Work, learn&communicate: what, when and why

José Kooken

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José Kooken

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Chapter

1 Mapping the field

Since the 1970s, the economic growth of many European countries changed from being industry-dependent or agriculture-dependent into being knowledge-dependent. Information and knowledge are replacing capital and energy as the primary wealth-creating assets, just as the latter two replaced land and labour 200 years ago (Carlaw et al., 2006). To emphasise that knowledge is the key to economic progress, the contemporary society is frequently characterized as “the Knowledge Economy”. Raicu and Nita (2008) state that we are now an information society in a knowledge economy, which is a development triggered by the information wave of the last 25 years (Targowski, 2005).

Targowski (2005) states that the major driver of the development of a society where knowledge is so important, is -besides innovations in the marketplace- lifelong learning. As a result, an ever increasing part of the working population is defined as “knowledge workers”, whose essential operational and value creating tasks rely on knowledge. Drucker was the first who used the term “knowledge worker” back in 1959 (Drucker, 1994). Drucker stated later in 1994 that although knowledge workers shall not be the largest group in the knowledge society, in many developed societies these knowledge workers will be the largest single population and work-force group that will give the emerging knowledge society its character, its leadership and its social profile (Drucker, 1994).

Knowledge is their critical work resource: developing, using, and/or transferring knowledge are their daily tasks. Continuous changes, like technological and scientific innovations, make workplace learning an essential component of knowledge workers’ daily activities. An educated person in the knowledge society is someone who learns continuously: he sees learning as a habit and a tool (Drucker, 1994). This learning is considered to be crucial for enhancing corporate competitiveness, employment and employability (Skule, 2004). Having the ability and opportunity to learn efficiently and especially to manage and apply new knowledge effectively in work processes, is important for the quality of knowledge-intensive work. Creating optimal conditions for knowledge workers to learn at work not only improves the competitiveness of organizations, it also supports the knowledge society in reaching its full potential.

This dissertation has as its goal to investigate the way workers in an organisation acquire new information and knowledge during work using a range of information sources. Before embarking on the studies, a closer look is needed at the literature on workplace learning and source usage for gaining knowledge to see what can be used in terms of concepts and findings to provide a well-founded basis for formulating the research questions.

1.1 Integrating working and learning: a complex and challenging research area

Fischer and Scharff (1998, p. 2) state that the earlier concept of a divided lifetime-education followed by work is no longer tenable: *"Learning can no longer be dichotomized, spatially and temporally, into a place and time to acquire knowledge (school) and a place and time to apply knowledge (the workplace)"*. Instead, learning is seen as something that must be smoothly incorporated as part of work activities (Fischer & Sugimoto, 2006). This need for learning does not only show in work contexts, but also in everyday life contexts. During their life, people learn always and everywhere, in and outside their work, in and out of educational settings (Bolhuis & Simons, 2001; Gerber, 1998). Learning in schools, colleges, universities and training centres constitutes only a minute fraction of all the learning that occurs throughout a lifetime (Candy, 2004). Accordingly, Ellinger (2005) states that the need to integrate working and learning has become more manifest. It is estimated that in a workplace setting 70 percent of new knowledge is acquired through informal learning in the workplace (Livingstone, 2001). The attention for the relation between working and learning has grown, from both a practical and theoretical point of view (Bolhuis & Simons, 2001). Although workers do not like to see themselves called a learner because of possible harmful associations with this term (Boud & Solomon, 2003), several studies show the occurrence and importance of learning through work for becoming and staying competent (for example, Billett, 2001a; Candy, 2002; Simons, 1999; Lee et al., 2004; Paloniemi, 2006). As a consequence, the relation between working and learning has attracted the attention of academic and practical research during the last decade.

However, workplace learning is a complex and challenging research area which lacks standardized research approaches and appropriate conceptual and methodological tools (Collin, 2006). Berings, Doornbos and Simons (2006) investigated the methodological practices in on-the-job learning research. Their review shows that researchers use many different operationalizations of this concept and that there is a large range of approaches across which the concept is investigated. Their study also shows that the instruments used are often limited to questionnaires and interviews. They explain this by referring to the implicit nature of most on-the-job learning processes: to capture these processes reflection (of participants) on these learning processes is required. Besides these methodological aspects, Lee et al. (2004) state that there is no single definition or unified approach to what "workplace learning" is, what it should be, or for whom it is, or should be for. Many forms of learning that are related to work are investigated, which can be very well illustrated by the terms used to describe the form of learning investigated.

These terms vary from formal to informal learning, from individual to organisational learning, from work-related to work-based learning, from just-in-time learning to lifelong learning, and from e-learning to learning-by-doing. Even when terms sound almost the same, this does not mean that they are conceptually similar. Streumer and Kho (2006) mention that the differences (and similarities) between terms like workplace learning, work-related and work-based learning are not entirely clear. This may be related to the fact that it is investigated by researchers from various disciplines (Streumer & Kho, 2006) using different concepts and theories. In addition, the fact that it is a relatively young and unexplored research area may hinder a consistent approach. Though in the 1960s and 1970s the first empirical studies of informal learning activities of adults and adults' self-directed learning projects were conducted (Livingstone, 2001), it is only since the beginning of the 1990s that workplace learning is again a prominent research area. Candy and Matthews (1998) summarize this situation by describing the three key problems the research area of workplace learning is suffering from: 1) a diversity of work in various parallel but non-overlapping fields of study and practice, 2) a proliferation of different terminology to refer to the same basic concepts and 3) the term itself can mean very different things depending on the ideological and organisational perspective of the writer or speaker. In this introductory chapter the literature regarding different conceptualizations of workplace learning and the way people in organizations shape the way they access information and information sources for gaining knowledge used during this activity are explored. The goal of this exploration is to identify and formulate interesting research questions.

1.2 Framing learning in this dissertation

As mentioned above, there are many ways of interpreting workplace learning illustrated by the terms used to describe it. But how is workplace learning seen in this dissertation?

1.2.1 Workplace learning

In general, learning during work refers to an advancement of knowledge and skills of the (knowledge) worker. From the learner's perspective, workplace learning is spontaneous and/or coincidental. Learning in this case is a by-product of the time spent at the workplace (Colley, Hodkinson, & Malcolm, 2002). The workplace is defined as the physical location where a knowledge worker performs his work. This may be on-site (for example, in an office) or off-site (for example, at a customer location or at home). The work environment consists of the set of all tools, artefacts, people, communication channels, etcetera which are available to the knowledge worker at his workplace.

The way workers learn can vary greatly as shown in research by Gerber (1998). He found eleven ways in which workers learn at work:

1. By making mistakes and learning not to repeat the mistake;
2. Through self-education on and off the job;
3. Through practising one's personal values;
4. By applying theory and practising skills;
5. Through solving problems;
6. Through interacting with others;
7. Through open lateral planning;
8. By being an advocate for colleagues;
9. Through offering leadership to others;
10. Through formal training; and
11. Through practising quality assurance.

The results of Gerber (1998) sometimes refer to more externally structured ways of workplace learning, for example, items ten and eleven. However, for this dissertation the less externally structured ways, (items one till nine), referred to as informal learning, are topical. These more informal ways of workplace learning can be seen as a by-product of performing one's work instead of learning as a by-product of more externally structured formal courses. In fact, as mentioned above, the focus is on knowledge acquisition of knowledge workers during work by using a range of information sources and thus not on knowledge gaining via, for example, formal training where sources are mostly made available by trainers. Nevertheless, there is no overall agreement in the literature about the meaning of what workplace learning precisely entails. Clearly there is some overlap with adjacent concepts, like informal learning.

1.2.2 Informal learning

Within workplace learning, informal learning is a widely recognised and investigated phenomenon. A recent exploratory study by Paradise (2008) using human resource and learning professionals investigating informal learning, shows that only 2% of the respondents mentioned that no informal learning was experienced in their organisation. The results also show that, according to the respondents, informal learning occurs to a high (34%) or very-high (7%) degree in their organizations.

In the literature, formal learning and informal learning are often used to distinguish between two different sorts of learning. Several researchers have questioned the value and validity of seeing formal learning and informal learning as two separate categories. For example, Colley, Hodkinson and Malcolm (2002) performed a literature study aimed at clarifying the conceptual differences between formal, non-formal and informal learning. They concluded that formal and informal dimensions

are always, or almost always, present in any learning situation, no matter how small. The results of their study show that formal learning and informal learning are not discrete categories, but rather jointly characterise almost all learning situations. Instead of separating formal and informal, investigations should look at indicators of informality and formality in learning situations (Colley, Hodkinson, & Malcolm, 2002). Billett (2001b) also disapproves of using informal learning to describe learning through work. He states that all learning at the workplace can be seen as having formal features because workplace activities are structured on behalf of the continuity of the organization. Thus, the structuring of learning experiences in workplaces is directed towards sustaining practice (Billett, 2001b). In his opinion, workplaces and educational institutions are both just examples of social practices in which learning occurs through partaking. Simons (2000) refers to the fact that in the literature often the distinction between formal and informal learning is often wrongfully confused with on-the-job (informal) and off-the-job learning (formal). This clearly is a misunderstanding, because informal learning also happens off-the-job and formal learning can also occur off-the job. Eraut (2004) also rejects thinking in dichotomies and he defines informal learning "as learning that comes closer to the informal end than the formal end of a continuum". As workplace activities are (indirectly) shaped by the organisation (Billett, 2001b), all learning activities that occur in the organisation can be seen as having some formal element(s). For example, learning is determined largely by the tasks someone is employed for and learning sources are mostly those made available by the organisation. However, in this dissertation the informal learning characteristics of learning are central and that is why the term "informal" is used to emphasize this. But what are these informal characteristics? Eraut (2000) defines non-formal learning by describing how it differs from formal learning. According to him, non-formal learning lacks the following five key characteristics of formal learning:

- A prescribed learning framework;
- An organised learning event or package;
- The presence of a designated teacher or trainer;
- The award of a qualification or credit;
- The external specification of the outcome.

This list can be helpful to identify formal learning, but for informal learning this could be questioned, as it states what it is not and not what it is. Colley, Hodkinson, & Malcom (2002) argue that Eraut does not make clear what the status is of learning in situations that meet some, but not all, of these "formal" criteria. In addition, part of the literature is not very clear about the distinction between learning as a property of an individual and the instructional activities that have as their goal to somehow improve this learning. If we take the five key characteristics above proposed by

Eraut (2000), it is easy to see that they do not characterize an individual learning process, that is a process that unfolds inside the individual mind, but characterize the way the instruction around a learning process is organized (or not). From this perspective it appears to be more precise to talk about “formal” or “non-formal” instruction, the latter being largely shaped by the learner herself. One could argue that learning, as an individual mental process, can be the same in either a “formal” or “non-formal” instructional setting. In fact we don’t know enough about individual learning processes to make empirically grounded statements about differences in individual learning processes in different instructional contexts (see also the next subsection).

Marsick and Watkins (2001) describe informal learning by contrasting it to formal learning. They define informal learning as learning that includes incidental learning, which may occur in institutions although it is not in general classroom-based or highly structured. In addition, they state that the control of learning rests primarily in the hands of the learner and point to the fact that informal learning is a concept that also includes incidental learning. Incidental learning is defined by them as a by-product of some other activity, such as task accomplishment or interpersonal interaction. Marsick and Volpe (1999, p. 4) define, in an earlier publication, informal learning as *“learning that is predominantly unstructured, experiential, and non-institutionalized and… triggered by people’s choices, preferences, and intentions”*. They conclude that informal learning can be characterized as follows:

- It is integrated with daily routines;
- It is triggered by an internal or external jolt;
- It is not highly conscious;
- It is haphazard and influenced by chance;
- It is an inductive process of reflection and action;
- It is linked to learning of others.

In addition, Marsick and Watkins (2001) also state that informal learning is usually task triggered (thus explicit). Intentional learning can be defined as learning heading for very specific or slightly vaguer pre-specified goals (Simons, 2000). Simons (2000) describes informal learning as learning by people themselves, mostly in the context of work. In contrast to formal learning it is not organised by some sort of pedagogical authority, like a supervisor, which implies that the shape of the instruction (if present) is under control of the learner. Furthermore, Digenti (2000, p. 2) highlights informal learning in groups when he states that it *“allows the tacit knowledge resident in a group to emerge and be exchanged, sometimes by serendipity, sometimes in the course of accomplishing a specific project, through the construction of spaces that support learning”*.

Conditions that help creating individual informal learning at the workplace were also

investigated by Skule (2004). The results of his study showed that the following seven conditions promote informal learning, independent of industry, type of company and individual factors:

- A high degree of exposure to changes;
- A high degree of exposure to demands;
- Managerial responsibilities;
- Extensive professional contacts;
- Superior feedback;
- Management support for learning;
- Rewarding of expertise.

Earlier it was mentioned that investigating workplace learning is challenging (see section 1.1), however investigating informal learning comes with its own definitional challenges. Eraut (2004), for example, characterizes informal learning by including (amongst other types of learning) implicit learning, because this type of learning comes closer to the informal end of the continuum of learning. He quotes Reber (1993) who defines implicit learning as learning that is on the one hand independent of conscious attempts to learn and on the other hand lacks explicit knowledge about what was learned. Eraut (2004) points to this tacit aspect of informal learning when he states that the main problems with investigating informal learning are that:

- Informal learning is largely invisible, because much of it is either taken for granted or not recognised as learning; thus respondents lack awareness of their own learning.
- The resultant knowledge is either tacit or regarded as part of a person's general capability, rather than something that has been learned.
- Discourse about learning is dominated by codified, propositional knowledge; so respondents often find it difficult to describe more complex aspects of their work and the nature of their expertise.

Taking note of the above views of how informal learning should be characterised and the accompanying criticisms about defining it as either formal or informal, informal learning in this dissertation is understood as learning that can be characterised as having more informal than formal characteristics. In addition, in this dissertation informal learning is seen as a not highly structured or planned process, is not explicitly awarded, is to a large extent controlled by the learner, is either reactive or deliberate, is often not recognised by the learner as learning and involves social interactions and group processes.

1.2.3 Learning processes

The notion of a learning process is ubiquitous in the literature about workplace learning, but also in the literature about learning in general. As already mentioned

in the previous subsection, quite often there is some confusion about what these processes exactly entail. From a psychological point of view, one could argue that learning processes are (hard to observe) mental processes inside an individual's mind that have as their result(s) that something you did not know at t1 you know at t2. At the other end of the spectrum, one could see a learning process as the complex interaction between individual mental processes and the context in which these mental processes are embedded, for example, the instructional support provided or the work task at hand. There is still a need to conceptually separate the individual learning process from the support (in terms of resources and instruction) provided. Several studies addressed how these learning processes (in the second meaning of the term) occur in practice under the term learning activities.

In her study of nurses' on-the-job learning activities, Berings (2006) developed and validated five main categories of on-the-job learning activities. These are: learning by doing one's regular job, learning by applying something new in the job, learning by social interaction with colleagues, learning by theory or supervision, learning by reflection, and learning through life outside work. In this dissertation the focus is on the first four of these on-the-job learning activities. These four categories refer to learning during work, learning that is directly related to doing one's work tasks; this is the research interest of this dissertation. The last category relates to learning outside a workplace context, which is, for instance, related to other concepts such as lifelong learning and adult learning in general. This type of learning is not addressed in this dissertation.

Eraut (2007) also has developed a classification of workplace learning in early career learning based on learning processes according to whether their principal object was working or learning. He discerns the following three processes: work processes with learning as a by-product, learning activities located in work or learning processes, learning processes at or near the workplace. In Table 1.1 an overview of his typology is given.

Table 1.1 A typology of early career learning (from: Eraut, 2007)

Work Processes with learning as a by-product	**Learning Activities located in work or learning processes**	**Learning Processes at or near the workplace**
Participation in group processes	Asking questions	Being supervised
Working alongside others	Getting information	Being coached
Consultation	Locating resource people	Being mentored
Tackling challenging tasks and roles	Listening and observing	Shadowing
Problem solving	Reflecting	Visiting other sites
Trying things out	Learning from mistakes	Conferences
Consolidating, extending and refining skills	Giving and receiving feedback	Short courses
Working with clients	Use of mediating artefacts	Working for a qualification
		Independent study

There is some overlap with the five categories mentioned by Berings (2006); for example, both include learning by being supervised. For this dissertation, several learning types from the three main processes mentioned by Eraut (2007) are relevant, especially those that refer to learning where learning is seen as a by-product of doing one's job and where learning activities are situated in someone's work (the first two columns) as these forms seem to be more informal and directly related to performing one's job. Nevertheless, one can say that each form of learning mentioned in this typology is more or less a by-product of the work itself. For example, learning by working for a qualification or an independent study are placed by Eraut (2007) in the column "learning processes at or near the workplace". However, one can argue that these learning processes can involve consultation and participating in group processes, and these two forms are placed in the first column. Another, earlier, classification by Eraut (2000) therefore seems better applicable in this dissertation. This classification involves some description of mental processes as it addresses, for example, the role of memory, recognition of learning opportunities and decision-making. Based on two dimensions, Eraut (2000) classified non-formal learning into:

1. Time of local event or stimulus: past episodes, current experience, future behaviour; and
2. Level of intention: implicit learning, reactive learning, and deliberative learning.

In Table 1.2 this typology is described. As shown in this table, implicit learning, reactive learning and deliberate learning are defined by means of the timing of the events providing the focus for the learning.

Table 1.2 A typology of non-formal learning (based on Eraut, 2000)

Time of Stimulus	**Implicit Learning**	**Reactive Learning**	**Deliberative Learning**
Past Episode(s)	Implicit linkage of past memories with current experience	Brief *near-spontaneous* reflection on past episodes, communications, events, experiences	*Review* of past actions, communications, events, experiences. More systematic reflection
Current Experience	A selection from experience enters the memory	*Incidental* noting of facts, opinions, impressions, ideas *Recognition* of learning opportunities	*Engagement* in decision-making, problem-solving, planned informal learning
Future Behaviour	Unconscious effects of previous experiences	Being prepared for *emergent* learning opportunities	*Planned* learning goals *Planned* learning opportunities

Based on the description and the type of learning processes addressed above, the learning processes investigated in this dissertation can be characterized, by using the above terms, as being based on current experiences (work), reactive (near spontaneous and unplanned) and deliberative (time set aside specifically for this purpose). More in general it is about a mixture of *incidental* noting of facts, opinions, impressions ideas and *recognition* of learning opportunities (reactive) and *engagement* in decision-making, problem-solving and planned informal learning (deliberative).
Another part of learning processes has to do with the way these learning activities are shaped depending on a context. This brings us to another key concept in this dissertation: self-directed learning.

