidden or non-independent sources.

5.4.2. Concept of eliminating barriers—selection and concatenation of the useful method fragments

Figure 55 presents a PDD with the method fragments related to sub-activities 14 and 15. This is followed by description tables (see Table 27 and Table 28).

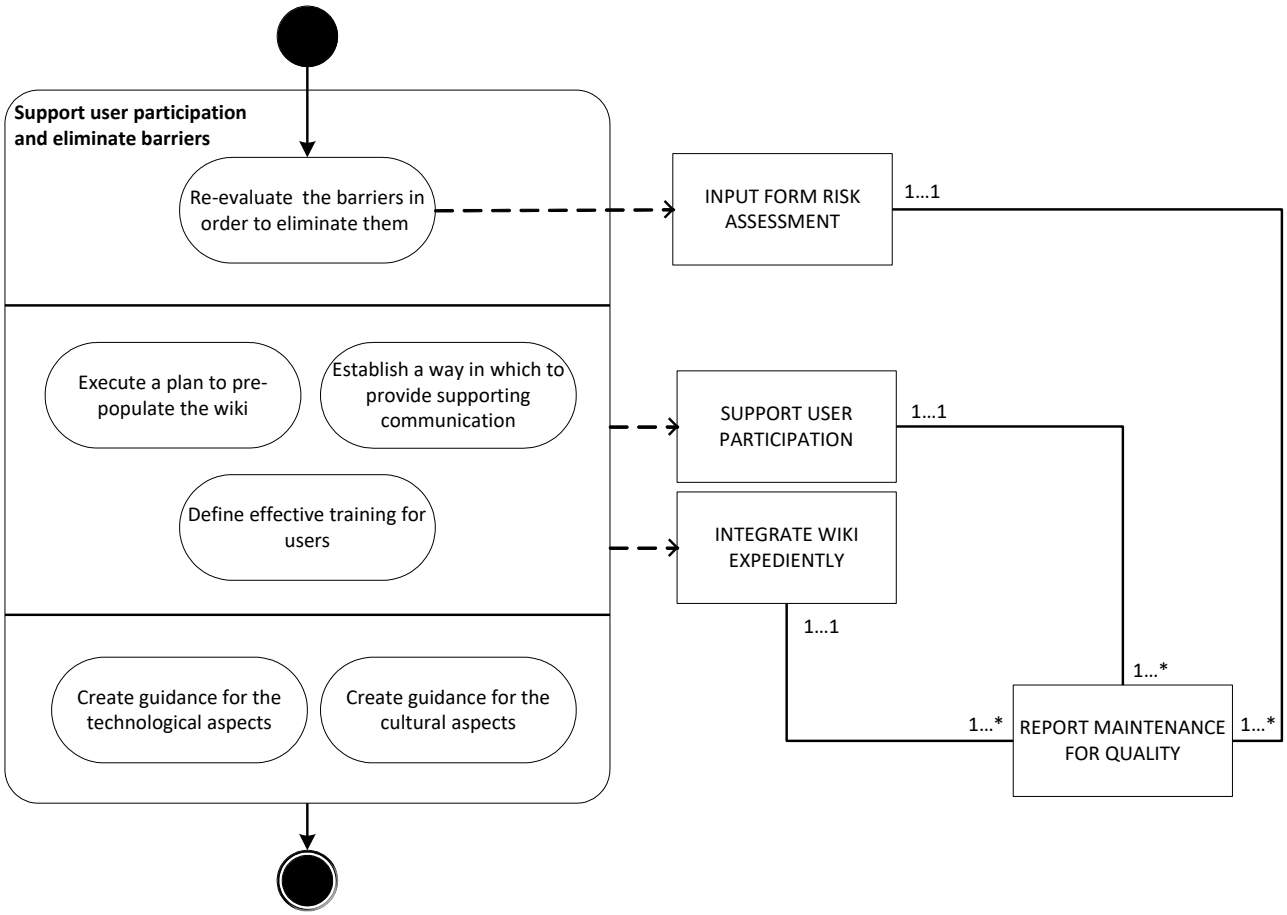

Figure 55: The PDD of sub-activities 14 and 15—participation, contribution, and uncertainties

Activity	Sub-activity	Description of (sub-)activity
Support user participation and eliminate barriers	Re-evaluate the barriers in order to eliminate them	In MODULE 1, the first barriers are established. During this sub-activity, these barriers will be revised, and new barriers will identified.
	Execute a plan to pre-populate the wiki	During this sub-activity, the already existing relevant content must be mapped (dedicated to a specific knowledge page).
	Establish a way in which to provide supporting communication	In cooperation with a communication advisor or department, a communication plan for a specific knowledge page must be created and implemented.
	Define effective training for users	Cultural as well as technical training must be conducted.
	Create guidance for the technological aspects	Before starting and while using the wiki, user must be provided with some instruction to effectively and efficiently using the wiki.
	Create guidance for the cultural aspects	Since the human factor is crucial to the implementation of IS integrations, extra attention to the cultural aspect is important for successful implementation.

Table 27: Activity table of PDD of sub-activities 14 and 15

Concept	Description of concept	Cardinalities
INPUT FROM RISK ASSESSMENT	In MODULE 1, we already begin by performing a RISK ASSESSMENT. However, since this is an iterative process, existing risks will be revised, and new risks will arise.	There is only one report maintenance for quality (concept: INPUT REPORT MAINTENANCE FOR QUALITY), but it is possible to have one or more inputs from risk assessments (concept: INPUT FROM RISK ASSESSMENT) in this report.
SUPPORT USER PARTICIPATION	Eliminating barriers supports user participation. The results of the following sub-activities: "Execute a plan to pre-populate the wiki," "Establish a way in which to provide supporting communication," and "Define effective training for the users", provided an overview how to support user participation.	It is possible to have one or more supports for user participation (concept: SUPPORT USER PARTICIPATION), but there is only one report maintenance for quality (concept: INPUT REPORT MAINTENANCE FOR QUALITY)
INTEGRATE WIKI EXPEDIENTLY	This concept is concerned how to integrate the wiki expediently.	There is only one report maintenance for quality (concept: INPUT REPORT MAINTENANCE FOR QUALITY), but it is possible to have one or more results of INTEGRATE WIKI EXPEDIENTLY.
INPUT REPORT MAINTENANCE FOR QUALITY	The concept INPUT REPORT MAINTENANCE FOR QUALITY is a collection of inputs of MODULE 3.	See previous concepts for the description of the cardinalities.

Table 28: Concept table of PDD of sub-activities 14 and 15

5.4.3. Confirm or disconfirm—selection and analysis of the method fragments

The aim of this part of MODULE 3 is to gain further understanding of how to use wikis to achieve an efficient, effective and improved so-called end-user performance. This is also helpful for organizations in the wiki development industry to improve their products, keeping in mind the perception of wiki users. Therefore, sub-activities 17 and 18 (see Figure 56) aim to ensure the information quality of an IS system. We start with the constructs and items of the confirmation part of the ECM to confirm or disconfirm the users' expectancy, which was established in MODULE 1 of our approach. Furthermore, we will use elements from total data quality management (TDQM) to create a quality control mechanism to ensure a high quality of information.

Generally speaking, the purpose of TDQM is to deliver high-quality information to customers, and it aims to facilitate the implementation of an organization's overall data quality policy, formally expressed by top management. To achieve such high quality, the TDQM cycle defines, measures, analyzes, and improves information quality continuously; this is essential to ensure high-quality information products (Wang, 1998).

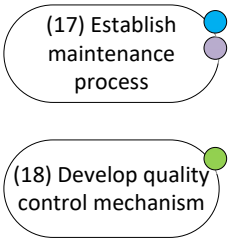

Figure 56: Sub-activities 17 and 18—confirm or disconfirm users' expectations

In MODULE 1 (see sub-activities 4 and 5), the users expectations of the following aspects are assessed:

- Condition of support;
- Perceived ease of use;
- Perceived enjoyment,
- Perceived service quality;
- Perceived security;
- Perceived playfulness;
- User interface.

"The measurement of IS success or effectiveness is critical to our understanding of the value and efficacy of IS management actions and IS investments" (Delone & McLean, 2003).

Since each element is already discussed in Chapter 5.2., we continue with the questionnaires. Note that we dismiss the redundant elements, as we did in Chapter 5.2. Table 29 illustrates the constructs and items from Bhattacherjee's (2001) study. The ECT can serve as a useful theoretical framework for explaining IS continuance behaviors. Table 30 illustrates the extension conditions of support adopted from the study by Halilovic and Cicic (2013).

Construct	Items
Information system continuance intention	INT1: My intention is to continue using [x] before I discontinue its use.
	INT2: My intention is to continue using [x] rather than any alternative means.
	INT3: If I could, I would discontinue use of [x].
Satisfaction	What was your general experience related to the use of [x]?
	SAT1: Very dissatisfied/very satisfied.
	SAT2: Very displeased/very pleased.
	SAT3: Very frustrated/very content.
	SAT4: Absolutely terrible/absolutely delighted.
Perceived usefulness	PU1: With [x], I will improve my job performance.
	PU2: With [x], I will increase my productivity at work.
	PU3: With [x], I am more efficient in my job.
	PU4: All together, I find [x]useful for my job.
Confirmation	CON1: My experience with the use of [x] has been better than expected.
	CON2: The functional properties of [x] are better than expected.
	CON3: All together, most of my expectations related to the use of [x] were confirmed.

Table 29: The ECT extended with IS continuance, Bhattacherjee (2001)

Construct	Item
Conditions of support	SUP1: There is a competent person (or group) I can address when I have difficulties in using [x].
	SUP2: I can establish a relationship with [x] supporting personnel related to my problems.
	SUP3: The [x] team adds new functions and advances existing opinions.
	SUP4: [x] is capable of adjusting or updating the software whenever the legislation related to [y] operations is amended.

Table 30: The ECT extended based on the study by Halilovic and Cicic (2013)

Table 31 provides the constructs and items based on the study by Thong, Hong, and Tam (2006). The aim of this study was to expand the set of post-adoption beliefs in the ECM in order to extend the application of the ECM beyond an instrumental focus, which incorporates the post-adoption beliefs of perceived ease of use and perceived enjoyment.

Construct	Items
Perceived ease of use	EOU1: Learning how to use [x] is easy for me.
	EOU2: My interaction with [x] is clear and understandable.
	EOU3: I find [x] easy to use.
	EOU4: It is easy for me to become skillful at using [x].
Perceived enjoyment	ENJ1: Using [x] is enjoyable.
	ENJ2: Using [x] is pleasurable.
	ENJ3: I have fun with [x].
	ENJ4: I find using [x] to be interesting.

Table 31: The constructs and items based on the study by Thong, Hong, and Tam (2006)

With regard to an extension that focuses on integrating technology readiness into the ECM for explaining individuals' continuance in the context of mobile data service usage (Chen, Liu & Lin, 2013), this extension consists of the following constructs: optimism, innovation, discomfort, and insecurity (see Table 32). This questionnaire is an assessment of a user's IS/IT usage at the moment.

Constructs	Items
Optimism	TR1: Technology makes me more efficient in my occupation.
	TR2: Technology gives me more freedom of mobility.
	TR3: Learning about technology can be as rewarding as the technology itself.
	TR4: I find new technologies to be mentally stimulating.
	TR5: I prefer to use the most advanced technology available.
Innovation	TR6: I figure out new high-tech products and services without any help.
	TR7: Others come to me for advice on new technology.
	TR8: I am among the first in my circle of friends to acquire new technology.
	TR9: I have fewer problems than others in making technology work.
	TR10: I keep up with the latest technological developments that I am interested in.
Discomfort	TR11: The manual for a high-tech product or service is hardly written in plain language.
	TR12: Technical support lines are not helpful because they do not explain things in terms that I understand.

	TR13: When getting technical support, I feel as if I am being taken advantage of by someone who knows more than me.
	TR14: I feel embarrassed when I have trouble with high-tech gadgets while people are watching.
Insecurity	TR15: I worry that the information I send over the Internet may be seen.
	TR16: It is not safe to do any kind of financial business online.
	TR17: It is not safe to give the vendor a credit card number over a computer.
	TR18: I do not feel confident doing business with a place that can only be reached online.

Table 32: The ECM for continuance in the context of mobile data service usage (Chen, Liu & Lin, 2013)

The study by Oghuma et al. (2016) presents a systematic approach to gaining further understanding of the user continuance intention with the following constructs: perceived service quality, perceived security, and user interface, all of which are listed in Table 33.

Construct	Items
Perceived service quality	PQ1: I feel comfortable in using the functions and services provided by the [x].
	PQ2: The [x] provides services with a sincere attitude when we face service and system problems.
	PQ3: The information provided by the [x] is accurate and reliable.
	PQ4: The [x] gives me individual attention.
	PQ5: The [x] gives me prompt services.
	PQ6: The [x] gives the right solutions to my request during service and system failures.
Perceived security	SEC1: The [x] implements security measures to protect all of its users.
	SEC2: The [x] has the ability to verify a user's identity for security purposes.
	SEC3: The [x] shows great concern for the security of any translations done via [x].
	SEC4: I feel secure using the [x] service.
User interface	UI1: Every feature and function in the [x] is easy to understand.
	UI2: The [x] is simple to use, even when using it for the first time.
	UI3: The content of [x] is organized in such a way that it makes it easy for me to know where I am when navigating it.
	UI4: The amount of information displayed in the [x] is appropriate.
	UI5: It is easy to connect to the function I need from the [x].
	UI6: It is easy to find the information I need from the [x].
	UI7: Searching and checking the information I need from the [x] is quick.
	UI8: The [x] provides accurate information and functions that I need.
	UI9: The visualization of the [x] is good.

Table 33: A systematic approach to gaining further understanding of the user continuance intention (Oghuma et al.,2016)

The study by Lin, Wu, and Tsai (2005) investigated the integration of perceived playfulness into the ECM within a web portal context. Table 34 lists this construct and its corresponding items.

Construct	Items
Perceived playfulness	PP1: When interacting with [x], I am not aware of the time as it elapses.
	PP2: When interacting with [x], I am not aware of distracting noise.
	PP3: When interacting with [x], I often forget other commitments.

Table 34: The ECT extended with perceived playfulness

5.4.4. Concept of eliminating barriers—selection and concatenation of the useful method fragments.

Figure 57 below illustrates a PDD with the elements to confirm or disconfirm user expectations. Then, Tables 35 and 36 describe the activity and concept respectively, and they provide a short explanation per (sub-)activity and concept.

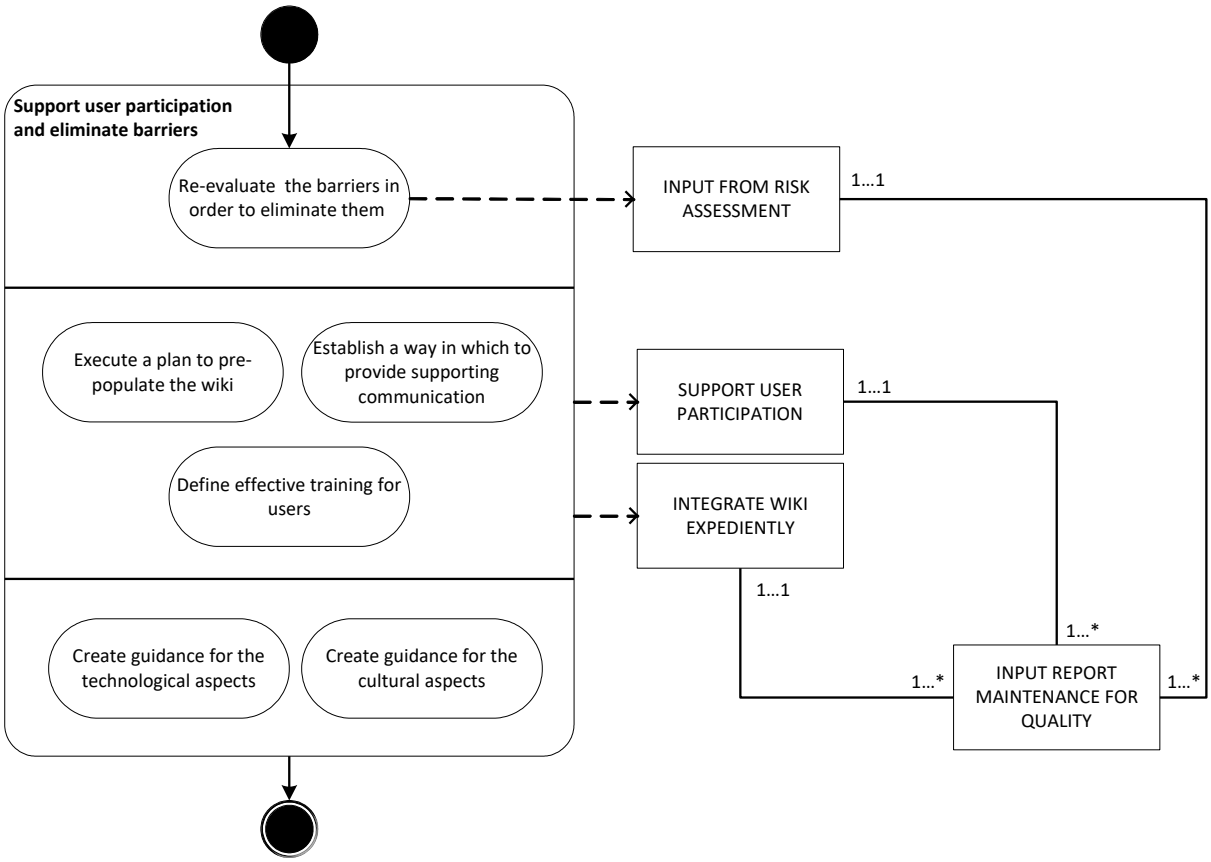

Figure 57: The PDD of sub-activities 16 and 17—confirm or disconfirm the users' expectations

Activity	Sub-activity	Description (sub-)activity
Confirm or disconfirm the users' expectations	Confirm the users' expectancy of the wiki	This sub-activity contains several statements that use a five-point Likert scale in the context of the condition of support, the ease of use, enjoyment, the quality of the system, security, playfulness, and the user interface elements.
	Establish the overall condition of support	The overall condition of support consists of four statements that use a five-point Likert scale, and it aims to measure the level of support experienced by the users.

	Assess the perceived ease of use	This sub-activity measures the perceived ease of use. This construct also consists of four statements that use a five-point Likert scale.
	Determine the perceived enjoyment per user	Perceived enjoyment measures users' experienced enjoyment while using the wiki. To measure this level of enjoyment, four statements are given (using a five-point Likert scale).
	Evaluate the perceived service quality of the system	The service quality of the system is more about the quality of the experience than the support (which is measured in the sub-activity "establish the overall condition of support"). This construct consists of six statements using a five-point Likert scale.
	Review the perceived security	While the security of a system is often implemented behind the screens, the perceived security is important to afford people trust in the system's safety. To assess the perceived security, four statements using a five-point Likert scale are employed.
	Assess the perceived playfulness of the users	Perceived playfulness is complementary to perceived enjoyment. It measures the experience that occurs when one plays a game—for example, "When interacting with the wiki, I am not aware of the time as it elapses." This sub-activity consists of three statements using a five-point Likert scale.
	Evaluate the user interface elements	This sub-activity is an assessment of the user interface of the wiki. It employs nine statements using a five-point Likert scale.

Table 35: Activity table of PDD of sub-activities 16 and 17

Concept	Description of concept	Cardinalities
CONFIRMATION OR DISCONFIRMATION OF EXPECTANCY	The answers to all questions of the ECM construct will result in a confirmation or disconfirmation of the expectancy of the users. Based on these answers, the wiki can be improved.	There is only one report maintenance for quality (concept: INPUT REPORT MAINTENANCE FOR QUALITY), but it is possible to have one or more results of the confirmation or disconfirmation of the expectancies (concept: CONFIRMATION OR DISCONFIRMATION OF EXPECTANCY).
ADDITIONAL CONFIRMATION ELEMENTS	We divided each ECM construct into different confirmation elements so that the organization can improve per subject. For example, the playfulness component is sufficient, whereas the user interface is insufficient.	It is possible to have one or more ADDITIONAL CONFIRMATION ELEMENTS, but there is only one report maintenance for quality (concept: INPUT REPORT MAINTENANCE FOR QUALITY).
INPUT REPORT MAINTENANCE FOR QUALITY	See Table 28.	See previous concepts for the description of the cardinalities.

