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Integrated Project

IST – Technology enhanced Learning

Workplace Learning Study 2

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Executive Summary

This Deliverable describes the results of the second WorkPlace Learning Study. The goal of the second WPLS was to obtain more insight into the relation between work-learn situations and the knowledge sources and communication media people use to acquire the knowledge needed to perform tasks at hand better and gain knowledge about the related topics. This context is central to the APOSDLE solution, as it intends to combine the three spaces people at work can be seen as operating in: the Work Space, the Knowledge Space and the Learning Space, with are connected through communication.

To theoretically underpin this research, the main theoretical perspective chosen was the Media Richness Theory. This theory links properties of tasks, uncertainty (about how to perform a task) and equivocality (what should be the results of a task), to knowledge sources and communication media that can be used to exchange knowledge about tasks at hand. In particular it states that when the uncertainty and equivocality of tasks increase, richer knowledge sources and communication media, media that can convey more cues, are needed to guarantee an effective transfer of knowledge. Based on predictions from this theory, support for selecting the best fitting knowledge sources and communication media in APOSDLE can be derived. In addition two other theoretical perspectives were briefly touched upon: Knowledge Space Theory and the Social Influence Model of Technology Use. The first states that during work, people will access each of the three spaces mentioned above to solve problems. The second claims that the Media Richness Theory is incomplete as organizational norms and habits can inhibit or promote the use of communication media, even if these don't fit the task at hand well.

In the study, two different situations a person can be in were addressed: a situation where the person plays the role of the knowledge seeker or learner (*learner situation*) and a situation where the person plays the role of the knowledge provider or knowledgeable person sharing knowledge with someone else (*knowledge sharing situation*). People participating in the research could 'construct' a specific combination of a work situation and a knowledge need (from a predefined list) and report about the knowledge source(s) and communication medium (or media) they used in that situation.

The study was carried out by means of an on-line questionnaire. Participants were recruited by using personal contacts and mailing lists from partners in the APOSDLE project. The sample consisted of 125 persons. The composition of this sample was almost the same as the sample in the first WorkPlace learning study, permitting a comparison.

Overall, the results confirm to a large extent the major finding from the first workplace learning study that personal contacts are very important, but must be combined with documented sources in a support environment. It is less easy to derive, at the moment of writing, specific design guidelines in this respect from the data that differ from the design of the second APOSDLE Prototype. In this sense, the outcomes are more confirmatory for the course the project has taken until now.

The results for the assumption that the Media Richness Theory can provide the basis for designing communication support in APOSDLE, shows that this must be questioned as about half the predictions could not be confirmed. At least additional analyses are needed to explore in more detail the possible role of other factors, like experience in the job. For the two alternative theoretical perspectives, it can be said that access to the different spaces of the Knowledge Space Theory differs for different work-learn situations is different, with the work space dominating when people are in the situation when they are new in the company and have to find things out. However, these differences could not be confirmed statistically. As for the Social Influence Model of Technology Use, there are only minor effects of organizational norms and communication media behavior of colleagues on the selection of media.

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1 Introduction

1.1 Purpose of this document

In this document an overview is given of the Second Work Place Learning Study (WPLS2) conducted between September 2007 and January 2008. This study continues with the line of research that started with the first WPLS that took place between March 2006 and October 2006, which investigated actual workplace learning behaviour. The focus of the WPLS2 is twofold. Therefore the WPLS2 was organised in two subsequent and related phases. For the first phase managers were approached to fill out a survey about the company perspective on knowledge work performance. This phase was conducted between September and November 2007. As these results are considered to be out of the scope of the WPLS2 and fit better in the exploitation plan deliverable, the results of this study can be found in DVII.3 “Dissemination, Standardisation and Exploitation Report and Plan II”¹. The managers that were approached in this first phase were also asked to also join the Knowledge Work Performance Network. Thereby a potential group of respondents (the colleagues and contacts of the managers) for the second phase of the WPLS2 was formed.

The second phase started in December 2007 and ended in January 2008. In this phase an online survey was distributed among knowledge workers. The aim of this survey was to understand the knowledge workers’ media usage in acquiring and sharing knowledge at the workplace. Understanding this media use is important for APOSDLE because it can inform the development of the communicational and collaboration support in APOSDLE. In addition, this is a research area that to date hasn’t been addressed much and it is an opportunity for APOSDLE to investigate it. Furthermore, context factors for learning at work, which were not so much in the focus of the first WPLS, could be explored in more depth. This contributes to a better understanding of the role APOSDLE can play in improving workplace learning. The results of the study can be found in this deliverable.

The document is organized as follows. The second chapter describes the design of both phases and addresses the theoretical background on which the second phase of the study is based. Chapter 3 details the method used in the second phase of the study. The results of the second phase are presented in Chapter 4. Finally, in Chapter 5 a summary of the results is given and conclusions are drawn about the implication of these results for the APOSDLE project.

1.2 APOSDLE project Scope of this document

As mentioned above, the research reported in this document is a follow-up of the research performed for the first Workplace Learning Study. We briefly summarize the main conclusions of this research below (see Kooken et al., 2007):

- At computer based workplaces learning is ubiquitous.
- Learning is currently overall reasonably successful, though bottlenecks are present.
- Workplace learning is strongly driven by work tasks, but learning driven by curiosity is also present.
- When seeking help, interpersonal help seeking using face-to-face contact is used most often. When seeking help from written material, digital sources are used most.

¹ See http://www.apostdle.org/results/horizontal_activities

In this study the focus is on obtaining better insight into the third and fourth findings listed above. Results will inform the design of the third prototype and will be triangulated with findings from the forthcoming evaluation studies of the second prototype.

1.3 Related Documents

There are two documents related to this deliverable, namely APOSDLE-D02.1-UT-WorkplaceLearningStudy and DVII.3 “Dissemination, Standardisation and Exploitation Report and Plan II”².

² See http://www.apostle.org/results/horizontal_activities

2 Design of the Study: Scope and theoretical framework

As mentioned above, the WPLS2 was organized in two phases. Although each phase has its own research focus, the methods used to conduct the research were quite similar. The perspective of companies on knowledge work performance (Phase 1) and knowledge workers' perspective on media usage in acquiring and sharing knowledge at the workplace (Phase 2) are both investigated by using a survey. In the first phase a printed questionnaire was employed, in the second phase an online questionnaire.

The design and the scope of phase 1 are described in section 2.1. In section 2.2 the theories used to design phase 2 of the study are described.

2.1 Phase 1: Knowledge Work Performance: Finding and Applying Knowledge at the Workplace

The survey distributed in the first phase was designed to explore the market potential of APOSDLE and to motivate people to participate in an extended survey later on. It was regularly distributed during APOSDLE tutorials, workshops and other events concerning *Knowledge Work Performance* and targeting companies and business organizations. By doing so, we established a fast feedback channel in response to the APOSDLE ideas, concepts and prototypes presented. Our objective was to gain understanding about the organizational perspective of knowledge work, its challenges and current solutions. Moreover, the survey of Phase 1 should help to get a better impression of the needs of the market place with regards to APOSDLE solutions.

The target audience of this short paper based survey were senior executives – persons in charge of making decisions about knowledge work support from an organizational perspective. Two versions, German and English, were available that could be quickly filled out by participants taking part in the events. In addition, the survey was used to form an APOSDLE interested network (Knowledge Work Performance Network). Organizations in this network expressed their interest in the topic and explicitly agreed to participate in the second phase of the WPLS2. On the last page of the survey, respondents had the opportunity to become a member of the Knowledge Work Performance Network which was initiated to maintain closer ties to interested parties.

In all, 24 persons (mainly from *Research and Development*) completed the survey of Phase 1 so far. The preliminary outcomes of this survey are presented in deliverable DVII.3 “Dissemination, Standardization and Exploitation Report and Plan II”³.

Members of the Knowledge Work Performance Network were asked to nominate participants for Phase 2 of the APOSDLE Workplace Learning Study, the extensive online survey on workplace learning in knowledge-intensive work domains to be filled out by knowledge workers themselves. In contrast to the first phase, we were interested in the perspective of individual knowledge workers in this second phase.

³ See http://www.apostdle.org/results/horizontal_activities

2.2 Phase 2: Acquiring and sharing knowledge at the Workplace

The aim of the Phase 2 survey was to understand the knowledge workers' perspective at media usage in acquiring and sharing knowledge at the workplace. In addition, the results of this survey can be used to verify the most important outcomes of the survey used in phase 1.

In this section the theories that are the rationale behind the design of phase 2 of the WPLS2 and informed the design of the 'Work Place Learning Survey' are described.

2.2.1 Theoretical framework

In phase 2 media usage in learning situations at the workplace are investigated. For APOSDLE this is interesting, because this information can be used to inform for the development of the APOSDLE tools. To make sure that the rationale behind the design of phase 2 is well-grounded, theories about media usages were compared and examined, to find out how they could contribute to relating work and communication. As this document is not intended as a comprehensive overview of all theories in communication science, we limit ourselves to two: one which does not fit the goals of the study and one which does.

A well-known approach for explaining media use is the uses and gratifications approach of Katz, Blumler and Gurevitch (1973). The basic idea behind this approach is that media fulfil different functions for users; people use media for gratification of their needs. In the uses and gratifications approach the focus lies on satisfying social or psychological needs of the individual, like maintaining interpersonal relations. It also is grounded in the use of mass media and users are seen as the 'audience'. In APOSDLE however, we are in the first place focusing on satisfying *learning* needs in the context of daily work (and not on social or psychological needs) and on more personalized communication media and not mass media. In addition, the user is not 'the audience' but more like the 'initiator' or 'maker'. Finally, work factors are not taken into account in this theory, which makes it less fitting to the purposes of the study.

Another explanation of media usage is the Media Richness Theory of Daft and Lengel (1984). According to this theory, rational and effective users should prefer media of fitting richness for tasks that involve communication. The theory holds that people will prefer the medium that functions most effectively given a work-learn context that can differ in uncertainty and equivocality (to be explained below). Using this theory makes it possible to focus on communication media usage to satisfy learning needs in a work context. By using this theory's premises, it is possible to predict which medium people would *prefer* in a learning-task situation. This makes this theory a fitting starting point from a research as well as a practical perspective. In the next section the theory is explained in more detail.

2.2.1.1 The Media Richness Theory

The Media Richness Theory (Daft & Lengel, 1984) was developed in an organizational context. The theory is derived from the contingency theory and information processing theory. The primary assumption of this theory is that organizations process information to reduce uncertainty and equivocality and that communication media differ in their ability (richness) to facilitate understanding within a certain time interval. That is, it views task-related communication, as a process in which information is exchanged and processed to reduce information uncertainty or to reduce information equivocality (Hung, Kong, Chua, & Hull, 2006). The theory focuses on matching tasks involving communication with communication media, by looking at the uncertainty and equivocality level of the task at hand and the richness of a medium. According to the Media Richness Theory, media are more or less appropriate for reducing uncertainty or equivocality and are therefore more or less effective in conveying information and knowledge and for facilitating understanding within a time interval (Robert & Dennis, 2005).

Uncertainty within the context of this theory refers to the absence of information to perform a task (*more* information is needed). Equivocality refers to the absence of a shared understanding of what information means in connection with the task being carried out (*richer* information is needed). When

media can reduce uncertainty or equivocality, understanding is facilitated. Within organizations, different communication media are used to access and share task related information and knowledge. In order to assess the ‘appropriateness’ of communication media given task characteristics (uncertainty and equivocality), the place of a medium in the continuum of media richness has to be established (Daft & Lengel, 1984). The theory argues that different communication media vary in their degree of richness. This richness is a characteristic of a medium that refers to the ability of a medium:

- to carry nonverbal cues like body language and facial expressions
- provide rapid mutual feedback,
- to convey personality traits,
- to support the use of high variety natural language.

The higher a medium can be classified along this continuum of richness, the richer the medium is. In Figure 1 the location of different media on the medium richness dimension, as originally proposed by Daft and Lengel (1984), is shown.

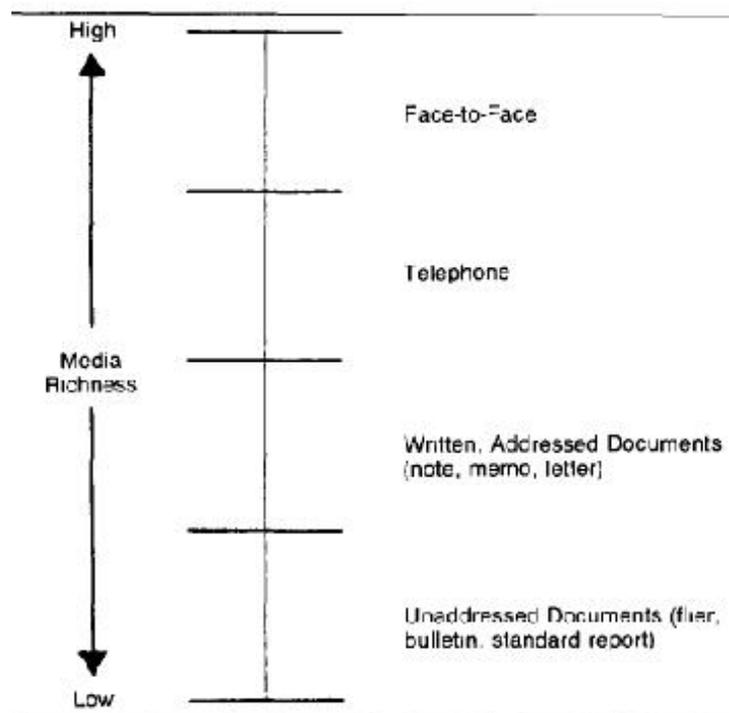


Figure 1 The location of different media on the dimension of media richness (Daft & Lengel, 1984)

The theory states that the more equivocal and uncertain a task is, the richer the used medium should be to be suitable for creating understanding. Richer media will lead to better task performance in case tasks have a greater equivocality or uncertainty (Robert & Dennis, 2005). Thus, the level of fit between media and task equivocality and uncertainty determines the task effectiveness, if communication is involved, according to the theory. The important prediction of the theory is that if the media choice of the individual corresponds with the optimal fit between media and task, they will perform better (Van den Hooff, Groot, & De Jonge, 2005). Daft and Lengel (1986) also relate the richness of a communication to learning when they state that: “*Communications that require a long time to enable understanding or that cannot overcome different perspectives are lower in richness. In a sense, richness pertains to the learning capacity of a communication.*”

The face-to-face medium is considered to be the richest medium and most effective for reducing equivocality. Also, Daft and Lengel (1984) concluded that written media were preferred for unequivocal messages.

The original list of media (see Figure 1) did not include electronic media like the Internet or e-mail and they have to be located somewhere on the richness dimension, depending on their ability to carry nonverbal cues, provide rapid feedback, convey personality traits, and support the use of natural language.

To illustrate the theory a bit more, the framework in Table 1 shows the framework of equivocality and uncertainty on information requirements (Daft & Lengel, 1986).

Table 1 Daft et al. (1986) “Framework of Equivocality and Uncertainty on Information Requirements”

Equivocality High	1. <i>High Equivocality - Low Uncertainty</i> Occasional ambiguous, unclear events; managers define questions, develop common grammar, gather opinions.	2. <i>High Equivocality-High Uncertainty</i> Many ambiguous, unclear events; managers define questions, also seek answers, gather objective data and exchange opinions.
Equivocality Low	3. <i>Low Equivocality- Low Uncertainty</i> Clear, well-defined situation; managers need few answers, gather routine objective data.	4. <i>Low Equivocality- High Uncertainty</i> Many, well-defined problems; managers ask many questions, seek explicit answers, gather new, quantitative data.
	Uncertainty Low	Uncertainty High

The framework describes four situations in which equivocality and uncertainty levels are combined. The framework shows that when both are low (cell 3), this is a “clear, well defined situation” and routine data needs to be collected. When the equivocality level is low and the uncertainty level is high (cell 4), it is a situation with “many, well defined problems”, and additional information is needed about many issues and it is known what questions to ask. When the equivocality level is high and the uncertainty level is low (cell1), there are few but ambiguous problems and it is unknown what questions should be asked or what problem have to be solved. Finally, when both levels are high (cell 2), there are many ambiguous problems and additional and richer information has to be gathered to understand the problems. Daft and Lengel (1986) characterise learning here as ‘trial and error’.

Concluding, it can be said that the key assumptions of this well-known Media Richness Theory can be used to investigate and predict use of communication media for a given task in a work situation. Predictions based on these assumptions (hypotheses) can then be tested for validation in the second WorkPlace Learning Study and, if validated, used to support media selection in APOSDLE, as APOSDLE is aware of the work and learn context of the user.

2.2.1.2 The media richness theory in this study

In the study we follow a multi-step approach in investigating media use. First respondents have to select a learning situation they did encounter at work, this provides the learn-work context. Next they have to indicate the uncertainty and equivocality of this situation. This learn-work context is further specified by selecting the knowledge need the person experienced. Following this, respondents will have to select a knowledge source and specify this source and finally select the used communication media.

As can be seen in Figure 1, the definition of ‘medium’ in the Media Richness Theory is a mixture between the communication channel used (for example, the telephone) and the source of the information (a document). Since the publication of Figure 1 (1984), the spectacular rise of electronic

communication channels like e-mail, has led to many more 'points' on the richness continuum than present in Figure 1. From this perspective it seems better to explicitly keep source and communication channel separated, as it does not make sense 'to make a telephone call to a document'. Clearly the 'upper' region of the richness continuum has to do with a person being the source of information and the 'lower' region with documents being the source of information. This leads to a two-level approach to media richness in this study. At the first level we make a distinction between knowledge sources which are located at the extremes of the richness continuum: *personal knowledge sources* and *documented knowledge sources*.

The knowledge sources at this level must also be located on the 'richness' dimension as shown in Figure 1. Three knowledge sources are involved, as shown in Table 2. This classification is based on judging the knowledge sources on the four aspects that determine 'richness' as described in section 2.2.1.1. It should be noted that this classification has been done by the researchers. This limits its validity to a certain extent, but time to verify this classification with experts was not available.