1.2.4 Self-Directed Learning

Candy (2004) points out that self-directed learning is learning that takes place without any influence of an ideology or pedagogical approach. According to Candy (2004), self-directed learning and formal learning contexts are closely related, because *"self-directed learning is often a precursor to, sometimes a consequence of, and increasingly accompanied by participation in formal courses of study"* (Candy, 2004, p. 3-4). Moreover, the insights gained by investigating it may inform formal educators to make education more responsive and relevant to learners (Candy, 2004). However, this is out of scope of this dissertation, as the focus is on self-directed learning during work. In this dissertation self-directed learning refers to self-directed exploration and application of knowledge by learners with the purpose of advancement in a learning domain. Self-directed learning largely relies on the learners' own initiatives and creativity. Self-directed learning often appears in working contexts where learners need to pursue their learning goals within time and resource restrictions of their work. Necessary pre-requisites for self-directed learning are: learner's having been empowered to take responsibility for their own learning attempts, availability to means that allow them to carry out various learning activities (self-directed literature research, collaboration in groups etc.), and access to various learning resources.
It was already mentioned that research into workplace learning has grown over the last decades. This also holds true for studies of self-directed learning, as currently self-directed learning is still a prominent focus of research (Montalvo & Torres, 2004). In 1996, Hiemstra already wrote that over the past decade there has been a phenomenal explosion of knowledge, research, literature, and interest related to self-directed learning (Hiemstra, 1996). One of his studies shows that 247 different terms were used in several books related to self-directed learning (Hiemstra, 1996). There also seems to be a need for further and detailed exploration of this area, as the *"extensive empirical work on self-directed learning in the 1970s has led to very little cumulative development of understanding of the phenomenon of informal learning*

to date" (Livingstone, 2001, p. 20). Schmidt and Braun (2006) describe the learning process of self-steered learning as a process in which learners, who know what they don't know, search on their own for suitable learning resources. The learners control the tempo of this process and will look for additional support if they experience a break-down. Brookfield (1995) describes self-directed learning as a learning process too. He describes it as a process in which adults take control of their own learning, in particular how they set their own learning goals, locate appropriate resources, decide on which learning methods to use and evaluate their progress. All these definitions can be linked to the theory that introduced the notion of self-directedness of adult learners: Knowles' theory of andragogy (1973). In his work, Knowles (1973) sees adult learners as being self-directed who are expected to take responsibility for their decisions. According to Knowles, self-directed learning refers to a process in which the initiative is taken by individuals in diagnosing their learning needs, formulating the accompanying learning goals, identifying the human and material resources needed for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. This can all be done with or without the help of others. In his theory of andragogy, which is a theory of adult learning, Knowles (1973, 1990) makes the following (not mutually excluding) assumptions about the design of learning for adults: 1) self-concept: during the ageing process, the self-directedness of adults increases, 2) experience: learners draw on their knowledge and experiences to aid their learning, 3) readiness: readiness to learn of adult learners becomes oriented increasingly to various developmental tasks and social role expectations, 4) orientation: adults approach learning as problem solving, and 5) time perspective: in maturity a person is most motivated to learn when immediate application is needed or can be seen. Later on a sixth assumption was added namely motivation: as a person matures, he receives motivation to learn from internal factors.

Although Knowles notion of self-directedness of adult learners fits with the concept of self-directed learning, Knowles' theory is intended for designing adult education; persons other than the learner could use this theory to shape the education. However, the learning of self-directed learners in the workplace is far from designed by any external person: it is informal and self-directed. Conceptually, self-directed learning can thus be seen as a situation in which the instructional part of the learning process is largely determined by the learner herself (see also the characteristics of non-formal learning proposed by Eraut (2000) as described in section 1.2.2). Part of this process is finding the needed information and knowledge as this is not made available by an instructor, as is mostly the case in "formal" instructional contexts.

1.2.5 The role of the context: contextual factors and social interaction

Several authors (Ellinger, 2005; Eraut, 2004) point out that, although there is agreement about its significance, investigating the influence of the organisational

context on informal learning is underdeveloped and needs more attention of researchers. Ellinger (2005) investigated contextual factors that influence informal learning during work. The results of this study show that learning-committed leadership and management has a very positive influence on the informal learning process. In addition, an internal culture committed to learning, access to work tools and resources, and people who form webs of relationships for learning were contextual factors that could have a positive influence on informal learning. Eraut (2004) found three contextual factors that influence learning during work: allocation and structuring of work, encounters and relationships with people at work and expectations of each person's role, performance and progress.

Besides these contextual factors that stimulate informal learning during work, Ellinger (2005) also found several contextual factors that inhibit and suppress informal learning. These were leadership and management not committed to learning, not accepting an internal culture of entitlement that is slowly shifting towards a culture of continuous learning, work tools and resources (for example, when they become a distraction), people who disrupt webs of relationships for learning, structural inhibitors, lack of time because of job pressures and responsibilities, too much change happening too fast and not learning from learning (Ellinger, 2005). Lohman (2000) studied environmental inhibitors to informal learning at the workplace for school teachers and found four inhibitors: lack of time for learning, lack of proximity to learning resources, lack of meaningful rewards for learning, and limited decision-making power in school management. For IT professionals she studied the same subject and found six environmental factors that inhibit IT professionals from engaging in informal learning activities (Lohman, 2009): lack of time, lack of proximity to colleagues, work areas, unsupportive organisational culture, inaccessibility of others, lack of equipment and technology, and lack of meeting/work space. In their model of work-related learning Doornbos, Bolhuis and Simons (2004) identified six work environment characteristics that are considered to promote work-related learning: autonomy, work pressure, support, task variation, interaction partner variety, and collegial availability.

Eraut et al. (2000) investigated mid-career learning and concluded, amongst other things, that besides the challenge of the work itself,informal learning at the workplace was mainly triggered by consultation and collaboration in the working group and consultation outside the working group. According to Dalkir (2005), there are several reasons why other people are the preferred source of information. The reason is that besides getting a direct answer one also receives "meta-knowledge". This "meta-knowledge" refers to information about the goal of the search and about a person's search capabilities. Examples are information about the location of the information, how the query or question should be reformulated, and whether someone is on the right track. He states that if a person is consulted, this person is often known and

can usually be considered to be a trusted, credible source. Earlier studies show that documents may serve as indices into social networks, and social networks can serve as pointers to documents (Erickson & Kellogg, 2000). Previous research has shown that seemingly inconsequential informal interactions serve critical functions such as coordination and learning (Nardi & Whittaker, 2002). Research by Paradise (2008) showed that email was ranked at the top in the list of used informal learning tools. Email was followed by intranet. This study also showed that many of the best practices could be classified into “embracing new technologies” or “creating time for face-to-face interaction”. The findings above can be placed in the conceptual framework proposed by Doornbos (2006), in particular the part that refers to what she calls developmental relatedness: work-related learning occurring either directly or indirectly during work-related interactions and contributing to both individual and socially shared learning outcomes. Three types of developmental relatedness are distinguished:

1. Learning individually: learning without direct social interaction, like reflection, this includes indirect interaction via the media and other cultural artefacts (for example, a document).
2. Learning from others: workers learn through interaction with other people and this contributes to their development, but not necessarily to the development of others.
3. Learning together: workers and their interaction partners both contribute to each other’s learning and this occurs with the awareness of both partners.

From a more general theoretical point of view, in this dissertation it is investigated how this developmental relatedness during self-directed learning at the workplace is shaped, in particular zooming in on the role information sources for gaining knowledge play in this process.

Summarizing, one can say that self-directed learning in a work context has to rely heavily on acquiring information and knowledge at hard to predict moments in time, for work related problems which cannot be foreseen and is closely tailored to the actual problem at hand. As a consequence, a learner at the workplace has to find the information and knowledge largely by his own wits, using existing information sources in the organization such as colleagues. The next sections will explore theories that can explain or predict how these communicative practices will take place in general, as we could not find any theories that directly link communicative practices and workplace learning. The search for knowledge starts with a knowledge need, which is elaborated below.

1.3 Framing knowledge needs in this dissertation

From a more general perspective, learning during work can be seen as contributing to a learning organisation, which is one of the major goals pursued by knowledge management. The field of knowledge management has developed several frameworks and in this chapter the focus is on frameworks that can be used for positioning knowledge needs. Learning during work is related to finding information and knowledge. However, learning can be seen as acquiring new knowledge, not information. Making a distinction between knowledge and information therefore seems crucial. In the next section knowledge and information are defined as these two concepts are essential in separating information needs from knowledge needs.

1.3.1 Knowledge and information defined

There is an essential difference between an information and a knowledge need. Information differs from knowledge because you can make predictions and can map cause-effect relationships based on knowledge. Knowledge is the basis for making intelligent decisions, predict, design, planning, diagnostics, making analysis, evaluation, and the passing of a judgment (Tiwana, 2002). Tiwana (2002, p. 4) defines knowledge as *"… a fluid mix of framed experiences, values, contextual information, expert insight, and intuition that provides an environment and framework for evaluating and incorporating new experiences and information"*. Looking at this definition, several concepts that can be related to workplace learning are used, such as experiences, insight and evaluating information. However, knowledge seems rather "intangible", that is, difficult to investigate as this definition emphasizes the more implicit cognitive and experience based nature of knowledge. For example, this makes it difficult to observe a knowledge need that occurs in the present and will be satisfied in the future.

Davenport and Prusak (1997) add two more elements that bring this definition to a, for this dissertation, usable level. That is, their definition adds elements that make knowledge more explicit and tangible and thus provides a starting point for making knowledge needs operational. The first element is that knowledge originates and is applied in the minds of knowledge carriers. This essentially means that a mental operation is required before one can speak about knowledge: the information is interpreted and given meaning. The second is the articulation of knowledge outside the human. They argue that knowledge in organizations is often not only embedded in documents and databases, but also in organisational routines, processes, practices, and norms (Davenport & Prusak, 1997). Knowledge is thus associated with the capability of an agent to carry out a task. It is a result of mental processing of information; information is given meaning by interpreting it in relation to the task. Knowledge can be applied for different purposes; knowledge is dynamic and related

to reasoning. Knowledge can be partially explicated in a knowledge artefact. In fact, this kind of knowledge one would like to have ready at all times. As mental limitations are present, the use of external sources is necessary. Therefore, taking the notions of mental operations and the link with the capability to carry out a task into account, in this dissertation knowledge is defined as "data that, as a result of an interpretation of a user, leads to the capability to carry out a task or an action repeatedly". This definition fits with Tiwana's (2002) notion that knowledge is actionable, that is, simply put, relevant and available information.

The definition of information is "data that are used and has to be interpreted anew every time it is used." Information is data to which meaning must be attached by the recipient of the data at a certain point in time, but does not form an essential part of the capability to perform a task in the future. Information is static and often needed for preparing the performance of a substantial task or to build knowledge upon. The research focuses on knowledge needs for which external information sources are consulted. To clarify the difference between information and knowledge needs, an example of both is given.

Example

A police employee working at the Police Info desk (in Dutch: meldkamer) receives a request to find the name of the owner of a car via its license plate number. It is the first time he has to do this and he does not know where (in which database) to find it. Therefore, he asks his experienced colleague where he can find this name of the car owner. This colleague explains in which database it can be found. Next, he searches the database and finds the name of the car owner. He gives this name to his colleague who asked for it. It is certain that during his work he has to perform this task again; now he knows where and how to find the name of a car owner via its license plate number.

- Knowledge need: knowing where and how to find the name via a license plate number. Knowing this is linked to the capability to perform this task now and in the future. It is a knowledge need.
- Information need: the name of the car owner. There is no need to remember the name: it is an information need.

Based on the definitions of information and knowledge, a knowledge need can be distinguished from an information need. The main difference is that information is not directly linked to the capability of a knowledge worker to perform a task. This implies that knowledge is associated to the capability to perform a task as it has intrinsic value, that is, it forms an essential part of the task. Knowledge needs can thus be discerned from information needs by looking at their impact on the capability to perform a task repeatedly.

1.3.2 Conceptual framework of knowledge management

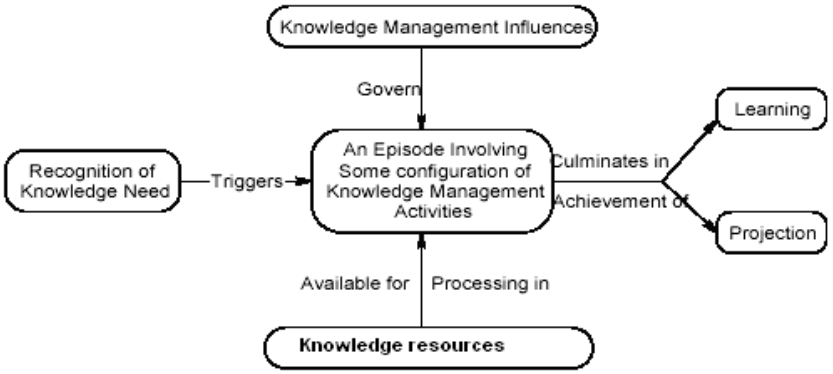
One of the most elaborated frameworks for knowledge management is proposed by Holsapple and Joshi (2003), which is partly based on consulting a wide range of authors and practitioners. The framework describes a so-called “knowledge ontology”.

This ontology provides a simplified and abstract view of knowledge management that can be applied in this dissertation. Holsapple and Joshi (2003) describe the period between the recognition of a knowledge need and satisfying it. This period is a called a “knowledge management episode”. The notion of a knowledge management episode finds it origins in the communication literature (Holsapple & Joshi, 2003). There it refers to a pattern of activities that are performed in order to satisfy a knowledge need (De Hoog, 2004). This notion of a knowledge management episode is useful in setting up the studies in this dissertation as it offers starting points for describing the used sources for knowledge.

In Figure 1.1 the framework of Holsapple and Joshi (2003) is shown. Central to the framework is the knowledge management episode. During a knowledge management episode, supported by the available resources, one or more participants perform knowledge manipulation activities in order to obtain or develop the needed knowledge. What a “knowledge manipulation” entails is not defined very precisely, but the general idea is that this is a skill to handle knowledge resources (De Hoog, 2004). The participants can refer to humans, but also to decision support systems. In our case they refer to persons, knowledge workers to be precise. A knowledge management episode starts with the recognition of a knowledge need, this triggers a knowledge management episode. During a knowledge management episode the knowledge worker performs several knowledge manipulation activities with/on the knowledge (partly the aforementioned mental processing as described in 1.3.1), and this episode is governed by management influences. Several information sources for gaining knowledge are available and support the execution of knowledge manipulating activities.

A successful knowledge management episode results, if it is not ended prematurely, in learning and/or a product or service in which the knowledge is embedded, the latter is called projection (De Kant, 2006). The result of satisfying a need for knowledge by going through a knowledge management episode creates value for the organization: for example, the value of information sources is changed by learning, but value is also added to the product (Holsapple & Joshi, 2003). Examples of knowledge episodes are taking a decision, brainstorming or solving a problem (Holsapple & Joshi, 2003).

Figure 1.1 Conceptual framework of knowledge management (Holsapple & Joshi, 2003)



The main knowledge manipulation activities that can take place during a knowledge management episode are (Holsapple & Joshi, 2003):

- *Acquiring* knowledge: Identifying knowledge in the area and turning it into a representation that can be internalized or used.
- *Selecting* knowledge: Identifying the knowledge that exists in the organisational knowledge resources and representing it a form that makes it usable.
- The *internalisation* of knowledge: making the knowledge your own or making it part of the knowledge of the organization, and thereby changing the organisational information sources.
- *Using* knowledge, including:
  - Generate: new knowledge is generated by applying existing knowledge,which is the result of selection, acquisition and/or previous generation.
  - Externalization: make something available outside the organization, or to produce income (projection).

In this dissertation, not all activities that occur during a knowledge management episode are relevant. In the description of learning processes above (see section 1.2.3.) individual mental processes were addressed only briefly. In this dissertation the focus is on behaviour, to be more precise: workplace learning behaviour, and not on the individual mental processes involved. The actual learning is not measured or tested with, for example, a knowledge test. This means that the focus is on those knowledge manipulating activities that include aspects of this behaviour. That is why internalisation of knowledge and the generation of knowledge, as described by Holsapple and Joshi (2003), are beyond the scope of this dissertation. However, the knowledge manipulating activities acquisition, selection, and externalization of

knowledge are relevant. The research questions aim to describe these activities and analyze them. Also the (manipulative) skills of the employee are important for a productive use of information sources (Holsapple & Joshi, 2003). When these skills are inadequate, the probability that the completion of a knowledge management episode creates value for an organization or results in learning decreases. Therefore there will also be limited attention to these skills.
As can be seen in Figure 1.1 and in the description of the main knowledge manipulation activities, information sources are connected to a knowledge management episode. With respect to information sources for gaining knowledge, two factors play a role: the availability and quality of information sources. In this dissertation, attention is on the effect of these two factors on workplace learning.
The descriptive framework of Holsapple and Joshi (2003) results in a number of issues to be incorporated in the research questions. First, it provides a framework for systematically describing knowledge needs. Second, we focus on type and quality of information sources. Starting from this conceptual framework, the next section describes the relation between knowledge needs and search behaviour.

1.3.3 Knowledge needs and search behaviour

Hardy (1982) emphasises the fact that the manner in which information is searched is an important factor influencing the satisfaction of knowledge needs. Studies investigating information search behaviour have been performed by several research fields and in several contexts (Case, 2007). Wilson (1981) states the same as Case and adds that among scientists there has been much debate about “information needs” and what it entails. Case (2007) concludes that information seeking is a topic described in over 10.000 documents from different disciplines. According to Wilson (2000) the foundations of investigating information seeking behaviour is found in work on the users of libraries and in readership studies in general.
Choo (1998) gives a description of the process from experiencing a knowledge need, satisfying this need and make a decision based on it. Choo (1998) assumes that information seeking and use is purposeful, which entails that information is sought and used because people want to move from the current state to a desired end state. This relation between experiencing a need and making a decision in order to move to a desired end state, makes his approach very usable for the studies in this dissertation: in a work context tasks have to be performed and the knowledge that is searched for is needed to decide how to perform or complete the task.
The search behaviour and the use of knowledge can be analysed on three levels according to Choo (1998). The cognitive level involves the question how information or knowledge is used to bridge cognitive gaps. Cognitive gaps are described by Choo (1998) in terms of movement towards a desired end state. For example, it focuses on the ways in which workers perceive their cognitive gaps. The affective level involves

how the emotional and psychological state of a person influences the search for information or knowledge. For example, research looking at the different emotions experienced at each stage of the search process can be related to this level. At the situational level the focus is on how work-related requirements form the information and knowledge need and the use of information and knowledge. Studies that can be placed on this level include focussing on investigating the style and culture of an organisation and its effect on perceptions on the value of information. The last two levels, the affective and situational level, are relevant for this dissertation. The aim is to investigate workplace learning behaviour (see section 1.2.1) and individual mental processes are therefore outside the scope of this dissertation. Thus, both affective elements of the behaviour, such as preferences for sources, and situational elements of the behaviour, such as the relation between type of work and sources used, are investigated. The research can be characterised as investigating several aspects of the use of sources for gaining knowledge. First, the knowledge needs and the use of information sources for gaining knowledge during task implementation are investigated (situational level). In addition, the preferences for information sources for gaining knowledge (affective level) are examined. These aspects are explained further in the following sections, especially in section 1.4 which addresses the general research questions of this dissertation. Investigating the use of sources for workplace learning also relates to the research field of organisational communication. Jones et al. (2004) reviewed organisational communication literature published between 1993 and 2004 and formulated several challenges for the research field. In this dissertation some of those challenges are, to some extent, taken up. For example, regarding the challenge to innovate in theory and methodology, this dissertation combines theories from communication science with theories from learning science in order to expand the understanding of organisational communication. As work context is one of the aspects taken into account, another challenge is met too: besides looking at micro level influences on workplace learning such as individual preferences, looking at macro level influences on organisational communication is addressed too. An example of this is the investigation of the work context aspect “size of company” on source usage during workplace learning. More specific for this dissertation, Jones et al. (2004) state that research on knowledge management will benefit from using theories about interpersonal and intergroup motivations that influence it. These interpersonal and intergroup motivations are addressed in this study as, for instance, the social influence model of technology use is examined for explaining source usage during workplace learning behaviour.

In order to place the knowledge needs and usage of information sources for gaining knowledge that occur during task implementation in the affective and situational dimensions of Choo (1998), theories from communication science are used. Although several theories exists that address organisational communication, two theories

(besides the social influence model of technology use) were selected that seem to fit best the need to describe the selection of information sources. In the following section the selection of information sources is described from the perspective of the Media Richness Theory.