Table 36: Concept table of PDD of sub-activities 16 and 17

5.5. Summary

Challenge 1—align manager and individual contributor expectations—contains the following two variables: (1) expectation of the wiki (from the stakeholder's perspective) and (2) organizational culture and style. The second challenge—content organization and flexibility—is also divided into two variables: (1) a wide variety of content, i.e., information needs, and (2) a suitable format for a wiki page. The final challenge—positioning a wiki in an existing information ecology and corporate culture—consists of three variables: (1) existing information ecology, (2) uncertainties regarding participation/contribution, and (3) maintenance quality. In the next section, we convert these challenges into three modules. The first module uses elements from the Stakeholder Theory, the ECM/ECT, Enterprise Modeling, the OCAI and the KMAI. The second module focuses on the content per knowledge field, and it aims to create a wiki page that is suitable for the target group. The sub-activities of this module are based on the study by Haake, Lukosch, and Schümmer (2005), which relates to the concept of wiki templates that allow users to determine the structure and appearance of a wiki page. Module 3 is centered around the integration of the wiki within an organization. This integration process focuses on the participations (and the uncertainties), the existing information ecology, and the wiki's maintenance for quality. Similarly, to the other two modules, this module also consists of two parts: human and technical factors. The evaluation of the approach in terms of MODULE 1, MODULE 2, and MODULE 3 is presented in chapter 6 by means of a prototype – the Wiki Support Tool.

Part III
Treatment validation

Chapter 6: The Wiki Support Tool

"Knowledge management will never work until corporations realize it's not about how you capture knowledge but how you create and leverage it."
(Etienne Wenger)

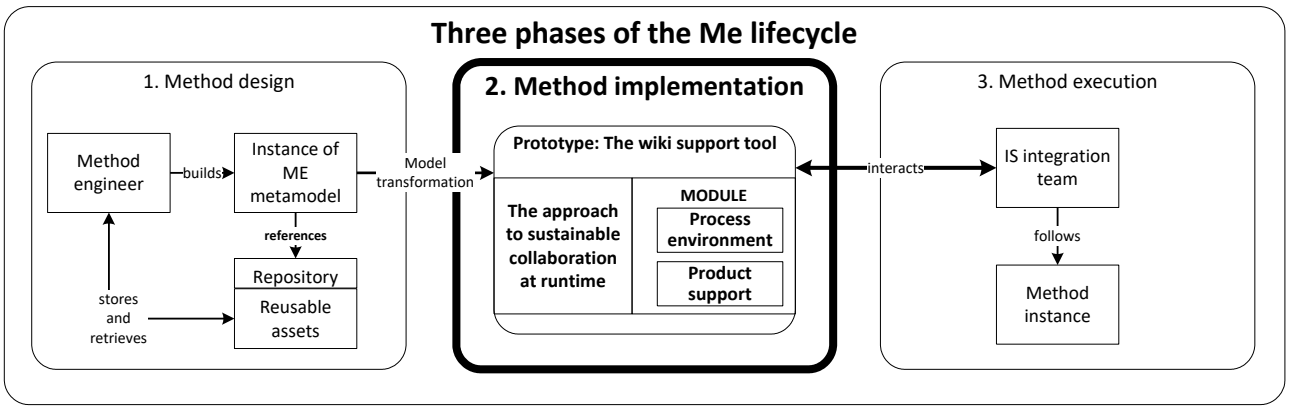

Figure 58: Method implementation, ME lifecycle

6.1. Introduction

The next step of our study is to validate our designed treatment. Here, we validate whether our method of sustainable collaboration has an effect on implementing a sustainable collaborative approach regarding stakeholders' perceptions. We will consequently answer the final research question (RQ):

What are the effects of implementing a sustainable collaborative approach regarding stakeholders' perceptions?

According to Wieringa's (2014) design science cycle, a way in which to validate the treatment is to justify the fact that the treatment would contribute to stakeholder goals when implemented in the problem context. In our case, the stakeholders are employees of a governmental organization, RWS. The goal is to implement a sustainable wiki, and the problem context of our study is RWS and its environment (such as partners, contractors, and other governmental organizations). In this chapter, we will specify and justify the requirements for the treatment, and at the end, we validate a treatment by demonstrating that it satisfies its requirements.

We also provide an example of how to use and/or implement the approach to sustainable collaboration (method implementation, see Figure 58). The validation of a treatment design is basically to justify that the approach would contribute to the stakeholders' goals if implemented. According to Wieringa (2003), validation consists of investigating the effect of the interaction between a prototype of an artifact in a problem context, and comparing these with requirements of the treatment. In this case, we created the Wiki Support Tool as validation prototype. During validation studies, the artifact prototype is exposed to different scenarios to see how it responds. In this case, we created per module different experimental tasks (see Chapter 7). In this study, the Wiki Support Tool supports the approach to sustainable collaboration, and is obtained by means of some kind of wizard environment.

The Wiki Support Tool includes a process environment as well as a product support. The process environment contains of multiple Intranet pages, and each page represents a module or a sub-module, wherein the (sub-)activities of the approach are described. The product support is a protocol per module. A protocol is a standard format in Microsoft Word or Excel, which contains specific questions or items in order to achieve the deliverables of the activities. The protocols are designed from the reusable assets that were linked to the method, concept or requirement elements during the design phase (see Chapter 5). Thus, the Wiki Support tool can be seen as a proof of concept, and its main purpose is to support the evaluation of the modules of treatment design - the approach to sustainable collaboration.

6.2. The model-driven method engineering the approach to sustainable collaboration

In chapter 3, we established that there are multiple studies on creating a sustainable collaboration; however, these studies provide general factors rather than a more practical realization. To create our approach, we used situational ME, as described in chapter 4. “The Method Engineering (ME) discipline emerged as a response to the need for methods that are better adapted to context” (Cervera et al., 2015). As mention before, we use the following definition of ME by Brinkkemper (1996): “We define model-driven ME as a paradigm for ME, where models play a key role in the design, construction, and adaptation of methods, techniques, and tools for the development of information systems.”

Over the years, researchers have commonly agreed that software development methods should be defined or adapted within a specific organization to determine whether the particular needs of the organization are met. The ME disciple intends to provide solutions to efficiently deal with the definition and adaptation of methods as well as for the construction of the supporting software tools (Cervera et al., 2012). In our case, we created an approach to sustainable collaboration. To support the design, implementation, and execution of this approach, we implement our approach in an Intranet environment: the Wiki Support Tool. The main purpose of validation research is to a design the theory behind an artifact in a context that allows us to predict what would happen if the artifact were transferred to its intended problem context (Wieringa, 2014). For this purpose, we will use a validation model that presents its targets by similarity. A validation model is used to answer questions about its targets (see Figure 59).

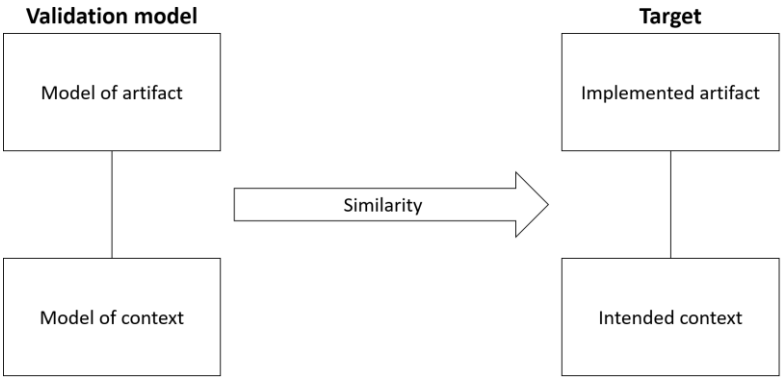

Figure 59: Artifact transferred to problem context

Our design method is a method model that involves several concepts, theories, or models (or parts thereof) founded on scientific literature. The method model specifies (among other elements) the tasks to be carried out, the people who participate in these tasks, and the products to be developed to reach the final system (Wieringa, 2014).

6.3. The Wiki Support Tool

The Wiki Support Tool is a way in which to apply the approach to sustainable collaboration, and it was created in an Intranet environment of RWS. An Intranet is a private network that often consists of several connected Local Area Networks (LANs) within an organization. It can be seen as a type of private version of the Internet, and most Intranets are linked to the global internet via a gateway. The primary goal of an Intranet is the electronic sharing of information within an organization.

Note that an Intranet is not a required environment to implement our approach; however, since this ICT medium is commonly used among our subjects, we decided that it would be a convenient way in which to demonstrate our approach to potential users. The general purpose of the Wiki Support Tool is not only to provide an example of how to use the approach to sustainable collaboration, but also it is used to evaluate the modules of the approach. The Wiki Support Tool is essentially a proof of concept.

The general idea behind this Wiki Support Tool was to create a wizard, which is an interactive computer program that helps a user to perform a difficult task, for example installing a specific type of software. The user goes through several steps, and he/she is also kept informed of the progress (for example regarding the user's current step or phase). To enhance the convenience for the user, the Wiki Support Tool is in Dutch. Below, we will describe the content and goal of each Intranet page. We converted the element of our approach into more practical guidelines for a more tangible experience for the users. We will also briefly discuss the Wiki Support Tool.

Home page

Figure 60 presents the home page of the wiki support. This page contains summarized information about a wiki, including what a wiki is. However, the most important aspect of this home page is that it piques the user's curiosity regarding the following questions: how can we use a wiki, and what is the surplus value of such a wiki?

Below the home page, there is a clickable button that directs the user to the related support page. The homepage aims to make users enthusiastic and to lead them in the right direction. On the right-hand side of the Intranet page, there is a navigation menu so that the user sees exactly where he/she is located on the Intranet. In addition to the application of our approach to sustainable collaboration, this Wiki Support Tool also contains more detailed information about a wiki. However, in this chapter, we will only focus on the approach part.

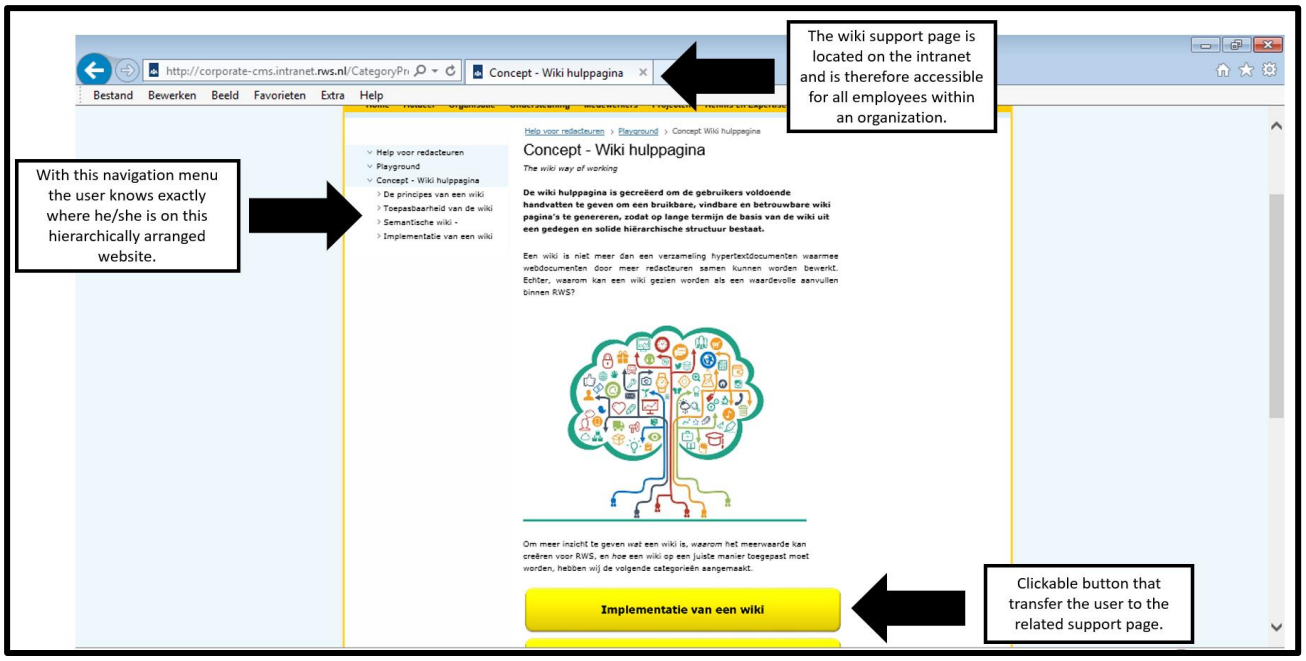

Figure 60: Home page of the Wiki Support Tool

When the user goes to the implementation of the wiki (button: "Implementatie van een wiki"), he/she first receives a short introduction of the approach, followed by the purpose, the description of the approach, and how to execute it, as depicted in Figure 61. On this implementation page, we also introduce the three modules of our approach. As described in chapter 5, our approach consists of three modules. The first module involves aligning manager and individual contributor expectations; it can be considered to be the preparation for the implementation of a sustainable collaboration. The second module is content organization and flexibility ("het creëren van een wiki pagina, uitvoering"), and the final module is positioning a wiki in an existing information ecology ("de evaluatie van de wiki, onderhoud"). Note that all these modules are related to the approach design mentioned in Chapter 5.

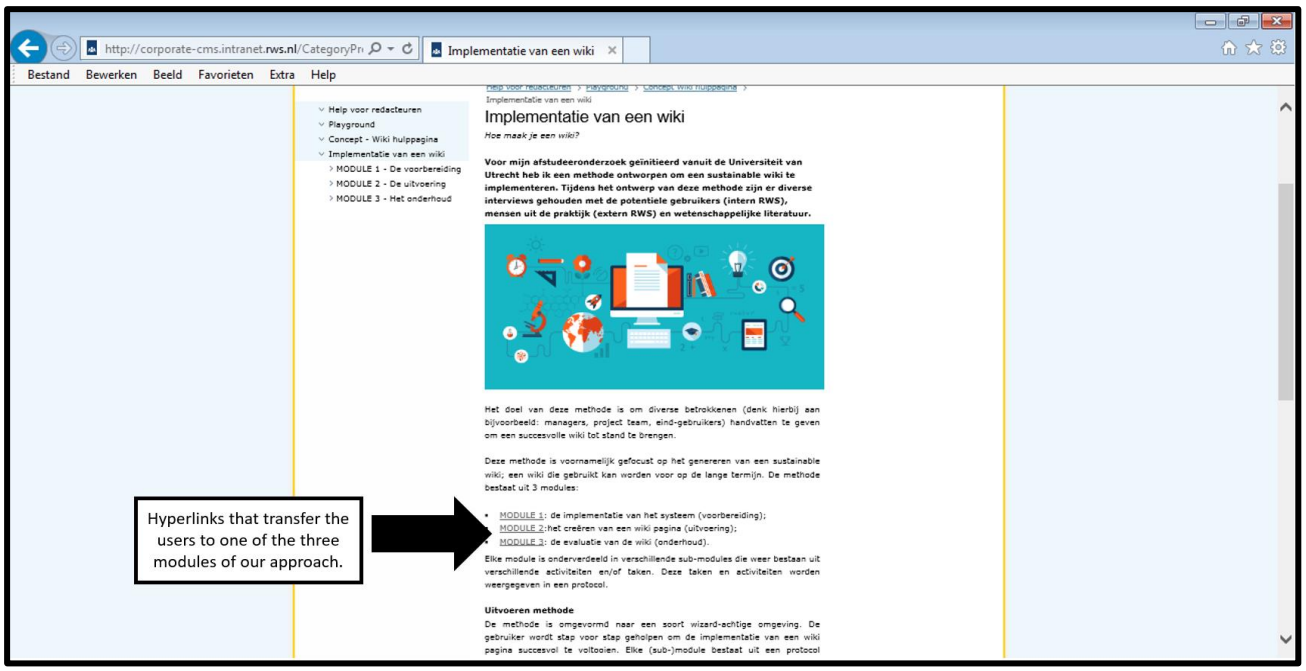

Figure 61: Implementation of a sustainable wiki

MODULE 1—aligning manager and individual contributor expectations

This module consists of four sub-modules (see Figure 62).

1. MODULE 1.1.—Identify all stakeholders (“Identificeren stakeholders en betrokkenen”);
2. MODULE 1.2.—Align the needs and requirements of the stakeholders (“Alignement wensen en behoeften stakeholders”);
3. MODULE 1.3.—Analyze business processes, systems, and applications (“Analyseren van bedrijfsprocessen, 133ecogniz en applicaties”);
4. MODULE 1.4.—Evaluate the organizational culture and business environment (“Beoordeel de bedrijfscultuur en omgeving”).

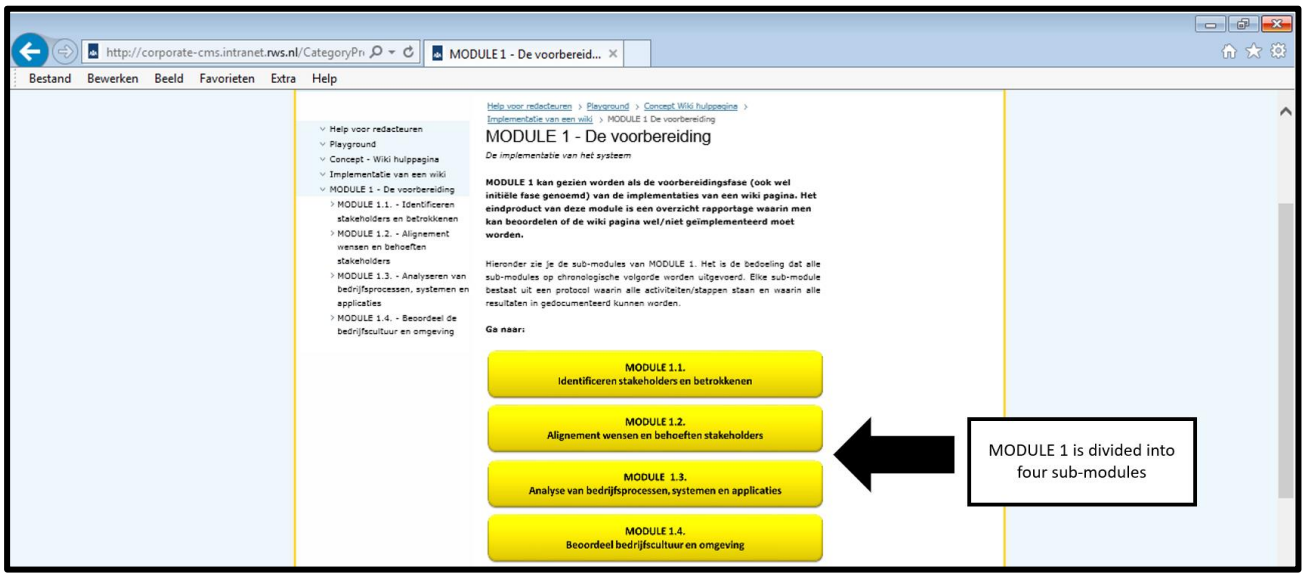

Figure 62: Overview of sub-modules of MODULE 1

After completing all sub-modules, the user receives an overview of the business processes, systems, organizational environment (organizational culture), and stakeholders and their needs and requirements. With the results of MODULE 1, the user can consider whether or not to implement a wiki page or whether to establish the method for implementing such a wiki. Figure 63 illustrates an example of one of the sub-modules. The sub-module page contains information about the end results of this sub-module, and a protocol Word document is provided as a guideline (see Figure 64).