Table 2 Overview of used knowledge sources and media and their richness

Documented (text based) source	Richness	A person	Richness	Both sources
Existing work results from myself or others	Lean knowledge source	A colleague I know very well	Rich knowledge source	Rich knowledge source
Documented experiences, FAQ, lessons learned	Lean knowledge source	A person I work together with, or have worked together with in the recent past	Rich knowledge source	Rich knowledge source
Learning material, like course slides, training notes	Lean knowledge source	My supervisor	Rich knowledge source	Rich knowledge source
Articles, books about a certain theme or topic	Lean knowledge source	A known expert for a topic	Rich knowledge source	Rich knowledge source
A help system, a guidebook	Lean knowledge source	A trainer, teacher	Rich knowledge source	Rich knowledge source
A database containing facts, for example, about customers, products	Lean knowledge source		Rich knowledge source	Rich knowledge source

Table 2 shows that a documented source is classified as a lean knowledge source but a person is a rich knowledge source. The category 'both' is a combination of the other two categories. When using both types of knowledge sources, the richness is rich. Each category is related to a number of media, which can also be judged on richness. For example, for documented sources, relatively lean media are applicable, like existing work results, documented experiences or FAQ. For the category 'a person' relatively rich media like a colleague, a supervisor or a known expert are relevant.

At the second level the channel comes into focus, but this is only relevant when a person is part of the selected knowledge sources: communication between at least two persons takes place. This is the step, where the communication media have to be selected. The following seven communication media are available to choose from, given the work-learn context selected and using a person as the knowledge source:

- A face-to-face conversation
- Telephone
- Video conference tool
- Chat
- Email
- Discussion Forum
- A written letter or memo

These communication media must also be located on the ‘richness’ dimension from Figure 1. Again the classification has been done by the researchers for those media not present in Figure 1, using the four aspects.

Face-to-face communication is the richest medium and a written letter or memo is leanest. A video conference tool is richer than chat or email because a higher variety of natural language can be used and facial expressions are visible. Chat is richer than email and a discussion forum, because via chat rapid and mutual feedback is possible. Email is richer than a discussion forum, as email makes it possible to express more personality traits.

Apart from media, the context (work and learn) must also be classified in terms of uncertainty and equivocality (see Table 1). This requires a more precise definition of those concepts.

The Media Richness Theory states that organizations process information to reduce uncertainty and equivocality. This includes three important assumptions: one is that organisations process information. So information has to be available, noticed, selected, interpreted and processed mentally by someone. The second assumption is that information can reduce uncertainty and equivocality. So after information is processed, it can be used to achieve better insight in a certain knowledge domain. The third assumption is that the existence of uncertainty and equivocality are somehow problematic, that is, organisations want to reduce them. However, to understand how information reduces uncertainty and equivocality and also to understand why uncertainty and equivocality are problematic, a proper definition of these variables is necessary. Unfortunately the literature is not very clear about how to define and operationalize these concepts in a more precise way. For this study we will use the following definitions:

- *Uncertainty*: For a task uncertainty refers to the absence of a sufficient amount of needed knowledge in order to perform a work task correctly; in other words *more knowledge is needed about how to complete the task*.
- *Equivocality*: For a task equivocality refers to the absence of a clear shared understanding of what information means in connection with the work task that is being carried out in the results that are required; in other words *richer information, not more information, is needed to figure out the task situation, in particular what the results of the task should be*.

Above we used the term ‘learn-work context’ and ‘task’ in a loose way, but it is not self-evident what in the APOSDLE context the ‘tasks’ are, as there are work task (related to a domain) and learning tasks (associated with learning activities). The next sections address this issue.

2.2.1.3 Work Situations

The context for learning APOSdle depends on the work at hand. This implies that we cannot investigate learning as such, but should first set a work context from which respondents can report about their use of knowledge sources and communication media to satisfy knowledge needs.

To address this question, a conceptualization for work situations was developed using several sources. First of all, the general classification of knowledge work in terms of Kelloway and Barling's (2000) conceptualization of knowledge work as discretionary behaviour in organizations. These authors differentiate knowledge work into the following four main types of behaviours exerted at the workplace: Creating knowledge, acquiring knowledge, applying knowledge and transferring knowledge.

For each work situation, *create knowledge*, *acquire knowledge*, *apply knowledge*, and *transfer knowledge*, several scenarios were formulated about situations in which knowledge workers typically find themselves at their workplaces. Additionally, some further dimensions were considered when formulating the scenarios. For the *acquiring knowledge* and *transferring knowledge* scenarios the general learning trigger was differentiated into knowledge of a general domain (learning domain, that is "your field of expertise") versus company specific knowledge (task domain, that is, "how things are being done"), as this had been an important differentiation in modelling the application partners domains.

For the *applying knowledge* scenarios, we consider two task types that are at the opposite of the spectrum of the Common KADS knowledge intensive task type classification (see Schreiber et al. 1999). We picked one synthetic task (design, configuration) and one analytical task (diagnosis). In general synthetic tasks are more open and ill-defined than analytical tasks, thus taking into account uncertainty and equivocality of the scenarios.

Below, the scenarios from our questionnaire are listed, and categorized into Kelloway & Barling's (2000) four main types of behaviours. The descriptions were formulated in a way that should allow the respondents to mentally immerse themselves into a similar situation which they experienced in the past. Therefore, the descriptions of the work situations all started with the words "*Remember the last time...*".

Acquire Knowledge

- you were new in a department or in a company, and you wanted to find out how things were being done.
- you had to tackle a new assignment or project, and you needed to acquire the most important knowledge very quickly.
- you were trying to catch up with recent developments in your field of expertise.

Create Knowledge

- you had to come up with a creative and innovative idea or solution to a problem.

Apply Knowledge (Diagnose and Design)

- you needed to solve a problem quickly because something had gone wrong or in an unexpected way.
- you needed to design or configure something, like a part of product, service or method for an internal or external customer.

Transfer knowledge

- you had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, e.g. by giving a presentation or by writing a report.
- you were contacted by someone else (a colleague or customer) who asked for advice or instructions in your area of expertise.

- you had to advise a new co-worker in your department or company of how things were being done.
- you had to document your expertise for someone else, e.g. in a project hand-over or because you left the department or company.
- you were part of a team to develop something new or innovative and you had to extensively exchange knowledge with the other team members.

In the online survey of Phase 2, the work situations were not listed using the categorization into Kelloway & Barling’s (2000) types of behaviour.

For the work situation categories listed above, their uncertainty and equivocality had to be established. Classification was done by the researchers based on the criteria described in Table 1. If time had permitted, this classification should have been subject to validation by experts. This could not be done, which implies that the interpretation of the results are conditional on the validity of this classification⁴. Table 3 displays the outcome of the classification for work situations/tasks.

Table 3 Classification of uncertainty and equivocality for work situations

Work situation	Uncertainty	Equivocality
Acquire Knowledge	Low	Low
Apply Knowledge: Diagnose	Low to moderately	Low to moderately
Apply Knowledge: Design	High	High
Create Knowledge	High	High
Transfer knowledge	Low to moderately	Low to moderately

In the work situation ‘acquire’ *more* knowledge has to be found and the knowledge that is sought for is well-defined. Therefore uncertainty and equivocality are low. In case of the work situations ‘transfer knowledge’ and ‘diagnose’, the knowledge that is dealt with (either transferred or used for the diagnosis) is not completely evident and also the desired results are not completely apparent. Therefore, uncertainty and equivocality vary between low till moderately. For the other two learning situations ‘design’ and ‘create’, the focus is on finding richer knowledge for getting a better interpretation of the situation and the desired results. Therefore, the uncertainty and equivocality are high for these situations.

2.2.1.4 Learning tasks

From a learning perspective, users of APOSDLE will become involved in learning tasks when they encounter a problem during their work for which more knowledge is needed or when they want to explore a particular domain (similar to the scenarios described in the previous section). In APOSDLE they can get access to learning events containing information and instructional support that fit the knowledge and learning need that arises from the work context. The learning events that are presented in the APOSDLE tool are based on the Anderson and Krathwohl’s (2001) taxonomy of human learning. This taxonomy is used to describe learning tasks in APOSDLE.

Anderson and Krathwohl’s taxonomy is a revision of Bloom’s (1956) well-known taxonomy of educational objectives, in which three learning domains, or educational objectives, are defined:

- Cognitive: mental skills (the objective is to acquire knowledge)

⁴ However, as will be explained in Chapter 3, we also asked the respondents about their experienced uncertainty and equivocality in tasks they reported about. This provides a second way to investigate the Media Richness Theory.

- Affective: growth in feelings or emotional areas (the objective is to acquire attitudes)
- Psychomotor: manual or physical skills (the objective is to acquire skills)

Based on Bloom’s taxonomy, Anderson and Krathwohl (2001) revised the hierarchical taxonomy of cognitive learning. Contrary to the one-dimensional taxonomy of Bloom (1956), Anderson and Krathwohl (2001) developed a two-dimensional taxonomy: a knowledge type dimension and a cognitive process dimension. The taxonomy classifies different types of the knowledge that have to be learned and cognitive processes used during/for learning. They discern four types of knowledge, namely factual knowledge, conceptual knowledge, procedural knowledge and meta-cognitive knowledge. In the taxonomy six levels of cognitive complexity in the learning process are discerned. For both dimensions, each ‘knowledge type’ or ‘cognitive process level’ includes the previous levels and has higher demands on our thinking abilities. The six cognitive processes are (Anderson & Krathwohl, 2001, pp. 67-68):

- Remembering: Retrieving, recognizing, and recalling relevant knowledge from long-term memory.
- Understanding: Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
- Applying: Carrying out or using a procedure through executing, or implementing.
- Analyzing: Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.
- Evaluating: Making judgments based on criteria and standards through checking and critiquing.
- Creating: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

Based on this taxonomy of cognitive learning and within the context of APOSDLE and the WPLS2, a learning task can be described as “a task occurring during work aiming at learning at least one type of knowledge described by Anderson and Kratwohl’s taxonomy and involving at least one of the cognitive processes described by Anderson and Kratwohl’s taxonomy”.

2.2.1.5 Defining uncertainty and equivocality for learning tasks

The learning tasks defined in the previous section must also be classified, just as work situations/tasks, in terms of uncertainty and equivocality. Classification was again done by the researchers based on the criteria described in Table 1. If time had permitted, this classification should have been subject to validation by experts. This could not be done, which implies that the interpretation of the results are conditional on the validity of this classification. The classification of learning tasks can be found in Table 4.

Table 4 Classification of uncertainty and equivocality for learning tasks of a learner

Learning task	Uncertainty	Equivocality
Remembering	Low	Low
Understanding	Low	Low
Applying	Low to moderately	Low

Analyzing	Moderately to High	High
Evaluating	Moderately to High	High
Creating	High	High

In case of a learning task that involves low uncertainty and equivocality, the learning task focuses more on the first three educational objectives of Anderson and Krathwohl (2001), namely on remembering, understanding and applying and less on the other objectives. These learning tasks relate to a relatively low till moderate (for applying) level of cognitive complexity and thus require a relatively low till medium level of cognitive effort. The focus in these learning tasks is on finding more knowledge.

When a learning task relates to higher levels of uncertainty and high levels of equivocality, the learning task focuses more on the last three educational objectives of Anderson and Krathwohl (2001) and less on the other three educational objectives. These last three objectives are analyzing, evaluating and creating. These learning tasks relate to a relatively moderate till high level of cognitive complexity and thus require a relatively medium till high level of cognitive effort. The focus in these learning tasks is on finding richer knowledge to support a better interpretation of the situation and the desired results.

The above classifications of learning tasks refer to situations in which an individual is the learner. In case that this individual is approached by someone else, to share his knowledge (the work situation “transfer knowledge”), it is expected that uncertainty and equivocality are low to moderate.

2.2.1.6 Knowledge types

Another aspect that could influence media selection is the domain that has to be mastered. As APOSDLE is intended to be as much as possible domain independent, the only way to take this into account is trying to figure out what type of knowledge is involved in the learning task.

For this we propose to use the classification by Anderson and Krathwohl (2001) mentioned above:

- Factual knowledge
- Procedural knowledge
- Conceptual knowledge

Meta-cognitive knowledge is excluded, as this seems to be less important in the APOSDLE context. It should be noted that currently APOSDLE does not contain information about these knowledge types, but it is foreseen that in the future knowledge types associated with domain concepts (for example, the domain concept ‘Sampling’ (from Statistics) is annotated as being ‘procedural knowledge’ about how to do sampling) can be used to improve learning events as presented in the APOSDLE system. If they are annotated with knowledge types, this can also be used for taking knowledge types into account when dealing with media choice.

2.2.1.7 A summary: visualizing the concepts and relations

The theories discussed in the previous sections, the media richness theory, the taxonomy of Anderson and Krathwohl (2001) and the conceptualisation of work situations based on Kelloway and Barling’s (2000) and the Common KADS typology, provide us with the factors to consider in the design of the second WPLS. We now know have means to look at the uncertainty and equivocality of learning tasks when we want to predict the appropriate media (Media Richness Theory). The taxonomy provides us with different knowledge types that have to be learned and there are different cognitive processes involved during learning. The work task is the factor that sets the context of the learning task.

So, summarizing the above, we identified four factors that constitute the theoretical frame for the study:

1. the learning tasks based on the six cognitive processes

2. the knowledge types that have to be learned based on the four knowledge types
3. the work situations based on Kelloway and Barling’s (2000) and the Common KADS typology
4. the appropriate media richness at the two levels defined previously: the level of the used knowledge source and the level of a communication medium when a person is the used knowledge source

The first three factors can be linked to their level of uncertainty and equivocality. For example, learning to ‘remember’ something is less equivocal and uncertain than learning to ‘create’ something. What is used for the fourth factor is determined by the levels of uncertainty and equivocality of the previous three factors. In the cube in Figure 2 below, the ideas are visualised in a 3-dimensional figure. Every location in this cube is a possible ‘state’ a user of APOSDLE can be in when she needs to learn during work. In each of these ‘states’ the theory predicts what would be the fitting knowledge source and/or communication medium that is used when knowledge needs to be acquired by a person. This cube can be seen as a visual ‘summary’ of the conceptual frame for the study.

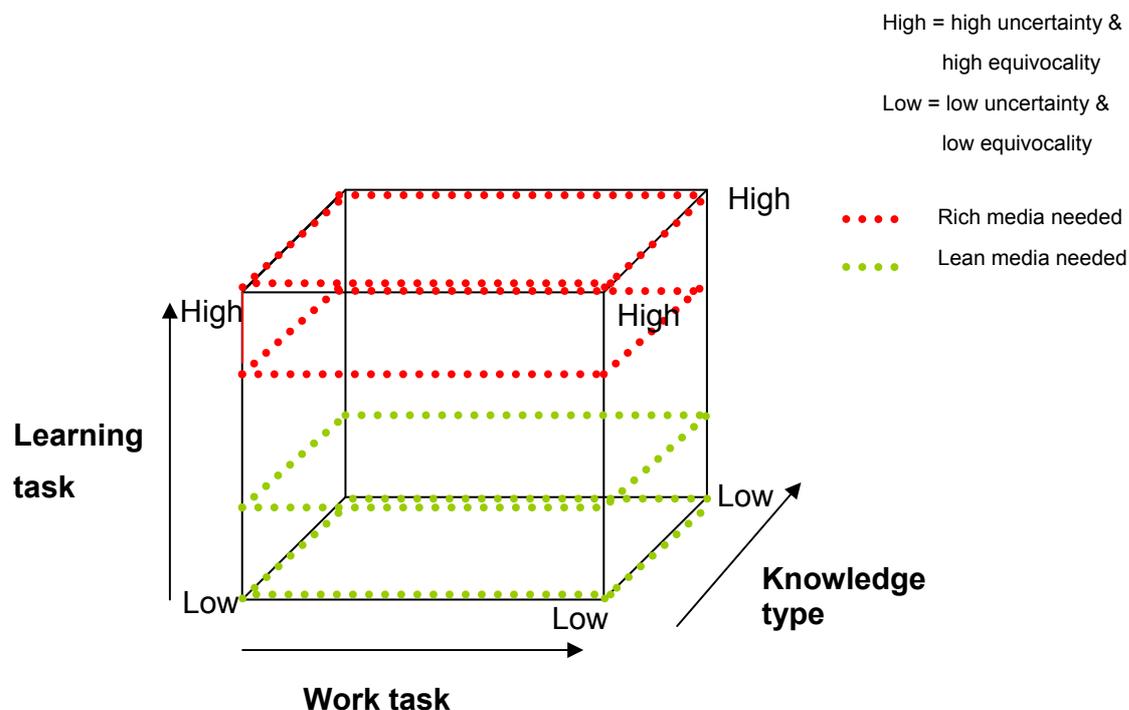


Figure 2 WPLS2 Cube of Communication Media Richness based on work task, learning task and knowledge type

2.2.1.8 Formulating hypotheses

Every ‘learning situation’ a respondent can ‘create’ by selecting options in the questionnaire (see the first paragraph of section 2.2.1.2) can be described as a triplet <work task scenario><learning task type><knowledge type> and the idea is that for the situation (the triplet) a respondent has created, we ask respondents which medium they actually used when they found themselves in this situation and which medium they would prefer. In total 108 learning situations can be constructed given the fact that there were six work situations, six learning tasks and three knowledge types which could be combined. However, as the sample turned out to be smaller than expected (see Chapter 3), conducting analysis for all these situations was not possible. Therefore, a decision had to be made about which hypotheses could be formulated and tested given the data. We decided to focus on the

learning task, as this is strongly related to the fundamental research interests of the APOSdle project: supporting self-directed learning. Therefore, six hypotheses about communication media usage for learning tasks situations and six hypotheses about knowledge source usage for learning tasks situations were developed (see Table 3).

Table 3 Matching communication media richness and specific media to learning tasks

Learning task	Description in survey (learning need)	Expected communication media richness	Hypothesized communication medium usage	Hypothesized knowledge source usage
Remembering	I was mainly trying to find facts and figures for which it was important that I remembered them well.	Lean	H1: lean communication media like text based impersonal documents	H7: Documented sources
Understanding	I was mainly trying to get a good and well founded understanding of the topic I was dealing with.	Relatively lean	H2: lean communication media like text based impersonal documents	H8: Documented sources
Applying	I was in need of a specific technique, procedure or method that I was seeking to apply.	Lean to moderately	H3: lean communication media like text based impersonal documents	H9: Documented sources
Analyzing	I was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.	Moderately to rich	H4: relatively rich communication media like audio/video based files and collaboration	H10: Person
Evaluating	I was evaluating something and judging it by comparing it with known standards in the field, for example, state-of-the-art works.	Moderately to rich	H5: relatively rich communication media like audio/video based files and collaboration	H11: Person
Creating	I was trying to create something new for which there was no predefined method or procedure.	Rich	H6: rich communication media face-to-face communication and collaboration	H12: Person

2.2.1.9 Alternative theoretical perspectives

In the previous sections the emphasis was on the role of the Media Richness Theory in developing the theoretical and practical framework that will guide the study. However, this is only one of many possibilities. In order to broaden the scope of the theoretical framework, we will include two other perspectives which can be seen extensions of this framework.