1.3.4 Selection of information sources

The question to be answered is which information sources are chosen for gaining knowledge and why someone chooses a particular information source. Selecting a source during a knowledge management episode is an important step. Moreover, the use of information sources, and thus the underlying reasons for using a particular medium, is a focus in this dissertation. One of the theories that predicts media selection is the Media Richness Theory by Daft and Lengel (1984). According to this theory, media are more or less appropriate for reducing task uncertainty or equivocality and are therefore more or less effective in conveying information and knowledge and for facilitating understanding in a time interval (Robert & Dennis, 2005). This theory assumes that the performance of tasks improves when there is a better fit between task characteristics and the suitability of media (their richness) to transfer information that is necessary to perform the task (Dennis, Valacich, Speier, & Morris, 1998). The theory predicts that as task/organisational ambiguity and uncertainty increases, richer media are better suited to reduce this uncertainty and ambiguity. The expectation is that in the case of a knowledge need, under certain conditions associated with the task at hand the most appropriate medium that fits best with the task is consulted. These conditions refer to two characteristics of the task as mentioned by Daft and Lengel (1984): its level of ambiguity and uncertainty. This dissertation will, in the study described in Chapter 4, investigate the correctness of these expectations as predictions of source usage for knowledge gaining based on this theory are tested. In Chapter 4 the Theory of Media Richness and how it is used in the study are described in more detail.

In another study, the Chapter 5 study, the use of sources for gaining knowledge is investigated in the context of the Theory of Reasoned Action (Ajzen & Fishbein, 2000). The Theory of Reasoned Action states that the behavioural intention is an accumulation of an individual his attitudes and perceived subjective norm towards that behaviour. This theory also states that an important predictor of actual behaviour is behavioural intention. Based on the assumption that the behavioural intention is the most immediate and important predictor of a person's behaviour, the behavioural intention and preferences (read: attitudes) toward sources usage of knowledge workers is investigated. In Chapter 5 it is investigated if the use of sources during knowledge gaining behaviour at the workplace can be described by Theory of Reasoned Action. A more detailed description of the Theory of Reasoned Action and how it is used can be found in Chapter 5.

1.4 General research questions

The theoretical framework described in this chapter addresses the most essential concepts investigated in this dissertation, centred on the concepts of linking working with learning, knowledge needs and usage of information sources. For definitions of the key concepts referred to in this dissertation, consult Appendix 1. Three types of questions are asked throughout the four studies performed: “What?”, “When?” and “Why?”. Each research question has its own identifier (A - C), which is used for reference in the remainder of this dissertation.
The overall research question is:

> *What are the practices and preferences of knowledge workers regarding the use of information sources for knowledge gaining in the context of their workplace and do the organisational context and individual characteristics of knowledge workers affect these practices and preferences of knowledge workers?* (A)

The overall research question refers to practices and preferences, thus leading to two sub-questions. The part of “practices” is covered by the first sub-question; the part of “preferences” is covered by the second sub-question.

Practices

> *What information sources are used by knowledge workers if they gain knowledge at work?* (B)

Chapter 2 will address this question partly, by looking at the use of sources for gaining knowledge by policemen. In this study actual use of sources and the position of a relative new information source for gaining knowledge among available sources is investigated. Although this study was carried out in one particular organisation, it offers insight into the use of different information sources in an organization as it, for example, compares the use of difference source types. It can be seen as an orientational study.
Next, Chapter 3 addresses the “What” question by investigating actual workplace learning behaviour of knowledge workers, especially their use of information sources at their computer based workplace. Which information sources are used by knowledge workers, how many information sources are used for satisfying a knowledge need and are there differences between knowledge workers with respect to the sources they use, are several questions that are addressed in this study.

Preferences

> *When and why do knowledge workers use these information sources if they gain knowledge at work?* (C)

Chapter 4 answers this question; it connects the context of use of information sources for knowledge gaining. The goal of this study was to obtain more insight into the relation between work situations and learn situations and the information sources and communication media people use to acquire the knowledge needed to perform tasks at hand better and gain knowledge about the related topics. Here the “When” question addresses the relation between information sources and communication media usage on the one hand and work-learn situations on the other, that is a situation at work where someone discovers he has a knowledge need. In this study the Media Richness Theory is used to predict the usage of information sources by knowledge workers in certain work-learn situations.
In the last study, described in Chapter 5, the trade-offs knowledge workers make when they are confronted with a choice between different information sources with different characteristics are investigated. Differing from the previous study, not the properties of the work context (work-learn situations), but the characteristics of information sources and the preferences of knowledge workers towards these source characteristics are taken into account when investigating the use of information sources for knowledge gaining. These characteristics do not refer to media richness as in Chapter 4, the focus in the Chapter 5 study is on investigating the influence of shared terminology, social networks and accessibility on the decision of knowledge workers to use a source. The “Why” question is addressed by investigating if the use of sources during knowledge gaining behaviour at the workplace can be described by Theory of Reasoned Action.

This dissertation ends with a summary and discussion in Chapter 6.

Chapter 2

2 Source usage for gaining knowledge at the Dutch Police Force[1]

This chapter concentrates on the practices regarding information sources people use to gain knowledge, in particular on, for example, the use of different source types and source usage by different types of workers. In addition, the position of a relative new information source, whose aim is to facilitate knowledge access and sharing, among the already available sources is investigated. Although this study was carried out in one specific organization, it will give insight into the use of information sources for gaining knowledge in organizations. It will be used to answer the research question that addresses practices (B) as described in Chapter 1. To be more precise, it relates to the knowledge management episode of Holsapple and Joshi's (2003) knowledge ontology as it focuses on triggers for knowledge needs and knowledge manipulating activities such as acquiring knowledge. It also relates to Choo's (1998) situational level as described in the previous chapter as differences in source usage between knowledge workers with different types of work are investigated. Choo's affective level is also addressed as the perceived degree of support given by various source is investigated. This chapter starts with a brief description of research related to the position of new knowledge sharing systems among existing facilities. The theories from Chapter 1 and the research described in section 2.1 were both used for defining this research and the design of this study. The research questions pursued will be elaborated.

2.1 New and old knowledge systems

Always new knowledge systems are developed to support information gaining by employees. These developments are mostly triggered by the need to reduce efforts to find relevant information and knowledge. Several studies point to the searching costs in organisations. Swaak et al. (2004), for example, state that much money and intellectual power is spent on reinventing the wheel and searching for knowledge. Feldman and Sherman (2003) describe that when knowledge workers create new reports, in fact, due to not being able to find relevant information, they are reinventing existing information 90% of the time. On average, knowledge workers spend 15% to 35% of their workday searching for information and are

[1] This study was conducted by the IPIT (Instituut voor Maatschappelijke Veiligheidsvraagstukken) & the Department of Instructional Technology of the University of Twente for Politie & Wetenschap. This chapter does not cover all results from the study. The reference of the orginal report is: Bakker, I., Gellevij, M., Hoog, R. de, Kooken, J., & Krommendijk, M. (2006). Politiekennis in gebruik. Een onderzoek naar het gebruik van het Politie Kennis Net. Politie & Wetenschap Verkenningen, Apeldoorn: Politie & Wetenschap.

successful half the time or less. They also describe one of the reasons why existing in-house knowledge is not exploited: 40% of information workers complain that they cannot find the information they need to do their jobs on their company intranets. The estimated costs of intellectual rework, substandard performance and inability to find knowledge resources are approximately $5,000 per worker per year. The study of Swaak et al. (2004) also showed that although employees are satisfied with their access to knowledge of others, they also feel that existing in-house knowledge is underexploited. For example, employees are not sure if what they know, their knowledge which is available for others, is apparent for colleagues. When looking at these problems, the need for excellent systems that facilitate access to knowledge seems undisputable. Although new technologies on one hand have improved information access, on the other hand they have made it more difficult to find specific information (Feldman & Sherman, 2003).

Davis (1989) states that in general there is often unwillingness to accept and use newly introduced information technology systems. In the context of computer supported cooperative work applications - which can be seen as groupware that, for example, supports knowledge sharing and development - Grudin (1988) lists three main factors that contribute to the failure of CSCW applications. First, he sees the disparity between those who will benefit from an application and those who must do additional work to support it as a factor. Second, he mentions decision-making failure. Decision makers tend to see only the potential benefits a system has for users similar to themselves and tend to forget to think about (dis)advantages for other user types. Third, the extreme difficulty of evaluating these applications is seen as a factor contributing to the failure to use new information technology systems. Benassi, Bouquet and Cule (2002) state that enthusiasm about new knowledge management systems often goes hand in hand with disappointment about their real effectiveness and use. Malhotra and Galetta (2003) point to the importance of motivation and commitment of knowledge workers when implementing knowledge management systems. Based on research, they state that these factors often determine the success or failure of these systems.

A study of Steinmann (2004) in a large Dutch company, demonstrates that knowledge systems are in competition with other media and sources, especially face-to-face communication and paper documents. Asked what they do when they need information or knowledge, the answer given most frequently by employees is to ask questions directly to someone, followed by searching in paper documents. The study of Swaak et al. (2004) also found that colleagues and personal archives were preferred above existing organisational information sources for gaining knowledge such as an Intranet. In addition, research by Stroek (2004) shows that knowledge workers hardly make use of an Intranet for knowledge work. It seems that many of these systems have been developed from a push approach: “If we

build it, they will come". Although people certainly do not come when it is not built, this is not a necessary and sufficient condition for use. Due to the enthusiasm for new technologies, the affordances of old technology to users are often overlooked. A very good analysis of this phenomenon can be found in Sellen and Harper (2001). Their detailed analysis of the role of paper in everyday work shows that in many cases it is impossible to develop computer applications that can equal the functionalities of existing devices, even in relative high-tech environments such as flight traffic control centres.

Summarizing, it can be said that studies show that finding the needed knowledge in available information sources in organisations is still a challenging task for knowledge workers. In addition, the acceptance of a new knowledge system is hard to predict as many factors affect the acceptance of such a system by knowledge workers. Therefore, it is interesting to see what the role of a new knowledge system among the already available sources for gaining knowledge in an organization is.

2.2 Investigating actual use of sources for gaining knowledge

The research reported in this chapter describes the use of information sources for gathering knowledge in an organization. In relation to Chapter 1, it can be said that the aim is to describe the knowledge manipulation activities acquisition, selection, and using (that is: externalization) of knowledge in a knowledge management episode (Holsapple & Joshi, 2003). Moreover, Choo's (1998) situational and affective level of search behaviour and the use of knowledge will be examined: knowledge needs and use of information sources during task implementation and their perceived support. Focusing on the study in this chapter, the specific aim is to obtain insight into practices of workers regarding the information sources used for gaining knowledge (research question B). Consequently the main research question of this chapter is:

> *What are the practices of workers regarding the information sources they use to gain knowledge, the triggers of knowledge needs and do they differ for different work contexts?*

As mentioned, the focus is on practices. However, comparing actual behaviour with preferences can reveal to what extent practices correspond with preferences. Therefore preferences are also taken into account. The first sub question is:

> *What are the general preferences for source types of workers regarding the information sources they use to gain knowledge?*

In addition, one can use a certain source type but this does not mean that this source type offers the best support in solving a knowledge need, as this can depend on the specific context. Therefore, the second sub question is:

> *Are there differences in the degree of support given by the various source types that workers use to gain knowledge for satisfying their knowledge need?*

The studies mentioned in section 2.1 point to difficulties that new knowledge systems can encounter in organizations. Therefore, also the position of a specific information source in relation to the already available sources will be examined. The third sub question is:

> *What is the position of a relatively new information source among the available sources for gaining knowledge in an organization regarding its use and the support it gives to satisfy knowledge needs?*

2.3 Selecting an organisation and research methods

The research questions can be positioned into two different ways to obtain data: a more objective and a more subjective one. The first approach that will be used in this study is based on observations of actual behaviour and is related to the more objective view: observing how workers in practice search for knowledge. In the second approach, the more subjective view will be leading to a focus on what people say about their knowledge gaining behaviour and their preferences and appreciation of sources types. In this approach, questions will be answered through self reports using interviews and an online questionnaire. That is, people will respond to specific questions formulated by the researcher. The combination of both approaches ensures collecting a variety of data to answer the research questions, covering both observed practices regarding source use and appreciation of and preference for sources.
To further clarify the questions and make them researchable, an organization has to be chosen where the study can take place. In section 2.3.1 the selected organisation, the Dutch Police Force, will be introduced and described. In section 2.3.2 the used methods are detailed.

2.3.1 The organization investigated: the Dutch Police Force

Based on the research questions three requirements for a fitting organisation(s) to be investigated were formulated:

- The organisation should have introduced fairly recently a new information/ knowledge system while there are already other systems and practices in use.

- In order to prevent too much bias, the organisation should be fairly large and have a wide variety of tasks and knowledge needs.
- Learning during work should be a major feature in the organisation.

Given these requirements and also some practical considerations such as easy access to collect the needed data, the Dutch Police Force was selected.
At the time of the study, the Dutch Police Force is the employer of more than 50,000 police men, divided into 25 regional corps having a wide range of different tasks and knowledge areas. Therefore, it can be stated that the Dutch Police Force is a large organisation; requirement two is met. Concerning the first requirement, the Dutch Police Force has since a few years a nationwide online information source for gaining knowledge available which is developed by and for police men: Police Knowledge Net (PKN[2]). It is a national knowledge database that stores professional knowledge which should be relevant to police practice, chain partners of the police (i.e., organisations with whom the police collaborates) and police education. Within the Police Academy, the major educational institute of the Dutch Police Force, the Police Knowledge Net was rolled out in January 2000 with the mission: *"to contribute to the professionalization of the police through the development of online knowledge services and encouraging the use of it at the individual and organisational level".* [3]
PKN aims at improvement in the following areas:

- Increasing the availability and accessibility of expertise;
- Increasing the potential for knowledge development;
- To promote opportunities for exchanging expertise between the corps;
- Increasing the quality of police work by making standards for business and work processes available;
- To promote the possibilities for police men to work together;
- And to increase the efficiency, effectiveness and quality of police education.[4]

The main function of the Police Knowledge Net is to act as a national knowledge repository where professional knowledge is stored that is relevant to police practice, police education and the police chain partners. The target groups of PKN are both policemen in executive services, as well as general staff and policy staff, but also teachers and students of the police education are expected to benefit from PKN. PKN matches the requested type of information source in this study. It is a relatively new information source and as it is in use in an organisation that has alternative sources for knowledge available. Investigating its use for gaining knowledge can give insight into the relative position this new source has among already existing sources. Bakker and Van der Vijver, (2003, p. 9) state

[2] In Dutch: Politie Kennis Net
[3] Businessplan PKN, 2000
[4] Businessplan PKN, 2000

that PKN should *"… support both operational activities, including important legal requirements, rules on handling standard procedures, as background information on (effects of) suddenly occurring events. Furthermore, the system should provide management information. It is a handbook for both the police officer on the street as for senior levels in the organization."*

Concerning the third requirement, after a formal educational phase, beginning police men should develop themselves, by doing police work, into all-rounders (Doornbos, Denessen, & Simons, 2004). They argue that for the development of police men in their current function, as well as for their development towards new functions, learning from police work is important. This learning can take place by searching, finding and using information to increase their knowledge. Overall, the Dutch Police Force is a knowledge intensive organization (Stam & Grotendorts, 2007) which needs and facilitates information and knowledge gaining using different sources.

2.3.2 Investigating source usage for gaining knowledge: research design and methods

As mentioned before, two views on collecting data are distinguished in this study: a more objective and a more subjective view. Each of these views will be linked to a suitable research method. In total three different data collection methods will be used: observations, interviews and an online questionnaire. This form of triangulation (observations and self-report in the form of a questionnaire and interviews) has the advantage that the limitations of each method, such as limited reliability of data from self-reporting, partly are compensated for. Using a combination of methods has a positive influence on the validity of the data. By using a combination of methods, the data collected include different types of data, making it possible to obtain a well-founded and accurate insight into the current nature and extent of use of sources for knowledge gaining and the position of PKN. Besides gathering supplementary information, data collected with one method can be often compared with and verified with data collected by the other method. For example, preferences for source type can be observed, asked about in an interview and asked about in the online questionnaire.
The study will be divided into three phases following one another and partly completed simultaneously. Findings from previous stages are used in subsequent phases. In this section, the methods used and the relation between methods and phases are described. The selection of research sites and a general description of the research approach are given.

2.3.2.1 Focusing on investigating actual behaviour

On one hand the practices of workers regarding information source usage for gaining knowledge and on the other hand the position of PKN are facets of the research

questions that will be investigated by using a more objective data collection method. This method should focus on investigating actual behaviour, as actual behaviour can give insight into the knowledge gaining behaviour and position of PKN. In the next section the method used, observation, is described. This method will be used in two phases of the study: in the first phase and in the third phase.

2.3.2.1.1 Examining information source use: general observations (phase 1)

Source usage for gaining knowledge in the police organization and the position PKN holds will be examined by means of general observations. The term “general” refers to the objective of the observations in this phase of the study; the aim will be to get a view on source usage by “typical” police men. In a subsequent phase of this study, a more specific view will be taken when we focus on more intensive users of knowledge databases, see section 2.3.2.1.2. Observations are seen as a suitable method to obtain insight into the actual practices regarding source usage as via observing behaviour they can be recorded directly and objectively. The purpose of the general observations will therefore be to objectively and in practice look at the use of PKN and other information sources.

The Dutch Police Force consists of 25 corps, that at the time of the study vary in actual strength between 890 employees (Zeeland) and 5099 employees (Rotterdam-Rijnmond). As observations are time consuming and as a deadline will have to be taken into account[5], it was decided that the observations will take place in four corps. One selection criterion for selecting the participating corps will be the relative use of PKN. As users who use a system frequently may have other behavior and opinions than users that use a system less frequently, it was decided that the position of PKN will be investigated for a user group that varies in the relative use of PKN. The term “relative use” refers to the use of PKN per police men per corps. This is determined based on the measured intensity of PKN use which is derived from PKN log registration over the year 2004 (Bakker et al., 2006). The second selection criterion will be the corps size, as corps differ notably in size. By ensuring differences in corps size, existing variations between the corps on this aspect is covered. Based on these two selection criteria four corps are selected, see Table 2.1.

Table 2.1 Corps selected for observations

	Intensity PKN-use	
Relative corps size	**High**	**Low**
Large	Brabant South-East	Amsterdam
Small	IJsselland	Twente

[5] The study had to be conducted in a limited time interval.

Within these police corps, police men must be selected that will be observed while working. The focus in this selection will be on maximizing the likelihood of (digital) information use as a result of a knowledge need and to observe different people working in specific locations as the main research question of this chapter addresses differences for work contexts. In addition, locations selected should be representative of generic police work in the Netherlands. Thus, representativity and context variety will be combined with maximizing the likelihood of observing knowledge gaining via sources. It is assumed that police men on the street have limited access to sources when compared to police men working indoors. This last group of police men has direct access to all types of sources distinguished in this study: written sources, digital sources and personal sources. In addition, a study by Doornebos, Denessen and Simons (2004) found that informal learning at the Dutch police is positively related with access to colleagues and contacts from outside the organisation. These contacts with colleagues and external contacts can mostly be made easier from an indoor workspace, using, for example, face-to-face contact or Internet. Therefore the choice is made to focus on police men working indoor. In order to cover representativity of generic police work and context variety, police men working in three different departments in each corps will be observed. Although the organisational structure of the corps is not exactly identical, the entities observed can be defined as District teams (in Dutch: wijkteams), Info desk/Control room (in Dutch: meldkamer)/Regional Communications and Information Centre (RCIC), and Criminal Investigation Department (in Dutch: recherche). There will be a difference between the observations and the interviews to be described later: the observed police men will be chosen more randomly as only the location will be known beforehand, but not the available police men. The police men that will be interviewed will be selected by the researchers rather than that they personally choose to participate, like with the questionnaire.