Figure 63: Illustration of sub-module 1.1.—identify all stakeholders

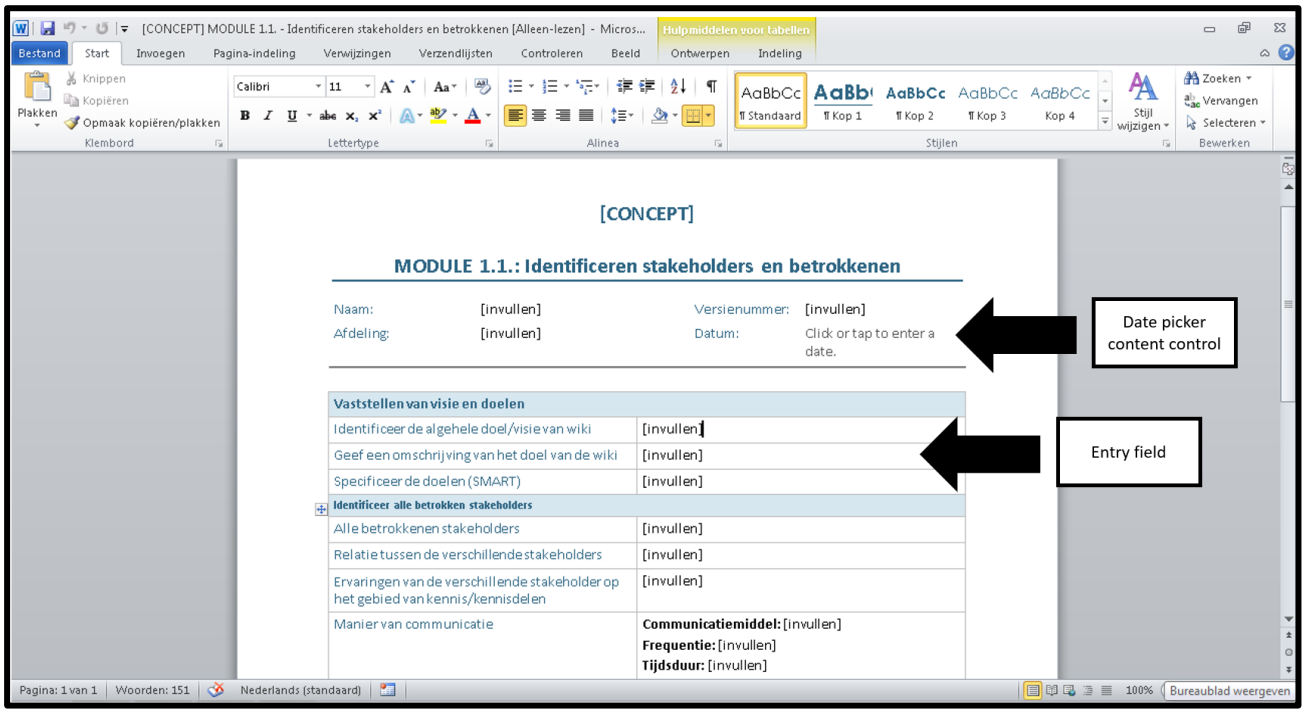

Figure 64: Example protocol of MODULE 1.1.—identify all stakeholders

MODULE 2

The second module involves the realization of a wiki page based on the answers to the following questions: what needs and requirements must we implement, and in what kind of organizational environment? As mentioned in Chapter 5, it is possible to execute each module individually, for example when an organization already has a fixed initial phase for IS projects. In this case, the organization can start with MODULE 2 and omit MODULE 1. However, in situations where the user omits MODULE 1, we created MODULE 2.1a. ("MODULE 2.1a. Vaststellen van stakeholders en de

wensen en behoeften") due to the fact that the stakeholders and their needs and requirements are crucial factors in a successful IS integration and/or implementation. MODULE 2.1a. is a unified module of MODULE 1.1. and MODULE 1.2. Furthermore, MODULE 2 consists of two sub-modules: (1) MODULE 2.1. Analyze the information needs in a specific knowledge domain ("Analyseer de informatie behoeften van een specifiek kennisdomein") and (2) MODULE 2.2. Identify a suitable format for a wiki page ("Identificeer een geschikte format voor een wiki pagina"), as seen in Figure 65.

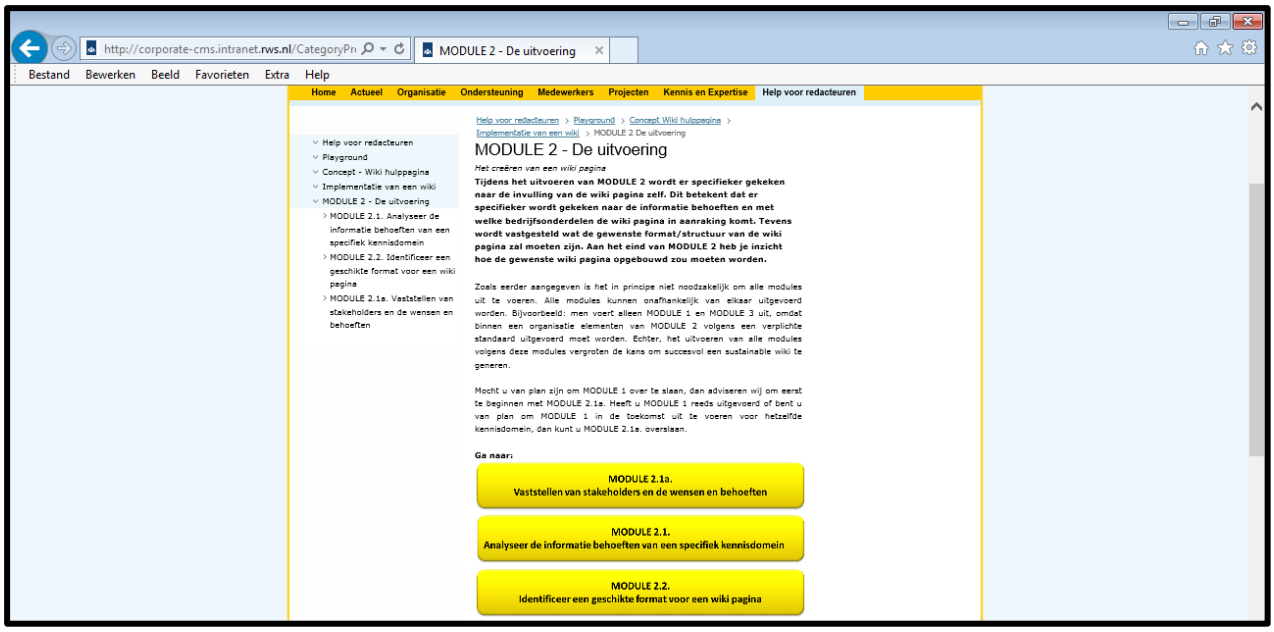

Figure 65: MODULE 2—the execution of a wiki page

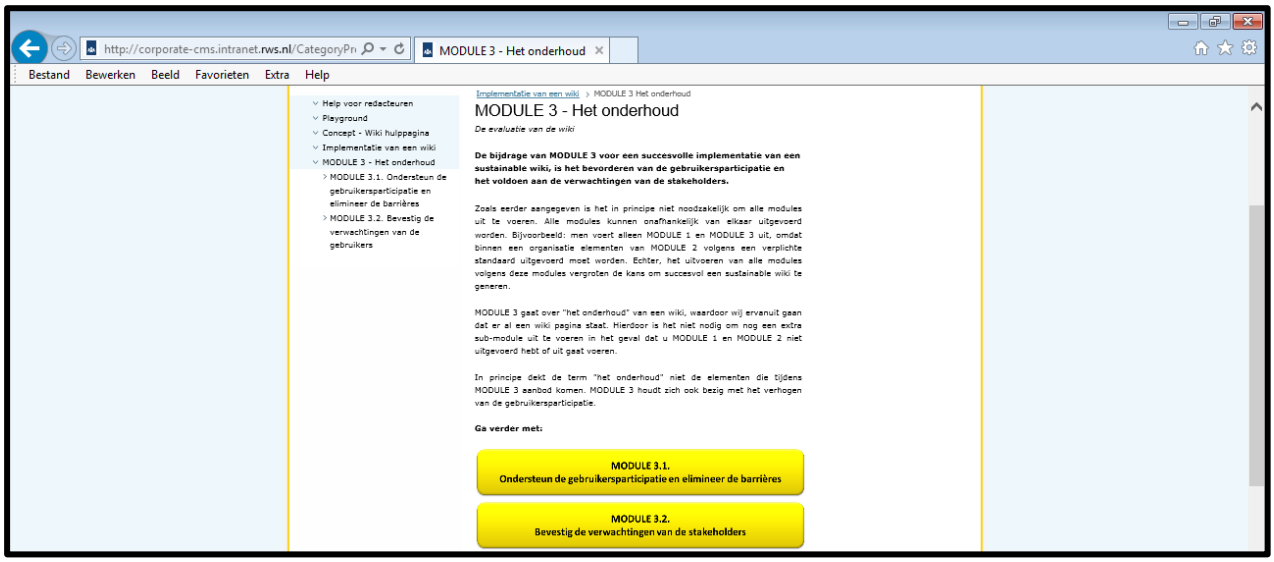

Figure 66: MODULE 3—the maintenance of a wiki page

MODULE 3

The final module is concerned with the maintenance of the wiki; i.e., whether the wiki page serves the user's needs, At the end of this module, an overview with potential improvements is provided. The following aspects are evaluated: condition of support, perceived ease of use, perceived enjoyment, perceived service quality, perceived security, perceived playfulness, and user interface improvements.

Since this module aims to improve user participation and content quality, no extra sub-module is needed. MODULE 3 consists of two sub-modules: (1) MODULE 3.1. Support user participation and eliminate the barriers (“Ondersteun de gebruikersparticipatie en elimineer de 136ecogniz”) and (2) MODULE 3.2. Comfirm the expectation of the users (“Bevestig de verwachtingen van de gebruikers”).

In Appendix F, all individual support wiki pages and protocols are provided.

6.4. Summary

Over the years, researchers have commonly agreed that software development methods should be defined or adapted within a specific organization to determine whether the particular needs of the organization are met. To support this challenge, the ME disciple intends to provide solutions to efficiently deal with the definition and adaptation of methods as well as for the construction of the supporting software tools. In our case, we created an approach to sustainable collaboration. To support the design, implementation, and execution of this approach, we implement our approach in an Intranet environment: the Wiki Support Tool. The general idea behind this Wiki Support Tool was to create a wizard to support users as they move through several steps and to keep them informed of their progress. The purpose of the Wiki Support Tool is to make it feasible to evaluate the modules of the approach to sustainable collaboration. Furthermore, the Wiki Support Tool is a proof of concept.

Chapter 7: Execution of the treatment validation

"We are making knowledge management have a business value. The more it's used, the smarter it gets."
(Suaad Sait)

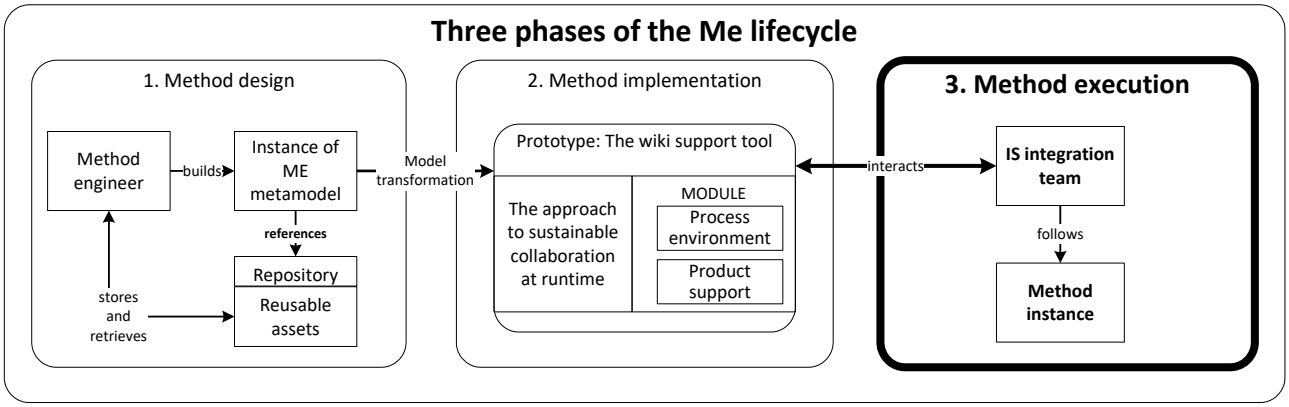

Figure 67: Method execution, ME lifecycle

7.1. Introduction

Chapter 7 involves the enactment of method instances in IS development projects using the Wiki Support Tool that was previously mentioned in Chapter 6 (method execution, see Figure 67). The goal of validation research is to develop an artifact's design theory in a context that allows the researchers to predict what would happen if the artifact were transferred to its intended problem context (Wieringa, 2014). In this study, we used an effect question (artifact x context)—"What effects are produced by the interaction between the artifact and context?"—to measure the produced effects, and we therefore defined the last RQ:

RQ3: What are the effects of implementing a sustainable collaborative approach regarding stakeholders' perceptions?

The artifact is an approach to sustainable collaboration that intentionally contributes to the sustainability part of a corporate wiki. The context is governmental organizations that are interested in performing KM activities with KMSs supported by Wiki technology. To conduct validation research, it is essential to use design theory principles for prediction purposes. The book by Wieringa (2014) states, "In design science research, we use validation models to simulate implementations."

As mentioned in Chapter 6, we presented the Wiki Support Tool, which exemplifies how a governmental organization can implement and use the approach to sustainable collaboration. The Wiki Support Tool provides an environment that assists the execution of the modules of the approach. Even though the approach to sustainable collaboration is based on scientific literature that contains sustainable collaboration factors or successful IS integration elements, the real benefits of this approach must be demonstrated via rigorous evaluation methods. For this purpose, we performed an

evaluation study to evaluate the approach to sustainable collaboration with respect to three quality attributes: usefulness, ease of use, and intention to use. These attributes are the variables of Moody's (2003) Method Evaluation Model. To collect data, we used the Think Aloud Method and Retrospective Think Aloud. We also gathered an expert opinion from one individual with an academic background in the IS discipline.

7.2. Overview of the evaluation study

Figure 68 depicts the validation model and the used research methods of this study. The validation model consists of the artifact interacting with a model of the problem context. The validation model provides an example of how the artifact could be implemented and how it could interact with real-world problem contexts. As illustrated in the validation model, we used two different research methods: a single-case mechanism experiment (Chapter 7.3) and expert opinion (Chapter 7.4).

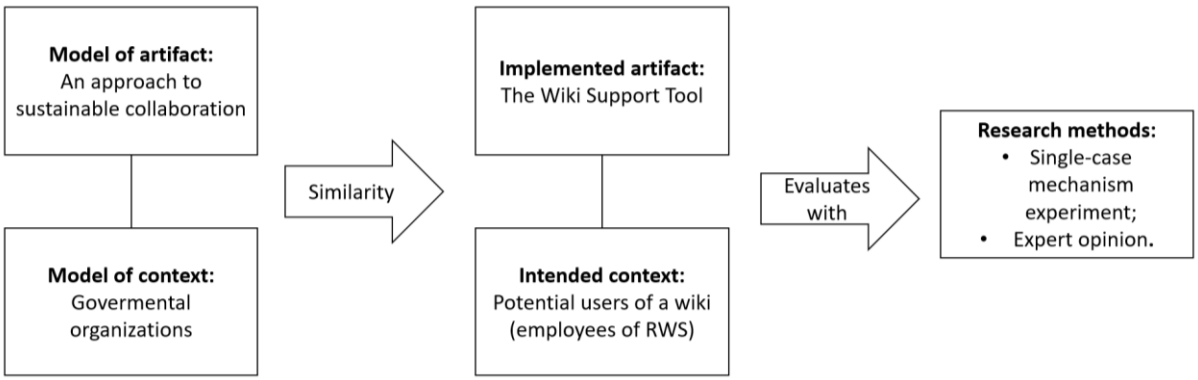

Figure 68: Validation model of study

7.3. Single-case mechanism experiments—the Method Evaluation Model

For the treatment validation, we conducted a single-case mechanism experiment; here, the researcher applies stimuli to a validation model and explains the response in terms of mechanisms that are internal to the model. In this case, we built the Wiki Support Tool (a prototype to apply the approach to sustainable collaboration) in its intended context, and we tested it with scenarios to observe its responses. This was done with the support of the Think Aloud Method and Retrospective Think Aloud. Figure 69 contains a summary of the used measurements of this study. As illustrated in that figure, this study employs two types of measures: subjective and objective. The reason for these choices is that each type of measurement may lead to different conclusions; however, even if we obtain similar results, this would reinforce the evaluation study. Likewise, this combination of subjective and objective measures grants us a more complete picture of the phenomenon that is studied.

For the subjective part, we used elements from the Method Evaluation Model of Moody (2003)—see Chapter 7.1.1. for details about this model. The subjective measures were used to evaluate users' satisfaction with the use of the Wiki Support Tool, since their satisfaction influences the confirmation of expectations. During the evaluation of our approach, we used questions defined by Moody that contained three measures: perceived usefulness, perceived ease of use, and intention to use.

The objective part evaluates the performance of the Wiki Support Tool users. We define the following objective measures: task completion time (efficiency), task completeness (effectiveness), task difficulty, and commentary. The first two measurements evaluate the usefulness of the Wiki Support Tool. To evaluate the ease of use of the Wiki Support Tool, we created the measurement task difficulty, which was tested in terms of the challenges or difficulties that users faced during the experiment of this study. Intention to use was measured with commentary, which contains comments and options regarding whether users will use this Wiki Support Tool. The commentary was gathered after the completion of the task of the experiment. The former two measures were tested quantitatively, whereas the latter two were tested qualitatively, and all the objective measures were tested through direct observation. The reason for choosing direct observation is that this method provides a more in-depth understanding of the phenomenon of the study (Cervera et al., 2015), and from all the methods based on direct observation, this study executed its experiment with the Think Aloud Method due to its systematic and valid characteristics. During a Think Aloud session, we gathered data while the user interacted with the Wiki Support Tool by speaking their thoughts out loud. However, we must take into account that users; answers to questions may be biased, given people's tendency to describe their behavior in terms of formal methods that deviate from their real actions.

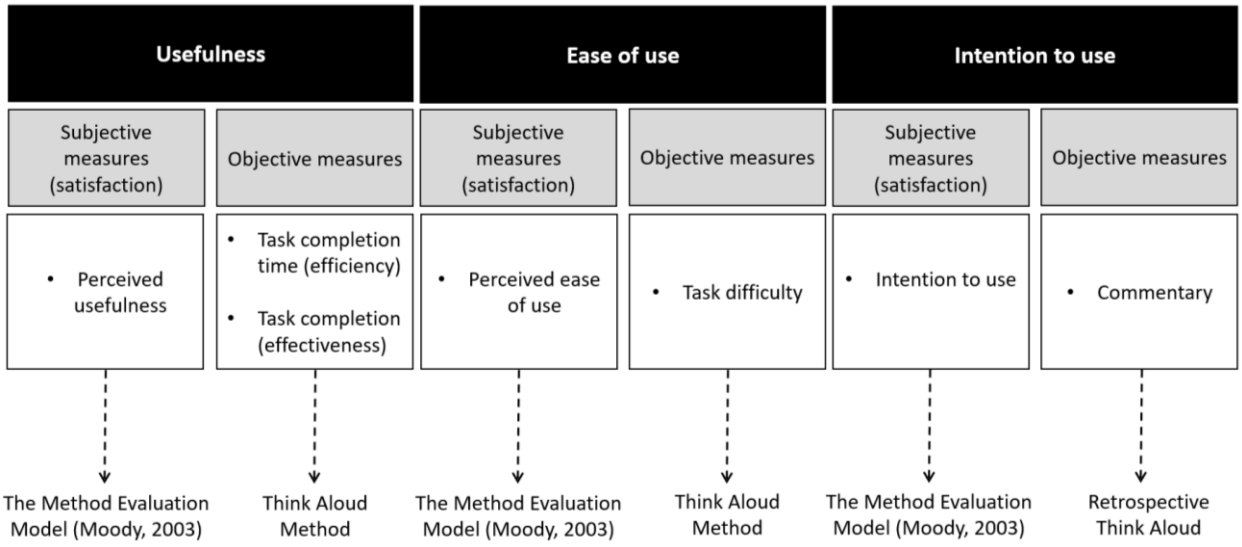

Figure 69: Measures used in the evaluation of our approach

During this evaluation research, Moody's (2003) theoretical model for evaluating an IS design method is used. This theoretical model employed the measurements usefulness, ease of use, and intention to use. To evaluate an IS design method, Moody (2003) argues that there are at least two dimensions of "success" that must be considered:

1. *Actual efficacy*—this aspect refers to whether the method improves performance of the task. It answers the following question: do we obtain sustainable collaboration with our approach?
2. *Adoption in practice*—this refers to whether the method is used in practice, since regardless of whether the method improves performance, unless it is used in practice, its benefits cannot be realized.

