Improving Efficiency and Effectiveness of Knowledge Exchange between Knowledge Workers*

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Abstract. Information technology increasingly influences the way we work and live. Contemporary businesses demonstrate significant concerns on how increasing amounts of available information can be converted into knowledge. An increasing need for new knowledge concerning the development of new services which an organization offers to the customers in order to be competitive in the market is but an example of how important the dissemination of knowledge within organizations is. The growth in the relative size of people working in the knowledge economy stresses these developments. The research discussed in this paper focuses on improving the efficiency and effectiveness of knowledge exchange between knowledge workers by means of automated support so that dissemination of knowledge within organizations improves.

1 Introduction

Our society is changing under the influence of advanced information technologies. Various authors who try to assess the influence of computer and information technology on humans, society, and organizations use metaphors such as: Being Digital [1] and Digital Economy [2]. It shall need no further arguing that information technology has an increasing influence on the way we work and live [1]. In 2003, the world produced about 800MB of information for each man, woman, and child on earth [3]. Well over 90% of information currently produced is created in a digital format, and this percentage will increase substantially in the future. At the same time, much of the existing content which is currently only available in a physical format will be digitized soon as well [3]. Contemporary businesses demonstrate significant concerns on how all this available information can be converted into knowledge. The importance of knowledge, and in particular the dissemination of knowledge in modern society does not need any further arguing [3,4]. Nowadays, organizations will frequently be confronted with the need to disseminate a new body of knowledge within the organization. The need for new knowledge concerning the development of new services which a company offers to the customers in order to be competitive in the market is an example.

With the growth of clerical occupations at the turn of the century, the ascendancy of knowledge-producing occupations has been an uninterrupted process. A movement from manual to mental, and from less to more highly trained labour has occurred. Several studies, including Porat [5] and Reich [6] have documented the growth in the relative size of people working in the *knowledge economy*.

The discussed PhD research in this paper takes up on the aforementioned social and organizational developments by concentrating on improving the efficiency and effectiveness of organizational knowledge exchange among knowledge workers by utilizing IT. This should on its turn improve organizational knowledge dissemination. Section 2 discusses the research questions. An identification of the field of research is discussed in section 3, as well as the state of art, significant problems in the field of research and the differences between existing research and this research. The proposed approach and preliminary ideas and results are presented in section 4. Section 5 sketches the applied research methodology and section 6 concludes this paper.

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2 Ensuing Research Questions

Given the main research problem:

> How to improve the efficiency and effectiveness of knowledge exchange between knowledge workers in a knowledge processing community so that organizational knowledge dissemination improves?

Three basic research questions can be formulated:

Q1 How can a knowledge processing community be defined including the actors, roles, and tasks within that community?

Q2 Which framework enables us to describe how knowledge is exchanged in a knowledge processing community and how can automated support improve the efficiency and effectiveness of knowledge exchange so that organizational knowledge dissemination improves?

Q3 Which framework enables us to describe how automated support can assist in managing a knowledge processing community with its actors, roles, and tasks in an organizational setting?

3 Identification of the Field of Research

This section provides insight in the problem domain, the state of existing solutions, and significant problems in the field of research.

3.1 A Classification of Knowledge Work Based on Work Characteristics

One of the most basic questions which arises when interpreting the research questions from section 2 might be: What is knowledge work? In the literature, knowledge work has been given many interpretations. Some classify the knowledge worker by focusing on industry professions and jobs [7,8]. Others compare the work characteristics of workers and classify workers based on those characteristics. Some of those definitions are somewhat narrow, because sometimes the concept of 'knowledge worker' is often equated with being someone who is producing and processing information without bringing forward a clear focus on the knowledge intensive part [9,10]. While an information worker is busy producing, processing, storing, transferring, and comparing information, a knowledge worker crafts and tunes the available information to create, distribute, and apply knowledge. Information is an enabler of these actions, so the work of an information worker is closely related with the work of a knowledge worker. However, classifying workers by primarily distinguishing on the information part and the knowledge part of their work might be too bland [11]. Challenges when defining the term *knowledge worker* are that the knowledge worker's inputs and outputs are often intangible and knowledge is used in almost all forms of activity. Therefore a worker's tasks are better understood if the organizational context is taken into account. Blackler [12] looks beyond what knowledge workers do to what they do for, or within, an organizational structure. Hayman and Elliman [13] state that a single definition of knowledge workers is inappropriate. It is too confined and such a definition might assume that all knowledge worker's activities are similar and that it can be supported by IT in the same way. The notions of having significant autonomy, being informed by the work and presence of tasks which are related to the creation, distribution, or application of knowledge appear to be indicators of knowledge work. From a more broader point of view, the work characteristics of a knowledge worker might now be summed up as follows:

- The worker is given significant autonomy in how to perform a task.
- The worker has a high level of education in a certain area of expertise.
- The worker performs a substantial amount of tasks in which knowledge is created, distributed, or applied.