In total five observers will perform observations. The observer will be introduced at each location as a researcher investigating knowledge and information use in the Dutch Police Force. By giving such a general introduction, it is intended to minimise the influence of the presence of an observer on the source usage behaviour of the employees. Per session one or more employees will be observed, depending on the actual work context. The observations took place in the spring of 2005. As on one hand the aim was to observe several police men on a single day at one location (corps) and on the other hand each police man had to be observed long enough to increase the likelihood of observing relevant behaviour, the objective will be to observe a police man for 90 minutes. If an employee will be absent for some time, this time will be noted down. This way the actual observation time can be determined afterwards. During a session the main goal of the observer will be to identify an emerging knowledge need, the source used to find the knowledge, the result of

the search (need satisfied or not) and if the knowledge is used in practice. This procedure will be followed in order to collect case descriptions of knowledge needs. By looking at these case descriptions, it will be possible to verify afterwards if the case really involved a knowledge need or not. This was done by using the definitions of knowledge and information as presented in Chapter 1. These definitions indicate the major difference between knowledge and information needs; information has to be interpreted anew every time it is used, while knowledge which results from mental processing of information and can be reused in the future. In addition, the case descriptions will be mutually checked between the involved researchers for accuracy of distinguishing information- and knowledge needs. This way the categorisation of knowledge needs and information needs will be verified.

2.3.2.1.2 Focusing on knowledge databases users: specific observations (phase 3)

Instead of focusing on source usage by "typical" police men, the users of sources observed and interviewed in this phase, are more intensive users of knowledge databases, such as PKN. Focusing on these users will shed more light on the actual use of sources for knowledge and the position of PKN among these sources as this is essential for answering the sub question that addresses the position of PKN among the already available sources for gaining knowledge.

At locations where, based on the findings from the general observations and questionnaire (see section 2.3.2.2.2), PKN-use could be expected, specific observations with subsequent interviews will be carried out. The intention is to select PKN-users as much as possible beforehand in order to maximise the likelihood to observe use of sources for knowledge but also of PKN. The results from the phase 2 questionnaire will be leading in this process. Based on the frequency of use, derived from self-reports, it will become clear in which corps and in which knowledge areas PKN-intensive use could be expected. The results for the question "How often do you use PKN?" will be leading. The number of respondents from a corps that will answer this question with "regularly" (more than once per month), divided by the corps size, will give an indication of the intensity of the use, and thereby the likelihood to be able to observe PKN-use. Anticipating on the results, they showed that the three highest scoring corps, Zeeland, Limburg-North and Brabant South-East, should be approached to participate in the specific observations. As getting access to these corps turned out to be particularly time-consuming, the opportunity to carry out specific observations in corps IJsselland will be taken up. Although this corps does not belong to the top three of potentially most intensive PKN users, the score was so high that regular PKN-use can be expected there.

Also the Police Academy in Apeldoorn will be added in order to determine whether PKN-use in a more formal training context differs from PKN-use in the work context.

The selected corps will be approached with the question if the observations can be done in departments or groups working in one of the knowledge areas in which PKN-use is high according to the results of the questionnaire. The expectation that contact persons in the selected corps are able to locate potential intensive PKN users was not fully met. On one hand, for the contact persons in the corps it generally proved difficult to determine who use PKN frequently. On the other hand, it turned out that the knowledge areas do not always provide sufficient guidance to select a specific group, department or even individuals. In some cases the contacts referred to more general departments (district teams, general criminal investigation department, and service centre). Due to the great effort it took the corps to find specialists in knowledge areas whose PKN-use could be expected to be intensive, the number of specific observations in the corps is lower than in the general observation. Table 2.2 contains a list of knowledge areas and locations observed.

Table 2.2 Locations of the specific observations

Department / unit / knowledge area	**Corps**
Foreigner Police	Zeeland / IJsselland / Limburg-North
General criminal investigation department	Zeeland / Brabant South-East
District teams	Zeeland / Brabant South-East / Limburg-North
Traffic Control Police	South-East Brabant / Limburg-North
Environment Police	IJsselland
Tactical criminal investigation department	IJsselland
Technical criminal investigation department	IJsselland
Service Centre	Limburg-North
Office Staff Corps leadership	
Youth Police	

The procedure that will be used during the specific observations will be almost similar to the one followed during the general observations.
The main difference will be the time reserved for observations: 60 minutes per observation session. This observation time is 30 minutes shorter than that of the general observations. Based on the experiences during the general observations, for example, the mobility of the employees, observing 90 minutes contiguously turned out to be very difficult.

2.3.2.2 Focusing on preferences and appreciation of information sources: interviews and online questionnaire

To enrich the objective data collected by observation and to collect data for answering the sub questions related to some more subjective parts of source usage behaviour (for example preference and support given by sources), interviews and an online

questionnaire will be used. Interviews will be held immediately after the observations in phase 1 and 3 and the online questionnaire is phase 2.
The purpose of these two data collection methods will be, besides gathering additional information, to verify that the observed activities are similar to the normal task performance of the observed person in order to prevent possible biases due to observing behaviour in a limited time frame only.

2.3.2.2.1 Interviews after the observations (phase 1 and 3)

After each general and specific observation session one or more of the observed individuals will be selected by the researcher for a short interview. During these interviews, employees will be asked the following four questions:

- Which digital information sources for gaining knowledge do you use and how often?
- Which other information sources for gaining knowledge do you use and how often?
- Can you list the use of digital, paper and personal sources for gaining knowledge in order of preference?
- Have you ever used PKN and, if yes, for what purpose?

These four questions relate to the main research question and sub questions of this chapter. For the interviews applies that the answers to the questions will be categorized afterwards based on the categories that can be extracted from the answers on these four interview questions.

2.3.2.2.2 Online Questionnaire (phase 2)

This phase took place in July 2005. The Group Information Management Police (CIP[6]) distributed the questionnaires in the corps. The chief of each corps will be asked in an accompanying letter for permission for their police men to participate, and specifically for distributing the questionnaires. Subsequently, the responsible person in each corps will be approached by phone or mail with the request to support the study and make the internal mail directory available to the CIP. The CIP will then send a separate mail to each employee, containing a login code for filling in the online questionnaire. The online questionnaire will be distributed via the Police Intranet to the different police regions. Many studies carried out for the police use this method, including the Employee Satisfaction Surveys (MTOs[7]). The Police Intranet is not similar to PKN; it is one of the other available sources and forms the start page when the internet browser is opened by a police man. Via the Police Intranet, PKN can be accessed. Eventually the questionnaire is distributed in the following corps who

[6] In Dutch: Concern Informatiemanagement Politie
[7] In Dutch: Medewerker Tevredenheids Onderzoeken

agreed to participate: Friesland, Drenthe, Flevoland, Gelderland-South, IJsselland, North and East-Gelderland, Gelderland-Mid, Zeeland, Utrecht, Limburg-North, Limburg-South, Brabant-South-East, Amsterdam-Amstelland, Rotterdam-Rijnmond, and Haaglanden. Thus in total 15 (58%) of the 26 Dutch Police corps (25 regional and 1 national corps) participated in this study. From each of the fifteen cooperating corps only one quarter of the staff was mailed, 8194 persons in total. This was done to reduce the load for the computer servers.
The questionnaire starts with some questions about background characteristics such as gender, age and duration of employment. Further, the questionnaire addresses several topics based on the research questions mentioned in section 2.2. That is, preference for information source type, support given by information source type, use of PKN and support given by PKN and other digital information sources.

2.4 Information source usage for knowledge gaining

The main research question of this study addresses the practices of workers regarding the information sources they use to gain knowledge, the triggers of knowledge needs and differences for different work contexts. Results can be found in section 2.4.2.
Section 2.4.3 relates to the sub question about the general preference for source types and section 2.4.4 describes results relating to the sub question about the support given by source types.
The question which addresses the position of PKN, a relatively new information source that is available for gaining knowledge, is answered in section 2.4.5.
First, before turning to the results directly related to the research questions, in section 2.4.1 the characteristics of the samples will be described.

2.4.1 Characteristics of the sample

As the investigation uses different samples of participants (police men), they should be described separately.

2.4.1.1 Observations and interviews

General observations and interviews

In total 137 persons were observed during the general observations. In about half of the cases of the general observations, interviews took place; 68 persons were interviewed, of which 17 (25%) were specialists. Not all observed police men could be interviewed. First, they were not able to participate due to urgent work tasks. Second, the planning of the observations, dictated by organizational constraints and available manpower, allowed for observing in certain limited time slots in one department. Therefore, the time in a department was limited and interviewing all

observed employees would take too much time away from observations at other departments. Some interviews took place in advance without observations; this way the number of interviews was somewhat increased. The general observations were, as planned, carried out at the four corps that were considered to be representative: Brabant South-East, IJsselland, Amsterdam and Twente. Within each corps three different departments were observed: District teams (in Dutch: wijkteams), Info desk/ Control room (in Dutch: meldkamer)/Regional Communications and Information Centre (RCIC), and Criminal Investigation Department (in Dutch: recherche).

Specific observations and interviews

As mentioned in 2.2.1.2 the number of specific observations in the corps is lower than in the general observations. However, students were observed too. During the specific observations, 205 persons were observed (75 police men and 130 students). For the same reasons as mentioned above, not all observed police employees and students were interviewed. In total 65 persons were interviewed, of which 48 (68%) were specialists.

The specific observations were carried out, as planned, at the corps from Zeeland, Limburg-North, Brabant South-East and IJsselland and at the Police Academy (see section 2.2.1.2 for an explanation of the selection of these corps).

2.4.1.2 Questionnaire

In total 2185 police men from the fifteen corps filled in the questionnaire. This is a response rate of 27%. Some participants (261) did not complete the questionnaire, so together 1924 respondents (24%) remained for analysis. This response rate is acceptable as the aim of this study is to gain insight into practices of police men and not to generalize practices for all knowledge workers.

To see if the police men that filled in the questionnaire are representative for the entire Police force, some background characteristics are checked.

The distribution of males and females in the sample is 66% male and 34% female. In the police corps this distribution is quite similar (Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2005). Table 2.3 shows the age distribution in the sample and the age distribution in the entire Police Force. Both distributions are quite similar.

Table 2.3 Age distribution in the police organisation and sample

Age categories	Within police organisation		Within sample	
	N	%	N	%
25 years or younger	nk*	6	208	10
From 26 till 35 years	nk	23	555	26
From 36 till 45 years	nk	33	634	29
From 46 till 55 years	nk	32	666	31
56 years and older	nk	7	108	5
Total	**nk**	**101**	**2171**	**101**

*nk= not known by the researchers, N values are not given in the source used, only percentages

(Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2005)

To see if the respondents were distributed evenly over the different corps, respondents were asked in which corps they work. Table 2.4 shows how the respondents are distributed over the different corps that participated[8]. Looking at the relative participation per corps, the results show that participation reflects the size of the corps. Between 5% and 9% of the employees of each corps have participated.

Table 2.4 Frequency distribution for respondents per corps

Corps (actual strength)[9]	N in sample	% of total sample	% participation per corps[10]
Amsterdam-Amstelland (5063)	385	18	8
Rotterdam-Rijnmond (5099)	343	16	7
Haaglanden (4502)	221	10	5
Utrecht (3133)	211	10	7
Limburg-South (1783)	145	7	8
Brabant South-East (1913)	134	6	7
Limburg-North (1149)	99	5	9
North and East Gelderland (1581)	99	5	6
Friesland (1543)	93	4	6
Gelderland-Mid (1552)	89	4	6
Drenthe (1031)	81	4	8
Gelderland-South (1178)	77	4	7
Flevoland (1003)	70	3	7
IJsselland (1355)	65	3	5
Zeeland (890)	51	2	6
Total (32775)	**2163**	**101**	**7**

[8] 22 police men worked at the time of the study in one of the 15 corps, but indicated their own corps as the correct corps. These police men are excluded.

[9] This data is based on data of CBS and of PolBIS of 31 December 2004.

[10] Number of respondents in the sample/ actual corps strength.

Respondents were also asked how long they are employed at the Police and how long they work in their current function. As shown in Table 2.5, approximately half of the respondents (45%) works more than 15 years in the police organisation. One out of four respondents (26%) works one till four years in the police organisation. Only three percent of the respondents work shorter than one year in the police organisation. More than half of the respondents (55%) works one till five years in their current function. About one out of six respondents (16%) works more than ten years in their current function. These results show that the distribution over experience at the police and in current function is rather varied, although police men working less than 1 year at the Police are not that many.

Table 2.5 Duration of employment years in the police and current function

	Within police organisation		**Within current function**	
Duration of employment (in years)	**N**	**%**	**N**	**%**
Shorter than 1 year	56	3	285	13
1 till 5 years	562	26	1177	55
6 till 10 years	326	15	357	17
11 till 15 years	241	11	191	9
Longer than 15 years	982	45	147	7
Total	**2167**	**100**	**2157**	**101**

When looking at the different ranks of police men, the three largest groups of respondents are chief constables, sergeants and administrative employees without investigation power (each of them around 20%). The other groups of respondents are distributed over the other seven ranks, see Table 2.6.

Table 2.6 Respondents ordered by rank

Current rank[11]	**N**	**%**
Commissioner	16	1
Superintendent	39	2
Inspector 215	10	
Sergeant 462	22	
Chief constable	455	22
Constable	117	6
Police Patrol officer	73	4
Police Trainee	134	7
Administrative with investigative power	170	8
Administrative without investigation power	30	18
Total	**2061**	**100**

[11] The Dutch names of the ranks are: Commissaris, Hoofdinspecter, Inspecteur, Brigadier, Hoofdagent, Agent, Surveillant en Aspirant.

Respondents were asked about their most important activity at work. Table 2.7 shows that almost a quarter of the respondents state that most of their working time is spent in operational support (24%). In addition, the most important activity of one out of five police employees (21%) is emergency assistance. The most important activity for almost one sixth of the respondents (16%) is criminal investigations. For as good as one out of ten respondents (11%) the main activity is being in command. This group is the smallest group in the sample.

Table 2.7 Most important activity

Most important activity	N	%
Area restrained work	279	15
Emergency assistance	378	21
Criminal Investigations	294	16
Being in command	191	11
Policy support	239	13
Operational support	425	24
Total	**1806**	**100**

The distribution of respondents over regional, district and unit levels show that the distribution is quite comparable. Of the respondents 36% works on the regional level (for example, South-East Brabant) and more than a quarter of the respondents (26%) works at district level (which is part of a region) and 38% works at basis unit or at unit level (which is part of a district).
The distribution of respondents based on background characteristics such as gender, age, duration of employment and distribution per corps, suggest that this sample can in general be seen as representative for the total police population.

2.4.2 Gaining knowledge: practices, triggers and work context

The main research question of this chapter (which is related to the overall research question B) addresses three different aspects. First the practices of workers regarding the information source types they use to gain knowledge and the triggers of knowledge needs are reported (2.4.2.2). Next, differences between different work contexts are looked at (2.4.2.3). Section 2.4.3 describes the general preference for source types and section 2.4.4 describes the support given by different source types. First, data preparation is explained in section 2.4.2.1.

2.4.2.1 Data preparation: scoring and coding the observations

During the analysis various aspects of knowledge needs were examined as the main research question of this chapter addresses these aspects. The first one is the trigger for the knowledge need, that is, what causes the worker to start searching

for knowledge. Two types of triggers were distinguished: the task at hand and own interest of the worker. In case of a task triggered knowledge need, the knowledge need finds its origin in the task a worker is performing when he experiences the knowledge need and starts to find the missing knowledge. The task at hand is the direct trigger for the search for knowledge; without the knowledge the task cannot be completed. In case of an interest triggered knowledge need, the knowledge does not directly originates from the task a knowledge worker is performing at a certain point in time but from his interest in a certain subject. This interest can be work related, but the knowledge is not needed immediately for the task at hand.
As two sub questions address source type, information sources were classified into personal, written and digital source. These source types were not further specified as this would lead to a very complex overview of source types; for example, many different written sources are used in the Police Force. Knowing the use of all these different source separately makes it difficult to see the big picture. The only aspect by which the source types were characterised is the channel of the message: either human (personal), paper (written) or the computer (digital). By generalising to these three main types of information sources, the level of detail needed to answer the research question can be achieved.

2.4.2.2 Use of information sources: frequency, triggers and source types

In this section the practices regarding the frequency of knowledge needs, the trigger of these needs and used information source types are described, as these aspects are part of the main research question of this chapter. We start with the results of the general observations. Besides a description of the observation data, such as observation time and frequency of types of knowledge needs and types of information sources used, several comparisons between and within groups will be made. To obtain insight into knowledge needs and use of sources to satisfy these knowledge needs, the data was standardized. This means that the data was adjusted for differences in observation time. Although it was strived to have an observation time of 90 minutes per session, experiences in the field showed that the mobility of the employees made it very difficult to adhere to this. The observed knowledge needs and use of sources were standardized for the knowledge needs and use of sources per hour. This means that the number of knowledge needs and source usages were divided by the number of observed minutes and then multiplied by 60 minutes. The average observation time of the general observations (61 minutes) was as good as equal to the standardised observation time. Effects of possible data extrapolation, this is, an artificial increase of the number of observations because of the data extrapolation (multiplication with a certain factor), were therefore limited. This incorrect increase of observations occurred only for observations which lasted substantially shorter than 60 minutes. Of the observations 27% lasted shorter than

40 minutes (37 of the 137 observations). The reported (standardised) observations times could therefore be a bit too high.
The total observation time was 139 hours and 30 minutes, almost three and a half 40-hour working weeks or more than 17 days. Depending on the coming and going of the different employees, the observation times of an individual varies from 6 to 97 minutes. In Table 2.8 means are reported for knowledge need trigger and information source use. On average 0.63 times per hour knowledge is needed. This corresponds to a knowledge need every 105 minutes. Of the 0.63 times knowledge need per hour, the need is 0.52 times task triggered and 0.11 times interest triggered. Most of the knowledge needs are thus triggered by questions that significantly relate directly to the currently executed task Personal sources are used more often than written sources. Also digital sources are used more often than written sources.

Table 2.8 Means (standard deviations) of knowledge need trigger and information source use standardized per hour.

Persons	Knowledge need		Type of information source		
	Task triggered	Interest triggered	Personal	Digital	Written
137	0.52 (1.03)	0.11 (0.39)	0.35 (0.69)	0.25 (0.85)	0.03 (0.19)

Besides data from the general observations, interview results from both the general and specific observations relate to source usage. During the interviews (almost) all police men reported to use digital sources; 97% during the general observations and 100% during the specific observations. (Parts of) Intranet and Internet are the information sources mentioned most frequently. During the specific observations, police men that were seen as more intensive users of knowledge databases were observed. The results of these interviews show that police men included in the specific observations use a greater variety of digital sources than the police men included in the general observations. In addition, they use them typically daily or weekly.
Almost all police men reported using non-digital information sources; 98% of the police men in the general observations and 100% of the police men in the specific observations. The most important information sources are colleagues, contacts from school (mentioned by students; think of other students and teachers), reference books, law books, pocket books and prints. The frequency of use varies: colleagues are consulted typically daily or weekly, while paper sources are consulted usually less frequent than monthly

Summarizing the results concerning the first part of the main research question of this chapter, it can be said that every 105 minutes a police employee experiences a knowledge need. Most observed knowledge needs of employees of the observed corps are triggered by the task they are performing. Knowledge needs that are

triggered by interest do occur, but less frequently. Police employees indicate in the interviews to use both digital and non-digital sources and the results of the observations confirm this. Personal and digital sources are used more than written sources.