2.2.1.9.1 Selecting knowledge sources and the concept of the three spaces

The Media Richness Theory gives us an idea of what channels people will select to gain knowledge depending on the type of situation they are facing. However, what exact knowledge source will they be selecting? This is something that cannot be explained by the Media Richness Theory only. Instead, to answer this question, we are borrowing from a conceptualization introduced by Lindstaedt (Lindstaedt 2002, Lindstaedt & Farmer 2004) which has been termed “three spaces model”. The three spaces

conceptualize the information space which knowledge workers deal with when they are looking for knowledge sources. The three spaces have been termed the *Work Space*, the *Learning Space* and the *Knowledge Space*. The three space conceptualization is schematically depicted in Figure 3.

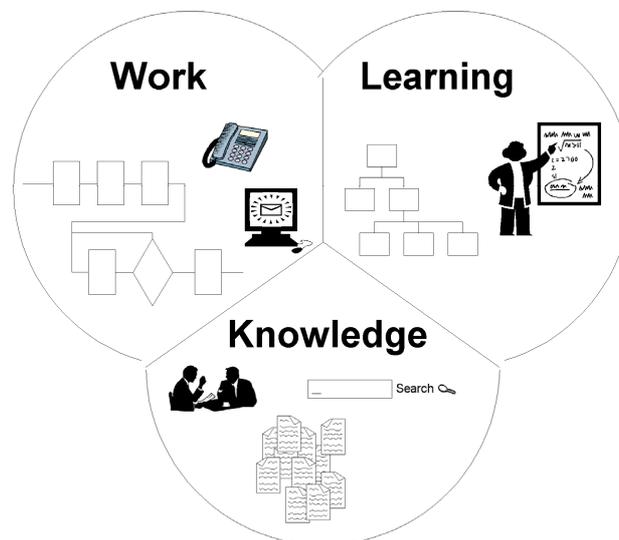


Figure 3 Three Information Spaces of a Typical Knowledge-Intensive Workplace.

The three spaces can most readily be seen when looking at the technological and information infrastructure that support working and learning. However, we hypothesize that the spaces are also valid in cognitive terms, in that they mirror the mental models of the people using them and shape the decisions about information and knowledge sources they seek. These sources are structured in a specific way and accessed accordingly. From a theoretical point of view, we have discussed these three spaces in terms of three distinct types of knowledge (see Ulbrich et al. 2006) which can be mapped to procedural (work space), declarative (knowledge space) and personal knowledge (learning space). We speak of a cognitive and technological disconnection when operation within and between these spaces is difficult and causes problems during workplace learning. The following discussion focuses on the three spaces as they may be found in a typical organizational Intranet setting.

Work Space: A process-oriented view. Work Spaces are used in the process of work. Accordingly, they are structured in terms of the work processes, that is, in terms of the tasks and their dependencies. In technical terms, the workspace represents the user's desktop PC and the shared document storage devices such as a common network file structure or a document management system. It contains the work documents which are needed by an employee on a day-to-day basis, such as project related documents.

Knowledge Space: The Organizational Knowledge Base. The knowledge space encompasses the expertise that has been developed by the organisation. It represents unconscious learning, application of past experiences (own and from others) to new situations, spontaneous search for information, and use of examples in order to better understand how to apply knowledge. Also groups of experts or communities of practice often operate in the knowledge space to exchange relevant knowledge and learn from each other. In technical terms, the knowledge space corresponds to the organisational memory. It is often distributed over different systems such as the Intranet, the Internet, a common file server, etc. The structure again is different: organisational knowledge often does not have one clear structure, but mirrors the internal cognitive map of each person providing the knowledge. Often a mix of the topics or a domain structure and the organisational department structures is found here.

Learning Space: Competencies and Learning Goals. The learning space stands for conscious learning situations, for example, attending seminars and taking courses. In the learning space, activities are usually structured according to very clear and explicit learning goals and their dependencies. Also the

learning space usually addresses different levels of expertise: different learning situations are planned for beginners than are for intermediates or experts. The learning space is either completely outside any technical system or represented by an e-learning platform. The structure of the learning space mirrors the structure of the learning topics as it is seen by course providers. It follows the didactical abstraction of the topic, and very often, it does not provide information about the relationship of work tasks to courses.

In this study, we are exploring the conceptualization of three knowledge spaces further by classifying the knowledge sources used in terms of the three spaces. The types of typical knowledge sources we have selected (both documented and personal) are shown in Table 6 with the corresponding space to which they were assigned to. Two of the personal sources were not assigned to one of the spaces as it depends on their exact role within context of learning and knowledge seeking. ‘A colleague’ was added to distinguish it from ‘a person I work together with’ in order to contrast the personal source in terms of working versus social relationships. ‘My Supervisor’ was added as it is a typical source that one may turn to. Depending on his/her role in this situation, the supervisor could be assigned to any of the three spaces.

Table 6 Knowledge Sources Used in the Study and Corresponding Information Space

	Learning space	Work Space	Knowledge Space	Undecided
Knowledge Sources	Learning material A help system, a guidebook A trainer, teacher	Existing work results A person I work together with	Documented experiences Articles, books A database containing facts A known expert	A colleague My supervisor

A purpose of this part of the study was to check whether the work-learn situation in which people find themselves has any influence on the type of knowledge source they seek.

2.2.1.9.2 The social influence model of technology use

Although his study is based the theories described above, it might not be possible to explain the results by using these theories only. Literature shows that several other perspectives of explaining media usage are possible. Therefore, the survey will also include some items representing an alternative explanation of media usage. The Media Richness Theory is a theory that explains media usage of individuals as a rational objective process. However, the social influence theory suggests that individuals look to their immediate work environments for cues to shape their behaviour (Turner, Grube, Tinsley, Lee & O’Pell, 2006). The social influence model of technology use was developed by Fulk, Schmitz and Steinfield (1990). This theory explains new media choices by relating it with social forces such as work group norms and co-worker and supervisor attitudes and behaviours (Webster & Trevino, 1995).

A study from Turner et al. (2006) focussed on investigating the existence of dominant media norms within organizations and describes their influence on, amongst others, the reported media use. Their study shows that the presence of strong organizational norms for instant messaging (IM) and e-mail use and supervisory behaviour may influence employees’ use of IM and e-mail. The measures used in this study for individual communication media use and organisational norms about media use are derived from the measures used in the study from Turner et al. (2006). Also, instead of supervisor media use, in this study we measure organisational media use. Knowledge works are often very self-regulating and therefore in our opinion more influenced by co-workers’ media use than supervisors’ media use.

3 Design of the study: Method

This chapter describes how the theoretical framework was converted into a questionnaire, how the questionnaire was administered and how the sampling was performed.

3.1 Design of the questionnaire

The questionnaire was structured in two parts. The first part contained questions about learning and knowledge sharing situations.

In the first context the respondent is in *the role of the knowledge seeker or learner*. We first asked respondents to select a work situation which was similar to the one they were involved in recently and which they could remember well (see for the work situation section 2.2.1.3). They had to put themselves back in that situation and answer the questions with that situation in mind. After selecting a work situation, they had to specify this situation using several aspects. Two of these deal with task equivocality and uncertainty. Although the equivocality and uncertainty of the work situation and learning situation were based on the theoretical framework which offered general rules to determine these aspects, the actual experienced uncertainty and equivocality could differ due to the specific case the respondent had in mind. Therefore, we also measured equivocality and uncertainty by asking the respondents to what extent they agreed with the following two statements:

In this situation...

- I felt very uncertain about the things I had to do.
- What I had to deliver was very well defined.

In addition to these statements, six other statements had to be answered: about the level of time pressure, if there were serious negative consequences if the knowledge could not be found, if someone was new to the company or department, if someone was an expert in the topic and if someone was working alone or in a team setting. All statements had to be judged on a 5-point scale, ranging from strongly disagree (1) to strongly agree (5). Subsequently they had to select a learning task (called 'knowledge need' in the questionnaire for reasons of understandability). For example, a learning task was described as 'I was in need of a specific technique, procedure or method that I was seeking to apply', representing the 'Apply' learning task (see section 2.2.1.4). Next, the knowledge sources used for this learning task had to be selected (see section 2.2.1.2 and Table 2). Finally the type of knowledge source (see also Table 2) and the used communication medium had to be selected (see section 2.2.1.2). If the respondent could remember a second work-learn situation in which she was in the role of the knowledge seeker or learner, the same questions were asked for this second situation.

In addition to this 'work-learning situation' part, the same kind of questions and statements were asked when the respondent is in *the role of the knowledge provider or knowledgeable person*. This is a situation in which the respondent was the knowledgeable person and someone else asked her to provide the knowledge she needed. In the knowledge sharing situation, the descriptions of the work situations and learning situations were almost similar to the ones in the work-learning situation. The difference was that they were now phrased from the perspective of the person being the knowledge provider. There were five work situations; the situation 'we are trying to catch up with recent developments in your field of expertise' was seen as irrelevant here. Also the questions concerning aspects of the work situation (see above, for example certainty, time pressure) were asked. There were again six learning task descriptions but they represented the context of the person asking for knowledge (the 'learner'). Similar to the role of the knowledge seeker, the respondent could also answer the same questions about another situation in which she was in the role of the knowledge provider.

The second part of the questionnaire consisted of some general questions concerning personal media usage, organisational media usage, organisational media usage norms, learning attitudes, personal background information and general information about the organization. Some of these questions were related to the alternative explanation of media usage. These questions were also asked to get an idea about the attitude towards self-directed learning, personal background and working environment of the respondents. They are related to information about the organisational work situation, which is important to understand the environment of the knowledge worker and his workplace. Also, the data from these questions could be used to interpret the results, for example to explain differences between respondents or explain individual preferences.

To improve the quality of the questionnaire, a pre-test was carried out at the Know Center and at the University of Twente. It is important that the content of the questionnaire is, for example, clear and comprehensible for the target group. The quality of the collected data depends on what is asked and how the question is asked. The purpose of the pre-test was to dovetail as good as possible to the experiences of the target group. Possible errors or ambiguities, such as errors in language, could come to light in the pre-test. A special pre-test version was made available on SurveyMonkey. The results were processed and the questionnaire was adjusted based on these results. The final version of the questionnaire can be found in Appendix B.

3.2 Sampling

For the second WPLS the same holds that held for the first WPLS: it's next to impossible to draw a random sample from the target users of APOSDLE. First, they are not precisely known, which precludes a proper definition of the population. Second, if they were known, they are probably very difficult to approach, in particular when resources available do not allow the hiring of very expensive market research companies. Furthermore, it's known that sending questionnaires to organizations and/or people in organizations yield very low response rates, mostly below 1%. Faced with these problems, we decided to follow the same kind of "snow balling" sample procedure that intends to maximize the response as used in the first WPLS. This approach entailed that each partner got in touch with some of their contacts in different organizations (first step) and asked them to find some suitable respondents (second step). This meant that there could be a few contacts that deliver many participants, but there could also be many contacts that each deliver a few participants. It also means that it was not possible to influence the precise number of people who received a request to participate, and thus it was not possible to calculate a response rate. The contacts could come from organizations like current or former customers, associations, daughter companies, and so on. Some of the participants could come from the partners' own organization, as long as they were not directly involved in APOSDLE.

The aim of this two-step approach method was to capitalize on personal relations. By approaching the contacts of all partners and ask them to look for some participants, relational obligations started to play a role. People tend to do more for people they know, because they feel a social obligation to do so. This aspect of the method was seen as an important factor to ensure a reasonably high response.

The contact organizations received an instruction which explained the type of participant looked for. These selection criteria for the respondents were provided in order to keep the selection of respondents under control. Suitable respondents were described as knowledge workers who spent at least 60% of their working time at a computer based workplace, a workplace where a personal computer is present.

3.3 Procedure

The final version of the questionnaire was accessible using the SurveyMonkey service. People willing to participate received via e-mail a URL to the site where they could find the questionnaire. They filled in the questionnaire anonymously. As we made also use of the network of companies maintained by

ICC⁵, the questionnaire was made available in English as well as German. We employed a native German speaker who was quite familiar with English to make sure that the questions, and as a consequence the outcomes, are comparable across both language groups.

⁵ The German Chamber of Commerce.

4 Results Phase 2⁶

4.1 Description of the sample

In this section we will present data on the description of the sample.

Due to an unexplained problem with the survey in SurveyMonkey not all people who filled in the questions dealing with learning situations also filled in the questions about their background. In 41 cases the questionnaire could not be finished by a respondent. As a consequence only 84 people answered the background questions. All percentages are based on these 84.

It is difficult to say anything about the effects of this problem on the composition of the sample, as any information about the cause of the problem (probably related to browser settings) is lacking. Assuming that these breakdowns occurred randomly, we can say that the distributions would not have been much different when those 41 persons were included. As will be shown below, most distributions in this sample are quite similar to the ones we found in the first Workplace Learning Study, save for level of experience in the job.

The first, and probably most important factor, is the nature of the work of the respondents. We asked them to distribute 100 points over three different types of work related activities: developing new knowledge (for example, working in a research environment), pass on knowledge to others (for example, teaching), use obtained knowledge (for example, applying just found knowledge about word processors to a document). Table 7 below shows the results.

Table 7 Average number of points (out of 100) distributed to three types of knowledge work (constant sum scale)

	Average number of points WPLS1	Average number of points WPLS2
Developing new knowledge	32	28
Passing on knowledge to others	32	32
Using obtained knowledge	38	40

From Table 7 it can be concluded that all types of knowledge work are present in the sample.

As APOSDLE is focused on working and learning at a computer based workplace we asked the percentage of their time the respondents worked at such a workplace (see Table 8).

⁶ Results for phase 1 are reported in section 4.4 when a comparison between both phases is made.

Table 8 Time spent at a computational workplace

Time spent at a computer based workplace	Percentage of answers WPLS1 (n=97)	Percentage of answers WPLS2 (n=84)
0-25 %	2 %	2 %
26-50 %	7 %	4 %
51-75 %	32 %	34 %
76-100 %	59 %	60 %

Table 8 shows that 60% of the respondents spend 75% or more of their time at a computer based workplace and another 34% still more than 50%. This makes the composition of the sample fit the target users of APOSDLE.

Phase 1 of the study was mainly conducted at relatively small organizations. Our intention was to broaden the organizational scope of the study in Phase 2, so we asked for the size of the organization (see Table 9).

Table 9 Size of company

	Percentage of answers WPLS1 (n=97)	Percentage of answers WPLS2 (n=84)
Small (<50 employees)	21 %	18 %
Medium (50-250 employees)	13 %	27 %
Large (>250 employees)	66 %	55 %

From Table 9 it is clear that in this sample more people from medium-sized companies are included than in the first WPLS. This could be due to the fact that the organisations were also approached using CCI's partner network, which consists of a fairly large number of medium-sized organisations. However, the proportion of people in large organisations is still the highest. This number is also higher than the number of companies participating in Phase 1 of this WPLS.

The three variables presented above are the key ones for assessing the nature of the sample. However, we also collected data about other variables that can provide insight in the properties of the sample. We will briefly deal with them below. The numbers in italics are the values for the first Workplace Learning Study.

The majority of the respondents (64%, 71%) is between 21 and 40 years, most (70%, 60%) of them are employed between 1-10 years by the company they are currently working for, they have spent between 1-10 years in their current job (64%, 67%) and males are in the majority (65%, 62%). As for working hours, 85% works between 31-40 hours or more (this "more" category amounts to 39%). Finally most of them see themselves as an expert (52%, 36%) or experienced (34%, 56%).

These numbers show an acceptable distribution over the relevant variables: they indicate a sample with experienced persons in their jobs. Compared with the sample of the first Workplace Learning Study, the numbers are almost the same, save for level of experience in their current job. For the purpose of this study the overrepresentation of experienced persons is maybe less serious than it would have been for the first one. The latter was more directed to obtaining a general overview of learning at work, while the current is more focused on specific patterns of learning during work. It also makes it more likely that they can meaningfully remember situations in which they played the role of

the knowledge provider. Nevertheless there is reason for some caution, as we can't be sure that the way experts deal with learning situations at work is similar to the way novices do it. In previous research in the Dutch Police we found that experienced persons were more inclined to use computer based sources when dealing with an information need (see Bakker et al., 2006).

An issue that was not addressed in the first WPLS has to do with the learning attitudes and motivations of the people in the sample. Data about these attitudes and motivations shed light on the relevance or importance of the reported work-learn situations and the situations in which a person plays the role of the knowledge provider. The more positive these attitudes, the greater the likelihood that their (self) reports represent situations they actually were involved in. Table 10 shows the results for the questions related to attitudes and motivations (Scale from 1(disagree) to 5 (agree)).

Table 10 Average judgements (mean scores on a 5-point scale) for learning attitudes (n=84)

	Minimum	Maximum	Mean	Std. Deviation
At work, I enjoy to learn	4	5	4.69	.465
At work, I learn something new every day.	2	5	4.04	.783
Learning is merely a way to increase my career opportunities.	1	5	2.52	1.207
I am more confident when I frequently increase my professional knowledge.	2	5	4.37	.708
I only learn what is necessary for completing work tasks.	1	5	1.81	.871
I organize my learning time carefully.	1	5	2.27	.974
When I am working on a new subject matter, I try to work out for myself exactly what is being said.	2	5	4.11	.761
When I am working on a new subject matter, I stop from time to time to reflect on what I am trying to get out of it.	2	5	3.57	.948

As can be seen in Table 10 all participants enjoy learning (4.69) and most also learn something new everyday (4.04). A reason why participants enjoy learning could be explained partly because most participants state that they are more confident when they frequently increase their professional knowledge (4.37). The results also show that most respondents do not learn only what is necessary for completing work tasks (1.81). The majority of the participants also state that they do not only see learning as a way to increase one's career opportunities (2.52), indicating that it has a value independent of immediate material returns. When the participants work on a new subject matter, most participants state that they stop from time to time to reflect on what they are trying to get out of it (3.57). In addition, the majority of the respondents tries to work out for their selves exactly what is being said when they are working on a new subject matter (4.11). Although learning seems enjoyable and important for being confident, learning time is generally not organised carefully (2.27).