– The worker is informed by or learns from the knowledge processed.
– The worker's tasks are not just clerical, communicative nor purely concentrated on information.

To avoid confusion, it is noteworthy that the concept of 'knowledge worker' is not synonymous to 'manager'. Managers get things done through other people and are not primarily busy with developing, disseminating, or applying knowledge. One can argue, however, that a manager is indeed a knowledge intensive worker, who will typically use the products of knowledge workers. A manager is using knowledge to make decisions, allocate resources, or to direct the activities of others. The growth of knowledge work however is expected to be a very important factor in driving the future of management [11].

3.2 The Knowledge Exchange Concept

There is literature discussing the topic of 'knowledge exchange' on itself and also specific ideas to improve efficiency or effectiveness of knowledge exchange. Berliant et al. [14] have established a basic foundation to explain the patterns and implications of knowledge exchange. Kuznets [15] mentions that knowledge exchange flourishes in dense intellectual settings, and the more intellectual contact flourishes, the more knowledge is added to resources of knowledge. However, Kuznets' research is more focused on intellectual capital in large cities, while the research discussed in this paper focuses on exchange of knowledge between knowledge workers in an organizational setting. *Heterogeneity* (in terms of different types of knowledge) is considered as an important factor in successfully exchanging knowledge [14]. Less knowledge exchange occurs when individuals' types of knowledge are too diverse and when individuals' types are too similar. To determine the efficacy of knowledge exchange, a function is introduced in [14] to measure the ideal 'knowledge distance measure' between two individuals. However, the research of Berliant et al. [14] specifically focuses on the relationships between knowledge exchange and population agglomeration, while in terms of this PhD research it is more interesting to determine a suitable knowledge distance measure between two knowledge workers from a certain knowledge processing community. Cowan et al. [16] associated knowledge exchange with the arousal of innovation in a community of actors, based on the idea that innovation is largely a result of knowledge exchange among a small group of agents. They specifically took the tacitness of knowledge into account in assessing innovative potential. On the contrary, a very modest approach to knowledge theory is taken when this PhD research is concerned. Therefore, it is only assumed that knowledge can be conceptualized as consisting of *knowledge particles* or also denoted as *knops*, just like the way Barwise [17] approached information theory. The reason that this approach to knowledge theory has been chosen for this PhD work is that the same approach to information theory has been applied to the field of information retrieval in the past (see e.g. [18]) and seemed successful to formalize theory in which such an abstract notion as information (in this case knowledge) played a key role (see e.g. [19]). In order to find answers for the research questions of section 2, these specific thoughts about knowledge theory will be used to study knowledge exchange between knowledge workers and are further elaborated in section 4.

3.3 Discussing Agent Theory as a Basis for Automated Support

Both academia and industry gradually anticipate on the social developments mentioned in section 1 by concentrating on providing automated support to assist the knowledge worker in carrying out work-related activities [20,21]. However, the efforts mentioned above are in its infancy and can only be seen as starting points for more extensive research. Nevertheless, those efforts may provide ideas for this research in terms of which automated support is suitable to improve the efficiency and effectiveness of knowledge exchange between knowledge workers. In order to restrict the scope this research mainly concentrates on developing a fundamental framework in order to provide automated support in the process of knowledge exchange between knowledge workers, instead of postulating a broad abstract goal 'to develop a virtual workspace' or something alike.