These dimensions will not lead to improvements in practice if they are considered separately from each other. Moody (2003) states, "A method that improves performance but that is not used will have

no effect on practices. Similarly, a method that people use but which reduces performance of the task will have a negative effect on practices."

Figure 70 illustrates the elements of the Method Evaluation Model with the primary constructs and causal relationships between them. The Method Evaluation Model consists of the following six constructs:

1. *Actual efficiency*— the actual effort that is required to apply a method;
2. *Actual effectiveness*—the degree to which a method achieves its objectives;
3. *Perceived ease of use*—the degree to which a person believes that using a particular method would be "free of effort";
4. *Perceived usefulness*—the degree to which a person believes that a particular method will be effective in achieving its objectives;
5. *Intention to use*—the extent to which a person intends to use the method;
6. *Actual usage*—the extent to which a method will be used in practice situations.

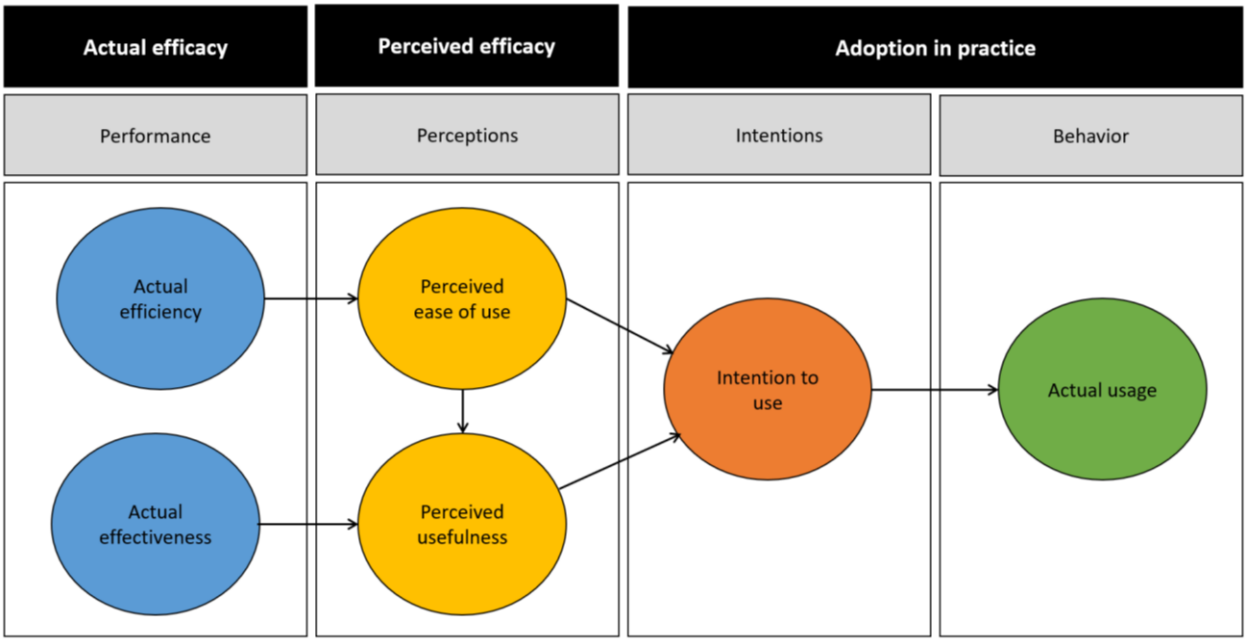

Figure 70: The Method Evaluation Model (Moody, 2003)

The efficiency of a method is established by the effort required to apply the method, which can be determined by several measurements, such as time (of completion), cost, or effort. The effectiveness of a method is defined by how well it achieves its objectives, through measures of the quantity and/or quality of the results. The three constructs, namely perceived ease of use, perceived usefulness, and intention to use, are constructs from the TAM.

7.3.1. Experimental setup single-case mechanism experiment

The process of the Think Aloud experiments is summarized in Figure 71. The Think Aloud sessions were individual; only one subject (and one observer) could participate per session. We began with an introduction and explanation of the experiment, which lasted approximately 10 minutes. During this introduction, the subjects were provided with the following information:

- A summary of my study (goals of the study, main RQ, research approach, treatment design, and treatment validation);
- A brief explanation of the Think Aloud method (the subjects were asked whether they are familiar with this method);
- The meaning of the Think Aloud session (the subjects were told that this is the treatment validation of my study);
- The structure of the Think Aloud session (the subjects were provided with the activities during the experiments).

During this introduction, the subjects also had the opportunity to ask further questions, and the observer ensured that each subject understood the purpose of the experiment. Before commencing with the Think Aloud session, the subjects were provided with the informed consent and the printed documents. At the same time, the observer made the subjects aware of the fact that they were participating in an academic study and that for analysis purposes, it was necessary to record video and sound throughout the experiment. The observer also ensured that the subjects knew that if they felt uncomfortable during the experiment, they could postpone it at any time. The subjects were then allowed some time to read the informed consent and to ask questions when necessary. Thereafter, a brief explanation of the printed document was provided; it contained the following: (1) the tasks of the Think Aloud session and (2) the user acceptance form. After a moment to ask questions, the Think Aloud sessions began; they were each a maximum of 60 minutes (even when a subject did not complete all the tasks).

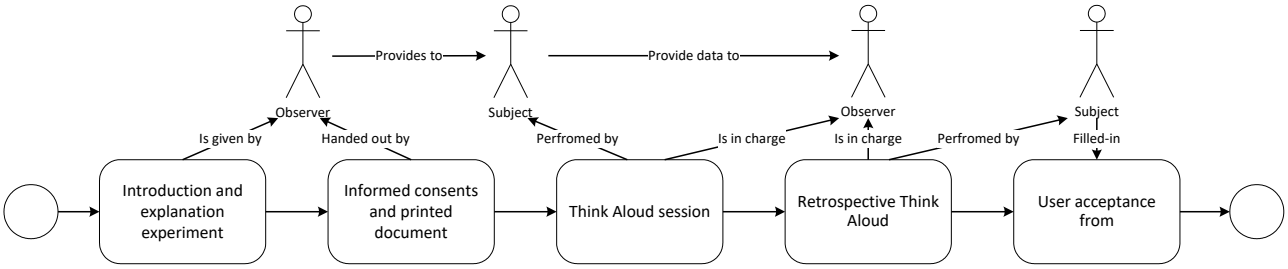

Figure 71: Experimental setup

Directly after the Think Aloud session, the Retrospective Think Aloud began; Retrospective Think Aloud is a usability method that collects the verbalization of a user's performance after the performance is over (Guan et al., 2006). In this situation, we did not design a whole protocol, but rather asked general question about their experiences, opinions, and thoughts without the pressure to perform tasks. The aim of the Retrospective Think Aloud method is to gather more in-depth data about the subjects in a more comfortable environment. The video stops recording, but the voice recording continues. This contributes to a more natural setting, which can yield fruitful and valuable data for our analysis (Van Den Haak, De Jong & Jan Schellens, 2003). The Retrospective Think Aloud took between five and 15 minutes. The final element of the experiment is that the subject completes the user acceptance form.

7.3.2. Experimental process single-case mechanism experiment

For the evaluation of the approach, we used the same guidelines for experimentation in software engineering that Cervera et al. (2015) utilized in their evaluation study. Cervera et al. performed four

sequential phases: (1) definition and planning, (2) execution, (3) data analysis (analysis of the subjective data), and (4) results. In the next subsection, we describe the four phases in more detail.

7.3.3. First phase—definition and planning of the experiments

This section details the first phase of the study. In this phase, we defined the goal of the study as well as the research items, subjects, objects, factors and context, experimental tasks, instrumentation, experimental setup, and validity evaluation.

7.3.3.1. Goal

The general goal of the treatment validation is to evaluate the effects of implementing a sustainable collaborative approach regarding stakeholders' perceptions. In part I of this thesis, we established that sustainability means that a wiki page will have continuity between 12 and 24 months (Majchrzak, Wagner & Yates, 2006), and since this MSc project only has a duration of 8 months, we have to find another way to evaluate our approach. This means that we have to rely on information provided by experts, regardless of whether our approach can be considered to be one that obtains sustainable collaboration. Therefore, we evaluate three attributes of the Wiki Support Tool: perceived usefulness, perceived ease of use, and intention to use.

7.3.3.2. Subjects

The subjects of this study are all employees within an organization, and they would all like to implement a sustainable wiki (or other similar collaboration environment). They include software developers, members of project teams, and CoPs; however, the approach is also intended to serve individuals who are not ICT experts. Therefore, our preference regarding our subjects was to have a group of people with a wide variety of expertise and knowledge in the field of IS and/or software development. The only requirement of the subject was that he/she is interested in or intends to create a wiki page. During the single-case mechanism experiment, we invited potential users (RWS employees) with different backgrounds and varying functions, work experience, education, and ages to participate.

7.3.3.3. Objects

As previously mentioned, the approach to sustainable collaboration can be divided into three modules, and each module can be executed separately. To ensure minimal erroneous results, it is important that all the cases are equivalent in terms of the complexity of the tasks. We attempted to create three cases with the same value: each case consisted of seven tasks for which two or three questions were related to a provided fictitious case study. Also, the first two tasks were similar for each situation. The Think Aloud session of MODULE 1 evaluated the alignment between manager and individual contributor expectations. After task 2, the first task comprised a simple question to allow the user to familiarize himself/herself the Wiki Support Tool (task 3). The next task was to determine the prescience and attitude of the stakeholder (task 4), followed by a task to identify the organizational culture of his/her own organization (tasks 5 and 6). The final task was to find a protocol to identify the stakeholder (task 7). MODULE 2 is about the realization of a wiki page, and the Think Aloud session evaluated whether the user was able to establish the needs and requirements. Furthermore, MODULE 2 has an extra module (MODULE 2.1a.) that needs to be performed when the user decides to omit MODULE 1, and with task 3, we aim to measure whether this aspect is clear to the user. The next task was based on

given information to find specific sub-modules and information (tasks 4, 5 and 6), and the final task evaluated one of the protocols (MODULE 2.1.).

The last case (MODULE 3) is concerned with the maintenance of the wiki, and it evaluates whether the wiki page serves the user's needs. Task 3 was similar to MODULE 2, and tasks 4 and 5 were based on given information to find specific sub-modules or information. Next, the user needed to perform task 6 to become accustomed to the protocol of a certain module, and the final task employed questionnaires to find out how to improve user participation (task 7). In the next section, we provide some examples of the experimental tasks.

7.3.3.4. Experimental tasks

The experimental tasks are characterized using search assessments and exercises. The search assessments are, for example, finding a certain module or answering a question that the subjects could extract from the content. The exercise is, for example, to evaluate the organizational culture. Table 37 and Table 38 presents examples of the experimental tasks for MODULE 1 and MODULE 2 respectively. See Appendix H for the original experimental tasks of all modules (note that they are provided in Dutch).

MODULE 1		
Task	**Description task**	**Characteristics**
1.	Go to the home page of the Wiki Support Tool	Search
2.	Search for more information about the implementation of a wiki. Take your time to read this page. How many (sub-)modules make up the approach to implement a sustainable wiki? You can look on multiple pages.	Search
3.	Go to MODULE 1. How many sub-modules exist for MODULE 1?	Search
4.	*Situation: You are the manager of the knowledge domain traffic, and you would like to create a wiki page for your team. You already have an overview of all the stakeholders (MODULE 1.1.), and now you would like to specify the requirements and needs of the stakeholders.* Go to the corresponding sub-module. What is the name of this sub-module? You would like to gather information about the prescience and attitude of the stakeholders. On the same page, you can find a protocol. Go to the protocol and fill in the following part: "level of readiness." Base your answers on real-life experiences.	Search and exercise
5.	*Situation: You collected all the information about the requirements and needs of all the stakeholders (MODULE 1.3.). Now you are curious about what the organizational culture is within your team; therefore, you would like to evaluate the organizational culture.*	Search

	Go to the module that is dedicated to evaluating the organizational culture. What is the name of this module?	
6.	Evaluate the organizational culture based on the related questionnaire. You can answer the questions based on your current situation. What kind of organizational culture could you establish within your business environment?	Exercise
7.	After analyzing the organizational culture (MODULE 1.4.), you observe that the goal of the wiki page and stakeholders has been changed. Go to the module that is dedicated to identifying the stakeholders. Search for the related protocol. In which module did you find the protocol?	Search

Table 37: Experimental tasks for MODULE 1

MODULE 2		
Task	**Description task**	**Characteristics**
1.	Go to the home page of the Wiki Support Tool	Search
2.	Search for more information about implementation of a wiki. Take your time to read this page. How many (sub-)modules make up the approach to implement a sustainable wiki? You can look on multiple pages.	Search
3.	Answer the following question: is it necessary to conduct all the modules in chronological order?	Search
4.	*Situation: You are the manager of the knowledge domain traffic. Together with your five other colleagues, you would like to create a wiki page for asphalt. To implement a wiki page, you used the following Wiki Support Page: "Implementation of the wiki." Your team already completed the preparation module. Go to the module that is dedicated to the execution of the wiki.* What is the name of this module?	Search
5.	Based on the situation described above, which modules do you need to complete?	Search
6.	Go to the sub-module that is dedicated to the determination of the wiki page.	Search
7.	Search for the protocol to specify the information needs. Open this protocol. How many elements does this protocol contain?	Search and exercise

Table 38: Experimental tasks for MODULE 2

7.3.3.5. Instrumentation

During the performance of this Think Aloud session, we used the instruments described in this paragraph. We began with the printed document, which contains the informed consent (see Appendix B) and an explanation of the experiment (provided in a short introduction; see Appendix H) with all the tasks. After completing each task, the subject needed to check off the task, and in some cases, a task was provided with a "control question." The second instrument was the u*ser* acceptance form. After

completing all the tasks, the user was required to fill in the user acceptance form. This form quantifies perceived usefulness, perceived ease of use, and intention to use (see Appendix G). This form was developed following Moody's (2003) Method Evaluation Model, which suggests using a five-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). The final instruments were the physical devices and tool. To perform the Think Aloud sessions, we used a camera to record the subjects' physical behavior and their uttered thoughts, and as backup, we also used voice records. We created a comfortable situation for the subject, where he/she could use his/her own laptop/computer to complete the experiment (in one situation this was not possible).

7.3.4. Second phase—the execution of experimental process

This subsection is dedicated to the second phase of the experimental process, containing three steps: preparation, operation, and data validation.

7.3.4.1. Preparation

The preparation of the treatment validation began with the selection of the subjects according to the snowballing sampling technique, which eventually resulted in a sample of five subjects. Figure 72 indicates the distribution of the sample. In consultation with my supervisor at the university and the supervisors of RWS, we agreed on and selected the number and the type of subjects. These subjects were a mix of individuals from academia and industry or a combination of both. All of the subjects had an overall understanding of the purpose of this study; however, they were not aware of the Wiki Support Tool and the experimental tasks themselves. Also, each subject is employed within RWS and is involved in some type of KM initiative. The approach to sustainable collaboration consists of three modules, which are individually executable. However, to obtain the optimum implementation in terms of sustainability, we recommend performing each module consecutively. Since we assumed that each module is independently realizable, we decided to divide the experiment into three cases for MODULE 1, MODULE 2, and MODULE 3 respectively. Each subject was dedicated to one of the experiments to determine whether the modules really could be used separately. Figure 72 indicates the number of subjects per module.

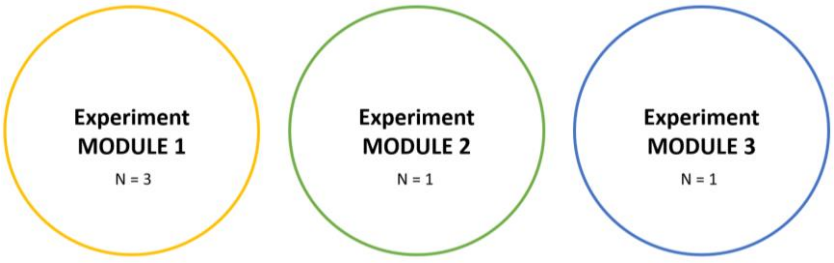

Figure 72: Subject/s per module

7.3.4.2. Operation

At the end of May 2018, we successfully conducted the five Think Aloud sessions over a two-week period. The average duration of these sessions was approximately 50 minutes per subject. During the execution of the experiments, we attempted to replicate the same settings; therefore, we provided the subjects with the same installations of the Wiki Support Tool, and these tools were restored to their original state after each session. Furthermore, to ensure that the experimental setup was strictly followed, the observer always remained inside the room in which the experiment was being

conducted. The observer only talked when (1) the subjects needed help, which occurred only a few times, or (2) when the subjects forgot to think out loud, in which case the observer reminded the subjects that each thought should be said out loud. As an illustration of a Think Aloud session, Figure 73 and Figure 74 present snapshots of subjects using the Wiki Support Tool. These snapshots demonstrate that the camera was directed at the screen of the subjects to provide a clear view of their movements on the screen. This facilitated the subsequent interpretation of the verbal data.

Figure 73: Illustration of a Think Aloud session, example 1

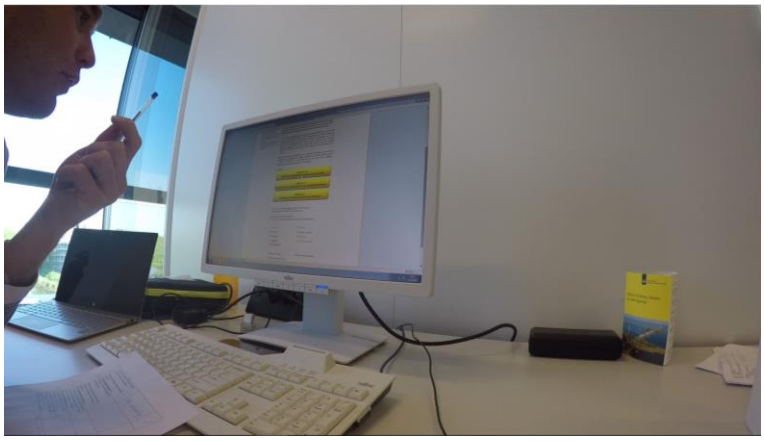

Figure 74: Illustration of a Think Aloud session, example 2

7.3.4.3. Data validation

The Think Aloud method handles verbal protocols, which are accessible for everyone as data; therefore, it can be seen as an objective method. The Think Aloud method consequently avoids interpretation by the subject, and it only assumes a simple verbalization process (Van Someren, Barnard & Sandberg, 1994).

During the execution of the Think Aloud sessions, only one subject could participate in each session, thereby enabling the observer to ensure that the experiment was performed according to the experimental procedure. Notwithstanding the fact that none of the subjects have experience with the Think Aloud method, we are quite sure that they all understood how to execute the tasks (containing checkboxes and control questions) and complete the user acceptance form.

7.3.5. Analysis of the subjective data

The subsection describes the subjective data, consisting of (1) the quantitative feedback obtained by means of the user acceptance form, based on Moody's Method Evaluation Model, and (2) the qualitative feedback obtained with the Retrospective Think Aloud method directly after the Think Aloud sessions.

1. Quantitative feedback

We used the user acceptance form to obtain a quantitative view of the subjects' perceived usefulness, ease of use, and intention to use the Wiki Support Tool. This view was obtained through the numerical values of the responses. We used the five-point Likert scale, ranging from 1 for "strongly disagree" to 5 for "strongly agree." With these results, we are able to calculate the minimum, maximum, and average values for each Likert item as well as the total averages combined. Furthermore, we also measured the frequencies of the responses. The frequency of a response is the sum of the occurrences of the response divided by the total number of questions.

2. Qualitative feedback

The qualitative feedback component reinforces the results obtained for perceived usefulness and intention to use. These data were collected through the use of the Retrospective Think Aloud method, which took place after the completion of the Think Aloud sessions. During the Retrospective Think Aloud, the observer asked open-ended questions, such as "What do you think about this approach?"

The transcribed Think Aloud sessions are provided in Appendix J (in Dutch).