Based on Table 10 we can conclude that from an attitudinal and motivational perspective the respondents are really involved in and committed to learning during work. This makes their answers more credible than if they were only marginally involved and not very motivated.

Though the composition of the sample is satisfactory, the number of participants is less than we intended. As will become clear in the next section (already mentioned in section 2.2.1.8), to test the hypotheses and analyze the data for different work-learn situations, there should be a sufficient number of respondents in every possible combination of work situation and knowledge need (learning tasks). As a consequence, only the hypotheses from Table 3 can be tested in the data set.

4.2 Results related to the conceptual framework

Respondents could, in total, fill out in the questionnaire two learning situations (where they played the role of the knowledge seeker/learner) and two knowledge sharing situations (where they played the role of the knowledge provider). Because the number of participants that filled out the first learning situation (n=125) and the first knowledge sharing situation (n=89) are the largest we focus on these two data sets. The second learning situation and the second knowledge sharing situation were filled out by respectively seventeen and six respondents, too few to be usable for analysis.

In the following we shall refer to the different situations as the first learning situation, the second learning situation, the first knowledge sharing situation and the second knowledge sharing situation.

4.2.1 Learning situations

A *learning situation* consists of two elements:

- 1) the selected work situation
- 2) the selected knowledge need.

We asked respondents if they could select a work situation in which they were involved in recently and which they could remember well. In total 125 respondents selected a work situation for the first learning situation. In Table 11,⁷ an overview is given of the selected work situations in which the respondents needed to find information, knowledge or expertise.

Table 11 Selected work situations (n=125)

Work situation	Percentage (%)
Had to tackle a new assignment or project, and you needed to acquire the most important knowledge.	35
Were new in the company or department and you wanted to find out how things were being done.	25
Were trying to catch up with recent developments in your field of expertise.	14
Had to come up with a creative and innovative idea or solution to a problem	10
Needed to design or configure something, like a part of a product, service or method for an internal or external customer	10
Needed to solve a problem because something had gone wrong or something occurred in an unexpected way.	6

Table 11 shows that respondents needed to find information, knowledge or expertise most when they 'needed to acquire the most important knowledge because they had to tackle a new assignment or

⁷ As the percentages in the tables are rounded-off, the sum in the tables can be 99%-101%

project' (35%). Also 'being new in the company or department and wanting to find out how things were being done' (25%) and 'catching up with recent developments' (14%) were selected relatively often. Solving a problem because something had gone wrong or something occurred in an unexpected way (6%) was selected least.

After selecting a work situation, respondents had to select the specific knowledge need⁸ they experienced in the above situations (see Table 12).

Table 12 Selected knowledge need (n=97)

Knowledge need	Percentage (%)
I was mainly trying to get a good and well founded understanding of the topic I was dealing with.	51
I was in need of a specific technique, procedure or method that I was seeking to apply.	14
I was trying to create something new for which there was no predefined method or procedure.	11
I was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.	10
I was mainly trying to find facts and figures for which it was important that I remembered them well.	8
I was evaluating something and judging it by comparing it with known standards in the field, for example, state-of-the art works.	5

As Table 12 shows, half of the respondents describe their knowledge need as 'getting a well founded understanding of a certain topic' (51%). Other knowledge needs that were selected relatively often were 'needing to apply a technique, procedure or method' (14%) and 'creating something new for which there was no predefined method or procedure' (11%). Analysis shows that the selected work situation is not related to the selected knowledge need ($\chi^2=36.93825$, $p>.05$), indicating that they are independent of each other.

4.2.1.1 Uncertainty and equivocality of learning situations: work situation and knowledge need

The selected work situations were judged on several aspects. Two aspects were part of testing the hypotheses: uncertainty and equivocality of the selected work situation. Via two statements, one about each aspect, respondents could judge the extent to which they agreed or disagreed with the statements. For uncertainty the statement was: 'I felt very uncertain about the things I had to do.' For equivocality the statement was formulated as⁹: 'What I had to deliver was very well defined.' In the 5-point scale, value 1 represents 'strongly disagree' and 5 represents 'strongly agree'. These judgements reflect the actual experienced uncertainty and equivocality by respondents when they found themselves in the selected work situation. Table 13 gives the results.

⁸ The reader should keep in mind that 'knowledge need' is the term used here but is the 'learning task' concept used in the conceptual framework.

⁹ The formulation of both statement was 'reversed' (one positive, one negative). This was done to prevent response sets in a list of statements which are all phrased in a positive way.

Table 13 Average judgement (mean) of uncertainty and equivocality of the selected work situation in learning situations

Work situation		N	Mean	Std. Deviation
Were new in the company or department and you wanted to find out how things were being done.	Uncertainty	26	3.58	1.238
	Equivocality	26	2.27	1.002
Had to tackle a new assignment or project, and you needed to acquire the most important knowledge.	Uncertainty	37	2.65	1.086
	Equivocality	37	2.62	1.210
Were trying to catch up with recent developments in your field of expertise.	Uncertainty	16	2.44	1.263
	Equivocality	16	3.06	1.611
Had to come up with a creative and innovative idea or solution to a problem.	Uncertainty	9	2.89	1.167
	Equivocality	9	2.56	.882
Needed to solve a problem because something had gone wrong or something occurred in an unexpected way.	Uncertainty	6	3.50	1.225
	Equivocality	6	2.67	1.506
Needed to design or configure something, like a part of a product, service or method for an internal or external customer.	Uncertainty	11	2.73	1.272
	Equivocality	11	2.36	.924

By looking at the results in Table 13 it becomes clear that uncertainty seems to play a role when someone is new in the company (mean=3.58) or when someone has to solve a problem because something had gone wrong or something occurred in an unexpected way (mean=3.5). In these situations more knowledge was needed to complete the work task. The experienced equivocality was not extremely high for all of the selected work situations. This means that in most situations, there was a relatively clear shared understanding of what information means in connection with the work task that is being carried out.

The experienced equivocality was not extremely high for all of the selected work situations. This means that in most situations, there was a relatively clear shared understanding of what information means in connection with the work task that is being carried out. This implies that the results do not support the expected higher level of equivocality for the work situation when someone had to come up with a creative and innovative idea or solution, and when someone needed to design or configure something for an internal or external customer. In addition, when someone is new in the company we expected that the equivocality would be lower. The results do support the other expectations of equivocality for the situation where someone had to tackle a new assignment or project or was trying to catch up with recent developments in their field of expertise.

To test whether there is a significant difference between equivocality and certainty for the selected work situations, analysis of variance can be used. However, Table 13 also shows that not all work situations were selected with equal frequency, the number of times a situation has been selected ranges from 37 to 6. When the number of selections is too low (in this case: lower than 26) variance analysis cannot be conducted. Therefore, if we want to see if there are significant differences between how respondents judge uncertainty and equivocality for the selected work task situations, we can only do this for two work situations, namely

- Had to tackle a new assignment or project, and you needed to acquire the most important knowledge.
- Were new in the company or department and you wanted to find out how things were being done.

The analysis shows that uncertainty was judged significantly higher ($F=.732, p<.05$) than equivocality ($F=2.041, p>.05$) in the case 'new in the company' or 'acquire the most important knowledge' were selected. As a consequence these two work situations can be classified higher in uncertainty than the other work situations. The work situations do not differ in their equivocality. Both, of course, based on the contextual judgment of the respondents concerning the experienced work situation about which they report.

Though the judged uncertainty and equivocality primarily refers to the work situation, the question is if the judgement of uncertainty and equivocality differ when we relate them to the selected knowledge need. This gives an impression about the link between work and learning for these concepts (see Table 14).

Table 14 Average judgement (mean) of uncertainty and equivocality of the selected knowledge need in learning situations

Knowledge need		N	Mean	Std. Deviation
I was mainly trying to find facts and figures for which it was important that I remembered them well.	Uncertainty	6	1.33	.816
	Equivocality	6	3.50	1.225
I was mainly trying to get a good and well founded understanding of the topic I was dealing with.	Uncertainty	44	2.14	1.305
	Equivocality	44	2.64	1.163
I was in need of a specific technique, procedure or method that I was seeking to apply.	Uncertainty	12	2.25	1.545
	Equivocality	12	3.17	1.115
I was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.	Uncertainty	9	2.11	.928
	Equivocality	9	3.33	1.500
I was evaluating something and judging it by comparing it with known standards in the field, for example, state-of-the art works.	Uncertainty	5	1.80	.837
	Equivocality	5	2.20	.447
I was trying to create something new for which there was no predefined method or procedure.	Uncertainty	10	1.80	.632
	Equivocality	10	3.10	1.101

Table 14 shows that mostly uncertainty and equivocality were not judged extremely high but rather moderate; most means vary between 2.00 and 3.20 (on a 5-point scale). These results do not support any of the expectations of equivocality of learning tasks. Only in case of 'facts and figures' the equivocality seems to be higher than average (mean=3.50), but this was not expected. On the contrary, the results support the expectation of a low uncertainty (mean=1.33) if the knowledge need is 'facts and figures'. Also for 'evaluating something' (mean=1.80), 'analyzing a problem' (mean=2.11) and 'creating something new' (mean=1.80) uncertainty is low, which was not expected. For 'technique, procedure or method' the results support the expected low to moderate level of uncertainty (mean=2.25).

Based on the results in Table 14, analysis of variance is not possible as only 'Well founded understanding' has sufficient judgements ($n=44$). So we cannot say if the judgement of uncertainty and equivocality differ significantly when we relate them to the selected knowledge need.

Summarizing these results, it is obvious that the expected uncertainty and equivocality of most work situations and learning tasks are not supported by the results¹⁰.

4.2.2 Testing the six hypotheses for the learning situations

In total six hypotheses were formulated (see Table 5). In this section we test if these hypotheses are true or false, based on the data from the survey.

Referring to Table 14, we can state that the reported levels of uncertainty and equivocality associated with the selected knowledge needs, is not what was expected theoretically. Especially when it was expected that the uncertainty and equivocality were high, they were judged to be relatively low. However, there are two things to take into account. First, the equivocality and uncertainty of a knowledge need was not measured directly, but derived from the work situation to which the selected knowledge need was linked. As there is no relation between selected work situation and selected knowledge need (see remark below Table 12), this derivation is open to discussion. Secondly, the hypotheses could still be true if we take this judged certainty and equivocality instead of the theoretical one as the starting point of the analysis, as they are about media usage and not about certainty and equivocality which are given.

4.2.2.1 Actual use and hypothesized use of knowledge sources and media

The data concerning knowledge needs and used knowledge source is shown in Table 15.

Table 15 Knowledge needs and used knowledge sources in learning situations (n=97)

Used knowledge source	Knowledge need					
	<i>Facts and figures</i>	<i>Well founded understanding</i>	<i>Technique, procedure or method</i>	<i>Analyzing a problem</i>	<i>Evaluating something</i>	<i>Create something new</i>
A person	25%	12%	29%	30%	20%	18%
A documented (text-based) source	13%	29%	29%	10%	40%	27%
Both	63%	57%	43%	60%	40%	55%
None	0%	2%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%

The first thing that is clear from Table 15 is that a combination of knowledge sources is used most frequently for satisfying a knowledge need. This, once more, stresses the importance of combining different knowledge sources in the same support environment, as envisioned in the APOSDLE system.

Furthermore it can be seen from Table 15 that lean knowledge sources only, that is documented sources, are not used relatively frequently for 'fact and figures', 'well founded understanding' and

¹⁰ A possible cause for this discrepancy could be that the sample consists to a large extent of experienced respondents. It seems likely that the same work situation can have a different uncertainty and equivocality for more and less experienced persons. Whether this is true, has to be investigated in the future.

'technique, procedure or method'. If only a documented source was used for satisfying the knowledge need 'fact and figures' (13%), a search on the internet was used (13%). For 'well founded understanding' only 29% used just a documented source to satisfy the knowledge need. The media that were used were articles and books (64%), learning material (21%), existing work results (7%), a help system or guidebook (7%). In case the knowledge need was 'technique, procedure or method' (29%) a help system or guidebook (50%), documented experiences (25%) or articles and books (25%) were consulted.

Using personal sources only happened less than using both sources when the respondents experienced these knowledge needs: the percentages vary from 12% for 'well founded understanding' and 29% for 'technique, procedure or method'. In case of 'facts and figures' an employee (13%) was consulted. For 'well founded understanding' a colleague (33%), a person someone works with (33%), the supervisor (17%) or a known expert (17%) were consulted. In case of 'technique, procedure or method' asking for information or knowledge at a person someone works with (75%) or a colleague (25%) were selected. In all these cases where a person was used as the knowledge source, face-to-face (rich) was the used communication medium. The results therefore do not support the expectation that lean communication media would be used.

Table 15 shows that using both sources to satisfy the knowledge needs was most popular for these three knowledge needs. For 'facts and figures' 63% of the participants stated they used both sources. Both sources were used in 57% of the cases for 'well founded understanding'. For the knowledge need 'technique, procedure or method' 43% of the participants used both sources. As can be seen in Table 16, articles, books about a certain theme or topic, existing work results from someone or others and documented experiences, FAQ, lessons learned were relatively used most in these three situations. These sources were combined most with a colleague, a person someone works with or a known expert, see Table 17. The communication media that were used most in these situations were face-to-face (rich) and email (relatively lean), see Table 18. This is not similar with the expectation of that lean communication media would be used.

The first three hypotheses can be rejected, based on these results of used communication media. However, these results are based on a small amount of data, so the results cannot be a bit trivial.

For the knowledge needs 'analyzing a problem', 'evaluating something' and 'create something new' rich knowledge sources were used, that is a person or both a person and documented sources. If a documented source was used in one of these three cases, these were articles and books. If a person was used in 'analysing a problem' this was a colleague (76%) or a known expert (33%). In case of 'evaluating something' or 'create something new' a known expert (100%) was used. All communication in these learning situations occurred via face-to-face contact, which is similar to the expectations about communication media usage.

Table 15 shows that if these knowledge needs were selected, the respondents used both sources in most cases. For both 'analyzing a problem' 60% and for 'create something new' 55% of the respondents used both sources. For the knowledge need 'evaluating something' 40% used both sources. If both sources were used, the documented media that were used most are articles and books, documented experiences, FAQ, lessons learned or existing work results from someone or others, see Table 16. These were in most cases combined with consulting a known expert, a person someone works with or a colleague, see Table 17. The communication medium that was used most in these situations was a face-to-face conversation (rich), see Table 18. These results are similar to the expectations about communication media usage in these more complex situations.

All the percentages in this part are based on small data sets, as these knowledge needs were not selected often. Nonetheless, these results seem to be in line with what was expected. Because there is only a small amount of data, we can say that these results show that there is a trend to use richer media in these cases. However, we do have to keep in mind the small amount of data where this acceptance is based on.

A χ^2 test reveals that the selected knowledge need is not related to the used source ($\chi^2 = 6.536$, $p > .05$).

Table 16 Knowledge needs and used media for the documented source in learning situations were both sources were used (n=49)

Documented source type		Knowledge need					
		<i>Facts and figures</i>	<i>Well founded understanding</i>	<i>Technique, procedure or method</i>	<i>Analyzing a problem</i>	<i>Evaluating something</i>	<i>Create something new</i>
Existing work results from myself or others	N	2	6	2	1	0	1
	% with Knowledge Need	50%	22%	40%	17%	0%	20%
Documented experiences, FAQ, lessons learned	N	1	4	0	2	0	1
	% with Knowledge Need	25%	15%	0%	33%	0%	20%
Learning material, like course slides, training notes	N	0	2	0	1	0	0
	% with Knowledge Need	0%	7%	0%	17%	0%	0%
Articles, books about a certain theme or topic	N	1	10	3	2	2	3
	% with Knowledge Need	25%	37%	60%	33%	100%	60%
A help system, a guidebook	N	0	3	0	0	0	0
	% with Knowledge Need	0%	11%	0%	0%	0%	0%
A database containing facts, for example, about customers, products	N	0	2	0	0	0	0
	% with Knowledge Need	0%	7%	0%	0%	0%	0%
Total	N	4	27	5	6	2	5
	% with Knowledge Need	100%	100%	100%	100%	100%	100%

Table 17 Knowledge needs and used persons for a person in learning situations where both sources were used (n=51)

A person		Knowledge need					
		<i>Facts and figures</i>	<i>Well founded understanding</i>	<i>Technique, procedure or method</i>	<i>Analyzing a problem</i>	<i>Evaluating something</i>	<i>Create something new</i>
A colleague	N	3	7	3	2	0	1
	% with Knowledge Need	75%	25%	50%	33%	0%	20%
A person I work together with	N	1	12	1	3	1	1
	% with Knowledge Need	25%	43%	17%	50%	50%	20%
My supervisor	N	0	1	0	0	0	0
	% with Knowledge Need	0%	4%	0%	0%	0%	0%
A known expert	N	0	8	1	1	1	3
	% with Knowledge Need	0%	29%	17%	17%	50%	60%
A trainer, teacher	N	0	0	1	0	0	0
	% with Knowledge Need	0%	0%	17%	0%	0%	0%
Total	N	4	28	6	6	2	5
	% with Knowledge Need	100%	100%	100%	100%	100%	100.0%

Table 18 Knowledge needs and used communication media in learning situations where both sources were used (n=52)

Used communication medium		Knowledge need					
		<i>Facts and figures</i>	<i>Well founded understanding</i>	<i>Technique, procedure or method</i>	<i>Analyzing a problem</i>	<i>Evaluating something</i>	<i>Create something new</i>
Face-to-face	N	3	23	5	5	1	4
	% within LS1 Knowledge Need	60%	82%	83%	83%	50%	80%
Telephone	N	1	0	0	0	1	1
	% within LS1 Knowledge Need	20%	0%	0%	0%	50%	20%
Email	N	1	4	1	1	0	0
	% within LS1 Knowledge Need	20%	14%	17%	17%	0%	0%
Discussion forum	N	0	1	0	0	0	0
	% within LS1 Knowledge Need	0%	4%	0%	0%	0%	0%
Total	N	5	28	6	6	2	5
	% within LS1 Knowledge Need	100%	100%	100%	100%	100%	100%

4.2.2.2 Preferred use and actual use of knowledge sources and media

In the previous section we investigated the relation between learning situations and actually used knowledge sources and media. Taken literally, the Media Richness Theory does not predict actual use but preferred use. Preferred use can be prevented by either organisational norms or technological shortcomings. To check for this, we must figure out whether actual and preferred use are the same, given the same type of learning situation.