2.4.2.3 Use of information sources: work context

The main research question of this chapter also addresses the question if there are differences in the knowledge gaining practices related to different work contexts. Results from the general and specific observations are used to answer this question as the practices of police employees in different work contexts are observed.

2.4.2.3.1 Type of work: generalists versus specialists

The use of sources is described for workers with different types of tasks as differences between knowledge gaining via sources in different work contexts need to be examined. Two types of workers will be distinguished: generalists and specialists. Generalists are police workers with more wide-ranging tasks and specialists are police workers with more specialized tasks. For example, constables and criminal investigators were seen as generalists and traffic specialists and the vice squad were seen as specialists.

In the general observations 19 employees (14%) of the 137 observed employees were marked as specialists. During the specific observations, 42 employees (20%) were marked as specialists.

General observations

In Table 2.9 means of used information sources and knowledge needs are shown for generalists and specialists.

Table 2.9 Means (standard deviations) of knowledge need and use of sources for generalists and specialists standardized per hour (general observations)

Type of work	Knowledge need		Type of information source		
	Task	Interest	Personal	Digital	Written
Generalists (n=19)	0.51 (1.02)	0.09 (0.34)	0.35 (0.70)	0.21 (0.81)	0.03 (0.19)
Specialists (n=19)	0.57 (1.08)	0.25 (0.60)	0.32 (0.69)	0.47 (1.08)	0.04 (0.15)
Total (n=137)	**0.52 (1.03)**	**0.11 (0.39)**	**0.35 (0.69)**	**0.25 (0.85)**	**0.03 (0.19)**

In Table 2.9 the comparison is between generalists and specialists for each of the columns in the table. For this a t-test on the means of independent samples was performed with the number of knowledge needs as the sample size. Sample sizes were sufficiently large for the “Task triggered” and “Personal” columns. However, no significant differences were found. As a consequence, in the general observations,

there are no differences between specialists and generalists in the type of knowledge need they encounter, nor the type of information source they consult.

Specific observations

Before reporting about the specific observations, it should be mentioned that the observed times were standardized too in order to make the data comparable. The total observation time of the specific observations in the corps was 64 hours and 40 minutes. At the Police Academy this was 58 hours and 13 minutes. Depending on the coming and going of different employees, the observation time of an individual at the corps varied from 6 to 86 minutes and at the Police Academy from 4 to 60 minutes. The average observation time of the specific observations at the corps was 51 minutes and at the Police Academy 27 minutes. To exclude effects of data extrapolation (artificially raising the number of observations because of multiplication with a certain factor), the observation time was standardised on 30 minutes. Given the range of the deviation from the averages with respect to the standardised times, effects of possible data extrapolation were limited. This occurred only for observations which lasted substantially shorter than 20 minutes. Nine percent of the observations at the corps lasted shorter than 20 minutes (7 of the 75 observations). Thirty-four of the observations at the Police Academy were shorter than 20 minutes (44 of the 130 observations). Within this last group, the risk of data extrapolation was somewhat larger.

For the employees of the corps (n=75) in the specific observations, also a distinction between specialists and generalists was made. Specialists have 0.42 times per half hour a knowledge need, generalists 0.14 times per half hour, see Table 2.10.

Table 2.10 Means (standard deviations) knowledge and knowledge need source use in general and specialized tasks, standardized at 30 minutes (specific observations).

Type of work	Knowledge need		Type of information source		
	Task	Interest	Personal	Digital	Written
Generalists(n=3)	0.14(0.29)	0.00(0.00)	0.06(0.19)	0.05(0.15)	0.03(0.12)
Specialists (n=42)	0.41(0.67)	0.01(0.07)	0.24(0.56)	0.12(0.27)	0.07(0.19)

Similar to Table 2.9, a t-test on the sample means of the columns could have been carried out, but the sample size of the knowledge needs en information sources were too small. As a consequence, no statistically based statements can be made about Table 2.10.

Summarizing, the results of the general and specific observations show no differences between generalists and specialists in the type of knowledge need they encounter, nor the type of information source they consult. Due to partly insufficient sample

sizes, t-tests on the sample means of the columns could not always be carried out. The conclusion is that there is no influence of type of work on the frequency of having a knowledge need, the trigger of this knowledge need and the sources used.

2.4.2.3.2 Career phase: police employees versus students

Another work context aspect, namely career phase, was taken into account to help answering the main research question of this chapter. Career phase refers to either police men that are still being trained at the Police Academy or police men that have finished formal education and are working at the Police force. Results from the specific observations can help to answer the question if the practices of police employees and students differ regarding the use of sources for gaining knowledge. In Table 2.11 the means are reported for observation time, knowledge need and information source use.

Table 2.11 Means (standard deviations) of knowledge need and information source use standardized per 30 minutes.

Type of work	Knowledge need		Type of information source		
	Task	Interest	Personal	Digital	Written
Corps(n=75)	0.29(0.55)	0.01(0.05)	0.16(0.44)	0.09(0.23)	0.05(0.16)
Police	1.06(1.66)	0.03(0.29)	0.41(1.10)	0.65(1.35)	0.05(0.22)

A t-test of the means of independent samples shows, for the columns in Table 2.11 having a sufficiently large sample size of knowledge needs, only a significant ($t=2.88$, $p<.05$) difference between Corps and Police Academy, the latter experiencing more task triggered knowledge needs

Summarizing, students from the Police Academy are experiencing a task triggered knowledge need more often than employees of the corps. Students experience a task triggered knowledge need almost four times more per half hour than employees of the corps. The career stage thus affects the frequency of having a task triggered knowledge need, but has no effect on the use of source types.

2.4.2.3.2 Police Department: three different police departments

In Table 2.12 knowledge needs and information source use are specified for each of the three observed police departments (District teams, Info desk/Control room/RCIC and Criminal investigation department) based on the general observations.

Table 2.12 Means (standard deviations) of knowledge need and type of information source used for District teams, Info desk/Control room/RCIC and Criminal investigation department standardized per hour

	Knowledge need		Type of information source		
Department / unit	**Task triggered**	**Interest triggered**	**Personal**	**Digital**	**Written**
District team (n=53)	0.41 (0.81)	0.12 (0.41)	0.34 (0.72)	0.16 (0.44)	0.04 (0.18)
Criminal investigation department (n=46)	0.58 (1.31)	0.16 (0.48)	0.32 (0.60)	0.36(1.30)	0.06 (0,26)
Info desk/Control room/ RCIC (n=38)	0.60 (0.91)	0.04 (0.17)	0.40 (0.78)	0.24 (0.53)	0.00 (0.00)
Total (n=137)	**0.52 (1.03)**	**0.12 (0.39)**	**0.35 (0.69)**	**0.25 (0.85)**	**0.03 (0.19)**

A t-test on independent samples performed on the differences between the three departments/units for those columns with a sufficiently large sample size, shows no significant differences. As a consequence, the department/unit of a police man is not related to the type of trigger for a knowledge need nor the type of information source consulted.

Summarizing the practices of used sources for knowledge gaining and the triggers of knowledge needs for the three different police departments, the conclusion is that the department/unit of a police man is not related to the type of trigger for a knowledge need nor the type of information source.

Concluding this section about the effect of work context on source usage for gaining knowledge, it is clear that only career phase has some effect on the frequency of having a task triggered knowledge need. No effect of type of work and department/ unit of a police man on the frequency of having a knowledge need, the trigger of these needs and the use of sources to satisfy these needs was found.

2.4.3 Preference for information source type

The first sub question addresses the general preference for a certain source type. In this study personal, written and digital information sources are distinguished. Respondents of the questionnaire were asked about their general preference for these types of information sources. More than half of the participants (52%) indicate that, when asked in general terms, they prefer to have knowledge presented by digital information sources. One out of five respondents (20%) has a preference for personal sources, see Table 2.13. The difference in preference for an information source type is statistically significant (taking an equal distribution of the percentages in Table 2.13 as the expected values (χ 2 =39.29, $p<.05$).

Table 2.13 Preferred type of information source

Type of information source	N	%
Personal	382	20
Written	256	13
Digital	993	52
No preference	293	15
Total	**1924**	**100**

During the interviews after the general observations, the participants expressed a slight preference for personal sources, though the difference found in preferences between personal and digital sources is small. They have the least preference for using written sources. For the specific observations, the preferred order from most to least preferred is: digital, personal and written source types. The difference between digital and personal source types is again very small. While the preferences of specialists and generalists in the interviews accompanying the general observations were as good as similar, specialists express a preference for digital sources in the interviews accompanying the specific observations and generalists for personal sources. Not every interviewed police man has a preference. Their preference appears to depend on the specific (search) task, that is, the type of information sought. Summarizing the results, it is clear that written source types are preferred the least. Although the questionnaire results show that digital sources are preferred over personal sources, this difference seems to be small when looking at the interview results. Most of the time, digital source types are preferred most, but the interview results of the general observations show a slightly higher preference for personal source types.

2.4.4 Support given by information source type

The second sub question addresses support given by the different source types in meeting knowledge needs. Although one may use a particular type of information source, one may appreciate the support given by another source type more. For example, one may use digital source types because the found information can be applied and stored for future use easily. However, at the same time one can appreciate the support given by personal contact more for the social aspect and the more detailed nature of the information given. Therefore, besides their preference for a source type, respondents of the questionnaire were asked about the support given by each of the three types of information sources discerned in this study. They could express it by distributing 100 euro over the three source type based on the criterion “the degree to which a source can help to solve a knowledge question”. The source type which generally helps the best, receives the most euros and the source that helps the least, receives the least. In slightly different terms, one can say that this is an estimate of the quality of the various types of information sources.

Figure 2.1 shows that the support given by written sources is on average valued the lowest (€ 19.59). Digital sources (€ 42.77) give on average the best support as they receive more euros than written ones (€ 19.59, t(1990) = 34.240, p<.05) and personal sources (€ 37.60; (t(1990) = 5.884, p<.05). In addition, the support given by personal sources is valued more than that of written sources (t(1990) = 30.127, p<.05).

Figure 2.1 Average appreciation of information sources in euros

Type of sources	Mean	Sd.	N
Digital	€ 42.77	21.73	1993
Written	€ 19.59	13.89	1992
Personal	€ 37.59	20.14	1993

These results show that, on average, respondents state that in case of a knowledge need, they are best helped by digital information sources, followed by personal sources. This order is similar to the preference order described in section 2.4.3.

2.4.5 The position of PKN

The third sub question requires investigating the position of a relatively new information source among available sources for gaining knowledge. As mentioned in section 1.1, research has shown that it is important to carefully investigate the position of new knowledge systems among existing sources. In the case of the Dutch Police force, PKN is a relatively new knowledge database. In the following sections, results addressing this question are presented. The results are mostly based on the data from the online questionnaire; if this is not the case, this is mentioned. First, the use of PKN is described in section 2.4.5.1. Next, the influence of different work contexts on PKN use is reported in section 2.4.5.2. Finally, in section 2.4.5.3 the appreciation of PKN is presented.

2.4.5.1 Use of PKN

Respondents were asked how often they use PKN; in this question no specification between use of PKN for information or knowledge was made. In Table 2.14 the reported frequency of PKN use is shown, based on the questionnaire. Results show that 7% of the respondents indicates to never use PKN. One out of three respondents (35%) indicate to use PKN rarely: 4% uses it less than once a year, 21% uses it only once a year and 10% uses it approximately once per quarter. One third (35%) of the police men indicates to use PKN, one or more times per month:

17% uses PKN monthly and 18% several times per month. Approximately one fifth of the respondents (19%) indicate to use PKN one or more times per week: 11 % indicates to use PKN weekly and 8% uses PKN several times a week. One in twenty respondents (5%) use PKN daily.

Table 2.14 Frequency of PKN use

PKN Use	N	%
Never	135	7
Less than once a year	84	4
Only once a year	397	21
Approximately once per quarter	189	10
Monthly	317	17
Several times per month	338	18
Weekly	204	11
Several times per week	160	8
(as good as) Daily	100	5
Total	**1924**	**101**

Interviews

The interviews conducted after the general observations show that 46 (68%) of the observed individuals have used PKN. They were asked how often they use PKN. Two persons could not remember this. Fourteen percent of the police men indicate to use PKN daily and more than one in ten (11%) state to consult PKN on a weekly basis, see Table 2.15. In addition, a small group (5%) uses PKN a several times a day. Approximately one quarter of the employees (24%) consult PKN less than once a month. Specialists seem to use PKN more than generalists. The purpose of using PKN differs: from consulting legislation, procedures and know-how, engaging in discussions, to searching for forms and information and using it to enter another system. When looking at these use purposes and relating them to information or knowledge needs, 48% of the purposes can be related to knowledge needs and 52% to information needs.

Table 2.15 Frequency of PKN use based on interviews after the observations

PKN Use	General observations interviews		Specific observations interviews	
	N	**%**	**N**	**%**
Never	22	33	8	13
Rarely	16	24	11	17
Monthly	9	14	4	6
Weekly	7	11	13	20
(as good as) Daily	9	14	27	42
Several times a day	3	5	1	2
Total	**66***	**101**	**64***	**100**

* These totals miss respectively the data of 2 and 1 persons (no specific data for this question was collected)

The interviews after the specific observations show that 13% of the interviewed police men state to have never used PKN; 56 (88%) say to have used PKN sometime. These PKN users were asked how often they use PKN. Seven persons could not remember this. More than two out of five (42%) indicate to use PKN on a daily basis and one in five (20%) weekly. This was, considering the selection criteria for the specific observations, to be expected. In fact, for one in six police men of the specific observations (17%) holds true they use PKN rarely. The purposes of using PKN mentioned, are quite similar to those mentioned by respondents in the general observations, although consulting legislation is more prominent. When looking at these use purposes and relating them to information or knowledge needs, 54% of the purposes can be related to knowledge needs and 46% to information needs.

The reported use during the interviews after the general observations is to some extent similar to that of the results of the questionnaire. Most respondents say they do not use PKN very frequently. Only the group that indicates to use PKN daily or more is larger than found in the questionnaire (5% versus 19%). The reported use during the interviews after the specific observations differs with the results of the questionnaire as most respondents state to use PKN more frequently, namely as good as daily (42%) or weekly (20%). It could have been that the interviewed police men felt they had to overestimate their use a bit when they discovered our interest in their PKN use.

Observations

Interesting is if the interview and questionnaire results are in line with the results from the general and specific observations. The results of the questionnaire and interviews indicate a regular use of PKN. However, during the general observations, PKN use was observed only once during more than 139 hours. Results from another study (that is, the more extended version of this study, Bakker et al, 2006) show

that PKN is not always clearly defined. Especially the distinction between PKN and other digital sources seems to be confusing for police men. This may have affected the reliability of the answers in the interviews and questionnaire, as it cannot be guaranteed that all participants had the same knowledge database in mind.

Summary

Results from the interviews and questionnaire show that PKN is used regularly (monthly or more) by approximately half of all police men. The reported use in the interviews after the observations is higher than reported in the questionnaire when it concerns daily or more frequent use. An explanation of this difference for the general observation interviews could be that police men felt some pressure to give socially desired answers. For the specific observations interviews it can be explained by the selection criterion for them (users of knowledge databases). Results also show that police men that are seen as frequent users of knowledge databases (that is, the police men observed in the specific observations) seem to use PKN more than police men observed in the general observations. In addition, results from the interviews show that police men observed in the specific observations use PKN slightly more often for acquiring knowledge than police men observed in the general observations. In contradiction with these results from self-reports, observational data shows that PKN is used rarely. A reason for this difference may be that PKN was confused with other knowledge databases. Another reason is that the use of PKN for acquiring knowledge is in fact dominated by use of PKN for other purposes, like finding information about telephone numbers and employment conditions, which is evidenced by log data from the system which are not reported here in detail.

2.4.5.2 The use of PKN in different work contexts

Based on the main research question of this chapter that addresses influences of work context on the practices regarding source usage for gaining knowledge, the use of PKN in different work contexts was investigated. The context aspects taken into account were corps size, rank and duration of employment. These work context aspects differ from the aspects taken into account in 2.4.2.3: type of work, career phase and police department. As these three context aspect show little effect on the use of sources for gaining knowledge, it was decided to select other aspects.

Corps size

The police men of the 15 corps that participated in the online questionnaire (see section 2.3.2.2.2 for a description of these corps) were divided into three categories based on corps size: Small (actual strength < 1178): Limburg-North, Drenthe, Gelderland-South, Flevoland, and Zeeland, Medium (actual strength 1355 - 1913): Limburg-South, Brabant-South-East, North and East-Gelderland, Friesland, Gelderland-

Mid, IJsselland and Large (actual strength 3133-5099): Amsterdam-Amstelland, Rotterdam-Rijnmond, Haaglanden and Utrecht. Respondents from the large corps use PKN less than respondents from medium and small corps (χ 2=21.135, p<.05). A possible explanation is that large(r) corps have better knowledge facilities already available on their own local Intranet. This is also consistent with a finding in the more comprehensive study that police men from the large police corps reported more Intranet use than police men from the small and medium sized corps (Bakker et al., 2006).

Rank

Within the Police Force, police men differ in rank. Table 2.16 shows the frequency of PKN use based on questionnaire data per rank. Sergeants indicate to use PKN relatively the most, half of the sergeants state to use PKN regularly. Commissioners state to use it the least.

Table 2.16 PKN use based on rank ordered by frequency of use

Rank	Frequency of PKN use (%)			
(total N=1846)	Rarely or never	Sometimes	Regular	N
Commissioner	44	44	13	16
Administrative without investigation power	49	23	28	328
Superintendent	41	24	35	37
Police Patrol Officer	32	31	37	62
Administratively with investigative power	36	24	40	144
Police trainee	24	34	42	107
Constable First Class	26	29	45	415
Inspector	30	24	47	204
Constable	27	26	48	101
Sergeant	24	26	50	432

It can be assumed that police men with a lower rank work more outside on the street; they do not spend much time inside behind a desk. Police men with higher ranks (and thus more often having an in house desk job) would be able to consult digital information sources as PKN more easily. Although not visible in Table 2.16, this result does show when the data is corrected for the size of the groups per rank[12]. Police men higher in rank use PKN relatively more than police men lower in rank (Kendall's tau = 0.106, p<.05[13]).

[12] For example, fewer commissioners and superintendents than sergeants have participated.
[13] Administrative employees and police men with another rank are not taken intro account in the analysis as they do not perform substansive police tasks.

Duration of employment and duration of employment in current function

In the questionnaire respondents were asked about their duration of employment at the Police Force. The use of PKN is the highest for respondents with an employment in the police for more than fifteen years (Kendall's tau =0.098, p< 0.001), see Table 2.17. Nearly half of them said to use PKN regularly (48%).

Table 2.17 Use PKN related to duration of employment at police

Duration of employment	Use PKN (%)			
at police (total N=1924)	Rarely or never	Sometimes	Regular	N
< 1 year	38	36	26	42
1 – 5 years	34	29	37	471
6 – 10 years	38	26	36	279
11 – 15 years	38	28	34	213
> 15 years	27	25	48	919

The finding related to duration of employment seems to confirm what the theoretical framework in Chapter 1 mentions about the Media Richness Theory and the role of contextual knowledge present with experienced humans when they use a relatively lean communication medium. When starting in a new organisation, there is uncertainty and ambiguity regarding contextual knowledge. To reduce this uncertainty and ambiguity, if present, the theory suggests that using rich personal sources is more preferred above using lean digital sources such as PKN. The results that police men that work longer with the police say to use PKN more, also relates to the findings concerning rank. As people work longer with the police, one generally has a higher rank than those being recently employed by the police.

No significant relation was found between duration of employment in current function and use of PKN; results do not show that PKN is used more by, for example, employees that are relatively recently working in their current function, which appears to support the notion that general contextual knowledge matters more in using PKN, or not, than function related experience.