In order to find an answer for research questions **Q2** and **Q3**, a suitable approach to agent theory will be taken. According to Wooldridge and Jennings [22], an agent is an encapsulated computer system that is situated in some environment and that is capable of flexible, autonomous action in that environment. As can be distilled from this definition, agents are autonomous, which means that agents can function on their own, without requiring human support. An autonomous agent has the control over its own actions and internal state. It can decide whether or not to perform a requested action. Agents are also placed in a particular environment, and their responsive behaviour is indicated by the implication that the agent senses and is affected by the environment. Agents are designed to fulfil a specific purpose and have particular goals to achieve, exhibiting flexible and pro-active behaviour. Agents are also often capable of 'social' behavior because they can communicate and cooperate with each other and with the users. Eventually, for agents to be highly intelligent, it is desirable that the agents are able to learn as they react and interact with their external environment.

The idea for this research is that agents can be part of a knowledge processing community and can provide support for a human knowledge worker when that knowledge worker is exchanging knowledge on the one hand, and that agents can also assist in managing a knowledge processing community with its actors, roles, and tasks in an organizational setting on the other hand. A prototype with the aim of checking the applicability of available agent tools to support knowledge sharing has already been developed by Khalil [23], which could be used as a starting point for finding answers when research questions **Q2** and **Q3** are concerned. As explained in [24], prototypes to simulate knowledge exchange between agents can be modelled in the 'Java Agent DEvelopment Framework', which can be used specifically when answering **Q2** and **Q3**.

4 An Overview of Preliminary Research Results

The proposed approach, the research results achieved so far, and the preliminary ideas are discussed in this section.

4.1 Proposed Research Approach

The research questions from section 2 are used as a guideline for the development of the PhD thesis. The various theoretical frameworks which will be developed will fill in the thesis' chapters. These are the four proposed parts:

1. Elaboration of the concepts in a knowledge processing community, which includes understanding of the actors, roles, and tasks which are part of such a community.
2. A clear exposition of the knowledge exchange concept within the previously defined knowledge processing community.
3. Development of theory concerning the role of automated support to improve the efficiency and effectiveness of knowledge exchange between knowledge workers. To measure efficiency and effectiveness various mathematical functions will be introduced but also reused by building upon existing theory. Examples from existing theory are the knowledge exchange function by Berliant et al. [14] and a fuzzy logic version of Jaccard's coefficient [25].
4. Elaboration of a way to manage a knowledge processing community in an organizational setting by means of automated support.

To develop the thesis, it is chosen to make use of an iterative approach which is depicted in table 1. Here,'Theory_0^2' denotes the second theoretical part (from the enumerated list depicted above) and iteration zero of the second part. Another example is 'Verification_1^2', which denotes the verification of the theory developed during the second part from the list above and iteration one of the verification process of the second part. It is assumed that each time a new theoretical part is developed, the preceded theory must also be verified again due to the newly gained research. Thus, it can be concluded from the table that for instance the first and most elementary theoretical part of the enumerated list above, namely elaboration of a defined knowledge processing community, will be verified four times.

Table 1. Iterative approach to theory development and verification

Theory_0^1	Verification_0^1	Theory_1^1						
Theory_0^2	Verification_0^2	Theory_1^2	Verification_1^1	Theory_2^1				
Theory_0^3	Verification_0^3	Theory_1^3	Verification_1^2	Theory_2^2	Verification_2^1	Theory_3^1		
Theory_0^4	Verification_0^4	Theory_1^4	Verification_1^3	Theory_2^3	Verification_2^2	Theory_3^2	Verification_3^1	Theory_4^1

4.2 A Knowledge Processing Community

All actors involved in the process of disseminating knowledge within an organization are part of a *knowledge processing community*. These actors are therefore referred to as *knowledge actors*. A knowledge worker is a member of the knowledge processing community and can fulfil certain roles in that community. Those roles can be fulfilled by a knowledge worker, or by an *agent*. A knowledge worker fulfils a certain role in the knowledge processing community. To understand the various knowledge processing roles which can be fulfilled by a knowledge worker, a characterization of various knowledge processing roles is necessary. A framework is introduced in which the settings of the knowledge processing roles can be formalized in terms of the behaviour in the knowledge processing community. See also [25] for a related framework. The three introduced knowledge processing roles, however, behave differently on two levels, namely: instance level behaviour and meta level behaviour. On the instance level, the actual knowledge on which certain operations are performed by a knowledge worker in terms of a knowledge processing role is determined. On the meta level, the requirements to indicate which knowledge is needed when performing a certain knowledge processing role are determined, which can also be denoted as *knowledge about knowledge*, or a more general description such as *structures that describe other structures* [26]. In other words, when a knowledge processing role is fulfilled on the meta level, an exchange of meta knowledge takes place (with another knowledge worker who fulfils one of the three roles). When a role is fulfilled on the instance level, an exchange of actual knowledge items takes place, each knowledge item containing knowledge about the Universe of Discourse. Davis [27] also divided knowledge in two rather similar types, namely object-level knowledge and meta-level knowledge. However, these two types are based on a task domain. Thus, object-level knowledge comprises information about a task domain and meta-level knowledge comprises information about the object-level.