Figure 4 shows bar charts of the used and preferred sources, which shows that the main difference is that using both sources is preferred but not always used in reality.

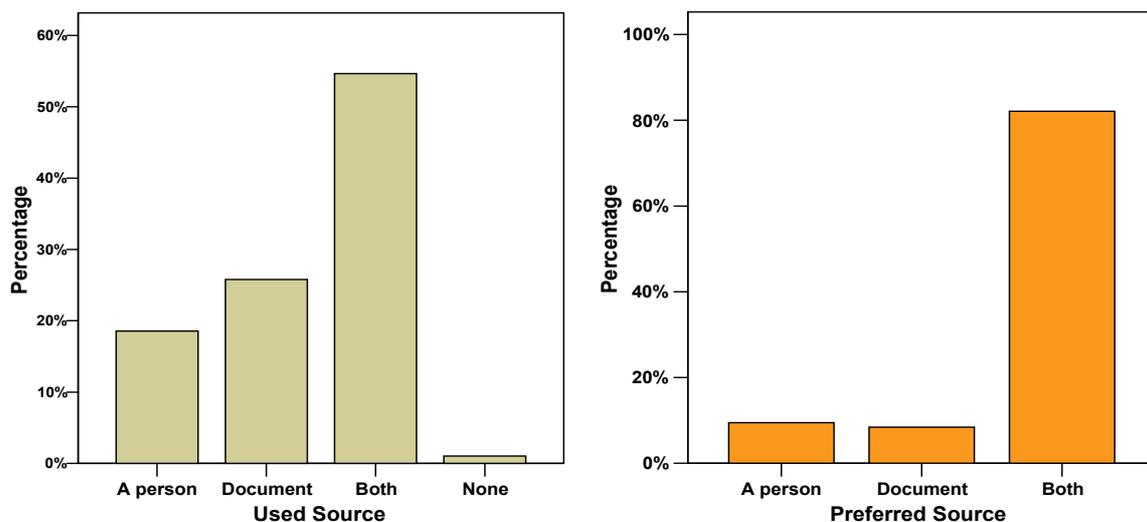


Figure 4 Comparing used source and preferred source in learning situations

The result of a test shows that the used source is significantly related to the source preferred ($\chi^2=21.336$, $p<.05$). As a consequence the data and conclusions presented in the previous section hold for actually used as well as preferred knowledge sources. Nonetheless Figure 4 shows that there is some discrepancy between what was used and what was preferred to be used. As the 'Both' category is dominant in Figure 4, this stresses the importance of making a variety of knowledge sources available when learning during work.

As used source and preferred source are related there is no need to repeat the analyses from the previous sections for preferred sources. It is very likely that the results will be the same.

4.2.3 Knowledge sharing situations

The study was not only about situations in which the respondent needed to find information, knowledge and/or expertise. The survey also addressed situation in which the respondent was asked to share his knowledge because someone else needed information, knowledge and/or expertise and play the role of the knowledge provider. In total 89 respondents selected a work situation for a knowledge sharing situation they experienced recently and could remember well (see Table 19).

Table 19 Selected work situations for the knowledge sharing situations (n=89)

Work situation	Percentage (%)
Were contacted by someone else (a colleague or customer) who asked for advise or instructions in your area of expertise.	29
Had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, e.g. by giving a presentation or by writing a report.	28
Were part of a team to develop something new or innovative and you had to extensively exchange knowledge with the other team members.	19
Had to document your expertise for someone else, e.g. in a project hand-over or because you left the department or Company	11
Had to advise a new co-worker in your department or company of how things were being done.	10
I can not remember a situation like this.	2

The results in 19 show that respondents were most frequently asked for 'advise or instructions in their area of expertise' (29%) and to 'comprehensively inform a colleague or customer about a certain topic in their area of expertise' (28%). Also, being asked to 'extensively exchange knowledge with team members in a project that developed something new or innovative' occurred relatively often (19%). Only 2% of the respondents could not remember a work situation like this. The selected work situation in the knowledge sharing situation does not effect the selected knowledge need in the knowledge sharing situation ($\chi^2=21.875$, $p>.05$).

We also asked how the respondents would describe the knowledge need of the other person in this situation (see Table 20).

Table 20 Selected knowledge need for the knowledge sharing situation (n=85)

Knowledge need of the other person	Percentage (%)
He/she was mainly trying to get a good and well founded understanding of the topic about which I was contacted.	45
He/she was in need of a specific technique, procedure or method that he/she was seeking to apply.	21
He/she was mainly trying to find facts and figures for which it was important to remember them well.	15
He/she was trying to create something new for which there was no predefined method or procedure.	7
He/she was evaluating something and judging it by comparing it with known standards in the field, e.g. state-of-the art works.	6
He/she was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.	5

As can be seen in Table 20, respondents were asked most frequently for sharing knowledge with the other person so she could get ‘a good and well founded understanding of a certain topic’ (45%). In addition, sharing knowledge about ‘specific technique, procedure or method’ (21%) and ‘facts and figures’ were also selected frequently.

4.2.3.1 Uncertainty and equivocality of knowledge sharing situations

Like in the previous part of the survey, the selected work situations had to be judged on uncertainty and equivocality. The two statements that were used to measure the level of experienced uncertainty and equivocality were the same as for learning situations.

Table 21 shows the averages for uncertainty and equivocality for the selected work situations in knowledge sharing situations.

Table 21 Average judgement (mean) of uncertainty and equivocality of the selected work situation in knowledge sharing situations

Selected work situation		N	Mean	Std. Deviation
Had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, e.g. by giving a presentation or by writing a report.	Uncertainty	25	2.08	1.288
	Equivocality	25	2.96	1.207
Were contacted by someone else (a colleague or customer) who asked for advise or instructions in your area of expertise.	Uncertainty	26	2.00	1.200
	Equivocality	26	3.00	1.095
Had to advise a new co-worker in your department or company of how things were being done.	Uncertainty	9	1.89	.782
	Equivocality	9	2.89	1.364
Had to document your expertise for someone else, e.g. in a project hand-over or because you left the department or company.	Uncertainty	10	2.40	1.430
	Equivocality	10	2.20	.919
Were part of a team to develop something new or innovative and you had to extensively exchange knowledge with the other team members.	Uncertainty	16	1.88	1.147
	Equivocality	16	2.94	1.340

It was expected that uncertainty and equivocality would be low to moderately for all transfer situations. Table 21 shows that both uncertainty and equivocality do not seem to play a major role in the selected work situations. The mean values are all 3.00 or lower. Interestingly, the results show that uncertainty is low, especially when someone has to advise a new co-worker or extensively has to exchange knowledge. Thus, for knowledge sharing situations the respondents did not feel very uncertain about what he had to do or about what he had to deliver. These results support the expected levels of uncertainty and equivocality of knowledge sharing situations.

We can test whether there are significant differences in uncertainty and equivocality between the selected work situations in knowledge sharing situations using analysis of variance. The frequency a situation has been judged ranges from 26 to 9. This means that variance analysis can only be conducted for the following two work situations:

- Were contacted by someone else (a colleague or customer) who asked for advise or instructions in your area of expertise.
- Had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, e.g. by giving a presentation or by writing a report.

For the other work situations the number of judgments is too low (in this case: lower than 25) to do analysis of variance. The ANOVA analysis shows that there are no significant differences between the judgement of uncertainty ($F=.117, p>.05$) and equivocality ($F=1.83, p>.05$) in the case one of the above two situations were selected.

When we look at the selected knowledge need, we can ask if the judgement of uncertainty and equivocality differ in relation to this selected knowledge need. In Table 22 the judgements of uncertainty and equivocality are shown.

Table 22 Average judgement (mean) of uncertainty and equivocality of the selected knowledge need in knowledge sharing situations

Knowledge need of the other person		N	Mean	Std. Deviation
He/she was mainly trying to find facts and figures for which it was important to remember them well.	Uncertainty	13	1.62	.506
	Equivocality	13	3.00	1.354
He/she was mainly trying to get a good and well founded understanding of the topic about which I was contacted.	Uncertainty	38	1.89	1.008
	Equivocality	38	2.68	1.188
He/she was in need of a specific technique, procedure or method that he/she was seeking to apply.	Uncertainty	18	2.61	1.720
	Equivocality	18	3.33	1.029
He/she was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.	Uncertainty	4	3.50	1.291
	Equivocality	4	1.75	.957
He/she was evaluating something and judging it by comparing it with known standards in the field, e.g. state-of-the art works.	Uncertainty	5	1.60	.894
	Equivocality	5	3.20	1.095
He/she was trying to create something new for which there was no predefined method or procedure.	Uncertainty	6	1.50	.548
	Equivocality	6	3.00	1.265

It was expected that uncertainty and equivocality would be judged as being low to moderate. The results show that uncertainty and equivocality were overall not high, which seem to support the expectations. However, in case that the knowledge seeker was analysing a problem uncertainty is judged relatively high (mean=3.50). In addition, equivocality is judge relatively high for most of the knowledge needs of the knowledge seeker. Namely, when the knowledge seeker was mainly trying to find facts (mean=3.00), was in need of a specific technique, procedure or method (mean=3.33), was evaluating something (mean=3.20) or was trying to create something new (mean=3.00) equivocality was relatively high. So concluding it can be said that these results support the most of expected levels of uncertainty but not those of the equivocality of the knowledge need of the other person.

As the number of judgments is only high for ‘well founded understanding’ (n=38), variance analysis is not possible. So it is not possible to say if the judgement of uncertainty and equivocality differ significantly when we relate them to the selected knowledge need in the knowledge sharing situation.

4.2.4 Testing the six hypotheses for the knowledge sharing situations

In the knowledge sharing situations respondents could only indicate which source they used. Table 23 gives an overview of the used sources in the knowledge sharing situation, differentiated for the selected knowledge need of the other person. For ‘fact and figures’, ‘well founded understanding’ and ‘technique, procedure or method’.

Table 23 Knowledge needs and used knowledge sources in knowledge sharing situations (n=85)

Used Source	Knowledge need of the other person					
	<i>Facts and figures</i>	<i>Well founded understanding</i>	<i>Technique, procedure or method</i>	<i>Analyzing a problem</i>	<i>Evaluating something</i>	<i>Create something new</i>
A person	15%	8%	11%	0%	0%	0%
A documented (text-based) source	62%	40%	50%	50%	40%	33%
Both	8%	29%	11%	25%	20%	50%
None	15%	24%	28%	25%	40%	17%
Total	100%	100%	100%	100%	100%	100%

The results in Table 23 show that most participants (resp. 62%, 40% and 50%) used a documented source if the other person had one of these three knowledge needs. In case of ‘facts and figures’ existing work results (63%) or articles and books (13%) were used often. For ‘well founded understanding’ existing work results (53%), articles and books (27%) and learning material (13%) were used most. For ‘technique, procedure or method’ existing work results (33%) and articles and books (22%) were used most too. The communication with the knowledge seeker occurred most via (the rich) face-to-face conversation. This is not in line with the expected use of lean communication media.

If a person was used a knowledge source, this was most times a colleague, but for ‘well founded understanding’ also a person someone works with or the supervisor was consulted. The communication with this knowledge source in case of ‘well founded understanding’ was face-to-face (see Table 24). For the other two knowledge needs this data is missing. The contact with the knowledge seeker occurred mainly via face-to-face (rich) communication in all these three situations. This is not in line with the expected use of lean communication media. Table 24 shows that only in case of ‘technique, procedure or method’ a discussion forum was used too.

In case both sources were used, existing work results, a colleague or a person someone works with were used mainly. The communication with the knowledge seeker and knowledge source mainly took place via face-to-face (rich) conversations (see Table 24). This is again not in line with the expected use of lean communication media. These results mean that the first three hypotheses can not be accepted, although the data set is very small.

For the last three knowledge needs Table 23 illustrates that documented sources were used more often in case of ‘analysing problem’ (50%) and ‘evaluating something’ (40%). In case of ‘analysing a problem’ documented experiences (50%) and articles and books (50%) were used. Using existing work results or a database occurred in case of ‘evaluating something’. For ‘create something new’ one out of three respondents used a documented source (33%), which was or existing work results or documented experiences. Most of the communication with the knowledge seeker took places via (rich) face-to-face communication, although email (relatively lean) was used for ‘evaluating something’ and a discussion forum (relatively lean) was used for ‘creating something new’. These results do not support the expectation of lean media usage.

No persons were used as a source in case of ‘analyzing a problem’ and ‘evaluating something’ the percentages for using both sources are 20% (evaluating) and 25% (analyse). For ‘create something new’ half of the respondents (50%) used both sources. The media that were used most were articles and books and documented experience most times combined with a person someone works with. The communication with the knowledge seeker and the contact with the knowledge source most times took

place via (rich) face-to-face communication, although using email (relatively lean) occurred too for 'creating something new'. These results have mixed support for expectation of using rich media.

Using no sources also happened frequently for 'evaluating something' (40%). The results do not support the hypotheses for the last three knowledge needs, although the results are based on very small data sets in the cells. Therefore, the hypotheses can not be accepted.

A test reveals that the selected knowledge need is not related to the used source ($\chi^2=12.933$, $p>.05$).

Table 24 Knowledge needs and used communication media to communicate with the knowledge seeker in knowledge sharing situations if a documented source was used (n=37)

Communication medium		Knowledge need					
		<i>Facts and figures</i>	<i>Well founded understanding</i>	<i>Technique, procedure or method</i>	<i>Analyzing a problem</i>	<i>Evaluating something</i>	<i>Create something new</i>
Face-to-face	N	8	10	7	1	1	1
	% with Knowledge Need	100%	67%	78%	100%	50%	50%
Telephone	N	0	1	1	0	0	0
	% with Knowledge Need	0%	7%	11%	0%	0%	0%
Email	N	0	3	0	0	1	0
	% with Knowledge Need	0%	20%	0%	0%	50%	0%
Discussion forum	N	0	0	0	0	0	1
	% within Knowledge Need	0%	0%	0%	0%	.0%	50%
A written letter or memo	N	0	0	1	0	0	0
	% with Knowledge Need	0%	0%	11%	0%	0%	0%
Video conference	N	0	1	0	0	0	0
	% with Knowledge Need	0%	7%	0%	0%	0%	0%
Total	N	8	15	9	1	2	2
	% with Knowledge Need	100%	100%	100%	100%	100%	100%

4.2.5 Conclusion

What can be said about accepting the hypotheses for the learning and knowledge sharing situations? An overview of the results is given in Table 25. Unfortunately, because of a small data set per “knowledge need-used source/medium”-set neither of the hypotheses are neither completely true nor false. The results are simply not convincing enough. However, based on the results we can state that there are some trends:

- for the three less complex learning tasks remembering, understanding and applying, there is a trend for using rich knowledge sources and communication media in learning situations, which is not line with the hypotheses H1, H2, H3, H7, H8 and H9.
- for the three less complex learning tasks remembering, understanding and applying, there is a trend for using rich communication media in knowledge sharing situations, which is not line with the hypotheses H1, H2, H3, H7, H8 and H9.
- for the three less complex learning tasks remembering, understanding and applying, there is a trend for using lean knowledge sources in knowledge sharing situations, which is in line with the hypotheses H1, H2, H3, H7, H8 and H9.
- for the three more complex learning needs ‘analyzing a problem’, ‘evaluating something’ and ‘create something new’ there is a trend for using rich knowledge sources communication and communication media in learning situations, which is line with the hypotheses H4, H5, H6, H10, H11 and H12.
- for the three more complex learning needs ‘analyzing a problem’, ‘evaluating something’ and ‘create something new’ there is a trend for using no or lean knowledge sources and communication media in knowledge sharing situations, which is not line with the hypotheses H4, H5, H6, H10, H11 and H12.

Table 25 Results of testing the six hypotheses related to matching knowledge source/communication medium richness and specific media to learning and knowledge sharing situations (note: n=small)

Learning task	Hypothesized communication medium usage	Used media in learning situations	Used media in knowledge sharing situations	Hypothesis true or false?	Hypothesized knowledge source usage	Used knowledge source in learning situations	Used knowledge source in knowledge sharing situations	Hypothesis true or false?
Remembering	H1: lean communication media like text based impersonal documents	False	False	False	H7: Documented sources	False	True	True for knowledge sharing situations
Understanding	H2: lean communication media like text based impersonal documents	False	False	False	H8: Documented sources	False	True	True for knowledge sharing situations
Applying	H3: lean communication media like text based impersonal documents	False	False	False	H9: Documented sources	False	True	True for knowledge sharing situations
Analyzing	H4: relatively rich communication media like audio/video based files and collaboration	True	False	True for learning situations	H10: Person	True	False	True for learning situations
Evaluating	H5: relatively rich communication media like audio/video based files and collaboration	True	False	True for learning situations	H11: Person	True	False	True for learning situations
Creating	H6: rich communication media face-to-face communication and collaboration	True	False	True for learning situations	H12: Person	True	False	True for learning situations

4.3 Results related to alternative theoretical perspectives

In this section we will explore results for the alternative theoretical perspectives proposed in section 2.2.1.9.

4.3.1 Selecting knowledge sources and the concept of the three spaces

In this section, we report on results about to which specific knowledge source respondents turned to when faced with the work situations described above. This refers to the role of the three spaces outlined in section 2.2.1.9.1. Across all situations, the most important knowledge sources selected were “A person I work together with” (19%), “A colleague I know well” (17%), “A known expert” (15%), “Articles, Books” (14%), “Existing Work Results” (12%), “Documented Experiences” and “Learning Material” (8%). The other sources (see for all knowledge sources Table 6) were mentioned sporadically.

Table 26 gives an overview of the knowledge sources used least and most considering the work situations.