Summary

The conclusion is that corps size influences PKN use: smaller and medium sized corps use PKN less frequent than larger corps. In addition, police men higher in rank use PKN more than police men lower in rank. The duration a police man is employed by the Dutch police is also a factor that influences PKN use: police men that are employed more than fifteen years use PKN most. This finding can be related to the Media Richness Theory: as experience increases, interpreting the information found in lean information sources, such as PKN, leads to less ambiguity

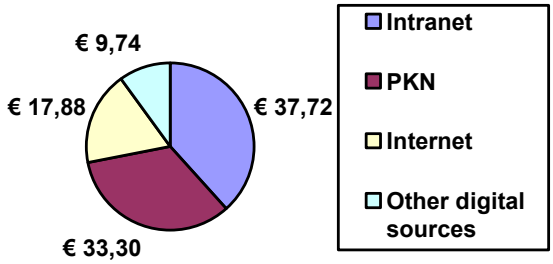
and equivocality as these police men have more rich contextual knowledge available which they accumulated during their work experience. The duration of employment in a current function does not influence the frequency of PKN use. This indicates that the experience and knowledge gained within a function does not make a difference, but the general contextual knowledge of the police organisation does; it seems that the ambiguity and uncertainty related to the organization is central instead of the ambiguity and uncertainty of the task.

2.4.5.3 Comparing support given by PKN and other digital information sources

In order to compare the support given by PKN with other digital information sources, the respondents of the online questionnaire were asked to compare the support given by PKN and other digital information sources. They could do this by allocating 100 euros. They had to allocate the euros based on the degree to which the digital information sources help to solve a knowledge question. They could choose from Intranet (also called Korpsnet), PKN, Internet and other digital sources.

On average, the support given by Intranet (€ 37.72) is appreciated more than PKN ($t(1978) = 6.729$, $p<.05$), the support given by Internet ($t(1978) = 28.443$, $p<.05$) and other digital sources ($t(1976) = 45.711$, $p<.05$), see Figure 2.2. The support given by PKN (€ 33.30) is on average more appreciated than that of Internet ($t(1978) = 22.695$, $p<.05$) and other digital sources ($t(1976) = 39.996$, $p< 0.001$). Internet (€ 17.88) gets on average a higher appreciation for its support given than other digital sources (€ 9.74; $t(1976) = 17.645$, $p<.05$), see also Figure 2.2. Proportionally, police men report to be assisted best by Intranet, followed by PKN, Internet and other digital sources.

Figure 2.2 Mean rating for digital sources in euro based on the support given



Type of sources	Mean	Sd.	N
Intranet	€ 37.72	21.72	1980
PKN	€ 33.30	20.13	1980
Internet	€ 17.88	16.81	1980
Other digital sources	€ 9.74	12.48	1978

These results show that the support given by Intranet is appreciated more than the support given by PKN. Compared to Internet and other digital sources, the support given by PKN is on average appreciated more. This last result is remarkable since

other results of the questionnaire (section 2.4.5.1) indicate that PKN is generally not used very regularly, while other digital sources in general are. However, the conclusion is that although PKN is not used that much, its support is valued relatively highly.

2.5 Summary and conclusions

In this study the use of information sources for gathering knowledge in the Dutch Police force was investigated. The main research question that is addressed in this study concerns the practices of workers regarding the information sources they use to gain knowledge, the triggers of knowledge needs they have and investigating differences for different work contexts. Results show that every 105 minutes a police employee experiences a knowledge need. Although knowledge needs triggered by interest occur, most observed knowledge needs are triggered by the task police employees are performing. Both digital and non-digital sources are used, but not with the same frequency; personal and digital sources are used more than written sources.
Several work context aspects were taken into account to see if they affect the frequency of having a knowledge need, the trigger of this knowledge need and source usage. It should be noted that, due to an insufficient sample size in some cases, significance tests could not always be carried out. Most of the time no differences between groups, determined by the work context aspects, were found. Type of work and Police Department do not affect the frequency of having a knowledge need, the trigger of these needs and the use of sources to satisfy these needs. However, career phase affects the type of knowledge need experienced. Students from the Police Academy are more often in need of knowledge triggered by tasks than employees of the corps. This difference is quite large: students experience a knowledge need almost four times more per half hour than employees of the corps. No effects were found for career phase on information sources used.
Actual source usage behaviour may differ from the source one prefers to use, see sub question one. Results show that written source types are preferred the least too. The found difference between digital and personal sources however is small. Although the questionnaire results show that digital sources are preferred over personal sources, this difference seems to be small when looking at the interview results. Most of the times digital source types are preferred most, but the interview results of the general observations show a slightly higher preference for personal source types.

Moreover, preferring one source does not automatically mean that this source offers the best support in solving a knowledge need, as this can depend on the specific context. The second sub question of this study addresses this by asking if there are

differences in the degree of support given by the various source types that workers use to gain knowledge for satisfying their knowledge need. Results show that, on average, respondents state that in case of a knowledge need, they are best helped by digital information sources, followed by personal and written sources. This rank-order of degree of support is similar to the preference rank-order.

New knowledge systems are developed to support information gaining by employees. Within the Dutch Police Force PKN was developed relatively recently. The last and third sub question therefore addresses the position of a relatively new information source among the available sources for gaining knowledge in an organization, and more specifically its use and the support it gives to satisfy knowledge needs. PKN is used regularly (monthly or more) by approximately half of all police men. Interestingly, the reported use in the interviews after the observations is higher than that reported in the questionnaire when it concerns daily use or more frequent use, which in turn is still higher than the actual use found during the general observations. An explanation for this difference with the general observation interviews could be that police men felt some pressure to give socially desired answers. Another reason for this difference may be that PKN was confused with other knowledge databases as these are not so clearly discernable in the browser(s) police men use. For the specific observations it can be explained by the selection criteria, which were mainly meant to involve users of knowledge databases. Results also show that police men observed in the specific observations seem to use PKN more than police men observed in the general observations. The reported use of police men interviewed after the specific observations is higher than that reported in the questionnaire or in the interviews after the general observations.

The effect of several work contexts on PKN use was also taken into account; the effect of corps size, rank, duration of employment (in current function) is investigated. The conclusion is that corps size influences PKN use: smaller and medium sized corps use PKN less than larger corps. In addition, police men higher in rank use PKN more than police men lower in rank. The duration a police man is employed by the Dutch police is also a factor that influences PKN use: police men that are employed more than fifteen years use PKN the most. This finding can be related to the Media Richness Theory: as experience increases, interpreting the information found in lean information sources, such as PKN, leads to less ambiguity and equivocality as these police men have more rich contextual knowledge available which they accumulated during their work experience. The duration of employment in a current function does not influence the frequency of PKN use.

Finally, the support given by PKN and other digital information sources was compared. Results show that the support given by Intranet is appreciated more than the support given by PKN. Compared to Internet and other digital sources, the support given by PKN is on average appreciated more. This last result is remarkable since other

results indicate that PKN is generally not used very frequently but digital sources in general are. However, the conclusion is that although PKN is not used much, its support is valued positively.

Looking at the results of this first study, some limitations have to be kept in mind. The selection of the corps participating in the observations, interviews and questionnaire is one of them. First of all, 4 of the in total 26 corps were involved in the observations and 15 corps were involved in the questionnaire. The selection of the corps was based on several criteria; for observations and interviews this was, amongst others, the relative use of PKN. By selecting corps that are seen as either intensive users of PKN or infrequent users of PKN, an important group of users may have been overlooked: those police men whose PKN use is somewhere in between. The relative use of PKN was based on the PKN log registration. This log registration could also have been interpreted wrongly as it gives a general idea of overall PKN use within one corps, not PKN use by individual police men in the corps. For example, there could have been a few very intensive users in one corps that together led to the label of “intensive PKN users” for one corps. As a consequence, the possible skewness of actual use was not taken into account. The limitation of this selection criterion is relevant for the conclusions drawn, which could have been different when the “in between users” were taken into account too. Especially the results for the interviews about PKN usage would have been affected: the reported use could have been more or less frequent. However, as the observations showed no differences in actual PKN use (PKN use was observed only once) and as the range of police men that filled in the online questionnaire was not limited by this selection criterion, the influence on the results is probably rather small.
The corps that participated in the online questionnaire participated because the chief of their corps agreed too participate and because the police men wanted to participate. This means that there were also self-selected non-participants. In addition, the focus of the observations and interviews was on police men working indoors, police men that work on the street were excluded. The aim was to maximise the probability of (digital) information use. It was assumed that police men on the street have limited access to sources when compared to police men working indoors. However, excluding these self selected non-participants and police men on the street could have affected the results and thereby the conclusion of this study. For example, the difference between the use and preference of digital and personal sources found in the study could have been different for police men on the street as they often have direct access to personal sources (a colleague they work with closely together when patrolling, for example) the reported overall use of these personal sources could be more intensive than that of the police men working indoors. In addition, police men that did not participate in the online questionnaire could have used the

three types of information sources differently for acquiring knowledge. The results of the questionnaire showed, for example, that most participants prefer to have knowledge presented by digital information sources. Taken together, these selection criteria could have affected the conclusions drawn (for example, differentiation based on police men working indoors and on the street) and thereby the findings of this study. Although a study of Doornbos, Bolhuis, & Simons (2004) relates informal learning (knowledge gaining) to access to colleagues and contacts from outside the organisation, keeping in mind these limitations, some care is needed when making generalizations of the findings to the entire police population. On the other hand, as different data collection methods are used, limitations of one method may have been (partly) solved by the other method. The consequences for answering the research question B as formulated in Chapter 1 are therefore perceived to be relatively small.

Another limitation of this study may be related to the reliability of the data collected about PKN use. Although PKN usage was observed only once during 139 hours, the interviews and questionnaire results indicated that PKN is used quite frequently. On the one hand, participants may have felt some pressure to give socially desired answers when they detected our interest in PKN. On the other hand, PKN itself may not have been clearly defined for the participants. Another study showed that the distinction between PKN and other digital sources is not always clear for police men (Bakker et al., 2006).Although the difference between the actual observed use and self reports about PKN usage has been noticed in the study, the reliability and thus the representativity of the data collected via self reports may be negatively affected by the possible ambiguity that exists about what PKN is and is not.

Chapter 3

3 Patterns and practices in self-directed learning[14]

In the previous study, source usage for gaining knowledge was investigated at the Dutch police force. The use of information sources for gaining knowledge was limited to one organization focusing on a few key points. In this study the aim is to expand findings to knowledge workers of several European organizations. In addition, looking at the framework of Holsapple and Joshi (2003), the focus in this study is not just on the recognition of a knowledge need and the information source(s) involved in a knowledge management episode (like in the first study), but even more on the specifics involved in the knowledge management episode. Instead of getting a broad view of information seeking behaviour for gaining knowledge, now the aim is to get insight into details of self-directed learning behaviour. More facets of the behaviour will be investigated; learning patterns and bottlenecks are two examples of aspects addressed in this study. The insight gained from this study is used to answer question B as formulated in Chapter 1.
Before specifying the research questions of this study, it is necessary to shed light on the theoretical framework used. This framework centres on practices and patterns that occur in self-directed learning, see section 3.1. In section 3.2 the research questions are described. In section 3.3 the research design is described and in section 3.4 the results are presented. This chapter ends with a summary and conclusion in section 3.5.

3.1 Identifying learning patterns and practices

Several psychological and educational scientists have studied self-directed learning and learning strategies. The first empirical studies of informal learning activities of adults date back to the 1960s (U.S. national survey), although first significant empirical research concerning adults' self-directed learning projects started in the 1970s, inspired by Knowles and pioneered by Tough (Livingstone, 2001). Still, it was only since the 1990s that this subject gained more attention. Currently, self-directed learning is still a prominent focus of research (Montalvo & Torres, 2004), for example, the studies of Candy (2004) and Schmidt and Braun (2006), described in Chapter 1, illustrate the more recent interest is this research area.

[14] This study was conducted in the project APOSDLE, a 6th framework programme for R&D of the EU. This chapter does not cover all results from the study. The reference of the orgininal report is: Hoog, R. de, Kooken, J.P., Ley, T., & Maiden, N. (2006). Workplace learning study. Deliverable EU APOSDLE project D2.1. Enschede: University of Twente. The study was also published as an article: Jose Kooken, Tobias Ley, Robert de Hoog (2007). How do people learn at the Workplace? Investigating Four Workplace Learning Assumptions. E. Duval, R. Klamma, M. Wolpers (Eds), Creating New Learning Experiences on a Global Scale. Springer, Lecture Notes on Computer Science 4753, p.158-171.

Burns (1995) conducted a study to identify the most useful and differentiating characteristics which enable salespeople to acquire and apply knowledge in both job and training situations. This study showed that self-directed learning was closely linked to two co-dependent dimensions of individual preferences: learning attitude and problem solving orientation. Holman, Epitropaki and Fernie (2001) tested a six factor model for cognitive and behavioural learning strategies that adults use in a work context. Their study shows that adults use similar learning strategies at work as they do in educational settings. However, a limitation of their research, which they mention themselves, is that it relies on self-report questionnaire-based measures only. The authors suggest broadening the methodological scope to include, among others, in-depth qualitative interviewing and observations.

Up till now, most research about self-directed learning is conducted in educational settings, from preschool till postgraduate levels. Learning strategies have also almost never been systematically measured in work-related research either (Warr, Allan, & Bidi, 1999). Livingstone (2001, p. 20) describes the current situation as follows: *"In light of conceptual confusion, varied measures and the very limited amount of comparative data, researchers' knowledge of the extent, processes, content, outcomes and trends of adults' informal learning and training remains very crude. The extensive empirical work on self-directed learning in the 1970s has led to very little cumulative development of understanding of the phenomenon of informal learning to date. Researchers keep rediscovering portions of informal learning anew with little effort to date to replicate earlier discoveries."*

Therefore, more needs to be known about current self-directed learning practices, especially learning patterns used in self-directed learning. Identifying learning practices and patterns is not the same as determining learning strategies. Patterns are seen as schemes, models and practices and can be described as (sequences of) actions. Instead, learning strategies are described as thoughts and behaviours engaged in by the learner in order to achieve certain goals or purposes (Olgren, 2000), that is, they are the goal directed interpretations of actions. Learning patterns can provide clues for the behavioural part of learning strategies, as they focus on the practices people use to aid the acquisition and development of knowledge. In their definition of learning strategies, Holman, Epitropaki and Fernie (2001) focus on the practices, although they also discern a behavioural and a cognitive part. In this dissertation the focus is on behaviour and not on cognitive processes, see Chapter 1. As our knowledge about these self-directed learning patterns and practices is limited, identifying learning patterns used in self directed learning is seen as an essential part of increasing our knowledge about learning strategies.

Summarizing, we can say that the topic of self-directed learning has been studied before, but there is considerable room for additional research that focuses on identifying how learning patterns and practices actually occur in the workplace.

3.2 Investigating learning patterns in self-directed learning

In general, the study is focused on obtaining data concerning actual self-directed learning behaviour of people at their workplaces. It focuses on the specifics of the knowledge management episode. In this study, a knowledge management episode is called a “learning event”. Using the term knowledge management episode could be associated with focusing on managerial influence or looking at the subject from the point of view of a manager. However, this is not the case in this study. In order to prevent any confusion and to strengthen the focus on the individuals’ point of view on the subject, the term “learning event” is used. A learning event is a moment during work when a knowledge worker starts to search for information having a high likelihood of future (re)use. The aim is to understand self-directed learning patterns and practices of knowledge workers during a learning event.
The main research question for this study is a modified version of research question B from Chapter 1:

> *What are the self-directed learning patterns and practices of knowledge workers at work regarding the use of information sources and media they use to gain knowledge?*

The main research question of this chapter mentions patterns and practices. To answer this research question, first learning patterns have to be investigated. In this study, a learning pattern is defined as a time ordered structure of activities consisting of a trigger, a solution type and communication media used during a learning event. A trigger refers to the trigger of a knowledge need, which can be the task, interest or coincidence. Solution type refers to the kind of solution that is attempted, which can be personal help seeking, seeking help from written material and practical application. Communication media refer to the communication media used when accessing a solution. This can be talking with someone face-to-face, using a paper based medium or using a digital medium.

3.2.1 Practices and problems during self-directed learning: knowledge type, success, bottlenecks and location

In this study, practices of self-directed learning refer to four aspects that are taken into account. As mentioned in Chapter 1, knowledge workers can search for different types of knowledge. Based on Merrill’s Component Display Theory (Merrill, 1983; see also Appendix 1) three types of knowledge are discerned: facts, concepts and procedures. The accompanying sub question is:

> *What type of knowledge is searched for?*

Knowledge workers can experience problems while searching for knowledge. For example, as described above in section 2.1, the Feldman and Sherman study (2003) showed that gaining the accessible knowledge is not unproblematic. The next two sub questions are related to this notion that bottlenecks are often encountered and that therefore efforts may not always be successful:

How successful are learning events?

In addition, not only the successfulness of learning events but also the experienced bottlenecks are of interest. These bottlenecks give more insight into the reasons for success or failure of learning events.

Which bottlenecks are encountered during learning events?

Holsapple (2005) states that modern knowledge management is inseparable and enriched by advances in computer-based technology. Furthermore, Barnett (1999) argues that one of the reasons that learning nowadays is embedded in work is the information technology revolution and the new forms of communication it makes possible. Simons, Germans and Ruijters (2003) confirm this when they state that as an increasing number of people are working with computers, their learning will take place integrated in their computer-work. Moreover, the electronic highway brings all kinds of new opportunities for learning and networking. Thus, the role the computer-based workplace plays in self-directed learning seems to be important. However, knowledge workers do not work exclusively behind a pc. Therefore the next sub question is:

At which work locations do learning events take place?

In addition, the relation between learning patterns and these learning practices aspects is something to look at. Learning patterns can depend on or have an influence on these learning practices aspects described above. For example, if someone encounters a bottleneck when using a certain communication media, he can decide to use another communication medium. This can results in another sequence length of activities of which a learning pattern consists. Therefore, the next sub question is:

Are there differences in self-directed learning patterns and practices related to the searched knowledge type, the success of a learning event, the frequency of bottlenecks encountered in learning events and the locations of learning events?