The possible knowledge exchange situations between the three roles are depicted in figure 1. On the meta knowledge level, knowledge flows from the utilizer to the teacher and from the teacher to the discoverer subsequently. The utilizer 'pushes' its meta knowledge to the teacher, namely the requirements to indicate which knowledge is needed for utilization. The teacher communicates this meta knowledge to the discoverer so that the discoverer can gather or develop the required knowledge. On the instance knowledge level, knowledge flows from the discoverer to the teacher and from the teacher to the utilizer subsequently. The discoverer pushes knowledge to the teacher, which on its turn mediates between the discoverer and the utilizer so that the knowledge is correctly interpreted by the utilizer.

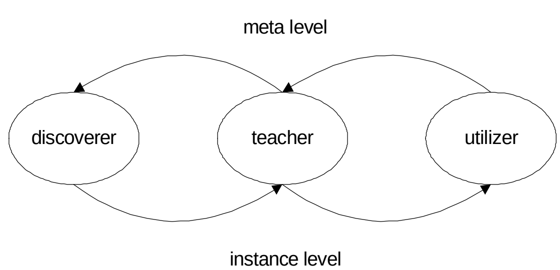

Fig. 1. Knowledge exchange between knowledge processing roles

The utilizer. When this role is fulfilled on the meta level, the knowledge worker disperses the requirements to indicate which knowledge is needed for utilization. On the instance level, the utilizer actually uses the gathered knowledge and applies the knowledge during outstanding activities if necessary.

The teacher. The teacher acts as a *broker* between the discoverer role and the utilizer role. On the meta level, the teacher generates an inventory of the utilizer's knowledge needs. Using this meta knowledge, the teacher is able to provide the utilizer with actual knowledge on the instance level. It 'teaches' the utilizer based on the provided meta knowledge.

The discoverer. The discoverer is able to actually find and *create* knowledge. Therefore, the discoverer requires meta knowledge, which the teacher provides, so that the discoverer knows which actual knowledge is needed by the teacher. Thus, the discoverer can provide the teacher with actual knowledge. If the teacher requires knowledge which is already present, the discoverer mines that knowledge from available resources without creating new knowledge. This is presumably less time consuming than the other situation in which the discoverer is obliged to create new knowledge if it is required by the teacher and if that knowledge is not available to the discoverer yet.

The knowledge exchange situations between the utilizer and the teacher and the knowledge exchange situations between the discoverer and the teacher are shown in figure 2. In this figure the meta level and the instance level of knowledge exchange are distinguished. The two arrows indicate the direction in which the (meta) knowledge flows. On the meta level, the teacher wishes to acquire knowledge about the utilizer's needs. On the instance level, the teacher passes on the knowledge which the utilizer wishes to learn. On the meta level, the discoverer asks which knowledge the teacher wishes to acquire. On the instance level the discoverer reacts by providing the teacher with necessary knowledge (either newly generated knowledge or gathered existing knowledge). The figure shows that three knowledge actors, namely 'actor A', 'actor B', and 'actor C' each fulfil a role on two different levels. Actor A fulfils the teacher role on the instance knowledge level and the meta knowledge level, actor B fulfils the utilizer role on the instance knowledge level and the meta knowledge level, and actor C fulfils the discoverer role on both knowledge levels. Actor A also exchanges knowledge with both the utilizer and the discoverer.