Table 26 Knowledge Sources used most (+) and least (-) in Work Situations

Work and transfer Situation (Remember the last time you...)		Knowledge Source sought
...were new in the company or department and you wanted to find out how things were being done.	+	A person I work together (31.3%) ; My supervisor
	-	Articles, books
...had to tackle a new assignment or project, and you needed to acquire the most important knowledge.	+	Articles, books; A person I work together with
	-	Learning Material
...needed to solve a problem because something had gone wrong or something occurred in an unexpected way.	+	A colleague; A help system
	-	A person I work together with
...were trying to catch up with recent developments in your field of expertise.	+	Articles, books; Learning material
	-	A person I work together with
...had to come up with a creative and innovative idea or solution to a problem.	+	Known expert
	-	Existing Work Results
...needed to design or configure something, like a part of a product, service or method for an internal or external customer.	+	Known Expert
	-	A Colleague
...had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, e.g. by giving a presentation or	+	Existing work results Documented experiences

by writing a report.	-	A known expert
...were contacted by someone else (a colleague or customer) who asked for advice or instructions in your area of expertise.	+	Existing work results
	-	My supervisor
...had to advise a new co-worker in your department or company of how things were being done.	+	Existing work results Articles, books
	-	A known expert
... had to document your expertise for someone else, e.g. in a project hand-over or because you left the department or company.	+	Existing work results
	-	Articles, books
... were part of a team to develop something new or innovative and you had to extensively exchange knowledge with the other team members.	+	Existing work results A database containing facts
	-	A person I work together with

The most interesting results of Phase 2 with respect to the selection of knowledge sources are briefly described subsequently. According to the results of our survey, people who are new in a company mostly ask persons they work together with (31.3%), or they ask their supervisor (9.4%). For few of the situations when the respondents wanted to find out how things were being done in the new company (3.1%), they stated that they were trying to find information in books or articles. Interestingly, in situations where the goal is to find the most important knowledge quickly, only in (2.3%) the respondents were using learning materials. Instead, (20.9%) stated that they had looked up the needed information in articles and books, or had asked a person they work(ed) together with (23.3%). In a problem solving situation, there is an interesting split in that mostly colleagues are asked for help (50%) rather than co-workers (0%) which may indicate certain social barriers.

Documented sources are used most when catching up with developments in the own field of expertise (learning material was used in 17.4% of the situations, and articles and books in 34.8% of the situations).

In this situation, co-workers are not a preferred source (4.3%). Known experts are preferred to other sources (46.2%) in situations where creative solutions are required as well as in situations, where a product or method is needed to be designed or configured (26.7%). In the knowledge transfer situations, existing work results were one of the most important sources of additional information (35.6%). When we consider the three spaces (learning, work, knowledge), there is overall a preference (44.5%) for the work space (using existing work results, or a person they work together with), followed by the knowledge space (43.4%) (known experts, documented experiences, articles and books). The learning space however, plays a much less significant role (12%).

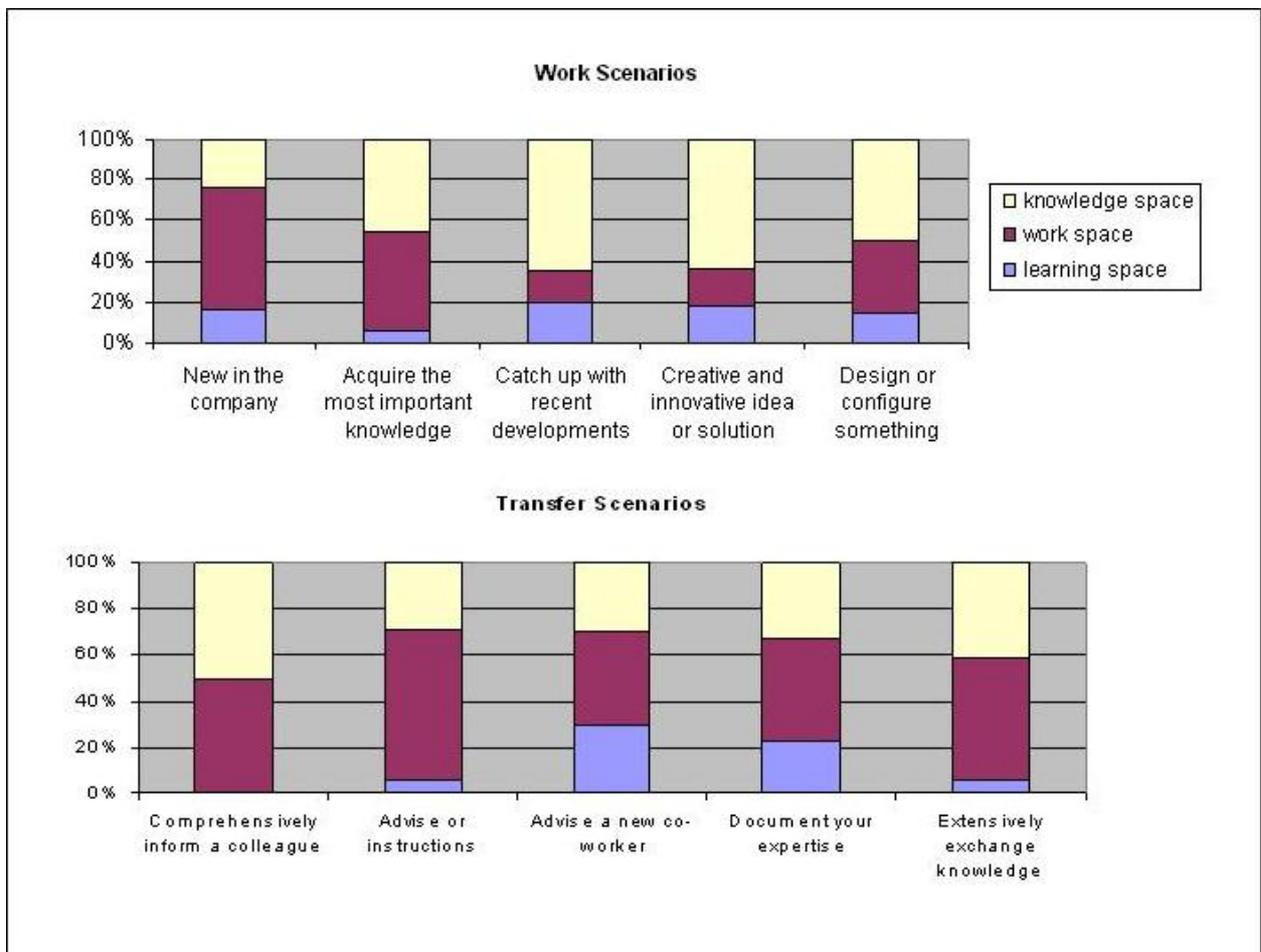


Figure 5 Part of the Information Space sought depending on work (upper chart) and knowledge sharing situations (lower chart)

There are marked differences in the use of the three spaces depending on the knowledge work situation. As it can be seen from the upper chart in Figure 5, the work space predominates in situations if the respondents were new in the company and wanted to find out how things were being done (60%), and in situations where they wanted to quickly acquire the most important knowledge (48.5%). In the knowledge sharing situations (lower chart), the situations comprehensively inform a colleague, advise or instructions, advise a new co-worker, document your expertise, extensively exchange knowledge, the work space is accessed more frequently.

In order to validate the reality of the three spaces as distinct information sources, a first test was performed to check whether Kelloway and Barling's (2000) knowledge work types (acquire, create, apply and transfer) differentiate between the three spaces. This is shown in Figure 6 Knowledge Work Types and Access to the Three Information Spaces.

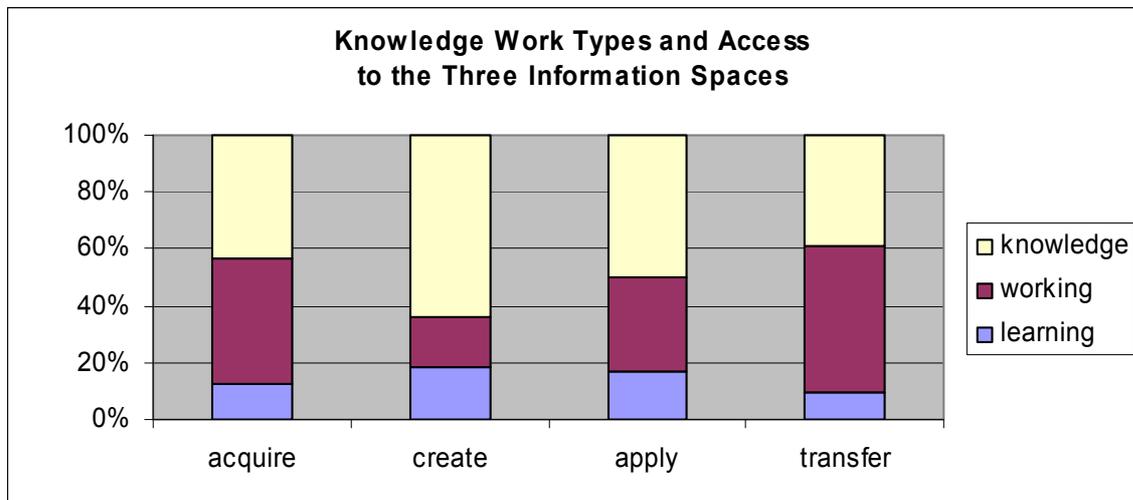


Figure 6 Knowledge Work Types and Access to the Three Information Spaces

Although there seem to be marked differences, the χ^2 Test rejected this hypothesis. We will continue to explore this effect in the further studies to be conducted.

4.3.2 The social influence model of technology use

As described in section 2.2.1.9.2, actual use of communication media is probably not only a question of individual preferences but can be influenced by organisational factors like norms about what are 'correct' media to be used in different settings and what colleagues and co-workers use.

Respondents were asked to indicate the extent to which their *organization* appreciates the use of the seven different media. This data represented the organisational norms about media usage. The seven media presented to the respondents were face-to-face conversations, telephone, email, chat, discussion forum, written letter or memo and video conference tool. We investigated if there is a difference in used media in the learning situations between the organisational norms about media usage for each of these media. The analysis of variance yielded that there were no significant differences¹¹. If organisational norms about media usage is considered as one variable, variance analysis yields that again there is no significant difference (F=.666, p>.05).

It was also investigated if there is a difference in the preferred media in the learning situation rooted in the organisational norms for each of the seven media. Results of variance analysis show that is a significant difference for discussion forum usage (F=4.602, p<.05)¹². The results of the Tukey post-hoc test (HSD) show that if a documented source is preferred in the learning situation the organisational norms about using discussion forums are lower then when using both sources is preferred.

For organisational norms about media usage and preferred source counts no differences were found (F= 1,722 p>.05).

For the used media in the knowledge sharing situation the same analyses were performed. The analysis of the difference in organisational norms about media usage in the knowledge sharing situations between the individual media usage for each of these media reveal that there is a significant

¹¹ Variance (One-Way ANOVA) analysis results: face-to-face conversations (F=.868 p>.05), telephone (F=.526, p>.05), email (F=.796, p>.05), chat (F=.358, p>.05), discussion forum (F=.103, p>.05), written letter or memo (F=.193, p>.05), and video conference tool (F=.476, p>.05)

¹² Variance (One-Way ANOVA) analysis results: face-to-face conversations (F=.920 p>.05), telephone (F=.021, p>.05), email (F=.873, p>.05), chat (F=1.296, p>.05), written letter or memo (F=.540, p>.05), and video conference tool (F=1.289, p>.05)

difference for chat ($F=3.179$, $p<.05$) and telephone ($F=5.046$, $p<.05$).¹³ The Tukey HSD post-hoc test shows that if both sources were used in the knowledge sharing situation the organisational norm about media usage of using the telephone was more positive than the norms about the other media. The post-hoc test also reveals that if a person was used as a source in the knowledge sharing situation, the organisational norms about using chat are more positive than if no sources were used. The variance analysis for organisational norms and used media in knowledge sharing situations shows no significant difference ($F=2.171$, $p>.05$).

The influence of organisational norms about media usage on the used and preferred source in the learning situation only shows for the preferred source and the organisational norms about discussion forum usage. If a documented source is preferred in the learning situation the organisational norms about using discussion forums are lower than when using both sources is preferred. In knowledge sharing situations, the influence of organisational norms about media usage on the used is significant for chat and telephone. Results show if both sources were used in the knowledge sharing situation the organisational norm about using the telephone was more positive than the norms about the other media. In addition, the results show that if a person was used as a source in the knowledge sharing situation, the organisational norms about using chat are more positive than if no sources were used.

As a second aspect of possible organisational influences on media use, the respondents could indicate the extent to which their *direct colleagues* use the seven different media during a typical work week. If we look at the difference in used media in the learning situations between the organisational media usage for each of these media, variance analysis shows that there are no significant differences¹⁴. If we compute a new variable from these seven variables that represents organisational media usage, we see that there is no significant difference in media usage in learning situations based on organisational media use ($F=.801$, $p>.05$).

When we look at the preferred sources in learning situations and organisational media usage there is a significant difference for organisational usage of the video conference tool ($F=3.213$, $p<.05$)¹⁵. The post-hoc test explains that if using a person as a source was preferred in the learning situation, video conferencing was used less than when a documented source was used. If organisational media usage is perceived as one variable, the variance analysis shows that there are no significant differences ($F=1.051$, $p>.05$). For used sources in knowledge sharing situations there are no significant differences for organisational media usage when we do a variance analysis for each of the seven media¹⁶. Also if organisational media usage is computed into one variable, no differences are found ($F=1.293$, $p>.05$).

There is an influence of organisational media usage on the used and preferred source in the learning situation. Results show that if using a person as a source was preferred in the learning situation, video conferencing was used less than when a documented source was used.

No significant influences were found for the knowledge sharing situations.

¹³ Variance (One-Way ANOVA) analysis results: face-to-face conversations ($F=1.003$, $p>.05$), email ($F=1.523$, $p>.05$), discussion forum ($F=2.265$, $p>.05$), written letter or memo ($F=1.557$, $p>.05$), and video conference tool ($F=.225$, $p>.05$)

¹⁴ Variance (One-Way ANOVA) analysis results: face-to-face conversations ($F=.663$, $p>.05$), telephone ($F=1.839$, $p>.05$), email ($F=.064$, $p>.05$), chat ($F=.054$, $p>.05$), discussion forum ($F=.153$, $p>.05$), written letter or memo ($F=2.581$, $p>.05$), and video conference tool ($F=.774$, $p>.05$)

¹⁵ Variance (One-Way ANOVA) analysis results: face-to-face conversations ($F=1.448$, $p>.05$), telephone ($F=.062$, $p>.05$), email ($F=1.486$, $p>.05$), chat ($F=.110$, $p>.05$), discussion forum ($F=.304$, $p>.05$) and written letter or memo ($F=.788$, $p>.05$)

¹⁶ Variance (One-Way ANOVA) analysis results: face-to-face conversations ($F=.011$, $p>.05$), telephone ($F=.054$, $p>.05$), email ($F=.422$, $p>.05$), chat ($F=1.849$, $p>.05$), discussion forum ($F=1.038$, $p>.05$), written letter or memo ($F=1.659$, $p>.05$) and video conference tool ($F=.755$, $p>.05$)

4.4 Comparison of Phase 1 and 2

In Phase 1 of this second Workplace Learning Study, knowledge work challenges were considered from an organizational perspective. In the questionnaire of Phase 1, the respondents were asked to decide for eight potential knowledge work challenges, how serious they felt they were for their organisation.

Table 27 shows the frequency of responses of the 24 participants for each challenge. According to the results of Phase 1,

- Challenge 1. Fitting in new employees,
- Challenge 4. Better transferring existing knowledge experiences, solutions and practices within the company so others can benefit from them,
- Challenge 3. Having employees stay up to date with the developments in their field of expertise,

occurred most frequently in their companies.

Table 27 Organizational Knowledge Work Challenges (Phase 1)

Challenges	Frequency	Percent
Challenge 1. Fitting in new employees. Letting them adapt to the way we do things around here.	22	91,67
Challenge 2. Bringing employees up to speed for new assignments. Providing them the most important knowledge to tackle a new task quickly.	20	83,33
Challenge 3. Having employees stay up to date with the developments in their field of expertise.	21	87,50
Challenge 4. Better transferring existing knowledge experiences, solutions and practices within the company so others can benefit from them.	22	91,67
Challenge 5. Improving the communication and knowledge transfer between experienced and less experienced employees.	20	83,33
Challenge 6. Improving communication and knowledge exchange in teams when they innovate and develop something new.	19	79,17
Challenge 7. Motivating employees to better perform.	16	66,67
Challenge 8. Freeing experts from routine work so they can concentrate on important value generating activities.	20	83,33

In Phase 2 of the Workplace Learning Study, we wanted to look at the Knowledge Work Challenges from an individual knowledge worker perspective. In order to bring organizational knowledge work challenges in relation with individual knowledge work challenges, we mapped some of the organizational challenges onto individual ones, and to formulate them as learning scenarios. Challenge 1 of Phase 1 was rephrased (see for Phase 2 work situations section 2.2.1.3) into *Remember the last time you were new in a department or in a company, and you wanted to find out how things were being done.* Similarly, Challenge 2 was reworded into *Remember the last time you had to tackle a new assignment or project, and you needed to acquire the most important knowledge,*

and Challenge 3 was reworded into *Remember the last time you were trying to catch up with recent developments in your field of expertise.*¹⁷

As described earlier, respondents were provided with the short descriptions of typical APOSDLE Knowledge Work Scenarios at several stages in the online questionnaire (this is due to the design of the questionnaire, which is described in Chapter 3). They were asked to pick any of these situations which they had experienced recently, and which they regarded as important. Figure 7 (Work situations) Scenarios) and Figure 8 (Knowledge Sharing Situations) depict the relative frequencies of the APOSDLE (rephrased) Phase 1 Knowledge Work Scenarios selected in Phase 2.