3.2.2 Social context: comparing learners, experts and groups

In addition to the learning practices aspects and work context aspects, social context can be important in shaping self-directed learning patterns. This refers to the specific social role a person is in at the moment the learning event takes place. Research shows that explaining in itself is an activity from which someone can learn. For example, Weinberger et al. (2005) refer to the socio-cognitive perspective in collaborative learning that claims that learners construct knowledge by actively participating in discussion and sharing knowledge with their learning partners when they are working in small groups. In addition, in the field of workplace leaning and as described in Chapter 1, Gerber (1998) found that workers learn by interacting with others, Marsick and Volpe (1999) stress that informal learning is linked to the learning of others and Eraut's (2007) classification of self-directed learning in early career learning mentions learning from group participation and giving feedback. Moreover, during a working day, it is very likely that a learner is consulted for his knowledge (as being an expert) or participates in a group. Although the main focus in this study is on the individual who is in need of knowledge, three different social roles at the workplace are discerned: learners, experts and groups. In case of a learner, the person who has the knowledge need is the focus; he wants to learn something to satisfy his knowledge need. In case of an expert, someone who is expected to possess the knowledge searched for and who can be consulted by learners is the focus. In case of a group, the focus is on a group of knowledge workers; in this setting learners and knowledge workers are present and knowledge workers can change roles. By comparing the learning behaviour in these three social contexts, a more comprehensive view on self-directed learning behaviour can be obtained. Therefore, the last sub question is:

> *Are there differences in self-directed learning behaviour between learners, experts and groups?*

3.2.3 Work context: influence of company size, experience in job and type of knowledge work

The main research question of this dissertation (A), addresses influences of organisational context and individual characteristics of knowledge workers on practices and preferences. In addition, Chapter 2 results showed that source usage of police men was affected by several work context aspects like duration of employment and, size of a location where police men work. In this study duration of employment in current function is taken into account. When new in a function, new tasks may have to be performed, which may change information and knowledge needs which could affect source usage. In the same Chapter 2 study it was found that the use of PKN differed for different police corps and size of the corps. For example, the larger

the corps, the less they used PKN. Carlson and Davis (1998) found that the media selections of managers and directors differ as they look at different criteria. A study by Leckie, Pettigrew and Sylvain (1996) showed that there are differences in the information seeking behaviour of, for example, different health care professionals such as nurses and physicians. Instead of looking at different functions as Carlson and Davis (1998) and Leckie, Pettigrew and Sylvain (1996) did, it is also possible to look at the type of knowledge work someone is performing. As the aim is to expand findings to knowledge workers of several European organizations, looking at specific functions is not possible. Instead, looking at functions at the more abstract level of type of knowledge work is feasible. Three types of knowledge work can be discerned (Lekanne Deprez, 2004[15]): developing new knowledge, passing on knowledge to others and applying knowledge. The following sub questions investigate the influence of these work context aspects:

Is self-directed learning behaviour affected by the size of the company where knowledge workers work?

Is self-directed learning behaviour affected by the number of years knowledge workers work in their current function?

Is self-directed learning behaviour affected by the type of knowledge work knowledge workers perform?

3.3 Design of the Study

This study consisted of two phases. Collecting detailed data about self-directed learning and its specifics in four organizations was carried out in Phase 1 of the study. These four organizations were involved in the EU project in which this study was conducted. The findings from this phase provided an in-depth insight into self-directed learning practices in a limited number of organizations. In order to obtain a more general insight, the objective of Phase 2 was to verify and generalize outcomes of Phase 1. To investigate this, knowledge workers from a larger sample of European organizations were involved.

3.3.1 Investigating self-directed learning of a limited group of knowledge workers

From previous research (see, for example, Holman, Epitropaki, & Fernie, 2001) it became clear that investigating self-directed learning in terms of actual behaviour

[15] In his article, Lekanne Deprez composed this typology using the following source: CBS (2004). Kennis en Economie 2003. Onderzoek en innovatie in Nederland. Voorburg/Heerlen: CBS

requires a variety of data collection methods that allow for data collected at different times and places in order to prevent a blinkered view on what actually happens.
The multi-method data collection approach for this study consisted of five methods that were used:

1. Workplace observations: collecting objective data about actual self-directed learning behaviour in a limited time span;
2. Interviews: collecting opinions and self reports about self-directed learning behaviour based on recollection of memories;
3. Simulations: replay of self-directed learning situations from the past if observations are not sufficiently rich or abundant;
4. Online diaries: self recording of self-directed learning behaviour over a longer time span than can be achieved with observations by using an online diary;
5. (Online) Questionnaire based survey: an online questionnaire containing the most important outcomes of the first four methods and aiming to collect data to verify these results.

The first four methods were used in Phase 1 of the study. The fifth one, the online survey, was used in Phase 2. In section 3.3.2 the research design of Phase 2 is described. Because organizations from the private, as well as from the public sector were involved and because the methods were distributed over time, work and people, generalization of the results in a wider range of contexts is possible.
In Phase 1 data collection was carried out in four organizations. These organizations represented different types of environments: two large private corporations, a public organization and a network of small and medium enterprises. In the following sections (3.3.1.1-3.3.1.5), the methods that were used in Phase 1 are described. The focus of Phase 1 was to collect data about learning patterns, bottlenecks, successes and failure of learning effort, the types of knowledge people acquire and if there are differences in self-directed learning behaviour based on the social context. In Phase 2, in addition to most of these topics, the work context aspect was taken into account too.

3.3.1.1 Time frame

The preparation of the observations, interviews and simulations started in the second week of March 2006. The actual data collection started early April 2006 and lasted till the end of June. In planning the first part of the study, several data collection contexts (places to observe, interview and perform simulations) were created. The emphasis was on creating a data collection context of actual workplaces that provide a high probability of observing self-directed learning at the workplace as the objective of the study was not on obtaining data about the relative frequency of the occurrence of learning events.

3.3.1.2 Goals and requirements for each method

Each method used in this study has its own goal and each method requires different conditions. The goals and requirements of each method used in Phase 1 are briefly described below.

Observations

- *Overall goal:* collecting objective data about actual learning in the workplace
- *Time span:* limited, two or three days for each organisation
- *Location:* computer-based workplaces, non computer-based workplaces, meeting room and workplaces outside the office
- *Persons:* six employees (knowledge workers) of each organisation; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles:* emphasis on the role as a learner and also (if this occurs during observation) on the role as an expert

Interviews learners

- *Overall goal:* collecting opinions and self reports about behaviour based on recollection of memories about experienced learning in the workplace
- *Time span:* limited, two or three days for each organisation
- *Location:* computer-based workplaces, non computer-based workplaces and workplaces outside the office
- *Persons:* four to six employees of each organisation; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles:* emphasis on the role as a learner
- *To focus on:* Interviewees are asked to remember three to four learning events[16] and for each moment questions will be asked

Interviews experts

- *Overall goal:* collecting opinions and self reports about behaviour based on recollection of memories about being consulted as an expert in the workplace
- *Time span:* limited, two or three days for each organisation
- *Location:* computer-based workplaces, non computer-based workplaces and workplaces outside the office
- *Persons:* depending on the observed number of employees of the organisations that act as expert; vary as much as possible in the tasks, functions and experience levels of the participants

[16] When the knowledge worker also played the role of an expert during the observations, he was asked to remember one or two learning events.

- *Roles:* emphasis on the role as expert
- *To focus on:* Interviewees are asked to remember one or two moments/ events where they were consulted as an expert and for each moment/ event questions will be asked

Simulation with learners

- *Overall goal:* replay with a single participant situations from the past if observations are not sufficiently rich or abundant to get an impression of learning at a computer-based workplace
- *Time span:* limited, two or three days for each organisation
- *Location:* computer-based workplace
- *Persons:* four employees of each organisation; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles:* emphasis on the role as a learner

Diary study learners

- *Overall goal:* self recording of actual learning activities in the workplace over a longer time span than can be achieved with observations
- *Time span:* six weeks, selected persons are asked to keep diaries for specific days in the week
- *Location:* computer-based workplaces, non computer-based workplaces and workplaces outside the office
- *Persons:* six employees of each organisation; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles:* the role as a learner

3.3.1.3 Participants

In Appendix 1 a definition of a workplace is provided, but only for its nature, not the details needed for data collection. In preparation for this, all organizations involved (because they are part of the EU project) received an e-mail with requirements for the selection of locations, times and participating employees. As they know their organization best, they were asked to select the locations, employees, situations and times that fit best the requirements of the study. No specific attention was given to the knowledge domain of the participants, since the focus was not on the content of what is learned but on the learning patterns and practices. Except for the employees for the observations and interviews (because the interviews will occur immediately after the observations), an employee only participated in one method. In the selection of employees there was as much variation as possible in tasks, functions and levels of experience.

3.3.1.4 Procedure

Before the start of the study, the organizations were visited in March 2006 to get an impression of the workplaces and opportunities for observation. For the observations, interviews and simulations, 2-3 day visits to each organisation were organized. The purpose of the visit was deliberately not told, to avoid an effect (a bias) on the usual behaviour of the employees. It was advised to inform the employees that the purpose of the visit was "observing information use at the workplace".

The data collection consisted of sessions that lasted approximately 60 to 105 minutes, depending on the number of methods involved. Observations at the workplace lasted 60 minutes and were followed by an interview, which lasted 45 minutes, or a simulation that lasted approximately 20 minutes. Depending on the type of workplace (computer-based, not computer-based, meeting room, outside the office) one (the observation) or two (observation and interview) of the methods were used; in case of a meeting or workplace outside the office not all observed persons were interviewed, although at least one observed person was interviewed at all times.

During an observation, the participant had to carry out his normal work activities and had to pretend there was no observer present, while the observer sat nearby the employee making notes about the behaviour. If something was unclear for the researcher, a short question had to be asked. The results of these observations were brief descriptions of the observed behaviour of the participants, especially self-directed learning behaviour.

For the interview, a schema was used which contained the questions for a learner and an expert interview. The answers of the participants were noted down by the observer.

For the simulation the protocol was to ask the participant to remember a learning event and replay it while the researcher observes the behaviour and take notes. The results were descriptions of the simulated behaviour of the participants, as explained and performed by the participants. The data collected during observations, interviews and simulations was verified by the researchers to see if it involved a knowledge need or not. This was done by using the definitions of knowledge and information as presented in Chapter 1. Only if it involved a knowledge need it was classified as a learning event.

As data collection using diaries is rather different from the other methods, more details are provided below.

The time-span of the diary study was six weeks between mid May and the end of June 2006. Participants were asked to report (un)successful personal learning events that take place in their work context. It was stressed that unsuccessful learning events could also be reported, because the amount of time that people spend in learning processes is not necessarily positively correlated with successful learning outcomes (Livingstone, 2001). Therefore, a participant could report about three types of learning events: successful and task triggered, successful and coincidental, and unsuccessful learning events. Key features of attention were different aspects of self-directed learning: what triggers a learning event, what is the intended goal or knowledge need that had to be

met, how learning takes place, which resources are consulted, bottlenecks, and so on. To report learning events, Eureka Reports, a type of diary study that focuses on recording learning events in everyday work, were used as a starting point for the design of a diary in this study (Rieman, 1996). The original Eureka Report was adjusted to the specific goals of this study by adding questions and changing the lay-out. The report contained questions related to the key features of attention mentioned above. Some answers were already pre-defined, but most questions were open-ended. Although it probably would have been simpler or less time consuming for the participants to answer the questions with pre-defined answers, open-ended questions offered participants the possibility to use their own terminology. Moreover, it was impossible to describe all situations that can occur in advance.

The organisations decided on suitable participants from their organizations, based on the request to find knowledge workers that spend at least 60% of their working time at a computer-based workplace. The preferred number of participants was six participants per organisation.

The Eureka Report is accessible through a webpage. Each participant received a personalized link to the website by e-mail. This way every participant had an unique ID and the participants did not have to log in or fill in questions about their name, the date and time. See Figure 3.1 for a screen shot of the first part of the Eureka Report. To reduce the burden for the participants, they were asked to fill in the Eureka Reports only a few (work) days a week. These days varied for each participant: some had to do it on Mondays, Wednesdays and Thursdays, others on Tuesdays, Wednesdays and Fridays or Mondays, Wednesdays and Fridays, and so forth.

Figure 3.1
Screen shot of
the Eureka Report

As the mother tongue of the participants was not the English language and because it was preferred by the organisations, the Eureka Report was also available in German. After all, it is easier to express oneself in one's own language. Participants were instructed by e-mail about the goal of the study and when and how they had to fill in an Eureka Report. In addition, an instruction document was sent to the participants by mail before the start of the study. A help-document, which explained the questions and terms used in the Eureka Report, was also linked to the questions on the website. Furthermore, additional comments could be noted by the participants at the end of each Eureka Report.
Every week each participant received an overview of their number of submitted Eureka Reports. At the end of each reporting week, and in case of ambiguous or unclear answers, the investigator contacted the participant by phone. After the first week, the submitted Eureka Reports (if there were any) were discussed and the participants were asked if they experienced any problems. The participants could also ask for clarification about the reporting procedure, like questions as to what constituted a learning event.
Each collected Eureka Report was verified by the researchers to see if it described a learning event involving a knowledge need or not. This was done by using the definitions of knowledge and information as presented in Chapter 1.

3.3.2 Generalising the observed self-directed learning behaviour of learners

3.3.2.1 Method: workplace learning survey

The preparation of Phase 2 started in the last weeks of August 2006. The actual data collection started mid September 2006 and lasted till the beginning of November. The goal of the workplace learning survey was twofold: the first was to verify the most important outcomes related to the learner role found in the first phase. We focused on the learner role as results of Phase 1 showed that learning events related to the learner role occur more frequently than those related to the expert role. Because of this, it was expected that remembering details of a learning event related to the learner role was less biased by memory loss and would thus be more reliable.
Results of Phase 1 determined the final design of the survey. Therefore, in section 3.4.2.1 the design of the survey is described.

3.3.2.2 Sampling

It's known that sending questionnaires to organizations and/or people in organizations yield very low response rates, mostly below 1%. Faced with this problem, it was decided to opt for a kind of "snow balling" sample procedure that intends to maximize the response. This approach entailed that each organisation involved in Phase 1 got in touch with some of their contacts in different organizations (first step) and asked

them to find some suitable respondents (second step). This means that there could be a few contacts that delivered many participants, but there could also be many contacts that each delivered a few participants. It also meant 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 approached participants (not more than 33%) could come from the organizations involved in Phase 1, as long as these approached participants were not directly involved in Phase 1 of the study.
The aim of this two-step approach method was to capitalize on personal relations. By approaching the contacts of all organisations involved in Phase 1 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 spend at least 60% of their working time at a computer-based workplace, a workplace where a personal computer is present, which make sense as computer using workplaces are becoming more and more ubiquitous.

3.3.2.3 Procedure

The participants were approached via an e-mail that was sent by contacts of the organisations, which explained the goal of the survey briefly and subsequently asked the recipient for their participation. Through a link in this mail they were able to access the online survey anonymously. Once the participant started to fill in the survey, the data was automatically collected in a data repository.

3.4 Results

In this section the results of this study are described. First the results from Phase 1 of the study (section 3.4.1), followed by the results of Phase 2 (section 3.4.2). Finally, results from both phases are compared (section 3.5).

3.4.1 Identifying self-directed learning behaviour

This section describes the results of Phase 1: collecting self-directed learning data in four organizations in order to identify self-directed learning behaviour of a limited group of knowledge workers. However, before reporting the results first the sample characteristics and data preparation are described in section 3.4.1.1. Subsequently,

in section 3.4.1.2 the results are described. Section 3.4.1.3 summarizes the finding of Phase 1.

3.4.1.1 Sample characteristics and data preparation

Participants

As mentioned before, one person could take part in more than one method, for example, in an observation and an interview. In the study 46 different persons participated. The 97 observation sessions, interview sessions, and/or simulation sessions were conducted, involving 41 different persons. Together 17 persons participated in the diary study and submitted Eureka Reports, of which 12 also participated in at least one of the other methods. This distribution of participants per organisation is shown in Table 3.1.

Table 3.1 Number of participants per method

Partner	Method			
	Observations	**Interviews**	**Simulations**	**Eureka Reports**
Organisation 1 public; chamber of industry and commerce -	22	9	1	6
Organisation 2 private; service and research company	5	6	0	1
Organisation 3 public; consultancy company	6	10	0	5
Organisation 4 private; research centre	8	8	0	5
Total	**41**	**33**	**1**	**17**

For observations, most observations were done at Organisation 1 and least at Organisation 2. This reflects the size of the organizations and the opportunities to observe. As part of the work in Organisation 4 was confidential, it was more difficult to find observation and interviewing locations. However, in the reported learning events in the diaries this was corrected. In addition, an equal distribution of participants over the Eureka Reports was achieved. Organisation 2 stands out with just one participant; however, looking at the relative size of Organisation 2 compared to the other three, it turned out to be difficult to find more persons fairly strongly bound to a computer-based workplace.

It should be mentioned that all collected data contained a larger number of observations, interviews, simulations and Eureka Reports. However, not all data

were usable, because it had to involve a knowledge need or because there was overlap in data, for example, if a diary entry of a person was similar to what was observed at the workplace of that person.

Coding and interrater agreement

The raw data (observation reports, answers to interview questions, diary entries) for the learning events were coded by two researchers from the University of Twente on 16 aspects. These aspects were, for example, basic personal or group characteristics, consulted sources (for example, who or what was consulted for finding the knowledge, like written material or a colleague), used media (e.g., what communication medium was used to contact a colleague, like email), type of learned knowledge (fact, procedure or concept), and if there were bottlenecks. After the raw data was coded by these two researchers, a third coder coded a subset of 50 (see Skalski, 2002) of the 175 learning events on the same 16 aspects. This was done to examine the reliability of the coding, that is, the interrater agreement was determined. This third coder was not involved in collecting the data. Cohen's Kappa, which is a suitable measure for mainly nominal data, was calculated (.807) which is good, so no changes to the original codings had to be made.

Learning events: the unit of analysis

To make the data collected comparable across different methods, we decided to take a "learning event" as the unit of analysis. Following the definition of learning in as given in Appendix 1, the key for an information seeking moment to be classified as a learning event is if a knowledge need drove it and that the intention of the knowledge worker was to (re)use the knowledge searched for. This criterion was used to separate information and knowledge needs: if knowledge was searched for, it was considered as the start of a learning event. This meant that collected events that turned out to be information need triggered, were excluded. In addition, this meant that if the knowledge was not or only partly found, it was still included as a learning event. To determine if information or knowledge was searched for the definitions of knowledge and information from Chapter 1 were used.

As one sub question addresses three social roles, namely that of learners, experts and groups, a distinction was made between learning events of individual learners, groups and experts. The learning events were therefore labelled as occurring in a *learner role*, in a *group setting* or an *expert role*. Learning events occurring in a learner role were all learning events in which a learner was observed or interviewed, or were taken from the Eureka Reports or simulations. Learning events related to an expert role were all learning events which were derived from interviews from persons in an expert role (that is, being approached by colleagues for help). Learning events occurring in group settings are learning events that occur at a departmental

meeting, a meeting with a customer or an internal meeting for customers which were observed. The size of the groups where learning events were observed varied from two to seven persons.
Data about 175 learning events (138 learner roles, 8 group settings and 29 expert roles) were collected. The data on the learning events were collected using Eureka Reports (71), observations (40), interviews (34) and simulations (1). The data for the expert roles were all obtained by interviews.
Because the data set for learner roles was largest (138 collected learning events refer to learner roles), they were used for nearly all analyses. The data of expert roles and groups settings were not used for all analyses as the data set was smaller (8 group settings and 29 expert roles) and therefore had limitations as to which analyses were meaningful. Whenever data from group settings and expert roles were included, this will be shown in the tables.

Sample characteristics
As mentioned in the section above, learning events were the unit of analysis; so we can describe the sample by describing the nature of these learning events. As for the sample characteristics it should be stated that as our unit of analysis was a learning event, not much was known about the population of the learning events. However, to obtain some insight into the characteristics of this population, some information about the sample of participants who generated the learning events can be described. The events were obtained by observing, interviewing and reporting knowledge workers in organizations. The selection procedure for these knowledge workers can be found in section 3.3.1.3 and the distribution over organisations and methods is described in Table 3.1. In addition to this, and the description of learning events in the next section, we only will present data about the gender of the participants as this was not part of the selection schema.
Table 3.2 shows that the overall ratio of men to women who were involved in learning events is 2 to 1, which means that more men than women were involved in learning events. Although the exact ratio in the organisations is not known, it seems that in most organizations men form the majority of the employees.

Table 3.2 Percentage of male and female participants involved in learning events (n=167, group role is not included)

Role	Male	Female
Learner role	67 %	33 %
Group setting	Na[17]	Na
Expert role	62 %	38 %
Total	**71 %**	**29 %**

[17] Na=not applicable (no data or not relevant).