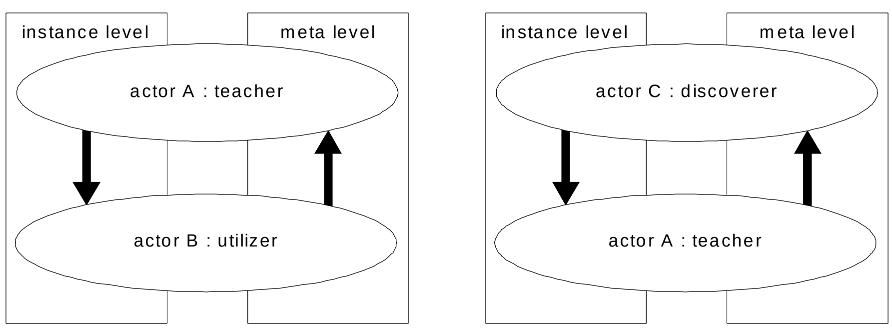

Fig. 2. Knowledge exchange between the knowledge processing roles

To further work towards a model describing a knowledge processing community, let $\mathcal{RT}$ be the set of role types depicted above. These role types are the utilizer, the teacher and the discoverer:

$$\mathcal{RT} \triangleq \{\texttt{utilizer},\texttt{teacher},\texttt{discoverer}\}$$

A specific fulfilment (which is a unique situation) of such a role type is depicted as a role enactment, determined by $\mathsf{RType} : \mathcal{RE} \rightarrow \mathcal{RT}$, where $\mathcal{RE}$ is the set of role enactments. The function $\mathsf{Player} : \mathcal{A} \rightarrow \mathcal{RE}$ depicts the specific actor who enacts a role type, where $\mathcal{A}$ is the set of knowledge actors. Furthermore, it is assumed that a role enactment encloses several task instances, determined by $\mathsf{Exec} : \mathcal{TI} \rightarrow \mathcal{RE}$, where $\mathcal{TI}$ is the set of task instances. Task instances are related to task types, just like role enactments are related to role types. This is depicted by the function $\mathsf{TType} : \mathcal{TI} \rightarrow \mathcal{TT}$.

The function $\mathsf{KLevel} : \mathcal{A} \to \mathcal{KL}$ determines the knowledge level in which an actor participates, where $\mathcal{KL}$ is the set of knowledge levels. The set of possible knowledge levels which can be distinguished in this model is depicted as

$$\mathcal{KL} \triangleq \{\texttt{meta-knowledge-level}, \texttt{instance-knowledge-level}\}$$

An actor can also produce input and output, depicted by the function $\mathsf{Input}, \mathsf{Output} : \mathcal{A} \to \wp(\mathcal{K})$. The set $\mathcal{K}$ refers to elementary knowledge particles or *knops* (see e.g. [17,19]). This function is necessary when formalizing the aforementioned two different knowledge levels. Assume that $x, y, z \in \mathcal{A}$ and that actor x has role type 'utilizer', actor y has role type 'teacher' and actor z has role type 'discoverer'. At the meta knowledge level, knowledge flows from the utilizer to the teacher and from the teacher to the discoverer so that the meta knowledge level can be formalized as:

[ME1] (Meta knowledge level) $x, y, z \in \mathcal{A} \wedge \mathsf{RType}(x) = \texttt{utilizer} \wedge \mathsf{RType}(y) = \texttt{teacher} \wedge \mathsf{RType}(z) = \texttt{discoverer} \Rightarrow \mathsf{Input}(y) \subseteq \mathsf{Output}(x) \wedge \mathsf{Input}(z) \subseteq \mathsf{Output}(y)$

However, at the instance knowledge level the knowledge flows from the discoverer to the teacher and from the teacher to the utilizer. This yields the following axiom:

[IN1] (Instance knowledge level) $x, y, z \in \mathcal{A} \wedge \mathsf{RType}(x) = \texttt{utilizer} \wedge \mathsf{RType}(y) = \texttt{teacher} \wedge \mathsf{RType}(z) = \texttt{discoverer} \Rightarrow \mathsf{Input}(y) \subseteq \mathsf{Output}(z) \wedge \mathsf{Input}(x) \subseteq \mathsf{Output}(y)$

The knowledge needed by members of the knowledge processing community is provided on knowledge carriers [19]. A knowledge carrier can be defined as any entity that is accessible for any actor in the knowledge processing community, and which can provide knowledge to other actors of the knowledge processing community. Examples of knowledge carriers are (in which aspects of knowledge are differentiated and articulated): Web pages (including free text, sound, images, and video fragments), databases, knowledge about the location of non-electronic knowledge carriers, a human brain, and aggregations / groupings of knowledge carriers. Formally, knowledge carriers are introduced as the set $\mathcal{KC}$, which is presumed to be closed under carrier composition (so any combination of given knowledge carriers is another knowledge carrier). The function $\chi : \mathcal{K} \to \wp(\mathcal{KC})$ provides the knowledge carriers which are relevant for a given knowledge particle.