7.3.6. Analysis of the objective data

We gathered objective data by analyzing subjects' behavior with support of video and voice recordings. To obtain these data, we followed the process adapted from Van Someren, Barnard, and Sandberg (1994), as presented in Figure 75. The first step was to transcribe the recordings of the Think Aloud sessions, which involved typing out the video (or voice) recordings verbatim as much as possible. Afterward, the annotation of the transcriptions took place, with the use of a coding scheme to obtain Think Aloud protocols. Due to the similar characteristics of this evaluation study, the coding scheme is a combination of the categories used in the evaluation study by Cervera et al. (2015) and the coding method mentioned in the book by Miles, Huberman, and Saldana (2013). We also used the latter method for the semi-structured interviews to determine the problem investigation (see Chapter 1.3.3.).

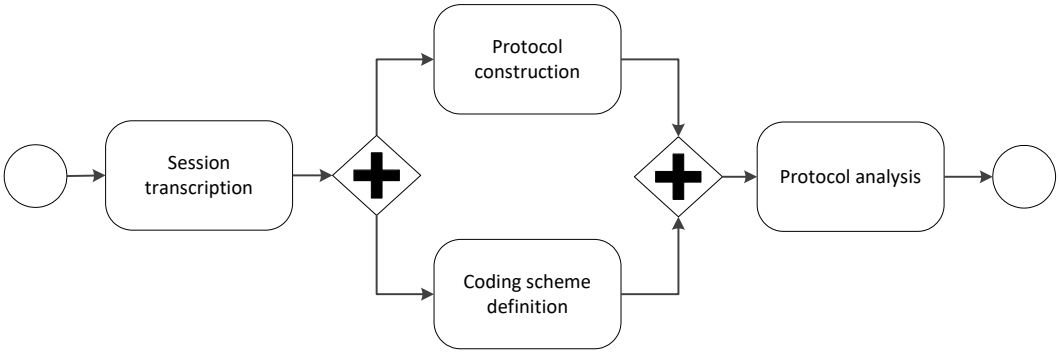

Figure 75: Process of analyzing data

During the treatment validation—the first cycle coding—we also performed descriptive coding. Therefore, we began with the seven categories of Cervera et al. (2015):

1. Actions (A);
2. Tasks (T);
3. Errors (E),
4. Comments (C);
5. Strategies (S);
6. Expert knowledge (EK);
7. Challenges (CH).

We elaborate on the meaning of the codes on the following page (in the section titled "Coding scheme definition"). In the second cycle coding, we used pattern coding: after the first cycle coding, we began to analyze the qualitative data, and throughout this process, we adapted, merged, and removed nodes based on the data (protocol construction). In the end, we established the following six categories:

1. Actions, tasks, and strategies (ATS);
2. Errors (E);
3. Comments and opinions (CO);
4. Improvements and challenges (IC);
5. Expert knowledge (EK);
6. Retrospective Think Aloud (RTA).

As a result, we could establish that the protocol consists of transcriptions whose utterances and actions are classified in, for example, challenges or actions. When completing the annotation of the transcriptions, the protocol analysis will take place. In the next subsection, we will provide more detail regarding the data analysis process.

Session transcription

To create analyzable data, the video recordings were transcribed into text, with the transcriptions containing utterances obtained from the video recordings. In total, we produced five transcriptions, and each of the segments of these transcriptions stores two items: type and text. The type indicates which text belongs to which category, and the text represents the context—verbatim utterances of the subjects. We also tracked the time completion per task, but not per segment, since this evaluation study is not interested in the point at which each segment occurs.

Coding scheme definition

For analysis purposes, we created a coding scheme that enables the classification of the different segments. The creation of the coding scheme starts with an analysis of the transcriptions using the seven categories mentioned in Cervera et al. (2015), and we concurrently created new codes for each segment either by adapting or merging them into a new code or by creating a new one when the segment did not fall neatly into the existing coding scheme. The final coding scheme contains the following six categories:

1. *Actions, tasks, and strategies (ATS)*—these are general actions (for example, reading or clicking). Tasks are actions that correspond to the method tasks (for example, evaluating the organizational culture), and a strategy describes a plan to achieve a certain goal or task.

2. *Errors (E)*—these refer to subjects' incorrect actions, for example trying to fill-in the wrong protocol.
3. *Comments and opinions (CO)*—these correspond to general utterances such as thoughts, opinions, or doubts.
4. *Improvements and challenges (IC)*—these relate to specific suggestions to improve the treatment design. This category contains both substantive and technical aspects.
5. *Expert knowledge and experiences (EKE)*—these refer to either utterances in which subjects suggest that further knowledge is required or speculation based on the subjects' previous experiences.
6. *Retrospective Think Aloud (RTA)*—this is about utterances made while the subjects do not perform the experimental tasks. In almost all cases, the Retrospective Think Aloud took place after completing all the experimental tasks. One subject started by exploring the Wiki Support Tool without focusing on the tasks. We also consider these segments as part of the Retrospective Think Aloud.

Protocol construction

To create the Think Aloud protocol, we annotated the transcription with codes from the coding scheme. The researcher analyzed the transcription to assign each segment to a category based on own perceptions and early experiences. Note that one segment could consist of only a few words up to multiple paragraphs. The protocol construction was created with the support of NVivo 11, which is a software for organizing, storing, and retrieving data for analysis purposes (see Figure 76 for an overview of the nodes).

Nodes

Name	Sources	References
Actions (A)	5	89
Facts (F)	3	18
Strategies (S)	2	3
Tasks (T)	1	5
Comments (C)	5	62
Errors (E)	2	3
Expert Knowledge (EK)	4	13
Improvements (EM)	4	25
Challenges (CH)	1	1
Retrospective Think Aloud	5	6

Figure 76: Overview of the node single-case mechanism experiment, Nvivo

Protocol analysis

After finalizing the protocols, we analyzed the data in two ways: (1) a review of the qualitative data and (2) the task completion time. The former was reviewed through the knowledge gathered from the earlier literature review. The latter aspect—measuring the completion time per experimental task—refers to the time subjects spent on the tasks of the study. However, creating a more efficient approach than the existing one is not the interest of this study. The efficacy of a method pertains to its pragmatic success (Moody, 2003); therefore, we would like to know the time completion per module.

7.3.7. Results—Think Aloud sessions

As mentioned before, the data analysis results in subjective data (results from the user acceptance form) and objective data (efficiency and effectiveness). In this section, we present the results of the study by analyzing the following elements:

- Perceived usefulness of the Wiki Support Tool;
- Perceived ease of use of the Wiki Support Tool;
- Intention to use the Wiki Support Tool.

First, start with the descriptive statistics. This section summarized the features of a collection of information—the description of the subjects and their performance behavior. For the sake of anonymity, we only provide data that are necessary to validate the approach to sustainable collaboration in a sufficient way. Table 39 summarizes the gender, performed Think Aloud case, and performance behavior.

ID	Gender	Think Aloud case	Performance behavior
S1	Male	MODULE 1	Exploratory
S2	Male	MODULE 1	Exploratory
S3	Female	MODULE 1	Exploratory
S4	Male	MODULE 2	Task-oriented
S5	Female	MODULE 3	Exploratory

Table 39: Summary of data subjects

As mentioned before, the approach consists of three modules: MODULE 1, MODULE 2, and MODULE 3. There are many reasons these modules are evaluated separately. First, we state that the modules can be conducted individually with the advantage that the approach is applicable in multiple situations. For example, an organization with a standardized project initiation can omit MODULE 1 and continue with MODULE 2. With this alternative, we attempt to create a flexible and applicable approach. The second reason is that the subjects have enough time to evaluate the approach extensively and to focus on the content rather than on only completing the experimental tasks. The latter also depends on the performance behavior, which refers to the way in which the subject performed the experimental tasks—in a task-oriented or exploratory manner, as depicted in Figure 77. Subjects who demonstrate task-oriented behavior only focus on the experimental tasks; they do not perform other activities, such as reading the whole Intranet page. On the other hand, subjects who demonstrate exploratory performance behavior perform the experimental tasks while simultaneously exploring the Wiki Support Tool by, for example, reading the whole Intranet page. To define whether a subject demonstrates task-oriented performance behavior or not, we admit the following requirements:

Task-oriented performance behavior—refers to a subject who only performs activities according to the Think Aloud session tasks that are given.

Exploratory performance behavior—refers to a subject who performs one or more activities that are not related to the experimental task that is given during the Think Aloud sessions.

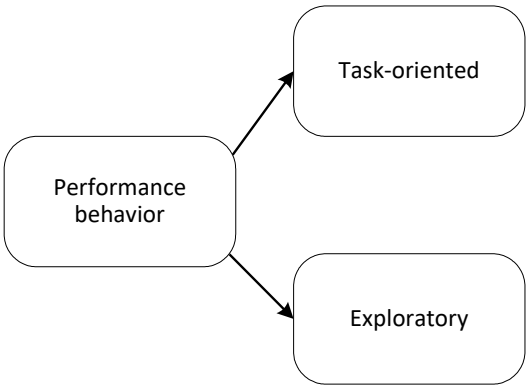

Figure 77: Performance behavior of subjects in single-case mechanism study

7.3.8. Results—subjective data

The subjective data were collected with the support of the user acceptance form, which measures the perceived usefulness, perceived ease of use, and intention to use a certain method—in this case, the approach to sustainable collaboration. The user acceptance form consists of 15 statements using a five-point Likert scale that ranges from strongly disagree (1) to strongly agree (5). These statements contain a combination of negative and positive statements (opposing statements format). To create a balance of items in the user acceptance form, approximately half of the statements were negated: seven statements were negative, and eight statements were positive. This is usually done to capture the attention of the subject, who might become increasingly alert to manipulated question items (Moody, 2003).

7.3.8.1. Quantitative feedback

To improve the readability of the results, we converted the negative results (i.e., 1 = 5, 2 = 4, 3 = 3, 4 = 2, and 5 = 1) so that the lower scores 1 and 2 are below average, and 4 and 5 are above average. The last column indicates whether the statement formulations are negative (N) or positive (P).

Perceived ease of use

The perceived ease of use is measured based on six items on a post-task survey (i.e., the user acceptance form), which is related to the first six questions of the user acceptance form (see overview in Table 40). These questions are a mix of positive (P) and negative (N) formulations. In the data analysis of the method evaluation form, we subsequently obtained the results that are presented in Table 41. The minimum (Min) and maximum (Max) columns indicate that the subjects' answers vary from strongly disagree to strongly agree. It is noteworthy that subject S1 has some contradictions in the results. For example, the subject provided the following results: Q1 agreed (4), Q2 strongly agreed (5), and Q3 strongly agreed (5). However, he/she did not have the confidence to implement the approach; for example, Q4 and Q5 are both answered with "strongly disagree" (1). Subject S2 rated the approach below average—he/she answered with disagree for Q1, Q2, and Q3—although the subject agreed (4) that he/she felt confident to apply the method in practice. Subject S3 rated all the elements of perceived ease of use with "strongly agreed" (5). Subject S4 could not answer each question, and answered Q3, Q4, and Q5 as not applicable. The final subject, S5, also had some contradictory answers: Q1, Q3, and Q4 were answered with strongly agreed (5), whereas Q5 and Q6 were answered with disagree (2). We obtained the best result for the third item (average: 4.25); that is, the subjects

expressed a strong belief that the method was easy to learn. The first item—the procedure for applying the method complex was clear and understandable—also scored above average (average: 4.00). Generally speaking, the perceived ease of used has a total average of 3.85.

ID	Question in user acceptance form	Item	N/P
PEOU1	Question 1 (Q1)	I found the procedure for applying the method complex and difficult to follow.	N
PEOU2	Question 2 (Q2)	Overall, I found the method difficult to use.	N
PEOU3	Question 3 (Q3)	I found the method easy to learn.	P
PEOU4	Question 4 (Q4)	I found it difficult to apply the method to the example data model.	N
PEOU5	Question 5 (Q5)	I found the rules of the method clear and easy to understand.	P
PEOU6	Question 6 (Q6)	I am not confident that I am now competent to apply this method in practice.	N

Table 40: Overview of questions related to perceived ease of use

Questions/results	Min	Max	Average
Question 1	2	5	4.00
Question 2	2	5	3.80
Question 3	2	5	4.25*
Question 4	1	5	3.50*
Question 5	2	5	3.75*
Question 6	1	5	3.80
Total average	-	-	**3.85**
***= situation in which the subject is omitted because he/she did not complete the question**			

Table 41: Results per question related to perceived ease of use

Perceived usefulness

The following eight questions are dedicated to the item called perceived usefulness (see Table 42 and Table 43 for an overview of the items). The results of perceived usefulness are comparable with those of perceived ease of use. The minimum (Min) and maximum (Max) columns indicate that Q7, Q9, Q10, Q13, and Q14 are rated as 3, 4, and 5, and we can conclude that all of the subjects agreed that the approach to sustainable collaboration reduces the effort, makes the correctness of the model easier to achieve, is an improvement on the existing method, makes communication easier, and is a useful method overall. We obtained the worst result (with an average of 3.20) for the question regarding the difficulty to maintain large data models. This could mean that the approach does not necessarily contribute to maintaining large data models correctly. The total average of the Wiki Support Tool is 3.96. A notable result is that subject S1 generally scored the Wiki Support tool above average, with the exception of Q11, which received the following rating: strongly disagree (1). Subject S4 did not provide answers for Q9, Q10, and Q13.

ID	Question in user acceptance form	Item	N/P
PU1	Question 7	I believe that this method would reduce the effort required to document large data models.	P
PU4	Question 8	Large data models represented using this method would be more difficult for users to understand	N
PU3	Question 9	This method would make it easier for users to verify whether data models are correct.	P

PU4	Question 10	Overall, I found the method to be useful.	P
PU5	Question 11	Using this method would make it more difficult to maintain large data models.	N
PU6	Question 12	Overall, I think this method does not provide an effective solution to the problem of representing large data models	N
PU4	Question 13	Overall, I think this method is an improvement on the standard Entity Relationship Model	P
PU5	Question 14	Using this method would make it easier to communicate large data models to end users	p

Table 42: Overview of questions related to perceived usefulness

Questions/results	Min	Max	Average
Question 7	3	5	4.40
Question 8	2	5	3.60
Question 9	3	5	3.75*
Question 10	3	5	4.50*
Question 11	1	4	3.20
Question 12	2	5	3.80
Question 13	3	5	4.25
Question 14	3	5	4.20
Total average	-	-	**3.96**
***= in situations when the subject is omitted because he/she did not complete the question**			

Table 43: Results per question related to perceived usefulness

Intention to use

The intention to use element comprises one question: Q15 (see Table 44). The minimum (Min) and maximum (Max) columns indicate that all the subjects intend to use the Wiki Support Tool. Subjects S1, S3, S4, and S5 answered this question with agreed (4) or strongly agreed (5); only subject S3 scored this question as neutral (3). The average score and total average is 4.20, as indicated in Table 45.

ID	Question in user acceptance form	Item	N/P
ITU1	Question 15	I intend to use this method in preference to the standard Entity Relationship Model if I have to work with large data models in the future.	P

Table 44: Overview of question related to intention to use

Questions/results	Min	Max	Average
Question 7	3	5	4.20
Total average	-	-	**4.20**

Table 45: Results per question related to intention to use

7.3.8.2. Quantitative feedback—Retrospective Think Aloud

The qualitative feedback used the data that are labeled within the node "Retrospective Think Aloud." In most cases, it contains data after completing the experimental tasks; however, in one case, it contains data before the experimental tasks began. The average duration of the Retrospective Think Aloud was 05:45 minutes, as indicated in Table 46. We divided the results into segments that are related to usefulness and intention to use.

Subject	Duration in minutes
S1	04:51
S2	15:49
S3	01:19
S3	03:04
S5	02:11
Average time	**05:45**

Table 46: Results—duration of Retrospective Think Aloud

Perceived usefulness

Based on the quantitative results, we can conclude that, in general, the subjects deem the Wiki Support Tool to be useful, although some changes are required to increase the perceived usefulness: "I think it really looks pretty nice. So if it sounds like I do not like it, that is not really the case, but it is a point for improvement" (Subject S5). The first change relates to the formulation of the content; for example, explain concepts and terms in laymen's terms, as subject S5 stated, "Yes, try to use as much simple language as possible because that really just does a lot better. I think this organization is very good at it, to describe a very small problem, very difficult. Then it all seems very big and complicated. And that only raises thresholds," and avoid academic language: "I think that the power of such a wiki is that the people who are in the implementation not always have an MSc degree, and just have a nice MBO. That is the knowledge, that is valuable for the wiki. Then you have to watch out for a bit of academic language and a lot of English terms, because then that club has just dropped out." Also, subject S2 suggested being careful with jargon: "This is jargon. I do not understand this myself," and subject S5 mentioned that one should keep in that the user does not always have an ICT background and/or experience: "This is beautiful for the people who have that knowledge, but it is a difficult subject. And not everyone is at home in the ICT world. Me neither." Another element that could add value is to make the user enthusiastic to add "powerful" sentences per MODULE with an overview of the exact deliverables; for example, a report: "What I miss here, is that what I do here… I get a bit confused here. Something you can add in the beginning. What if you complete all the 3 modules, and then?" (Subject S1). The content could be extended to include information on how to create a wiki page in the Wiki Support Tool: "Suppose this is really going to work. That you can also find somewhere, that you have to go through all the steps to make a wiki" (Subject S3).

In addition, a suggestion is to clarify whom this wiki tool is for, since it is not only for managers and project teams, but also for everyone who would like to share knowledge. Within RWS, it is especially for people who will be retiring within a few years. The intention of the wiki for RWS is that people gradually store their knowledge during their career: "Purpose of this method ... Managers, project leaders. I would add anyone who wants to share information. Because it's not about those managers, it's not about those project leaders and it's not about those end users. Anyone can simply share that information. Think also about people who are getting retired, and will leave with a lot of knowledge. This person also thinks to himself: I do not want RWS to call me 300 times. I express my knowledge in a wiki, so that they can find this information easily. That is the common ground" (Subject S2). Moreover, on the same subject, there is also a need to provide additional background at the start: "Background, goal ... MODULE 1, 2, 3, more questions or something. Because I first want more context, what can I find here?" (Subject S4). Finally, creating a findable wiki is another aspect that influences its perceived usefulness: "A wiki can also be found by putting words that belong together in a row. You

have to say something about that findability. Applicability and findability, which belong together. But that is my idea" (Subject S2).

Intention to use

Based on the quantitative results, we can assume that the users intended to use the Wiki Support Tool. Subject S1 was enthusiastic about the idea of this Wiki Support Tool because it provides a user with structure, guidelines, and incentives to start a wiki page with more confidence: "I am really enthusiastic about it. At the moment the point is that unsuspecting users lose their way, and when they look at it and think, yes it is all green, now I dare to start." Subject S3 also mentioned that the Wiki Support Tool is clear, and it provides the guidelines for creating a wiki: "Yes, it is clear to me. It gives me handles to make a wiki. How I should do this. What I did not see is how to implement a wiki; how do you create a wiki? Whether I create a wiki with this tool. I assume that when I am following all the steps, that I just make a wiki." Nevertheless, some barriers were detected that could negatively influence the intention to use. In this case, subject S2 mentioned that the content of the Wiki Support is too difficult to understand and therefore expects that no one would invest time in finding out whether he/she would like to use a wiki: "Yes, I think it's too difficult. Nobody is going to invest this time to find out if they want it or not." On the other hand, the overall story of the Wiki Support Tool is reasonable, according to subject S2.

7.3.9. Results—objective data

The objective data contain information based on data from the video and voice recordings. Perceived usefulness measures the efficiency and effectiveness, and perceived ease of use looks at the number of errors and challenges. For the intention to use element, we will use the comments and improvement nodes.

7.3.10. Perceived usefulness

Perceived usefulness is "a person's subjective probability that using a particular system would enhance his or her job performance" (Moody, 2003). In this case, we measured the efficiency based on task completion time, and the effectiveness via task completion.

Table 47 provides the results per subject, per task. We attempted to create the experimental task with an equal difficulty, although we had to take into account the different content of the modules. Based on the results, we can conclude that each subject did complete all the experimental tasks within 60 minutes.