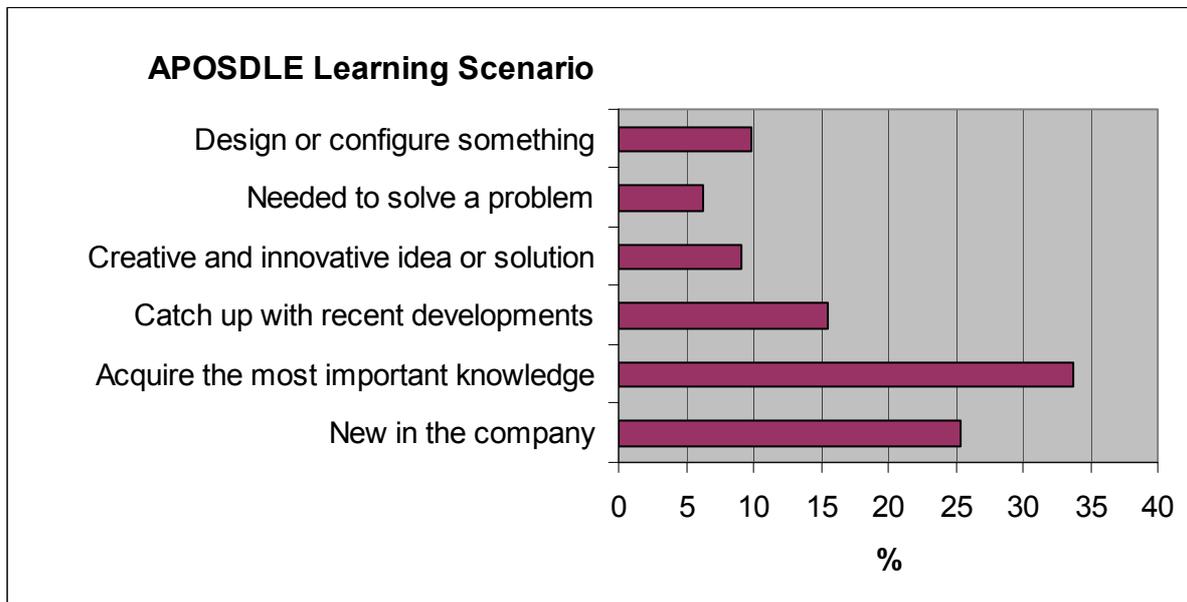


Figure 7 Frequency of APOSDLE Learning Scenario Selected (Phase 2, see also Table 11, n=125)

¹⁷ Challenge 5, and Challenge 6 from Phase I were dealt with in Phase II, only if the respondents had stated that they would select "Personal Sources" in a learning situation under consideration. Challenge 8 was addressed with the APOSDLE Knowledge Transfer Scenarios in Phase II, where the respondent should answer questions for situations in which he or she was acting as "expert". Challenge 7 of Phase I, *Motivating employees to better perform* was neglected in Phase II.

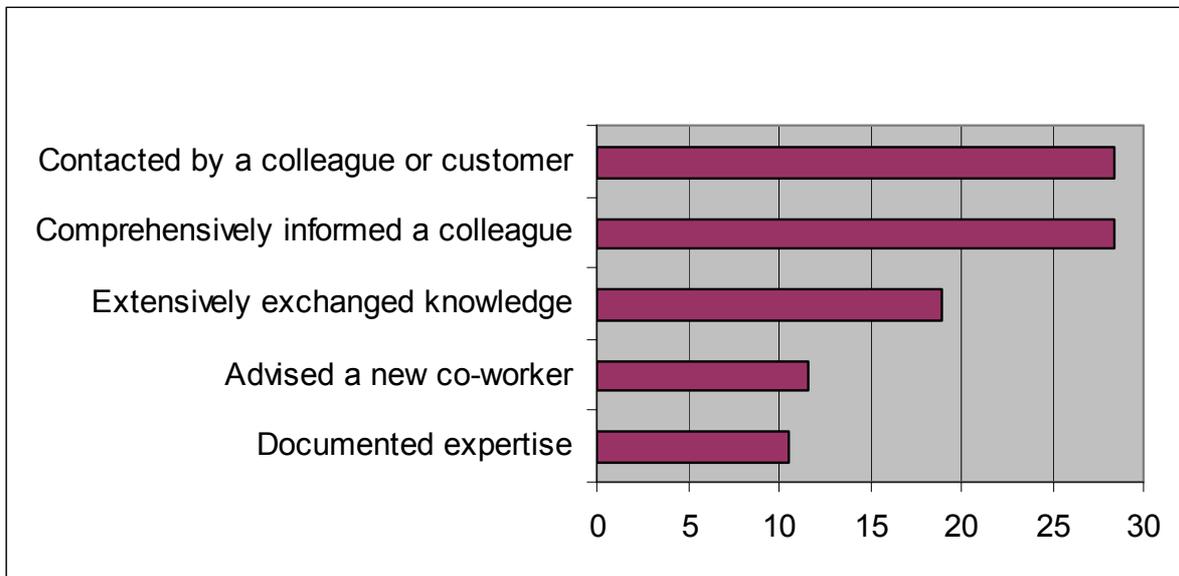


Figure 2: Frequency of APOSDLE Knowledge Transfer Scenario Selected (Phase 2, see also Table 19, n=83))

The APOSDLE Learning Scenario that was selected the most frequently (33,8%) by the respondents was *Remember the last time you had to tackle a new assignment or project, and you needed to acquire the most important knowledge very quickly*. In 25,4% of the cases, the scenario *Remember the last time you were new in the company or department and you want to find out how things were being done* was chosen, and in 15,5% of the cases, the scenario *Remember the last time you were trying to catch up with recent developments in your field of expertise* was selected.

For Knowledge Transfer, the most frequently selected scenarios were *Remember the last time you had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, e.g. by giving a presentation or by writing a report* and *Remember the last time you were contacted by someone else (a colleague or customer) who asked for advise or instructions in your area of expertise* (both 28%).

Although there is of course an effect of order of the scenarios (the scenarios were not presented in a randomized order), we take the frequency of selections as one indicator for the importance of the scenario in the responding companies. The “new in company” and the “acquire most important knowledge quickly” challenges had been assigned importance also in the first phase from an organizational perspective. In the second phase, these two were also the two most frequently selected scenarios from an individual viewpoint. Thus it can be concluded that for the frequency of occurrence of certain work/sharing situations annex scenarios, in both phases the results are similar. This makes it more likely that these are the core situations in many organisations at the organisational as well as the individual level.

5 Summary and Conclusions

The goal of the second WPLS, consisting of two phases, was to obtain more insight into the relation between work-learn situations and the knowledge sources and communication media people use to acquire the knowledge needed to perform tasks at hand better and gain knowledge about these. This context is central to the APOSDLE solution as it intends to combine the three spaces people at work can be seen as operating in: the Work Space, the Knowledge Space and the Learning Space, with are connected through communication.

To theoretically underpin this research, the main theoretical perspective chosen was the Media Richness Theory. This theory links properties of tasks, uncertainty (about how to perform a task) and equivocality (what should be the results of a task), to knowledge sources and communication media that can be used to exchange knowledge about tasks at hand. In particular it states that when the uncertainty and equivocality of tasks increase, richer knowledge sources and communication media, media that can convey more cues, are needed to guarantee an effective transfer of knowledge. Based on predictions from this theory, support for selecting the best fitting knowledge sources and communication media in APOSDLE can be derived. In addition two other theoretical perspectives were briefly touched upon: Knowledge Space Theory and the Social Influence Model of Technology Use. The first states that during work, people will access each of the three spaces mentioned above to solve problems. The second claims that the Media Richness Theory is incomplete as organizational norms and habits can inhibit or promote the use of communication media, even if these don't fit the task at hand well.

In the study, two different situations a person can be in were addressed: a situation where the person plays the role of the knowledge seeker or learner (*learner situation*) and a situation where the person plays the role of the knowledge provider or knowledgeable person sharing knowledge with someone else (*knowledge sharing situation*). People participating in the research could 'construct' a specific combination of a work situation and a knowledge need (from a predefined list) and report about the knowledge source(s) and communication medium (or media) they used in that situation.

The first results have to do with the frequency with which work situations, knowledge needs and communication media were reported for both roles a person can play.

In the *learner situation*, the most frequently selected work situations are acquiring new knowledge when starting a new assignment and finding out how things are done in the company when you are new. The first is associated with a relatively high uncertainty, for the second both uncertainty and equivocality are average. The knowledge need selected most frequently was trying to get a good understanding. This knowledge need is associated with average uncertainty and equivocality. For satisfying the knowledge need a combination of personal and documented sources is used by far the most, stressing the importance of supporting both sources in an integrated environment. When a personal source is selected, colleagues or a person someone works with together are favoured. Finally, face-to-face communication dominates when personal sources are accessed.

In the *knowledge sharing situation*, the most frequently selected work situations are being contacted by someone else who asks for advice in the area of expertise and comprehensively inform a colleague or a customer in the area of expertise by giving a presentation or writing a report. In both situations uncertainty and equivocality are relatively low. Concerning the knowledge need of the person seeking assistance, finding a good and well founded understanding of the topic of the knowledge sharing is selected most frequently, which is in line with what was found for the learner situation. Again uncertainty and equivocality are relatively low. The most frequently used knowledge source used by knowledge provider is a documented source only, with both documented and personal sources next. This is different from the learner situation, which is not surprising given the different context. When both documented and personal; sources were used, existing work results and a colleague or a person someone work with were mainly used. Face-to-face communication dominates in case a person is used as a knowledge source.

Taken together these results confirm to a large extent the major finding from the first workplace learning study that personal contacts are very important, but must be combined with documented sources in a support environment. It is less easy to derive, at the moment of writing, specific design guidelines in this respect from the data that differ from the design of the second APOSdle Prototype. In this sense, the outcomes are more confirmatory for the course the project has taken until now.

The second set of results is relevant for the theoretical (and as a corollary) practical point of view. As can be seen from Table 25, only a limited subset of the hypotheses derived from the Media Richness Theory could be confirmed. When learning tasks become less complex (in terms of uncertainty and equivocality) there is a tendency to access less rich ('lean', documented) knowledge sources in the knowledge sharing situation. If learning tasks become more complex (again in terms of uncertainty and equivocality), there is a tendency for using rich knowledge sources (personal ones) and rich communication media in the learning situation. Based on these results, the usefulness of the Media Richness Theory to provide the basis for designing communication support in APOSdle must be questioned. At least additional analyses are needed to explore in more detail the relation between experience in the job and the results, as the majority of the respondents were experienced. It could be that results are different for less experienced people.

For the two alternative theoretical perspectives, it can be said that access to the different spaces of the Knowledge Space Theory differs for different work-learn situations is different, with the work space dominating when people are in the situation when they are new in the company and have to find things out. However, these differences could not be confirmed statistically. As for the Social Influence Model of Technology Use, there are only minor effects of organizational norms and communication media behavior of colleagues on the selection of media.

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Appendix A Phase 1 Knowledge Work Performance Questionnaire

Knowledge Work Performance: Finding and Applying Knowledge at the Workplace

This is a study conducted by the APOSDLE project (<http://www.apostdle.org>), a research project co-funded by the European Community. Our research is guided by the following question:

How do knowledge workers find and apply knowledge at their workplace so they can more effectively perform in their job?

In previous studies that we conducted directly at knowledge intensive workplaces, we have found that people experience several bottlenecks when trying to find and apply knowledge. With the current study we are exploring where **organizations experience the greatest challenges** in terms of supporting their knowledge workers, and their **needs for technological solutions**.

This survey deals with **Knowledge Workers**. In our understanding these are employees whose essential operational and value creating tasks **consist in the production and distribution of knowledge**. Knowledge Workers **use computers** frequently to do their work. Examples of knowledge workers include engineers, marketing, PR or HR specialists, consultants, researchers, analysts, designers or managers.

Part A: Knowledge Work Challenges

Below you can find eight challenges that today's businesses experience when dealing with knowledge workers.

Are you facing these challenges?	
For each challenge which your business is facing, please indicate by checking the appropriate box.	
Challenge 1. Fitting in new employees. Letting them adapt to the way we do things around here.	<input type="checkbox"/>
Challenge 2. Bringing employees up to speed for new assignments. Providing them the most important knowledge to tackle a new task quickly.	<input type="checkbox"/>
Challenge 3. Having employees stay up to date with the developments in their field of expertise.	<input type="checkbox"/>
Challenge 4. Better transferring existing knowledge experiences, solutions and practices within the company so others can benefit from them.	<input type="checkbox"/>
Challenge 5. Improving the communication and knowledge transfer between experienced and less experienced employees.	<input type="checkbox"/>
Challenge 6. Improving communication and knowledge exchange in teams when they innovate and develop something new.	<input type="checkbox"/>
Challenge 7. Motivating employees to better perform.	<input type="checkbox"/>
Challenge 8. Freeing experts from routine work so they can concentrate on important value generating activities.	<input type="checkbox"/>

solutions and practices within the company so others can benefit from them.	
Challenge 5. Improving the communication and knowledge transfer between experienced and less experienced employees.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Challenge 6. Improving communication and knowledge exchange in teams when they innovate and develop something new.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Challenge 7. Motivating employees to better perform.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Challenge 8. Freeing experts from routine work so they can concentrate on important value generating activities.	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>

Part C: General Questions

What is the approximate **number of employees** in your company? _____

What **branch of industry** is your company working in? _____

Please indicate **approximate percentage of knowledge workers** in your company:

_____ engineers _____ consultants _____ PR, marketing, HR specialists
 _____ researchers _____ analysts _____ designers
 _____ managers _____ others, namely _____

Please indicate your **own position** in your company:

CEO Middle Management Group/Project Leader
 Specialist Administrative Other, namely _____

Please indicate which **functional department** you are working in:

General Management Human Resources Research & Development
 Information Technology Engineering Project Management
 Other, namely _____

Part D: Join the Knowledge Work Performance Network!



If you are interested in the work we are

Your benefits:

- Receive detailed results and benchmarks from this study and others
- Benefit from early access to research results and demonstrations
- Free participations in Workshops and Tutorials
- Display your company logo on the network website (if you wish)

Here is what you will have to do:

- Nominate 8-10 of your employees to take part in an extended survey (takes about 30 minutes to complete)
- Supply your details in the form below (this will be kept separate from the data you provided in this survey in order to ensure confidentiality)

Yes, I **want to join** the APOSdle Knowledge Work Performance Network:

Name: _____

Company: _____

Email: _____

Telephone: _____

**Please return the survey personally, or send it by fax: +43 316 873 9252
Thank you for your participation!**

Appendix B Phase 2 Work Place Learning Questionnaire

The next pages contain the questionnaire used in Phase 2. The lay-out is sub-optimal as the electronic version at SurveyMonkey is only delivered as a pdf file. This file cannot be converted to MSWord without losing lay-out features. As a consequence the lay-out is far from perfect. Nonetheless all questions asked are present in bold face below a kind of header. Choice alternatives can be recognized as the unformatted list in normal face immediately after the question. When scales are used the scale values are displayed in the beginning of the question only.

Introduction and start

This is a study conducted by the APOSDLE project (<http://www.apostdle.org>), a research project co-funded by the European Community. The main focus of the APOSDLE project is to find out how people can be supported when they search and apply knowledge at the workplace. To answer this question, this survey is conducted. It is about learning situations at work where knowledge has to be found or shared.

The first part contains questions about learning situations you were involved in and the way you found the knowledge you needed. The second part is about situations where you shared your knowledge with someone else. You can choose to answer the survey for 1 or several learning and knowledge sharing situations you have experienced. Depending on how many you choose to answer, the total duration of filling out the survey will be 30 minutes or longer. The last part consists of some general questions concerning media usage, personal information and general information about your organization.

We emphasize that all your answers will be handled with the appropriate discretion, and that your anonymity is guaranteed. If you are interested in the results of this study, you can enter your e-mail address at the end of this survey.

Thank you very much for participating in this survey!

Success!

>> To have an optimal view of the questions, put your window on full screen. Click on Next to start the survey.

Part 1: learning situation

This survey may be different than other surveys you are familiar with. In this survey, you will have to put yourself back into a situation you were involved in. It is very important that for all following questions, you will keep this situation in mind. Answering the questions will be much easier if you remember this situation well.

This first part of the survey is about a learning situation at work where you needed to find knowledge.

Selecting a learning situation

Below you can find several brief descriptions of situations in which people sometimes find themselves while they are working and where they need to find information, knowledge or expertise they don't have.

Please pick one of these situations which is similar to one you were involved in recently and which you can remember well. Then try to put yourself back in that situation and answer the questions following this one with that situation in mind.

Remember the last time you...

were new in the company or department and you wanted to find out how things were being done.

had to tackle a new assignment or project, and you needed to acquire the most important knowledge.

were trying to catch up with recent developments in your field of expertise.

had to come up with a creative and innovative idea or solution to a problem.

needed to solve a problem because something had gone wrong or something occurred in an unexpected way.

needed to design or configure something, like a part of a product, service or method for an internal or external customer.

Characterizing the learning situation

You have selected a learning situation you can remember well. Keeping this situation in mind, please indicate the extent to which you agree or disagree with the following statements.

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neither agree nor disagree
- 4 = Agree
- 5 = Strongly agree

In this situation, I ...

1 2 3 4 5

I was under very strong time pressure.

I felt very uncertain about the things I had to do.

There were serious negative consequences if I could not find the knowledge.

What I had to deliver was very well defined.

I was very new to the company or department I was working in.

I was an expert in the topic.

I was working in a team setting.

I was working alone.

Selecting the knowledge need in the learning situation

In order to cope with this situation, you were seeking for information, knowledge or expertise. This need for information, knowledge or expertise is called a "knowledge need".

Which of the following descriptions of knowledge needs best describes the knowledge need you had in this situation? You can select only one description.

I was mainly trying to find facts and figures for which it was important that I remembered them well.

I was mainly trying to get a good and well founded understanding of the topic I was dealing with.

I was in need of a specific technique, procedure or method that I was seeking to apply.

I was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.

I was evaluating something and judging it by comparing it with known standards in the field, for example, state-of-the art works.

I was trying to create something new for which there was no predefined method or procedure.

Used source(s) in the learning situation

We are interested in what you personally did in the situation you found yourself in. Which of the following source(s) have you consulted? If there were many sources you used, please think about which source(s) helped you most in this situation.

Consulting a person was the most helpful

Consulting a documented (text-based) source was the most helpful

Consulting both a person and a documented (text-based) source was most helpful

I did not consult any source in this situation

Used a documented source in the learning situation

You indicated that a document (text-based) source was most helpful. Please specify this source:

Existing work results from myself or others

Documented experiences, FAQ, lessons learned

Learning material, like course slides, training notes

Articles, books about a certain theme or topic

A help system, a guidebook

A database containing facts, for example, about customers, products

Other (please specify)

Where did this source come from?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

Used personal source in the learning situation

You indicated that a personal source was most helpful. Please specify this source.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

Where was this person located?

Within the organization I work

Outside the organization I work

Other (please specify)

How did you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)



Used both sources in the learning situation, part 1

You indicated that one of the sources that was most helpful was a document (text-based) source. Please specify this source:

Existing work results from myself or others

Documented experiences, FAQ, lessons learned

Learning material, like course slides, training notes

Articles, books about a certain theme or topic

A help system, a guidebook

A database containing facts, for example, about customers, products

Other (please specify)

Where did this source come from?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

Used both sources in the learning situation, part 2

You indicated that also a personal source was most helpful. Please specify this source.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

Where was this person located?