Viewed in this light, relevant knowledge carriers of a certain type in fact exist of the knowledge carriers of all possible instances of that type. Assume that a specific web site w is an instance of knowledge carrier type W (i.e. the type 'web site'), then the following equation holds:

$$\chi(W) = \bigcup_{w \in W} \chi(w)$$

In other words, the knowledge carrier of type 'web site' formally consists of all instances of the type 'web site'. A more general equation can be depicted as:

$$\chi(\Upsilon) = \bigcup_{\upsilon \in \Upsilon} \chi(\upsilon)$$

Here, Υ is a certain knowledge carrier type and υ is a knowledge carrier instance of type Υ. The knowledge processing community model thus far is summarized in table 2.

5 Applied Research Methodology

A good scientific theory is a *model* of *cause-and-effect* to explain some *phenomenon of interest* [28]. In order to create a theoretical framework the 'action research' method [29] will be used. The action research method is a qualitative research method which associates research and practice, so that research informs practice and practice informs research synergistically. Action research combines theory and practice (and researchers and practitioners) through change and reflection in an

Table 2. A knowledge processing community model

Knowledge processing community		
$\mathcal{A}$	knowledge actors	
$\mathcal{K}$	knowledge particles	
$\mathcal{KC}$	knowledge carriers	
$\mathcal{RT}$	$\triangleq \{\texttt{utilizer},\texttt{teacher},\texttt{discoverer}\}$	
$\mathcal{RE}$	knowledge processing role enactments	
$\mathcal{TT}$	knowledge processing task types	
$\mathcal{TI}$	knowledge processing task instances	
$\mathcal{KL}$	$\triangleq \{\texttt{meta-knowledge-level},$ $\texttt{instance-knowledge-level}\}$	
$\mathsf{RType}:$	$\mathcal{RE} \rightarrow \mathcal{RT}$	role type having possible role enactments
$\mathsf{Player}:$	$\mathcal{RE} \rightarrow \mathcal{A}$	role enactment of an actor
$\mathsf{TType}:$	$\mathcal{TI} \rightarrow \mathcal{TT}$	task type having possible task instances
$\mathsf{Exec}:$	$\mathcal{TI} \rightarrow \mathcal{RE}$	role enactment having possible task instances
$\mathsf{KLevel}:$	$\mathcal{A} \rightarrow \mathcal{KL}$	knowledge level in which an actor participates
$\mathsf{Input}, \mathsf{Output}:$	$\mathcal{A} \rightarrow \wp(\mathcal{K})$	knowledge input and output which an actor produces
ME1:	**(meta knowledge level)**	$x, y, z \in \mathcal{A} \wedge \mathsf{RType}(x) = \texttt{utilizer} \wedge \mathsf{RType}(y) = \texttt{teacher} \wedge \mathsf{RType}(z) = \texttt{discoverer} \Rightarrow \mathsf{Input}(y) \subseteq \mathsf{Output}(x) \wedge \mathsf{Input}(z) \subseteq \mathsf{Output}(y)$
IN1:	**(instance knowledge level)**	$x, y, z \in \mathcal{A} \wedge \mathsf{RType}(x) = \texttt{utilizer} \wedge \mathsf{RType}(y) = \texttt{teacher} \wedge \mathsf{RType}(z) = \texttt{discoverer} \Rightarrow \mathsf{Input}(y) \subseteq \mathsf{Output}(z) \wedge \mathsf{Input}(x) \subseteq \mathsf{Output}(y)$
$\chi:$	$\mathcal{K} \rightarrow \wp(\mathcal{KC})$	relevant knowledge carriers for a knowledge particle
$\chi(\Upsilon)$	$= \bigcup_{v \in \Upsilon} \chi(v)$	a type comprises instantiated knowledge carriers

immediate problematic situation within a mutually acceptable ethical framework. Action research is an iterative process involving researchers and practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning. In action research, the researcher tries out a theory with practitioners in real situations, gain feedback from this experience, modifies the theory as a result of this feedback, and tries it again. Each iteration of the action research process adds to the theory, so it is more likely to be appropriate for a variety of situations. The PhD student involved in this research works closely with practitioners on a daily basis and thus gains feedback from these experiences which can be used for the research. Now the ideal domain of the action research method is characterized by a social setting where the researcher is actively involved, with expected benefit for both researcher and organization. The knowledge obtained can be immediately applied. This research project can be classified as a cyclical process of linking theory and practice together.