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	MODULE
Subject 1	00:22	03:27	05:45	07:10	10:25	21:12	42:30	1
Subject 2[8]	00:02	01:02	01:22	10:46	19:26	37:46	41:04	1
Subject 3[9]	00:01	05:43	06:10	19:08	21:07	38:43	46:00	1
Subject 4	01:03	02:38	03:58	04:57	06:58	09:53	11:57	2
Subject 5	X	02:23	02:37	06:49	12:11	24:19	42:08	3
Average time	00:18	03:03	03:58	07:40	14:01	26:22	36:43	

Table 47: Overview of tasks' completion times in minutes per task

[8] Subject 2 – Think Aloud session started at 15:49 minutes, calculated the time -15:49 minutes

[9] Subject 3 - Think Aloud session started at 02:00 minutes, calculated the time -02:00 minutes

Table 48 presents the results of the task completion. Subject S5 forgot to check off the first task: "Go to the home page." This subject started this page; however, we could not find information in the data that he/she identified the first task. Therefore, the completion rate is 96%.

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Completion per subject
Subject 1	1	1	1	1	1	1	1	5/5
Subject 2	1	1	1	1	1	1	1	5/5
Subject 3	1	1	1	1	1	1	1	5/5
Subject 4	1	1	1	1	1	1	1	5/5
Subject 5	0	1	1	1	1	1	1	4/5
Completion per task	4/5	5/5	5/5	5/5	5/5	5/5	5/5	
1 = completed, 0 = not completed								

Table 48: Results of the tasks' completion

7.3.11. Perceived ease of use

Perceived ease of use "refers to the degree to which a person believes that using a particular system would be free of effort" (Moody, 2003). During the Think Aloud sessions, two subjects (S2 and S3) required some correction/help during the execution of the tasks. Although both subjects performed the correct activities, they were located on the wrong Wiki Support Tool page, as the below dialogue demonstrates:

Subject S3: "Do you want me to fill this in 100%?
Observer: "Actually, you have to be at another module."
Subject S3: "Are you serious?"
Observer: "MODULE 1.1. now you would like to continue with the specification of the wishes and needs of the stakeholders.
Subject S3: "Oh, I did it wrong…"

See Table 49 for an overview of the completion per subject/task.

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Help per subject
Subject 1	0	0	0	0	0	0	0	0/5
Subject 2	0	0	0	1	0	0	0	1/5
Subject 3	0	0	0	1	0	0	0	1/5
Subject 4	0	0	0	0	0	0	0	0/5
Subject 5	0	0	0	0	0	0	0	0/5
Help per task	0/5	0/5	0/5	2/5	0/5	0/5	0/5	
1 = needed help, 0 = no help needed								

Table 49: Results for help needed per subject/task

7.3.12. Intention to use

Intention to use is defined as "the extent to which a person intends to use a particular system" (Moody, 2003). For the intention to use measurement, we used the commentary—the nodes comments and improvements—starting with the comments per subject.

Subject 1

Subject S1 found the brief and to-the-point nature of the Wiki Support Tool appealing because everything could be seen at a glance: “It is condensed text, that is pretty nice. You see everything in one glance.” Subject S1 was also positive about the protocol and the content: “And a protocol that shows the elements for a good analysis ... That's nice. It is an enrichment; I can also reuse that. I can do that in other places.” During the implementation of the approach to sustainable collaboration in the Wiki Support Tool, we tried to make it compact so that the user could digest all the elements of the approach easily. Subject S1 appreciated the used formulation: “What I see here, it makes me curious. I keep clicking through, separate from the assignment. I like that. It is attractively formulated.” However, I need to ensure that I do not use too much jargon, since it can negatively influence the readability of the approach: “Integration. Sponsor. This is a lot of jargon. If you are an expert, you understand these terms, but if you are not familiar with these terms, then you do not know exactly what it is about.” Also, a wizard would be a sufficient option for implementing the treatment design: “This is also useful. The click is good on sight. It is also intuitively good. If you go there, it will be fine again. That's nice.”—MODULE 1.

“That knowledge management and corporate culture are not necessarily in line with each other is just the opposite. That is a very good one. Very recognizable. Good to do this check” (Subject S1).

Protocol MODULE 1.4.—Subject S1 recognized the used language in the questionnaire to evaluate the relationship between KM and organizational culture within a company. A suggestion from subject S1 is to provide an even rather than an odd number of options because it provokes people to choose a direction. Another consideration is related to the OCAI tool. Subject S1 suggests expanding the scores for the future perspectives. For example, at the moment, the score is 100 for both situations (current and future); it may be an idea to raise the future score to 250 in total: “Then you can see there are a few notches allowed, and for some aspects a notch less. That is fun. In this way, the information becomes a little bit smarter.”

“I notice that this is a gold mine. And that it is for the unsuspecting user, which can be further helped to translate into practical consequences. Now this is interesting.”

“It is called a module, so that is for someone who sees this for the first time and then never in his life anymore, that is to look at, to those words. People who are sensitive or who find it exciting. Who then no longer understand what the difference is between a module, form, and protocol because the terminology is correct.”

Protocol MODULE 1.1.—An idea for this protocol is to specify the stakeholder more thoroughly in order to define stakeholders who notice benefits or, on in contrast, drawbacks (such as extra work or costs), or to define colleagues who get involved. This challenges the user to think from a more broader perspective.

Subject 2

Overall, subject S2 was somewhat skeptical about the Wiki Support Tool; he/she was unsure whether a user would understand the value of the tool, stating that “I am wondering a bit… When someone is going to create wiki, and then think… Is he/she really fill-in these questions? I think the user does not

understand why he/she has to answer these questions. It is very thorough, but then?". Subject S2 mentioned that one has to deal with individuals with different backgrounds in terms of their studies, knowledge, or experience, and he/she also stated that the overall purpose of the Wiki Support Tool is not clear. Subject S2 felt like the purpose of the approach is about making the decision as to whether to implement a wiki or not. Another improvement we could made in the Wiki Support Tool is to incorporate more tangible examples—providing more descriptions that suit the users: "Try to be a bit more descriptive. Not too big but stick to the practice." Since some knowledge is only explicit knowledge, which can be captured in report or other static medium, the Wiki Support Tool also needs to answer the following question: is the wiki a suitable communication medium for me?.

Subject 3

Subject S3 as mentioned that we need to avoid jargon and elaborate on the meaning of a concept or term more thoughtfully: "Have a look. The execution method. Do I understand what it says? The user is helped step by step ... I do not know what a wizard environment is. But I would find that later… I think." A point to retain is to provide some background information about the content of the Wiki Support Tool; i.e., that it is derived from a master thesis. This little information can build the user's trust in the tool: "I really like that research data is mentioned. It gives a familiar feeling, say. A solid feeling. That it is not just something." The final improvement suggested by subject S3 is to offer more guidance regarding the execution; for example, mention beforehand how much sections/question a questionnaire has.

Subject 4

Another improvement relates to the names of the modules and the sub-modules. In the Wiki Support tool, the sub-modules are labeled as, for example, MODULE 1.1. or MODULE 2.2. The name conversion of the sub-modules and modules can lead to some confusion: "Which modules must be implemented to complete MODULE 2? I find that a bit confusing. Maybe sub-modules? Because which modules do I have to do to complete MODULE 2 completely. Have a look."

Subject 5

MODULE 3—Subject S5 appreciated the protocol with elements to identify the barriers: "I think it is a nice form. Just clear, what are the thresholds. I am looking at the top of the form. There you suggest that the barriers can be divided into technical, people-oriented, economic, and organizational." It allows the user to think further, taking into consideration the four different perspectives, and it provides the user with a view of all the issues and how they are related to his/her working environment. Subject S5 also emphasized the importance of communication: "I also think it is very important that the phenomenon wiki needs a lot of communication, at least more than what is happening at the moment. Just by telling how useful having a wiki is. But also come with good examples about existing wiki pages."

MODULE 3.2.—We attempted to be consistent in text through using similar words; however, this sometimes led to redundant information: "If I am very honest, then I have the feeling that I often read the same things on this page. At least, in the head, that's what I think ... I read 3x confirm the users, and then there is on the right side, confirm the expectations of the stakeholders. And the protocol also consists of confirming the expectations of the stakeholders." Another consideration is the formulation of the questions or statements in the forms; sometimes, they are formulated as negative statements,

which can influence users: “My experience with the RWS wiki ... It is very clear. The questions actually suggest that you do not have such high expectations. I think that is a bit of a shame about the question. I would like to ask something about the performance. Something of: how did you experience that? But the question seems a bit like that, the expectations were not so high and then it is now better than expected. I would be slightly more positive.”

7.3.13. A list of improvements per module

Throughout the execution of the treatment validation, interesting improvements appeared. Below is a summarized list of these improvements:

- MODULE 1.4. is missing some elaboration regarding why the human factor is inextricably linked to a successful implementation of a wiki. The subject mentioned the absence of an explanation and an example of this subject; i.e., a description of how the influence of an organizational culture contributes to the success or failure of an IS implementation. → *“It is there, but I miss the explanation. I want to believe it, but what is the reason? It is a result based from literature, but that they can also give an example. That the culture contributes to the success or a failure.”*
- We also need to make further refinements to the Wiki Support Tool; for example, providing better explanation of the concept we mentioned. → “However, I wonder why it is important to know what kind of conflicts arise. I understand that it is useful to know who is involved, who your stakeholders are. You can focus your page on those people. I do not understand so well what a conflict then could be. That could perhaps be explained somewhere, if people would like to know” (Subject S3). Subject 5 also mentioned that some concepts could be explained more extensively → “MODULE 2, for example, the implementation in the navigation, I read that on the screen and on the page. It gives some interpretation. Not very much. Remains very limited.” (Subject S5).
- *MODULE 1.4.* Another way in which to improve the Wiki Support Tool is to make it more concrete regarding which perspective is needed—the department, the division, or the organization as a whole.
- *MODULE 1.* The subject suggests using terms and concepts that are used within the company; i.e., customize the Wiki Support Tool to a certain situation. The reason is that this could enhance the user acceptance.
- *MODULE 1.4.* Some doubts arose regarding the OCAI tool; subjects questioned whether the future aspect is necessary. Also, suggestions were made to make it more concrete in terms of time. → *“That is a bit vague… You need to fill in based on what you think that fits best to stay successful… You could make it more concrete. For my part, you put down 5 years, so that people do not take a year or 10 years. I always know people who avoid answering these questions.”*
- *MODULE 1.* Since the approach to sustainable collaboration is applicable to a wide variety of users (technical as well as non-technical employees), it is necessary to make the terms and concepts more concrete → *“What the meaning of these terms or concept are, I need to guess it.”*
- *MODULE 1.4.* In the Wiki Support Tool, the relationship is between the organizational culture and KM is not clear. → “What does the culture for knowledge management mean? I cannot see that confrontation yet.”

- *MODULE 1.4.* During the design of this approach, as far as possible, we attempted to create a complete implementation approach to sustainable collaboration. However, there is a risk that the approach is too comprehensive. → "There is a lot of information coming up and there is a risk that people drown in that information due to the fact that they are provided with too many interesting things." (Subject S1).
- *MODULE 1.* Another result is that the subjects require more practical guidelines. → "This is very good basic material, but there is still a need to draw the conclusion. That is then another one that needs to be added, but the run-up is very good." (Subject S1). In addition, Subject S2 mentioned the importance of translating the approach into laymen's terms. → "This is about explicit and implicit knowledge. Sure, I get it, but I really need to think about it. It may be me, but I do not know. I find it very difficult. You have to realize that the wiki is made by customers, in any case, which I have spoken, not by the scientifically educated." (Subject S2). Subject S3 stated, "That would be great, whether you see the results immediately, when possible. Because certainly, if you want to do that for the user… If you are a student, you are still in this kind of graphs, but I do not. That you get something of a direction, how to read this."
- *MODULE 3.* Some improvements could be made in terms of the order of the confirmation questionnaire. → "Actually about the whole form. Think about the order of the questions. Because if you ask these kinds of questions. They are very easy to answer because that is just about their experiences; Do you like it? These are very simple. Either you finish with it, or you start with it as an introduction. Now the situation is that you are thinking deeply about a subject, and then these simple questions appear. Just think about the structure of your questions; then it gets easier and then it gets more difficult, and at the end, you have to have a few nice valves. But now it is a bit mixed up. With this there is also a little overlap …"(Subject S5); therefore, some checklists or a shop model should be created.

7.4. Expert opinion

In addition to the single-case mechanism experiment, we gathered expert opinion from an expert in the field of IS, which is also advanced in conducting scientific research, including design science research. The expert opinion was conducted with one subject, during which time we also used the Wiki Support Tool. An expert is used as an instrument to "observe," by imagining, a validation model of the artifact. The aim of the expert opinion is to evaluate the approach as a whole rather than each module individually from an objective perspective.

7.4.1. Goal

This expert interview is an extension of the single-case mechanism, and it aims to validate the main objective of the study by means of analyzing the modules together. During the execution of the single-case mechanism experiment, we treated each module in such a way that it could be performed individually with the purpose of being situationally oriented; i.e., the approach can support different situations to implement a corporate wiki. However, through the expert opinion, we would like to gain further understanding of the approach to sustainable collaboration as a whole in order to evaluate how all the elements together would contribute to sustainability. The general aim of the expert opinion is to obtain answers to the questions below:

- Based on your knowledge and experience within ICT, do you think these elements can contribute to a corporate sustainable wiki? And why?

- Which elements do you think have a positive influence on the sustainability?
    - Are there elements that are missing?
    - Why are these elements important?
    - How do they contribute to sustainability?
- In general, do you think the Wiki Support Tool can help to ensure the sustainability of a corporate wiki?

Afterward, we evaluate whether the predicted effects do or do not satisfy requirements; this could be a reason to redesign the artifact.

7.4.2. Subject and object

"Validation by expert opinion only works if the experts understand the artifact, imagine realistic problem contexts, and make reliable predictions about the effects of the artifact in context" (Wieringa, 2014). An expert is an individual who can first imagine how such an artifact will interact with the problem contexts that he/she conceives and then predict the subsequent effects. There are three substantial requirements for successfully performing an expert interview, as illustrated in Figure 78. First, the expert must properly understand the artifact. As previously mentioned, the artifact is the approach to sustainable collaboration (the Wiki Support Tool). The expert we selected has the following knowledge and experience to indicate the tool's suitability:

- Was involved in a KM project within RWS for approximately two years as an IT consultant (2 years ago);
- Has experience with the design science approach;
- Fulfills the roles of IT researcher, developer, and consultant;
- Completed a Ph.D. in the field of IS—about metaphors in systems;
- Has knowledge about sustainable systems and systems using Wiki technology.

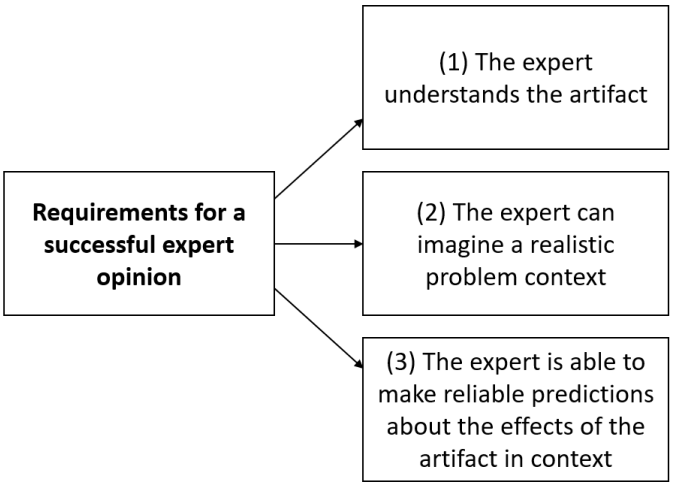

Figure 78: Requirements for successful expert opinion

The second requirement is that the expert can imagine a realistic problem context. Since the expert was involved in a KM project within RWS, and based on the fact that his daily occupation was as an IT researcher, a developer, and a consultant, he meets the second requirement. The final requirement is that the expert is able to make reliable predictions about the effect of the artifact in context. Since the selected expert has a clear view of both RWS itself (such as the organizational culture, processes, and

decision -making of management) and the knowledge during various studies, we could establish that he is able to make predictions about the effect in context—in this case, a governmental institution.

7.4.3. Instrumentation

For the expert interview, we used the instruments described in this paragraph. We began with the printed document, which contained the informed consent (see Appendix B) and an overview of our proposed design to provide the subject with an idea of the structure of the approach to sustainable collaboration (see Chapter 1.6). One major requirement for conducting a valid expert interview is that the subject understands the artifact and the problem context. Despite the fact that the subject was already reasonably familiar with the problem context and the artifact, we still delivered a PowerPoint presentation, which summarized this whole study. Furthermore, we recorded the entire evaluation for analysis purposes.

7.4.4. Preparation and operation

The preparation for the treatment validation of the expert opinion starts with selecting an appropriate subject. As mentioned before, we must ensure that we select a subject who has knowledge about the artifact and problem context—see Chapter 7.5.2 for the exact requirements for successfully performing an expert opinion session. My second supervisor at RWS suggested someone who is academically educated and has an IS background, and this person also participated in projects within RWS for approximately two years. After contacting the potential subject, we established that this person could provide us with valuable information to validate our approach to sustainable collaboration. We conducted the interview in June 2018, and we followed the procedure illustrated in Figure 79. To ensure that the subject was aware of the purpose of this evaluation study, we provided him with a short introduction to the purpose of the evaluation study, followed by a presentation supported by PowerPoint slides to offer the subject a total picture of the study (duration: around 15 minutes). After the presentation, we asked the subject to complete the informed consent, and we presented an overview of our proposed design (duration 5 minutes); during this step, the subject could ask further questions about the expert interview. The final step was to gather the expert opinion itself (duration: around 40 minutes). The main aim was to obtain high-level feedback because of the time frame, and we also conducted the Think Aloud session per module. In this validation study, we were also interested in the overall validation of the modules combined.

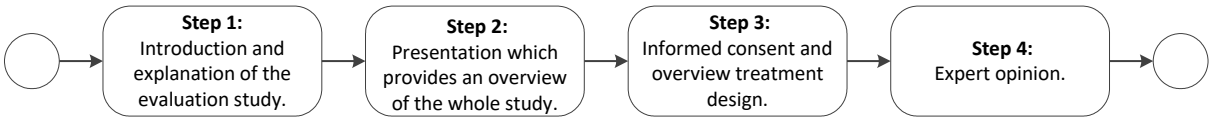

Figure 79: Process execution expert opinion

7.4.5. Data validation and data analysis

For the data validation, similarly to the single-case mechanism experiments, we also handled the verbal protocols, which are accessible for everyone as data; therefore, it can be seen as an objective method. To analyze the data, we first partly transcribed the video recording using tagging (also used in Chapter 1.4.3.). During data collection, we have to deal with two situations: positive and negative opinions. In general, negative opinions are more useful than positive opinions because they provide early indications of improvement opportunities for the artifact. According to Wieringa (2014),

"Negative opinions can indicate conditions of practice not thought of by the researcher. Expert opinion is useful to weed out bad design ideas early." In Appendix K the data (tagged quotes) of the expert opinion is provided.

7.4.6. Results—expert interview

The results of the expert interview are divided into two elements: (1) background information of the expert and (2) positive and negative opinions, as depicted in Figure 80. During the background section, we wanted to validate the ability of the expert. The second part relates to the expert's opinion regarding the effects of our approach to sustainable collaboration (see Table 50 for an overview of the results and whether the opinion is positive or negative). In Appendix I the structure of the expert opinion is shown (in Dutch).

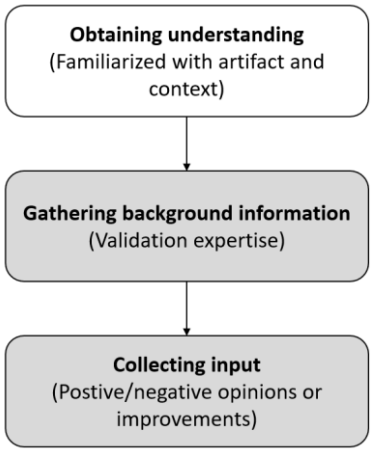

Figure 80: Overview of elements from the results of the expert interview

ID	Opinion	Positive/negative/improvement
OP01	It is concrete	Positive
OP02	Need for a support team or department	Improvement
OP03	It provides structure	Positive
OP04	Differences in interpretations	Negative
OP05	Connect it to practice	Negative
OP06	It provides more understanding	Positive
OP07	Relate to different structures	Negative
OP08	Organizational culture	Positive
OP09	Barriers to the maturity level and experience/knowledge	Negative
OP10	How to manage the accessibility of the approach	Improvement
OP11	Perspective of the approach	Improvement

Table 50: Overview of expert opinion

The three types of opinions listed in Table 50—positive, negative, and improvement—are explained below.