Within the organization I work

Outside the organization I work

Other (please specify)

How did you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)



Preferred source in the learning situation

Imagine you were again in a comparable learning situation. Each of the source types below would be equally accessible and they are all able to provide you with the needed knowledge.

Which source type or combination of source types would you prefer to use?

Consulting a person

Consulting a documented (text-based) source

Consulting both a person and a documented (text-based) source

I would not consult any source in this situation

Prefers to use a documented source in the learning situation

Please specify the documented source you would prefer to use.

An existing work result from myself or another person that corresponds to the problem I had.

A documented experience (e.g. FAQ or lesson learned) that describes the problem I had.

One sequence of learning material (e.g. course slides, training notes) that addresses my problem.

One article or part of a book that addresses my problem.

A section from a help system or guidebook corresponding to my problem.

One fact from a database, e.g. about customers, products.

Other (please specify)

In your case, where would this source be located?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

Prefers personal source in the learning situation

Please specify the personal source you would prefer to use.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

In your case, where would this person be located?

Within the organization I work

Outside the organization I work

Other (please specify)

How would you contact this personal source?

A face-to-face conversation

Telephone

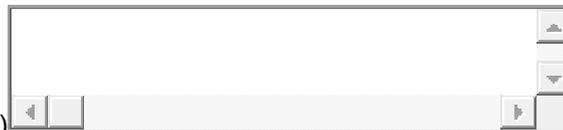
Email

Chat

A written letter or memo

Video conference tool

Other (please specify)



Prefers both sources in the learning situation, part 1

Please specify the documented source you would prefer to use.

An existing work result from myself or another person that corresponds to the problem I had.

A documented experience (e.g. FAQ or lesson learned) that describes the problem I had.

One sequence of learning material (e.g. course slides, training notes) that addresses my problem.

One article or part of a book that addresses my problem.

A section from a help system or guidebook corresponding to my problem.

One fact from a database, e.g. about customers, products.

Other (please specify)

In your case, where would this source be located?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

Prefers both sources in the learning situation, part 2**Please specify the personal source you would prefer to use.**

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

In your case, where would this person be located?

Within the organization I work

Outside the organization I work

Other (please specify)

How would you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

A written letter or memo

Video conference tool

Other (please specify)

Part 2: knowledge sharing situation

This second part of the survey is about a situation at work where you shared your knowledge with someone else.

Selecting a knowledge sharing situation

For the next questions you are in a different role than before. Someone else asks you to provide knowledge s/he needs to acquire: you shared knowledge with that person.

Please pick one of these situations you were involved in recently and which you can remember well. Then try to put yourself back in the situation and answer the following questions with this situation in mind.

Remember the last time you ...

had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, e.g. by giving a presentation or by writing a report.

were contacted by someone else (a colleague or customer) who asked for advice or instructions in your area of expertise.

had to advise a new co-worker in your department or company of how things were being done.

had to document your expertise for someone else, e.g. in a project hand-over or because you left the department or company.

were part of a team to develop something new or innovative and you had to extensively exchange knowledge with the other team members.

I can not remember a situation like this.

Characterizing the knowledge sharing situation

You have selected a knowledge sharing situation you can remember well. Keeping this situation in mind, please indicate the extent to which you agree or disagree with the following statements.

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neither agree nor disagree
- 4 = Agree
- 5 = Strongly agree

In this situation, I ...

1 2 3 4 5

I was under very strong time pressure.

I felt very uncertain about the things I had to do.

There were many consequences if I did not find the knowledge.

What I had to deliver was very well defined.

I was very new to the company or department I was working in.

I was an expert in the topic.

I was working in a team setting.

I was working alone.

Selecting the learning need of the other person in the knowledge sharing situation

How would you best describe the knowledge need of the other person in this situation?

He/she was mainly trying to find facts and figures for which it was important to remember them well.

He/she was mainly trying to get a good and well founded understanding of the topic about which I was contacted.

He/she was in need of a specific technique, procedure or method that he/she was seeking to apply.

He/she was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.

He/she was evaluating something and judging it by comparing it with known standards in the field, e.g. state-of-the art works.

He/she was trying to create something new for which there was no predefined method or procedure.

I can not remember.

Used source(s) in the knowledge sharing situation

When you were in the knowledge sharing situation described before, did you use any source to provide this person with the needed information, knowledge or expertise? If there were many sources you used, please think about which source(s) helped you most in this situation.

Consulting a person was the most helpful

Consulting a documented (text-based) source was the most helpful

Consulting both a person and a documented (text-based) source was most helpful

I did not consult any source in this situation

Used a documented source in the knowledge sharing situation

You indicated that a document (text-based) source was most helpful. Please specify this source:

Existing work results from myself or others

Documented experiences, FAQ, lessons learned

Learning material, like course slides, training notes

Articles, books about a certain theme or topic

A help system, a guidebook

A database containing facts, for example, about customers, products

Other (please specify)

Where did this source come from?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

How did you communicate with the person in need of the knowledge?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

Used personal source in the knowledge sharing situation

You indicated that a personal source was most helpful. Please specify this source.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

Where was this person located?

Within the organization I work

Outside the organization I work

Other (please specify)

How did you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

How did you communicate with the person in need of the knowledge?

A face-to-face conversation

Telephone

Email

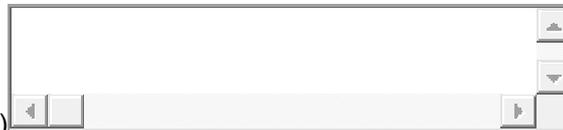
Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)



Used both sources in the knowledge sharing situation, part 1

You indicated that one of the sources that was most helpful was a document (text-based) source. Please specify this source:

Existing work results from myself or others

Documented experiences, FAQ, lessons learned

Learning material, like course slides, training notes

Articles, books about a certain theme or topic

A help system, a guidebook

A database containing facts, for example, about customers, products

Other (please specify)

Where did this source come from?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

How did you communicate with the person in need of the knowledge?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

Used both sources in the knowledge sharing situation, part 2

You indicated that also a personal source was most helpful. Please specify this source.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

Where was this person located?

Within the organization I work

Outside the organization I work

Other (please specify)

How did you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

Defining another learning situation

You can choose to answer the previous questions for another learning situation you were involved in. This situation has to be different from the one you previously had in mind. Your help would be greatly appreciated. If you don't want to do this, you can skip this part.

Answer questions for another situation

Skip this part

Part 3: selecting the second learning situation

Below you can find several brief descriptions of situations in which people sometimes find themselves while they are working and where they need to find information, knowledge or expertise they don't have.

Please pick one of these situations which is similar to one you were involved in recently and which you can remember well. Then try to put yourself back in that situation and answer the questions following this one with that situation in mind.

Remember the last time you...

were new in the company or department and you wanted to find out how things were being done.

had to tackle a new assignment or project, and you needed to acquire the most important knowledge.

were trying to catch up with recent developments in your field of expertise.

had to come up with a creative and innovative idea or solution to a problem.

needed to solve a problem because something had gone wrong or something occurred in an unexpected way.

needed to design or configure something, like a part of a product, service or method for an internal or external customer.

I don't want to answer questions for another learning situation.

Characterizing the second learning situation

You have selected a learning situation you can remember well. Keeping this situation in mind, please indicate the extent to which you agree or disagree with the following statements.

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neither agree nor disagree
- 4 = Agree
- 5 = Strongly agree

In this situation, I ...

1 2 3 4 5

I was under very strong time pressure.

I felt very uncertain about the things I had to do.

There were serious negative consequences if I could not find the knowledge.

What I had to deliver was very well defined.

I was very new to the company or department I was working in.

I was an expert in the topic.

I was working in a team setting.

I was working alone.

Selecting the knowledge need in the second learning situation

In order to cope with this situation, you were seeking for information, knowledge or expertise. This need for information, knowledge or expertise is called a "knowledge need".

Which of the following descriptions of knowledge needs describes the knowledge need you had in this situation best? You can select only one description.

I was mainly trying to find facts and figures for which it was important that I remembered them well.

I was mainly trying to get a good and well founded understanding of the topic I was dealing with.

I was in need of a specific technique, procedure or method that I was seeking to apply.

I was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.

I was evaluating something and judging it by comparing it with known standards in the field, for example, state-of-the art works.

I was trying to create something new for which there was no predefined method or procedure.

Used source(s) in the second learning situation

We are interested in what you personally did in the situation you found yourself in. Which of the following source(s) have you consulted? If there were many sources you used, please think about which source(s) helped you most in this situation.

Consulting a person was the most helpful

Consulting a documented (text-based) source was the most helpful

Consulting both a person and a documented (text-based) source was most helpful

I did not consult any source in this situation

Used a documented source in the second learning situation

You indicated that a document (text-based) source was most helpful. Please specify this source:

Existing work results from myself or others

Documented experiences, FAQ, lessons learned

Learning material, like course slides, training notes

Articles, books about a certain theme or topic

A help system, a guidebook

A database containing facts, for example, about customers, products

Other (please specify) 

Where did this source come from?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify) 

Used personal source in the second learning situation

You indicated that a personal source was most helpful. Please specify this source.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

Where was this person located?

Within the organization I work

Outside the organization I work

Other (please specify)

How did you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)



Used both sources in the second learning situation, part 1

You indicated that one of the sources that was most helpful was a document (text-based) source. Please specify this source:

Existing work results from myself or others

Documented experiences, FAQ, lessons learned

Learning material, like course slides, training notes

Articles, books about a certain theme or topic

A help system, a guidebook

A database containing facts, for example, about customers, products

Other (please specify)

Where did this source come from?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

Used both sources in the second learning situation, part 2

You indicated that also a personal source was most helpful. Please specify this source.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

Where was this person located?

Within the organization I work

Outside the organization I work

Other (please specify)

How did you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

Preferred source in the second learning situation

Imagine you were again in a comparable learning situation. Each of the source types below would be equally accessible and they are all able to provide you with the needed knowledge.

Which source type or combination of source types would you prefer to use?

Consulting a person

Consulting a documented (text-based) source

Consulting both a person and a documented (text-based) source

I would not consult any source in this situation

Prefers to use a documented source in the second learning situation

Please specify the documented source you would prefer to use.

An existing work result from myself or another person that corresponds to the problem I had.

A documented experience (e.g. FAQ or lesson learned) that describes the problem I had.

One sequence of learning material (e.g. course slides, training notes) that addresses my problem.

One article or part of a book that addresses my problem.

A section from a help system or guidebook corresponding to my problem.

One fact from a database, e.g. about customers, products.

Other (please specify)

In your case, where would this source be located?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

Prefers personal source in the second learning situation

Please specify the personal source you would prefer to use.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

In your case, where would this person be located?

Within the organization I work

Outside the organization I work

Other (please specify)

How would you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

A written letter or memo

Video conference tool

Other (please specify)

Prefers both sources in the second learning situation, part 1

Please specify the documented source you would prefer to use.

An existing work result from myself or another person that corresponds to the problem I had.

A documented experience (e.g. FAQ or lesson learned) that describes the problem I had.

One sequence of learning material (e.g. course slides, training notes) that addresses my problem.

One article or part of a book that addresses my problem.

A section from a help system or guidebook corresponding to my problem.

One fact from a database, e.g. about customers, products.

Other (please specify)

In your case, where would this source be located?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify)

Prefers both sources in the second learning situation, part 2

Please specify the personal source you would prefer to use.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

In your case, where would this person be located?

Within the organization I work

Outside the organization I work

Other (please specify)

How would you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

A written letter or memo

Video conference tool

Other (please specify)

Defining another knowledge sharing situation

You can choose to answer the previous questions for another knowledge sharing situation you were involved in. This situation has to be different from the one you previously had in mind. Your help would be greatly appreciated. If you don't want to do this, you can skip this part.

Answer questions for another situation

Skip this part

Part 4: selecting the second knowledge sharing situation

For the next questions the roles are reversed and you are asked by someone else to provide them with knowledge they need to acquire: you shared knowledge.

Please pick one of these situations you were involved in recently and which you can remember well. Then try to put yourself back in the situation and answer the following questions with this situation in mind.

Remember the last time you ...

had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, e.g. by giving a presentation or by writing a report.

were contacted by someone else (a colleague or customer) who asked for advice or instructions in your area of expertise.

had to advise a new co-worker in your department or company of how things were being done.

had to document your expertise for someone else, e.g. in a project hand-over or because you left the department or company.

were part of a team to develop something new or innovative and you had to extensively exchange knowledge with the other team members.

I can not remember a situation like this.

Characterizing the second knowledge sharing situation

You have selected a knowledge sharing situation you can remember well. Keeping this situation in mind, please indicate the extent to which you agree or disagree with the following statements.

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neither agree nor disagree
- 4 = Agree
- 5 = Strongly agree

In this situation, I ...

1 2 3 4 5

I was under very strong time pressure.

I felt very uncertain about the things I had to do.

There were many consequences if I did not find the knowledge.

What I had to deliver was very well defined.

I was very new to the company or department I was working in.

I was an expert in the topic.

I was working in a team setting.

I was working alone.

Selecting the learning need of the other person in the second knowledge sharing situation

How would you best describe the knowledge need of the other person in this situation?

He/she was mainly trying to find facts and figures for which it was important to remember them well.

He/she was mainly trying to get a good and well founded understanding of the topic about which I was contacted.

He/she was in need of a specific technique, procedure or method that he/she was seeking to apply.

He/she was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.

He/she was evaluating something and judging it by comparing it with known standards in the field, e.g. state-of-the art works.

He/she was trying to create something new for which there was no predefined method or procedure.

I can not remember.

Used source(s) in the second knowledge sharing situation

When you were in the knowledge sharing situation described before, did you use any source to provide this person with the needed information, knowledge or expertise? If there were many sources you used, please think about which source(s) helped you most in this situation.

Consulting a person was the most helpful

Consulting a documented (text-based) source was the most helpful

Consulting both a person and a documented (text-based) source was most helpful

I did not consult any source in this situation

Used a documented source in the second knowledge sharing situation

You indicated that a document (text-based) source was most helpful. Please specify this source:

Existing work results from myself or others

Documented experiences, FAQ, lessons learned

Learning material, like course slides, training notes

Articles, books about a certain theme or topic

A help system, a guidebook

A database containing facts, for example, about customers, products

Other (please specify) 

Where did this source come from?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify) 

How did you communicate with the person in need of the knowledge?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)



Used personal source in the second knowledge sharing situation

You indicated that a personal source was most helpful. Please specify this source.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

Where was this person located?

Within the organization I work

Outside the organization I work

Other (please specify)

How did you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

How did you communicate with the person in need of the knowledge?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

Used both sources in the second knowledge sharing situation, part 1

You indicated that one of the sources that was most helpful was a document (text-based) source. Please specify this source:

Existing work results from myself or others

Documented experiences, FAQ, lessons learned

Learning material, like course slides, training notes

Articles, books about a certain theme or topic

A help system, a guidebook

A database containing facts, for example, about customers, products

Other (please specify) 

Where did this source come from?

From my personal collection

From the personal collection of another person (and sent to me e.g. by email)

From the organizational intranet

From the Internet

Other (please specify) 

How did you communicate with the person in need of the knowledge?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)



Used both sources in the second knowledge sharing situation, part 2

You indicated that also a personal source was most helpful. Please specify this source.

A colleague I know very well

A person I work together with, or have worked together with in the recent past

My supervisor

A known expert for a topic

A trainer, teacher

Other (please specify)

Where was this person located?

Within the organization I work

Outside the organization I work

Other (please specify)

How did you contact this personal source?

A face-to-face conversation

Telephone

Email

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

Part 5: general questions

This is the last part of the survey with some general questions concerning media usage, personal information and general information about your organization.

Communication media use

How often do you use the following communication media in a typical work week?

1 = Never
5 = Very frequently

1 2 3 4 5

- A face-to-face conversation
- Telephone
- E-mail
- Chat
- Discussion Forum
- A written letter or memo
- Video conference tool

Organizational norms and media use

Learning attitude

Please indicate the extent to which you agree or disagree with the following statements:

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neither agree nor disagree
- 4 = Agree
- 5 = Strongly agree

1 2 3 4 5

At work, I enjoy to learn.

At work, I learn something new every day.

Learning is merely a way to increase my career opportunities.

I am more confident when I frequently increase my professional knowledge.

I only learn what is necessary for completing work tasks.

I organize my learning time carefully.

When I am working on a new subject matter, I try to work out for myself exactly what is being said.

When I am working on a new subject matter, I stop from time to time to reflect on what I am trying to get out of it.

Background questions part 1 of 3

This survey is concluded with some general questions about you and your organization. Please select the correct options.

What is your gender?

Male

Female

What is your age?

Younger than 20 years

41 - 50 years

21 - 30 years

51 - 60 years

31 - 40 years

61 years or older

How many years are you employed by the company you are currently working for?

Less than one year

16 - 20 years

1 - 5 years

21 - 25 years

6 - 10 years

26 - 30 years

11 - 15 years

31 or more years

According to your work contract, how many hours per week do you work at the company you are currently working for?

0-20 hours

31-40 hours

21-30 hours

40 hours or more

Background questions part 2 of 3

How many years have you spent in your current position in the company you are currently working for?

Less than one year

16 - 20 years

1 - 5 years

21 - 25 years

6 - 10 years

26 - 30 years

11 - 15 years

31 or more years

The size of the organisation for which I work is:

small (less than 50 employees)

medium (50 – 250 employees)

large (more than 250 employees)

Please choose one description of the jobs below which is closest to your current job.

engineer

analyst

teacher/trainer

consultant

designer

service/help desk worker

specialist/professional

administrative worker

sales worker

researcher

manager

Other (please specify)

Background questions part 3

The work people do can be categorized in three different types of work related activities.

If you had 100 points, how would you distribute them over the 3 types of work related activities listed below? The activity that occurs most frequently should receive most points. Please base

your distribution on the degree these activities occur in your daily work.

Note: Make sure they sum up to 100.

Developing new knowledge

Transmitting knowledge

Using obtained knowledge

What is your level of experience in your current job?

I'm a novice

I'm experienced

I'm an expert

The percentage of my working time I spend at a workplace with a computer is:

0-25%

51-75%

26-50%

76-100%

End

You have finished the questionnaire.
Thank you very much for your participation.

If you are interested in the results of this study, you can leave your e-mail address in the text box below. In addition, any questions or comments can be written down in the text box too.