An action research description adopted from [30,31] details a five phase, cyclical process. The approach first requires the establishment of a research environment. Figure 3 illustrates this action research structural cycle as well as the action research team formation, which will be discussed below. The interpretations of the five phases for this research project are as follows:

- The diagnosis phase consists of the development of theoretical assumptions (i.e., a working hypothesis). A contribution to this phase is made by this doctoral consortium paper.
- Researchers and practitioners then collaborate in the next activity: action planning. The discovery of the planned actions is guided by the theoretical assumptions, which indicate both a desired future state (when due to implementation of the theoretical framework the efficiency and effectiveness of knowledge exchange between knowledge workers in an organizational setting improves) and the changes that would achieve such a state, i.e. finding answers for the research questions achieves that state.

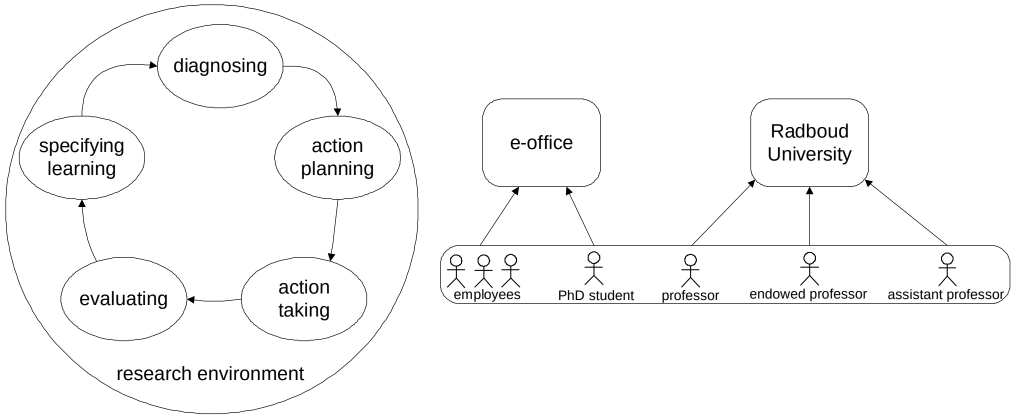

Fig. 3. The action research cycle, adopted from [30,31] and the team formation

– Action taking then implements the planned action. The researchers and practitioners collaborate in the active intervention into the client organization, causing certain changes to be made. This phase consists of implementing an operational form (research question **Q3**) of the theoretical framework which can be developed by answering research questions **Q1** and **Q2**.
– After the actions are completed, the collaborative researchers and practitioners evaluate the outcomes.
– In the 'specifying learning' phase, knowledge can be provided for diagnosing future action research interventions. The success or failure of the theoretical framework also provides important knowledge to the scientific community as well as the industry when dealing with future research settings. Furthermore, new knowledge gained by the research can be used for organizations involved in the research.

The action research team formation consists of academic people as well as practitioners. The author of this paper is employed at a Dutch IT service provider called e-office, where the lion's share of the research takes place. Because of this research, e-office closely collaborates with the Radboud University in The Netherlands from where two professors and one assistant professor provide theoretical as well as methodological assistance from a scientific point of view. A huge advantage of this cooperation is that the employees at e-office are able to try out the developed theoretical framework in practice by means of real-life (internal or customer) cases before it is even officially published to the scientific world and the business world. This feedback can be used to improve the theoretical framework due to practical experiences.

6 Conclusion

An approach as well as the current status of that approach have been elaborated to develop a theoretical framework so that the efficiency and effectiveness of organizational knowledge exchange between knowledge workers is improved by utilizing IT. This should on its turn improve organizational knowledge dissemination. The latter problem originates from social and organizational developments, such as the increasing influence of IT on the way we work and live and contemporary businesses struggling to convert increasing amounts of available information into knowledge. The paper includes a basic problem statement with three research questions, an identification of the field of research, a research approach, an outline of current work in progress, and a specific application of the 'action research' methodology.

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