- *Positive opinion*—this opinion suggests that an element of the approach or the approach as a whole can contribute to the objective of the study, namely to ensure the sustainability of a corporate wiki. Therefore, a positive opinion is related to the strengths of the approach.

- *Negative opinion*—this opinion suggests that there are some weak elements in the approach. These weaknesses could be converted to improvements.
- *Improvement opinion*—the improvement differs from the negative opinion; it provides suggestions that could improve the approach, and it is not related to a weakness of the approach (or an element of the approach).

Background of subject

The subject is an independent operator and serves as a professional operative to guide positive organizational change through the use of improvisations, value networks, and meaningful ICT; his focus is in the field of healthcare and health services. The subject stated that there is a need for an integrated approached in IS: "It is not only about the physical but also about the inside. No duality, but an integration of something. What do you get when you see this?". Healthcare support also frequently uses IT; therefore, the subject stated that his organization works with open IT standards in that particular landscape for various stakeholders. These standards are specifically designed with a community of IT suppliers, who are often competitors, so that the standards are truly related to the practice. Since there are many standards that originate from either the theory or worldwide standards in IT, the following challenges may appear: how to apply these IT standards, or how to use them in a way in which people benefit from them.

Next, we describe the subject's method of working. The starting point is a discussion with all the suppliers to determine which standards should be applied in context. In many situations, an organization uses multiple systems, and the main challenge is to ensure that they are operational through one entity. Therefore, the subject's specialty is developing the method of working. This was also the topic of his Ph.D.—how metaphors play a role in this situation and how we can design relatively with them. The subject was involved in a project to provide support to the CoPs: " I actually had to make sure it was suitable for the community of practices and for the knowledge fields. That the requirements of the knowledge fields entered the system well. In practice, it came down to the fact that the program was very stuck, at a given moment. That we actually made a kind of plan B. To make that program a little easier or to develop an alternative, as long as the program yielded something. So that one could continue with the KM process. One of those alternatives was to work with an open-source wiki." In the context of RWS, the IT standard was not about whether SharePoint or MediaWiki should be used to perform KM activities, but more about ensuring that agreements are both made with a specific knowledge domain and can be displayed in a semantic way, for example in an ontology in the knowledge domain and in CoPs. Furthermore, if that ontology is available in a technology-independent manner and managed by RWS, then people must be able to use it in different systems so that they can relate relationships therefrom. This way of thinking was difficult to adopt within the organization, since the employees believe that the system or IT solution will solve all the problems. This is a maturity issue for management—to really support those kinds of ideas while there was a network of experts within the organization who were willing to work together with this vision.

Opinion 1: It is helpful in the sense that it is concrete

Generally speaking, the expert notion is that the Wiki Support Tool could be helpful for RWS. Based on the subject's experience, RWS is an organization whose staff hold many meetings and conversations. In addition, employees also need to discuss projects thoroughly. The risk arises that they become stuck and do not concretize anything: "I think that this is very helpful, knowing RWS. Because it is an

organization where a lot of meetings take place. A lot of conversation and the need that people discuss thoroughly; talking about it, but there is also a risk. Because they get stuck very much into it. Without making things concrete. This approach is very concrete. So if I want to do something, I will go through this, step by step."

"That in his general comment. I think this helps enormously, just to make it concrete."

Opinion 2: Provide support
A suggestion to improve the approach to sustainable collaboration is to provide a support team or department for users who have questions or run into any problems: "And if there is also a support team or department, such as a KM team, if I have questions, or I run into something, the better."

Opinion 3: It provides structure
Opinion 3 is an extension of opinion 1, and it states that the approach provided structure: "But with this you offer structure. I think that it is crucial to have a project succeed. The multitude of languages and the need to consult can result very quickly in an impediment." This way of working is suitable for the organizational culture within RWS, especially for the knowledge domains, although it may be less suitable for the management or staff: "And then I am talking about the culture that I have experienced. This is an intervention on its own; doing it in such a structured way. Which also fits, in a certain way, with the culture. Especially for the people who are occupied in the knowledge domains. Perhaps not so much for the management and the staff, but for the people from the business at Rijkswaterstaat." I also think these employees understand the content of the approach, given the high maturity level of their project management: "They understand these things. The level of project management is perhaps the most mature when it comes to those outsourcing of project from 30 years or projects of 1 billion."

Opinion 4: Different interpretations
One comment during the Think Aloud sessions was that the approach was too difficult to apply. The expert also mentioned the difference between the analysis method from individuals with an MSc and those with a BA study, although BA studies nowadays pay more attention to research methods, and MSc studies focus more on practice. Therefore, the expert's opinion is that the elements of the approach to sustainable collaboration should not be idiosyncratic within RWS.

Opinion 5: Connect it to practice
The expert stated that it is possible for some methods to become vaguer for employees because they may have rigidly looked to a method for a long time. Therefore, the approach needs to be connected to people's daily practices and experiences: "The question is, how concretely does it fit in with their practice, or their daily experience. If you connect with it for a moment, you will get through it."

Opinion 6: It provides more understanding about what organizational culture could mean
According to the expert, much sense-making is occurring within RWS regarding the organizational culture. However, it is unclear whether that is reflective awareness about the corporate culture. This could be a great advantage of the wiki—making users aware that they evaluate the organizational culture and understanding what that means for implementing a wiki page. However, it is also possible that analyzing the organizational culture in order to implement a wiki page is overwhelming; the expert did not know the exact answer. This could be determined through observation rather than analysis. The expert mentioned previous research, where they observed employees to determine the proper set up of an office. During this research, employees were asked to describe their daily activities, for example time spend and way of working. In this case, the requirements are not immediately acquired; instead, one gains further understanding about the indirect requirements because, as a designer, one can observe what people do and then build the structure of the wiki so that knowledge will be shared, which provides a different approach as a designer.

"It is possible that, as a designer, you unconsciously turn the user into a designer."

Opinion 7: Relate to different structures
Another suggestion is to specify the target group of the approach in more detail. Instead of creating an approach for all the users, we have to characterize a typical user of our approach and then relate him/her to different structures. For example, within RWS, we recognized a knowledge domain; this knowledge domain consists of one or more sub-knowledge domains, and each sub-knowledge domain can be related to other sub-knowledge domains and have a CoP, which is a one-to-one entity. Figure 81 depicts these relations in a class diagram.

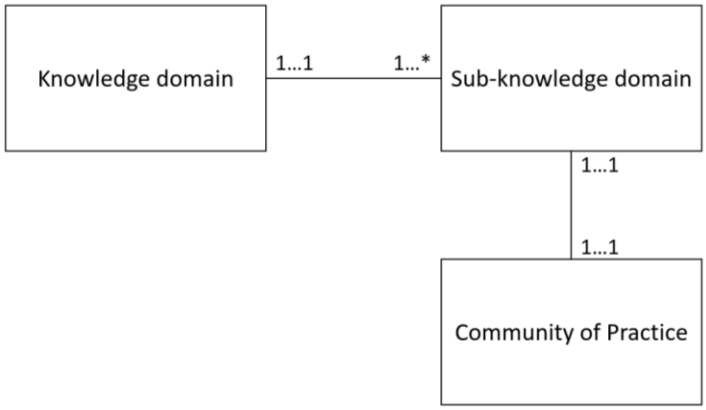

Figure 81: Knowledge domain and sub-domains and their relations

To reduce the threshold for different types of users, an idea is to design the approach in a way that allows different structures. For example, in the situation of RWS, three types of users were established: users who would like to create a wiki page for the whole knowledge domain, users who are interested in a certain sub-knowledge domain, or users who would like to create support for their CoP. The knowledge domain is related to the whole approach, and the sub-knowledge domain and CoP are subsets of the approach. Therefore, the knowledge domains have the opportunity to determine a well-considered strategy for their KM collaboration, which is also important for the sub-knowledge domains and the CoPs. Nevertheless, since the knowledge domains have already defines their strategies, the sub-knowledge domain and CoP could adapt this strategy and thus avoid redundant work. The expert

suggested that the threshold is not dedicated to the complexity of the approach alone; it is necessary to define a proper strategy to create something sustainable—something RWS definitely aims for.

Opinion 8: Organizational culture

Evaluating the organizational culture can be considered to be a valuable instrument for the organization; it provides reflection and more perspective about the organization. With this information, a wide variety of applications are possible, such as determining the style that is needed for maintenance. For example, when a project is more family- or collaboration-oriented, Action Research could be a recommendation: "This is a very valuable tool. With perspective and the reflection thereupon, and with this tool, you can apply a lot of things, such as what kind of style do you need for the maintenance. Is it together or per project? If a project more family or in a collaborative way, you can, for example, recommend Action Research. When a department is more structured, then you need another approach. In this way, you can vary per approach." The aim of this approach is not to establish the best practice; there are fundamentally adequate practices, although choosing the most suitable approach depends on the organizational culture. In this way, it also becomes easier to perform and complete projects successfully.

Opinion 9: Barriers to the maturity level and experience/knowledge

One barrier that could arise during the execution of the approach is the maturity level of the users. For example, the execution process of the approach is different for an individual who has never heard of the concept of organizational culture and one who has experience with evaluating organizational culture. The former is not able to deploy the organizational culture evaluation in a strategic way. An idea is to measure the maturity of the knowledge per aspect (for example per module or concept) before adapting the approach.

Opinion 10: How to manage the accessibility of the approach

Even though adding a maturity model or measurement will increase the understandability of the approach, this element could make the approach more complicated. The more elements and/or information an approach contains, the more intimidating the approach will be. Therefore, it would be ideal to create some kind of intake that extracts the information, given the level of the goal, that can be related to certain aspects—a type of quick-scan based on, for example, duration of implementation (within 4 weeks or 3 months), business vision, capacity, interest in subject, experience, maturity, and goals. The approach consequently becomes richer on the one hand and more accessible on the other.

Opinion 11: Perspective of the approach

Another consideration is some confusion about the subject in the sentences—whether it is the project manager or a group of individuals. More specified information is desirable regarding the context before the user will take further steps. For example, the following questions should be answered upfront:

- Is this activity performed with one or more people?
- Who is the reader of the wiki page?
- How does the user revise the context of a wiki page?
- What are the requirements to successfully complete this approach?

These are the prerequisites before someone starts a wiki project. The expert suggests writing these in the supplier-customer language; however, this language does not clarify how the stakeholder should be involved per step.

In general, the expert stated that the approach is a complete list of elements, with literature to support it. Some elements sound old, such as 2.0 applications, since they stem from older literature. While such labels are undoubtedly true and typical in the software industry, they have a certain shelf life. Collaboration, interaction, and applications, which are themes that originated in the 1940s, are still themes and always will be. However, we call them by other names no—different from those in literature, which is from 2005 or 2006.

"The analysis of data will not by itself produce new ideas…"
(Edward de Bono)

7.5. Validity evaluation

During the treatment validation of this study, we considered the four types of validity: (1) conclusion validity, (2) internal validity, (3) construct validity, and (4) external validity. First, conclusion validity refers to the extent to which the data from certain research can reasonably be regarded as revealing a link or a lack thereof between dependent and independent variables. Second, internal validity refers to the degree to which the researchers ensure that extraneous variables have been controlled and confounds have been eliminated. Third, construct validity is about the use of well-established definitions and measurement procedures for variables. Finally, external validity is concerned with the method of observation; it assesses whether the observation and measurement of dependent variables are performed under natural conditions.

7.5.1. Conclusion validity

The ultimate goal of research is to produce dependable knowledge. Conclusion validity comes into play when the conclusions of a study are gathered based on an adequate analysis of the data. This generally means that, besides the fact that the analysis is capable of providing an answer to the RQ, adequate statistical methods are used, and their small-sample behavior is accurate (García-Pérez, 2012). Conclusion validity is relevant in situations where researchers attempt to decide whether there is a relationship in the observation; it is basically the degree to which conclusions are reasonable based on the data. Conclusion validity is actually only concerned with whether there is a relationship (or not). There are two possibilities when investigating a relationship: either there is a relationship in the data or there is no relationship. In both cases, it is possible to draw incorrect conclusions. For example, researchers can conclude that there is a relationship when in fact there is not, or they might infer that there is no relationship when in fact there is, but they did not detect it.

In terms of conclusion validity, this study is affected by three threats. The first one relates to the reliability of the data collection measures. Since we used both video and voice recordings, instead of only voice recordings, and/or notes throughout the Think Aloud sessions, we separated the collection of objective measurement from human judgement (of the observer); therefore, we can consider our data collection measures to be reliable. Furthermore, we also increased the reliability of subjective measures by using scales that were previously validated in other studies—in this case, the Method Evaluation Model by Moody (2003) and a five-point Likert scale. Despite the effort to create similar experimental environments, the fact that the Think Aloud sessions took place on different dates could be considered as a threat. To reduce this threat, we attempted to provide each subject with the same environments; however, in some cases, external noise could have led to distractions. Furthermore, we tried to reduce the random heterogeneity of the subjects by evaluating their experience beforehand.

7.5.2. Internal validity

To eliminate or control the extraneous variables and to rectify the internal validity of this study, we have to consider the following two threats that affect that internal validity: maturation and social threats. Furthermore, to obtain external validity, we first need the required internal validity. Maturation refers to the reaction and behavior of the subject during the experiment, such as concentration loss or time pressure. To minimize this threat, we set up the Think Aloud sessions so that the subjects could finalize the tasks within one hour. We also explicitly mentioned to each subject that completion of the tasks is not the main goal of the study; it is about learning and get more understanding about the approach to sustainable collaboration. With regard to social threats, we managed to avert them due to the fact that the Think Aloud sessions were held individually rather than in a group. Besides, the Think Aloud sessions were divided into three different experimental cases, so it was not possible that one of the subjects had inside information about the experimental tasks. The observer also asked the subjects not to talk about the experiment during the execution period.

7.5.3. Construct validity

Construct validity is concerned with the use of well-established definitions and measurement procedures for variables. In our case, there were two threats that affected the construct validity of this study. The first one is about reducing hypothesis guessing by hiding the goal of the study and the mechanisms that were used to collect the data. In this regard, the observer only explained to the subjects that this experiment was testing the treatment design; no mention was made of the used measurements. In this way, the subject could completely focus on the experimental tasks at hand in the most spontaneous way possible. The second threat relates to the effect of the experimenter's expectancies. The observer attempted to minimize this effect by allowing interaction during the experimental tasks only when necessary. In this case, the subject was only allowed to talk to the observer when there were urgent questions about the experimental tasks. Before commencing with the experiment, the observer also mentioned that she would not talk during the experiment and would only observe and take notes. Nevertheless, to create a comfortable environment for the subjects, it was possible to ask questions throughout the experiment.

7.5.4. External validity

External validity is the extent to which the conclusions can be generalized to, among other things, the entire population, groups, persons, or other situations. For our study, we are interested in other situations (i.e., governmental organizations), in which case the approach can be used.

During the execution of our study, we detected two threats that affect the external validity. The first threat involves the selection of subjects who are not representative of the population of interest. We minimized this threat by selecting subjects based a non-probability sampling technique, namely snowball sampling, in which selection was based on different expertise within a network. Due to the non-probability factor of this sampling technique, the bias we have taken into account is the fact that the subjects were selected based on other subjects' suggestions/opinions; therefore, direct colleagues had higher chances of being recruited for the research.

The major advantage of the snowballing sampling technique is that it is an appropriate method for collecting expert information. Snowball sampling can be used to identify and select experts/individuals

in a specific field—in this case, experts who would like to perform KM initiatives with the use of a collaborative IS integration. Alongside the advantage, we have taken into account the disadvantage related to this sampling method. The first disadvantage is communication bias, which refers to the strong impact of the first subject on the sampling process. The risk of snowball sampling is that it can be inexact and lead to varied and inaccurate results. This method depends not only on the skills and expertise of the individual conducting the actual sampling, but also on his/her ability to vertically network and suggest other appropriate subjects. To address this risk, it is important to have contacts within the target areas. We did this through updates via presentations about the state of work of our study or an update per email contact. Also, the first subject was closely involved in this thesis project; however, he/she was not informed about the execution of content of the experimental tasks. Therefore, while the first subject did have knowledge about the research area, he/she was not affected by the purpose and the goals of the treatment validation part.

Another disadvantage is that the snowball sampling technique is not random; therefore, it contravenes the assumptions supporting conventional notions of random selection and representativeness. Other disadvantages are unknown sampling population size; unknown total size of the population; and lack of control over the sampling method, meaning the known sampling pool using a method outside of the researcher's control. The second last disadvantage needs to be considered during our conclusion and discussion, and we attempted to negate the last disadvantage as much as possible by first holding discussions with several individuals within the organization.

For the second threat, which involves an inadequate experimental setting, we utilized a tool that is commonly used within governmental organizations: an Intranet environment (Chapter 6.3 describes the Intranet). In this case, we attempted to simulate a familiar environment without the risk of anxiety related to new technology. In this way, the subjects could focus on, evaluate, and validate the designed treatment design.

7.6. Summary

For the treatment validation, we conducted a single-case mechanism experiment. The researcher applied stimuli to a validation model and explained the response in terms of mechanisms that are internal to the model. In this case, we built the Wiki Support Tool in its intended context, and tested it with scenarios to observe its responses; this was done with the support of the Think Aloud Method and Retrospective Think Aloud. The general goal of the treatment validation was to evaluate the effects of implementing a sustainable collaborative approach regarding stakeholders' perceptions. In part I of this thesis, we established that sustainability means that a wiki page will have continuity for between 12 and 24 months. The expert opinion is an extension of the single-case mechanism, and it aims to validate the main objective of the study by means of analyzing the modules together. The total average task completion time was 36:43 minutes, with the fastest subject having a task completion time of 11:57 minutes, and the maximal duration time was 46:00 minutes. The effectiveness score (task completing) was 96%, which means that only one subject did not complete one task; in this situation, the subject forgot to check-off the first task, which was to find the home page. To determine the extent to which the Wiki Support Tool can be used free from difficulty (objective measurement is perceived ease of use), we used the node error: when the subject made an error while executing the tasks. In total, two errors were made: task four, subjects S2 and S3. During the expert interview, the subject stated that, on the one hand, the approach is a complete list of elements with literature to support it

and that it provides structure, guidelines, and concreteness. On the other hand, more studies and improvements are required in terms of the specification of the structure, accessibility, and utility, among other things. During the treatment validation of this study, we considered the four types of validity threats: (1) conclusion validity, (2) internal validity, (3) construct validity, and (4) external validity.

Part VI:
Conclusion and future work

Chapter 8: Discussion and conclusion

"Science is organized knowledge. Wisdom is organized life."
(Immanuel Kant)

8.1. Discussion

This MSc thesis presents the initial fundamentals for an approach to sustainable collaboration to support KM initiatives. The general purpose of this approach is to provide structure and guidelines to each type of user so that he/she can successfully perform a corporate wiki that fulfills the requirements for sustainability. These requirements are that the wiki must be in existence for at least 12-24 months, and it must also contain content of a sufficient quality (this can be determined based on the contributors and participants—the number of contributors, the number of lurkers, and the level of expertise, among other things). With the support of the ME technique, we evolved the approach with design chunks from literature. Thereafter, we evaluated the approach during a single-case mechanism experiment using the "Think Aloud Method" and through one expert interview. The most relevant aspects are highlighted below:

- A wiki tends to be sustainable if it exists for between 12 and 24 months. To obtain such a sustainable wiki, the following main challenges need to be overcome: (1) the alignment of manager and individual contributor expectations, (2) organizations' content and its flexibility, and (3) the positioning of a wiki in an existing ecology and corporate culture. These three challenges are used as the foundation of the approach, and throughout this study, these challenges were evolved by making them more specific and extending them with a further literature study.
- An approach to sustainable collaboration is a possibility to ensure the sustainability of corporate wikis. This approach was created from design chunks of the Stakeholder Theory, Expectation-Confirmation Theory/Model (ECT and ECM), Enterprise Modeling, Organizational Culture Assessment Instrument (OCAI), KM Assessment Instrument (KMAI), and concepts for providing a suitable format and for eliminating the barriers.
- With the support of the ME technique, the approach to sustainable collaboration was designed. The approach essentially contains three main modules, and each module consists of multiple sub-modules, as described below.
    - MODULE 1—the preparation—is divided into the following:
        - MODULE 1.1. Identify the stakeholders;
        - MODULE 1.2. Align needs and requirements of the stakeholders;
        - MODULE 1.3. Analyze business processes, systems, and applications; and
        - MODULE 1.4. Evaluate organizational culture and environment.
    - MODULE 2—the execution—consists of the following sub-modules:
        - MODULE 2.1. Analyze information needs in a specific knowledge domain, and
        - MODULE 2.2. Identify a suitable format for a wiki page.
    - MODULE 3—the maintenance—is divided into the following two sub-modules:
        - MODULE 3.1. Support user participation and eliminate barriers, and
        - MODULE 3.2. Confirm the expectations of the stakeholders.

    - Furthermore, this approach is situationally oriented. Therefore, it can support the implementation of a corporate wiki different situations; each module can be performed individually.
- A way in which to implement the approach to sustainable collaboration is to create a wizard that corresponds to all the modules and sub-modules of the approach. As an example, we created the Wiki Support Tool, which is an option for users to perform the approach. The Wiki Support Tool was also used during the treatment validation of the design.
- With Moody's (2003) Method Evaluation Model, we evaluated the modules based on the following constructs: perceived usefulness, perceived ease of use, and intention to use. We omitted the constructs of actual efficiency and actual effectiveness, since these elements did not fit within the objective of this study.
- Generally speaking, the subjective results indicate that the subjects intend to accept and use the Wiki Support Tool, although we have to keep in mind that the results for perceived usefulness and perceived ease of use varied from strongly disagree (1) to strongly agree (5). We can assume that these variances are due to the subjects' different demographic backgrounds, such as function within the organization, work experience, education, or age. However, it is not possible for us to identify the reason for the variances, since this was not the aim of the treatment validation.
- The majority of the subjects did not experience difficulties during the execution of the experimental tasks. Only subjects S2 and S3 needed some correction; however, their errors are of a low severity—the users opened the wrong protocol (instead of opening the protocol of MODULE 1.2., they opened that of MODULE 1.1.). Therefore, we can consider the Wiki Support Tool to be almost free from difficulties.
- In terms of intention of use, most subjects consider the Wiki Support Tool to be something that could help them to implement a sustainable wiki. However, further research is required to confirm this assumption.
- Some improvements are required in terms of the structure and composition of the Wiki Support Tool, and extra attention should be paid to the description and formulation of the content of the approach to sustainable collaboration. Nonetheless, the majority of the subjects reacted in positively rather than negatively. One subject emphasized the difficulty in language (too academic), and another subject found it difficult to say whether he/she intends to use the Wiki Support Tool. Despite most of the subjects being positive about the Wiki Support Tool, the list of improvements mentioned in the result section (Chapter 7.3.23.) must be assimilated.
- According to expert opinion, the strengths of the approach to sustainable collaboration are that the modules provide concreteness and structure, and the approach provides more understanding of the relation between organizational culture and IS integration.
- The weaknesses that should be taken into account are the different interpretations of the users, and to counter this problem, there is a need to be more connected to the user's practice with examples and applications. However, further understanding is first required regarding the real-world implementation (for example, by conducting Action Research). Another weakness of the approach is that there is only one type of structure for each type of user, which can lead to a threshold for some users; the approach can be too complex for certain situations. A suggestion is to create multiple structures for different types of users (i.e., alter the existing sub-modules to an appropriate subset of the approach per type of user). Also, related to the

previous weakness, the approach can cause barriers in terms of the maturity level or experience/knowledge of the user.

- An improvement or element that could enhance the usability of the approach is the provision of support within RWS, for example a support team.
- Accessibility is also an important improvement to consider. One way in which to increase accessibility for different users is to create a quick-scan before using the approach to sustainable collaboration. In this way, the approach becomes richer on the one hand, and more accessible to different types of users on the other hand.
- The final improvement relates to the language—interpreting the activities/modules in terms of the different roles. The exact roles are currently unclear.

8.2. Conclusion

This research is interested in finding a way to implement sustainable collaboration. For this research, we presented an approach to this type of collaboration containing three main modules. Its general purpose is to ensure the sustainability of a collaboration (i.e., a corporate wiki) in IS. Therefore, we determine the following main RQ:

How can we ensure the sustainability of a corporate wiki in a governmental institution?

Corporate wikis tend to be sustainable, (Majchrzak, Wagner & Yates, 2006), and success factors and challenges are established to obtain a sustainable wiki (Grudin & Poole, 2010). However, these factors and challenges are abstract and can be interpreted in multiple ways; there are no practical guidelines, specific activities, or concepts described. This study aims to expand on the challenges and success factors discussed in the study by Grudin and Poole (2010) with elements from an existing literature study to create our treatment design. Prior to the development of the treatment design, we scrutinized and adapted the challenges of Grudin and Poole (2010) in the problem design part by conducting a literature review, semi-structured interviews with potential wiki users, and unstructured interviews with practitioners who have experience with some type of KMS. At the end of the problem investigation, we converted and specified the challenges for a sustainable corporate wiki (RQ1), which resulted in the proposed design. The proposed design is the starting point of our treatment design, which constantly evolved during the treatment design (RQ2) with the situational ME method, thereby creating an approach using several design chunks from methods/models, concepts, and requirements from an extensive literature study. The approach to sustainable collaboration consists of three different modules: MODULE 1, which is the preparation; MODULE 2, the execution; and MODULE 3, the maintenance. Each module is situationally oriented, meaning that each module can be executed separately so that it can be adapted to support different wiki implementations. To implement and evaluate the approach to sustainable collaboration, we implemented the approach in an Intranet environment of RWS in the form of the Wiki Support Tool. This tool is an example of how organizations can use the approach. Since this tool contains all the elements of the approach to sustainable collaboration, we used it to evaluate our approach with Moody's (2003) Method Evaluation Model and the data collected from both the Think Aloud sessions (consisting of seven tasks) and the Retrospective Think Aloud as well as an expert's opinion (RQ3). Below, we discuss each RQ separately.

RQ1: What are the existing supports for sustainable collaboration and KM ISs?

Over the years, many studies have been conducted regarding the KM discipline, KMSs, and Wiki technology. Also, a number of studies shed light on the field of sustainable corporate wikis. The paper of Majchrzak, Wagner, and Yates (2006) concluded that a wiki appears to be sustainable, and it only provides a brief overview of the sustainability aspect of the system. Furthermore, the study by Grudin and Poole (2010) established three main success factors that will contribute to a sustainable wiki: (1) aligning manager and individual contributor expectations, (2) content and flexibility, and (3) positioning a wiki in an existing information ecology and corporate culture. Diving deeper into each challenge, we found that to obtain an effective implementation of a wiki within an organization, it is important to take into account not only the technological aspect but also the (organizational) culture aspect. A focus on the human factor rather than on the technical aspects was also confirmed as a challenge in the unstructured interviews. In the case of RWS, for example, it is important to first shift the organizational culture in a more open way and create a safe-to-contribute environment. Another important aspect that is worth mentioning is that management must actively urge users to share their knowledge and to promote interaction between different knowledge parties. For potential users, the added values are finding the right knowledge efficiently, accessing the market easily, and managing large amounts of information. The content and flexibility factor is related to the balance between the proposed structure and the potential freedom to express oneself; this is also a challenge, as mentioned during the interviews with the potential users. The basic idea mentioned during the expert interview is to keep the approach simple so that the KMS satisfies the goals and creates a basal system rather than a custom-made one. The last challenge in relation to an IS within an existing environment and culture is that it tends to fail because of a low participation rate as a result of continuously pressing tasks, a chronic lack of spare time, and motivational reasons. Based on the interviews with potential users, the researcher establishes that some types of reward systems (for example, a ranking system) are not suitable for the RWS environment and can even have a counterproductive effect.

RQ 1.1: What is the current positioning of the information ecology of a governmental institution in relation to the organizational KM operations and culture?

In our case, the positioning of the information ecology refers to the current KM situation; therefore, we measured the current KM and KMS within a governmental organization. Within RWS, KM currently occurs by finding knowledge via an open, online search engine—Google—and not via RWS's internal Intranet because it is difficult to find the right knowledge therein. Therefore, there is no suitable IS to perform KM initiatives. Furthermore, since RWS has an open culture, internally as well as between RWS and the market, there is room to pursue an open discussion. Also, people find information in an informal way; there is thus a need for a KMS that is dynamic rather than static to create added value for RWS. The department currently shares knowledge through presentations. However, it has the need to capture its knowledge in a physical way because people currently ask for knowledge through different communication channels, which is time consuming. There is also a need to make information more accessible to everyone (internal as well as external individuals). Within RWS, knowledge sharing occurs in a fragmented manner; for example, RWS has multiple software packages for document management systems, and it often reinvents the wheel multiple times, which costs additional time.

RQ 1.2: How does one overcome barriers and pitfalls during the implementation of a collaborative tool/support in KM ISs?

Wikis are essentially designed to promote and encourage group collaboration rather than individualism. Wiki adoption can be accelerated through an open-ended editing process that contains guidance, and collaborative authoring norms will increase the participation of wiki users. People's enthusiasm is one of the main factors that influences the quality of a wiki, because it can result in the lack of knowledge exchange within a KM community. To increase the usage of a wiki system, it is important that the wiki is easy to use and provides recognizable advantages over previous technologies; this was also confirmed during the interviews with the practitioners. Furthermore, to positively influence the ease of use, adequate training in Wiki technology is desirable. The employees of an organization need to have the capacity (time and money) to contribute to the wiki on a long-term basis, otherwise nothing will happen, and the KMS will not succeed. There is a need for a sponsor who arranges this capacity. For an organization, it is crucial that the KMS is running constantly. A KMS needs to be smart in terms of management and the technical environment around the system; the suggestion is to not repeatedly reinvent the wheel, but to connect the individual knowledge elements and add a revision control function.

RQ2 (TRP): How should an implementation approach to sustainable collaboration be designed so that it supports stakeholders' activities in a KM context?

We adjusted this starting point with elements from several literature studies that are related to sustainable collaboration or the successful implementation of collaboration. Thereafter, these elements were reshaped and reformed into a substantial approach to create sustainable collaboration within an organization. This eventually resulted in three modules with corresponding sub-modules. First, MODULE 1—aligning manager and individual contributor expectations—consists of four sub-modules: MODULE 1.1. Identify all the stakeholders; MODULE 1.2. Align needs and requirements of the stakeholders; MODULE 1.3. Analyze business processes, systems, and applications; and MODULE 1.4. Evaluate organizational culture and business environment. These sub-modules are modeled based on the elements from the Stakeholder Theory to sufficiently identify stakeholders and their goals. The ECM/ECT contributes to managing the users' expectations during implementation of a new IS. This study suggests that it would be in management's best interest to develop strategies that ensure that these expectations in particular will be maintained at a realistic level. Moving on to Enterprise Modeling, this was used to establish the architecture of an organization so that the organization has the right knowledge to implement a sustainable collaboration. Since the effective implementation of a wiki and both technological and cultural aspects are inseparable, we can conclude that organizational culture plays a crucial role in the successful implementation of a KM collaboration. Finally, we considered the following final models: the OCAI and the correlating KMAI. These two models were instruments to evaluate the combination of the organizational culture and the KM activities of an organization. Second, MODULE 2, which is about the realization of a wiki page, considers the needed requirements and the type of organization/environment in which the wiki will be implemented. As mentioned before, it is possible to execute each module individually; for example, when an organization already has a fixed initial phase for IS projects. In this case, the organization can start with MODULE 2 and omit MODULE 1. However, in the situation where the user omits MODULE 1, we created MODULE 2.1a.—Establishment of the stakeholders and their requirements and needs—due to the fact that the stakeholders and their needs and requirements are crucial factors for a successful IS integration and/or implementation. MODULE 2.1a. is a unified module of MODULE 1.1. and MODULE

1.2. Furthermore, MODULE 2 consists of two sub-modules: MODULE 2.1. Analyze the information needs in a specific knowledge domain and MODULE 2.2. Identify a suitable format for a wiki page. For MODULE 2, we mainly used elements from Enterprise Modeling-related studies. The final module, MODULE 3, is concerned with the maintenance of the wiki. In this case, it confirms whether the wiki page meets the expectations and needs of all the stakeholders. This confirmation part is comprised of the ECM/ECT elements. In our approach, we incorporated the following: condition of support, perceived ease of use, perceived enjoyment, perceived service quality, perceived security, perceived playfulness, and user interface. MODULE 3 aims to improve user participation and content quality by means of eliminating barriers. The confirmation component provides the user with more understanding of the following: the areas in which the wiki page could benefit from additional improvements and the expectations that are rated with sufficient/insufficient. MODULE 3 consists of method chunks from Enterprise Modeling, the ECM, and the ECT. Thus, the main artifact of this thesis is an approach to sustainable collaboration formed by three modules. We determine that the approach has the shape of a method, but further research is required to indicate elements, such as stakeholders, frameworks, and notations in order to provide a holistic support.

RQ3 (KQ): What are the effects of implementing a sustainable collaborative approach regarding stakeholders' perceptions?

The treatment evaluation part of this thesis used Moody's (2003) Method Evaluation Model to evaluate the approach to sustainable collaboration. This model is a theoretical model, and it provides an associated measurement instrument for evaluating IS design methods. In essence, this theoretical model is a combination of two different but related dimensions of the "success" of a method: actual effectiveness and adoption in practice. The Method Evaluation Model is designed based on two previously unrelated areas of theory: the TAM from the IS success literature and Methodological Pragmatism from the philosophy of science. Moody states that this model is applicable to all types of IS design methods as well as methods used in other domains. With regard to the effects in terms of the method success, we used the following constructs: actual efficiency (task completion time), actual effectiveness (task completion), perceived ease of use, perceived usefulness, and intention to use. The total average of perceived usefulness (3.96) and perceived ease of use (3.85) is between neutral (3) and agreed (4), although there is a wide variety of minimal and maximal scores, ranging from 1 to 5. An explanation for these results could be that we had different types of users with varying education levels, backgrounds and functions. Intention to use has a score between agreed (4) and strongly agreed (5), with a total average of 4.20. Based on the minimal and maximal of this construct varying from neutral (3) to strongly agreed (5); we can conclude that users intend to use the Wiki Support Tool in the future. Since there is no real standard, we could not compare efficiency improvement in terms of reducing time, cost, or capacity. Therefore, we only measured the task completion time; the subjects had to complete all experimental tasks within 60 minutes (the objective measurements of efficiency and effectiveness are related to perceived usefulness). The total average task completion time is 36:43 minutes, with the fastest subject having a task completion time of 11:57 minutes, and the maximal duration time was 46:00 minutes. Note that the fastest subject demonstrates task-oriented performance behavior; i.e., the subject focused on completing the experimental task rather than exploring the approach. For example, instead of reading and understanding the content on the Wiki Support Page, the subject scanned it and tried to find the answers as quickly as possible. The effectiveness score (task completion) is 96%, which means that only one subject did not complete one task; in this situation, the subject forgot to check-off the first task, which was to find the home page,

and based on video recordings or task form, we could not determine whether the task was completed. With regard to the measurement of the extent to which the Wiki Support Tool can be used free from difficulty (objective measurement was perceived ease of use), we used the node error—when the subject made an error while executing the tasks. In total, two errors were made: task four, subjects S2 and S3. The final objective measurements were qualitative instead of quantitative (commentary)—from the Retrospective Think Aloud. The main conclusion of the commentary is that the way in which the content is formulated needs some improvement; one subject mentioned that some elements are too academically focused, while other subjects appreciated the background information of this study. Finally, with regard to the expert opinion, in general, the expert stated that the approach is a complete list of elements with literature to support it, and it provides structure, guidelines, and concreteness. However, more studies and improvements are required in terms of the specification of the structure, accessibility, and utility, among other things.

8.3. Limitations of the study

One of the main limitations of this study is that the population only represents a few governmental institutions, which leads to a limited angle of the results. In the context of this limitation, the used sample for the treatment validation is also relatively small: n = 5, and the subject of the treatment validation only consists of employees from a single organization: RWS. For the treatment design, we used the snowballing non-probability sampling technique; therefore, there was a lack of a randomized sample, since only recommended subjects could be selected as part of the sample. Furthermore, the subjects were mainly selected based on prior knowledge and their expert knowledge; however, to diminish the bias in the results, we took into account different types of subjects: a mix of experts and non-experts in the fields of IS integration and sustainable collaboration (i.e. the wiki technology) or a combination of these expertise fields. Nevertheless, the subjects are all employed within the WVL[10] division of RWS, and all of the subjects are involved in the KM team. Due to the low quantity of subjects and their characteristics, further research is required to generalize this approach for all governmental organizations. Another limitation is that this study especially focuses on systems or application that use Wiki technology (wikis). During the treatment validation, we also used KMS and IS integration-related studies, although the main focus was on wikis. The main reason that we consider wikis to be suitable KMSs is because they meet the requirements for performing KM for an aging workforce—a group of knowledgeable employees who are retiring within a few years. During the problem investigation, we also performed some validation steps by confirming or extending the information and knowledge found in the literature review with interviews (semi-structured and structured). Nevertheless, we only based the content of the approach on the literature review. The next limitation is that the expert opinion is only from one subject; therefore, we must keep in mind the subjectivity of these results. Despite taking into account the objectivity and expertise of the expert, the results can be considered to be partial. The final limitation we would like to mention, is about the fact we only focused on governmental organization instead of generalizing our scope to the private sector as well.

8.4. Future work

This research contributes to an approach to implementing a sustainable corporate wiki through its design of a framework in the form of three main modules, which essentially provides the users of the

[10] Water, Verkeer en Leefomgeving (translated in English: Water, Traffic, and Living-environment)

approach with guidelines and a structure. Despite the fact that this study contributes to an initial framework for an approach to sustainable collaboration, more research opportunities have arisen.
The next step is to provide eventually a validated method that indeed ensures a sustainable collaboration in governmental organizations, and therefore, further evolvement by means of future research is required. First, this research only validates the elements of the approach using the following constructs of Moody's (2003) Method Evaluation Model during the single-case mechanism experiment: perceived usefulness, perceived ease of use, and intention to use. We omit the constructs of actual efficiency and actual effectiveness, since these elements did not fit within the scope of this study; therefore, we dismiss Rescher's concept of pragmatic success. This could be a valuable expansion point for the validation of the approach and modules to further understand the prediction of whether the approach and module are more efficient and effective in achieving their objectives. Moreover, the majority of the input for the treatment design and treatment validation originated from employees of RWS (also known as the potential users) and from several external parties (practitioners in KM and KMSs). For this reason, further validation with other governmental organizations is required to evolve our framework. The involvement of multiple organizations could also improve, confirm, and make the modules more precise. In addition to the single-case mechanism experiment, we conducted one expert interview with someone from academia. The expert opinion provides more understanding about the approach as a whole; however, it is based on one expert's opinion. Therefore, the first suggestion is to obtain multiple expert opinions in order to critically evaluate the content, composition, and structure of the approach. These expert opinions could be gathered through expert interviews or focus groups. Also, further validation with a higher number of subjects from different (governmental) organizations is required. Another valuable follow-up study could be to perform Action Research to determine the applicability of the approach/modules in users' daily work; for example, research could be conducted to observe users performing their daily tasks and determine whether the elements of the modules fit in these situations. While this research assumes that the approach can be used by each kind of user, further research should be carried out to test whether this assumption is true. A related suggestion is to perform a more detailed study of whether this approach is suitable for each type of end user (experts as well as non-experts in the field of IS integration). Another important follow-up study could focus on establishing whether this approach contributes to sustainability with a minimum duration of 12 months. Since the maximal duration of this MSc is less than 12 months, such an experiment did not fit within our scope. Furthermore, during this research, we only focused on governmental organization rather than including private-sector companies. For in the future, it also could be interesting to investigate and validate the approach in such environment. Since the characteristics of a private-sector company differs from a governmental one, we are not able to provide early insights or conclusions.

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