This is reflected in Table 3.3 where the ratio of male and female participants involved in learning events per organisation is shown. Only at Organisation 1 an equal number of men and women were involved in learning events. We do not know whether this skewed distribution has any consequences for the results. We don't know of any studies that have reported women experiencing significantly different learning events. In any case, the number of women involved in learning events and the number of found learning events makes it likely that any "woman specific" learning event, if it exists, was captured.

Table 3.3 Percentage of male and female participants involved in learning events per organisation (n=167, group role is not included)

Role	Organisation	Male	Female
Learner role		67 %	33 %
	Organisation 1	50 %	50 %
	Organisation 2	78 %	22 %
	Organisation 3	58 %	42 %
	Organisation 4	75 %	25 %
Group setting		Na	Na
Expert role		62 %	38 %
	Organisation 1	17 %	83 %
	Organisation 2	86 %	14 %
	Organisation 3	78 %	22 %
	Organisation 4	57 %	43 %
Total		**71 %**	**29 %**

As we could (and would) not control the submission of Eureka reports, checking the distribution over people and organisations makes sense. The number of Eureka Reports (ER) submitted per participant varied from none to 11. The average is 4 per participant (4.4). Looking at the submitted Eureka Reports per organisation, the distribution is as follows: Organisation 1: 11, Organisation 4: 38, Organisation 2: 7, and Organisation 3: 14, thus Organisation 4 submitted most. This can have an influence on the results, as almost half of the learning events were derived from their Eureka reports. However, this influence is not so easy to trace. It seems that the nature of the work at Organisation 4 is slightly different from that of the other organisations, being more research oriented

Summarizing, it can be said that as for the population of the learning events, it holds true that more men than women were involved in learning events and that participants from Organization 4 have submitted most Eureka Reports. We do not know for certain whether this skewed distribution has any consequences for the results.

3.4.1.2 Self-directed learning in four organisations

The main research question of this chapter addresses self-directed learning patterns and practices, in particular the use of information sources by knowledge workers for gaining knowledge. First, the found learning patterns are described in section 3.4.1.2.1. In this section the learning patterns are characterised by describing the triggers, solution type, used communication media and the structure of the found learning patterns. Subsequently, the sub questions are addressed. In section 3.4.1.2.2 the type of knowledge that is learned is described, in section 3.4.1.2.3 is described how successful the learner roles were, in section 3.4.1.2.4 the encountered bottlenecks are described and in section 3.4.1.2.5 the locations where the learning took place are described. In section 3.4.1.2.6 the relation between learning patterns and some learning practices aspects (knowledge type, success, location, frequency of bottlenecks) is investigated and described. In the last section of the Phase 1 part, the results are summarized (section 3.4.1.3). One sub question relates to social context in which three roles are discerned: learners, experts and groups. This sub question addresses results of several (sub) questions and thus sections. Throughout the results, if data is available and applicable, results per role are reported.

3.4.1.2.1 Learning patterns: trigger, solution type and used media

As the first research question of this study addresses the patterns people follow when attempting to learn something during their daily work, these patterns must be classified. As mentioned in section 3.1, patterns refer to schemes or models, suggesting patterns are structured abstractions of certain aspects of reality. A learning pattern, as an abstraction of a learning event, is defined as a time ordered structure consisting of a trigger, a solution type and communication media used. A learning pattern focuses on modelling the learning behaviour: what are people doing at the time the learning takes place (trigger of learning), how did they find the knowledge (solution type) and which type of communication medium is used (communication media).
These components of a learning pattern of a learning event thus are:

1) *Trigger*: the primary mover for the need to learn something
    - Task triggered learning (1): A person lacks certain knowledge to continue in a task.
    - Interest learning (2): A person intentionally looks for new knowledge, not because a task needs it, but because the person has a general interest in the topic that is related to the work in general.
    - Coincidental learning (3): A person accidentally discovers new knowledge when reviewing information sources or when talking to others.

2) *Solution type*: what kind of solution is attempted
    - Personal help seeking (1): Contacting a colleague for assistance.
    - Seeking help from written material (2): Looking for knowledge in digital or paper based documents
    - Practical application (3): Trying things out and discovering some new knowledge
3) *Communication media*: media that are used to communicate when searching for a solution
    - Face-to-face (1): for example, face-to-face meeting, telephone
    - Paper based medium (2): for example, letters or memos
    - Digital (3): for example, email, chat

It is important to note that there is an essential difference between solution type and communication media used. The first refers to the kind of solution where the knowledge seeker aims to obtain knowledge (the solution) from; it covers the way the knowledge is found. The second refers to the information channel (medium) that is used by the knowledge seeker to contact the source of this solution type. For example, a digital article (solution type 2) can be found by using the medium email (communication medium type 3); not the person that is emailed to obtain the article is seen as the solution but the document he makes available. This distinction between solution type and medium is made to clarify each step taken by the knowledge worker during his search for knowledge as precisely as possible. The numbers in the above list are used for the description of the learning patterns (see later on). For example, if the trigger is task triggered, the solution type was practical application and the used communication media was digital, the pattern is: 1(1) ->2(3)->3(3).
First we will present separate results for these learning pattern factors in section 3.4.1.2.1.1, which are also split for each of the organisations. Next in section 3.4.1.2.1.2, the learning patterns that were detected are described, followed by a description of the learning practices aspects (section 3.4.1.2.2-3.4.1.2.6).

3.4.1.2.1.1 Characterization of each learning pattern factor

Trigger: task triggered learning or not?
Most learner role events (75%) were task triggered, meaning that someone intended to learn something to continue the task they were performing, see Table 3.4. One out of four learner role events (25%) was coincidental. An example of coincidental learning is learning something during a coffee break, when talking to colleagues. All group settings and expert role learning events were task triggered. Interest driven learning did not occur.

Table 3.4 Percentage of task triggered and coincidental learning events (n=175)

Role	Task triggered	Coincidental
Learner role	75 %	25 %
Group setting	100 %	0 %
Expert role	100 %	0 %
Total	**80 %**	**20 %**

Solution type

When someone notices that his own knowledge isn't sufficient to continue to perform a work task, leading to a knowledge need, they can try different solution types to find the knowledge. In Table 3.5 an overview of these solutions types is given. Each type that was used in a learning event was counted and more types could be used in one learning event. Seeking help from written material is used most frequently (80%), in particular in group settings learning events (100%). Practical application, that is trying things out in practice, also doesn't occur relatively often (16%). In group settings however, paper sources are often consulted (50%).

Table 3.5 Solution types involved in each of the learning events (n=146, expert roles are not included)

Role	Solution type		
	Personal help seeking	**Seeking help from written material**	**Practical application**
Learner role	70%	80%	16%
Group setting	100%	100%	0%
Expert role	Na	Na	Na
Total	**42%**	**48%**	**9%**

Knowing what solution types people used in their attempt to find the knowledge they needed is only one aspect of a learning pattern. The used communication medium is another aspect investigated.

Used communication media

The communication media used when finding a solution were categorized in three groups: face-to-face, paper and digital, each with different instances. In the first study at the Dutch Police force, the same classification was used for source types (in that study however, no distinction between solution type and communication medium was made). Face-to-face media include direct contact with persons, like a conversation with a colleague or a phone call. Paper media includes letters or memos and digital media refer to e-mail and chat programs. More than one communication medium could be used in one learning event.

When looking at the used communication media in learning events (see Table 3.6), the frequency of face-to-face and digital media usage is equal in learner role events (68%). Face-to-face is used in group settings events only (100%). Experts mentioned more digital media (83%) use than the learners. Paper media is used relatively the most by learners (20%), although experts mention to rarely use them too (7%). Results show furthermore that in case of seeking help from written material, digital material like the internet, intranet or PDF-articles are used most (73%). Paper based written material, like books, prints or magazines, play a less important role. Personal help seeking, like approaching colleagues or clients, is also used frequently (70%), also in group settings learning events (100%).

Table 3.6 Communication medium used in learning events (n=175)

Role	**Communication medium**		
	Face-to-face	**Paper**	**Digital**
Learner role	68 %	20 %	68 %
Group setting	100 %	0 %	0 %
Expert role	100 %	7 %	83 %
Total	**75 %**	**17 %**	**68 %**

The three components of a learning pattern are described above. The next section deals with the structure of learning patterns.

3.4.1.2.1.2 Structure of learning patterns

Using the three components (trigger, solution type and communication medium), every learning event can be described in a structured way. When this is done, one can identify more and less frequent patterns, giving an indication about which behavioural sequences dominate self-directed learning.
Every learning pattern has *one and only one* trigger, but can consist of any sequence of solution type-communication medium combinations. For example, a learning event that starts with a task triggered learning need and in which a colleague is consulted by means of face-to-face contact, is coded as 1 ->1(1) (see for codes section 3.4.1.2.1). If in that same learning event after consulting a colleague also a written digital source is consulted, the coding is 1->1(1) ->2(3).
Of the 175 learning events, 140 (80%) are task triggered and 35 (20%) are triggered by coincidence all of them in learner roles. None of the events is triggered by interest.

In the list below the frequency of the pattern types for coincidental learning events is shown (note that the first symbol is deleted as it is always 3):

- 17 times the pattern 1(1)
- 12 times a patterns that consist of some sequence of solution type 1 (personal help seeking) and/or 2 (consulting written material)
- 5 times the pattern 2(3)
- once the pattern 1(1) -> 3(3)

As can be seen from this list, the majority has the pattern “personal help seeking->face-to-face”, followed by “seeking help from written material->digital”. These two patterns are considered key patterns for coincidental learning. Other patterns are less frequent, in particular patterns that consist of a sequence of more than 2 solution types, or combinations with both of the two key patterns.

For *task triggered learning events in learner roles* alone, the list looks as follows (note that the first symbol is deleted as it is always 1):

- 25 times the pattern 2(3)
- 23 times the pattern 1(1)
- 17 times some sequence consisting of solution type 1 (personal help seeking) and solution type 2 (consulting written material), for example, 1(1)->2(3)
- 8 times some sequence consisting of four patterns consisting of at least once the pattern 2(3) or 1(1), for example, 2(3)->2(3)->1(1)->2(2)
- 7 times the pattern 2(2)
- 6 times some sequence consisting of twice solution type 2 (consulting written material) and once solution type 1 (personal help seeking), for example, 2(3)->2(3)->1(1)
- 4 times some sequence consisting of solution type 1 (personal help seeking) and solution type 3 (practical application), for example, 1(3)->3(3)
- 4 times some sequence of the patterns 2(3) and 3(3)
- 4 times some sequence consisting of twice solution type 1 (personal help seeking) and once solution type 2 (consulting written material), for example, 2(3)->1(1->1(3)
- 3 times some sequence consisting of twice solution type 2 (consulting written material) for example, 2(3)->2(3)
- 3 times some sequence consisting of three times solution type 2 (consulting written material), for example, 2(2)->2(3)->2(3)
- 3 times some sequence consisting of the patterns 1(1), 2(3) and 3(3)
- 2 some sequence consisting of the patterns 1(1), 1(3) and 3(3)
- 2 times the pattern 3(3)

- once the pattern 1(1)->1(1)
- once the patterns 2(3)->2(2)->3(3)
- once the pattern 1(3)
- once the pattern 2(3)->1(3)->2(3)->2(3)->3(3)->2(3)
- once the pattern 1(1)->2(3)->2(3)->2(2)->1(3)->2(3)->1(1)->1(3)

Again the patterns “seeking help from written material->digital” followed by “personal help seeking->face-to-face” are important key patterns, but less so as in coincidental learning. There is more variation in the combination of patterns. The patterns 1(1) and 2(3) are key ones as they are often either exclusively used or in combination with other patterns. Also one step patterns form half of the patterns found (50%), though there are also several plural step patterns.
For the expert role learning events, which were all task triggered, the distribution was (note that the first symbol is deleted as it is always 1):

- 28 times the pattern 1(1)
- 13 times the pattern 1(3)
- 6 times some sequence consisting of solution type 1 (personal help seeking) and solution type 2 (consulting written material), for example, 1(1)->2(3)
- 5 times the pattern 2(3)
- 3 times some sequence consisting of twice solution type 1 (personal help seeking) and once solution type 2 (consulting written material), for example,1(3)->2(3)->1(1)
- 2 times some sequence consisting of twice solution type 1 (personal help seeking), for example, 1(1)->1(3)
- 2 times some sequence consisting of three times solution type 1 (personal help seeking), for example, 1(1)->1(3)->1(1)
- once the pattern 1(1)->3(3)
- once the pattern 3(3)
- once the pattern 2(2)

For expert role learning events holds true that the pattern “personal help seeking->face-to-face” is distinctive, as it is the pattern that is used most, either exclusively or in combination with other patterns. Since few data were collected about group learning, no key patterns for this type of self-directed learning were found.

Summarizing the found patterns, the key patterns for coincidental and task triggered learning are quite similar: they all involve face-to-face personal help seeking and seeking help from digital written material. For the expert, role face-to-face personal help seeking is characteristic.

Looking at these patterns, one may notice a difference between the total number of learner and expert role related learning events and learner and expert role related patterns in learning events. During the interviews, experts and learners described learning events based on their recollection of memories about experienced learning in the workplace. As it turned out, the learning patterns involved were sometimes not unambiguous; in those cases learners, and especially experts, reported more than one learning pattern related to the learning event. We decided to take all reported learning patterns related to one learning event into account. This results in a difference between the total number of learner role related learning events (138) and learner role related patterns in learning events (35 coincidental and 116 task driven=151). The same holds true for expert role related learning events (29) and expert role related patterns in learning events (62).

3.4.1.2.2 What was sought or learned: knowledge type

The first sub question of this chapter addresses the type of knowledge that is learned during a learning event. The learning that was observed and reported covered a wide variety of topics. A rather straightforward example is learning how to handle spreadsheet columns in MS Excel, a more complex one is learning about the features of the engine of an airplane allowing more efficient assembling and maintenance.
As mentioned before, three more general types of knowledge were discerned: facts, procedures and concepts, see Table 3.7. A concept is the type of knowledge that was learned most frequently, especially in group settings (63%) and learner roles (43%), but all three types are present in substantial amounts. Experts, however, mentioned procedure as the type of knowledge they were consulted for most (45%). Learning of procedures occurred more often in learner roles (29%) than in group settings (13%).

Table 3.7 Type of knowledge acquired in the learning events (n=175)

Role	**Knowledge type**		
	Fact	**Procedure**	**Concept**
Learner role	28%	29%	43%
Group setting	25%	13%	63%
Expert role	21%	45%	35%
Total	**27%**	**31%**	**42%**

3.4.1.2.3 Successfulness of learning events

The second sub question relates to the successfulness of learning events. The question is how successful the efforts of knowledge workers that wanted to gain knowledge were. Proportionately many learner roles (72%) and group settings (63%) are successful, that is, the needed knowledge is found, which indicates that

mostly people learn what they wanted to learn (see Table 3.8). There were also some learning events (15%) that weren't finished at the time the observation/reporting took place. It didn't occur frequently that learner role learning was postponed (6%) or failed (7%).

Table 3.8 Percentage of successful learning events (n=146, expert roles are not included)

Role	Successfulness			
	Successful	**Failed**	**Not finished yet**	**Postponed**
Learner role	72 %	7 %	15 %	6 %
Group setting	63 %	0 %	38 %	0 %
Expert role	Na	Na	Na	Na
Total	**71 %**	**7 %**	**16 %**	**6 %**

3.4.1.2.4 Problems encountered: bottlenecks

Even though a learning event was successful, there could have been difficulties (bottlenecks) that influenced the learning event in a negative way. This is why the third sub question deals with the bottlenecks encountered during learning events. In total 76 learning events (43%), out of the 175 learning events, involved one or more bottlenecks. In absolute numbers most bottlenecks occurred in learner role events, simply because the majority of learning events are situated in a learner role. In terms of learning events with and without bottlenecks, expert roles are proportionally more bottleneck prone (72% with a bottleneck) than learner (48%) and group settings events (13%), see Table 3.9.

Table 3.9 Percentage of learning events with and without one or more bottlenecks (n=175)

Role	Bottleneck	
	Yes %	**No %**
Learner role	48	53
Group setting	13	88
Expert role	72	28

After determining that one or more bottlenecks occurred in a learning event, a more detailed analysis of the bottlenecks was conducted. All the bottlenecks were categorized and the frequency per category was recorded. No group settings bottlenecks remained; the bottlenecks that remained were too incidental and out of the scope of the study[18]. In total 147 bottlenecks remained, distributed as follows: 106 bottlenecks for the learner role events and 41 bottlenecks for the expert role events. The bottlenecks that occurred most frequently in learner role events, that is, more than three times, are shown in Table 3.10. Most problems seem to be related to

[18] The found bottlenecks in the group setting were seen as too incidental, for example, "Construction noise from outside the room disturbs the concentration for a moment."

information: there is too much information, the information is not sufficient to solve the problem or no information is available. Problems also occur often when people search for information: it is unclear what has to be found, what is important to know or where the information can be found. Not having sufficient time to learn is also a problem that is mentioned frequently.
All the bottlenecks in the expert role events are shown in Table 3.11. Similar to the learner role events, time is also often a bottleneck: not having enough time to help is mentioned most frequently. Lacking the knowledge or experience to help is also mentioned often. Not being able to remember something or communicating with other departments are also bottlenecks mentioned sometimes.

Table 3.10 Bottlenecks participants experienced most often during learning events in learner role events

Category	Description	Frequencies learner role
Personal help seeking	• Can't reach colleagues to help.	5
	• Colleagues can't help (for example, because of the specific nature of the question(s).)	6
	• Can't reach colleagues to help.	5
Information problems	• The information is too specific for immediate use.	5
	• Too much information (for example: needs to filter it to find the information looked-for, which costs time.)	7
	• The information is not sufficient to solve the problem.	8
	• No information is available.	7
Search problems	• Don't knowing exactly what it is you're looking for.	7
	• Don't knowing exactly what it is important to know.	4
	• Don't knowing exactly where to look for the information.	6
"Opportunity" problems	• Not having enough time to learn.	7
	• Not having access to all information.	5
Media problems	• Lack of a supporting (KM/learning) system.	3
	• Doesn't like certain characteristics of a medium (more general than 21).	4
Internal sources	• Clear rules about knowledge storage are missing.	2

Table 3.11 Bottlenecks participants experienced most often during learning events in expert role events

Description	Frequencies expert role
The question isn't formulated clearly.	1
Not having time to help.	9
Not able to help.	2
Not able to remember it.	4
Communicating with other departments is difficult.	2
Not knowing if you it is your responsibility to help someone.	1
Lacking (domain) knowledge/experience.	7
Being a perfectionist. (And thus spend much time in making your assistance perfect).	1
Presenting what you say in an understandable way.	2
Language problems with foreigners.	1
Organization of internal communication.	1

3.4.1.2.5 Locations of learning during work

As the fourth sub question addresses the location where the learning events take place, this was investigated at the four organisations. It is important to note that these results can be biased as many learning events (41%) were collected via Eureka Reports in the diary study and in order to fill in an Eureka Report a computer-based workplace was needed. Therefore, the computer-based workplaces can be overrepresented. Most recorded learner role events (68%) took place at computer-based workplaces and far fewer (4%) took place at workplaces without a computer, see Table 3.12. Group settings often occurred in a meeting room (75%), this could be a separate room or an office were people gathered to meet. Some learner roles events (12%) took place outside the office, for example, at customer sites.

Table 3.12 Locations in which learning events were experienced (n=175)

Role	Location			
	Computer-based	**Not computer-based**	**Meeting (room)**	**Outside the office**
Learner role	68%	4%	16%	12%
Group setting	13%	0%	75%	13%
Expert role	48%	35%	17%	0%
Total	**62%**	**9%**	**19%**	**10%**

3.4.1.2.6 Analysing learning patterns in more detail: relations with context variables

The fifth sub question in this study addresses the relation between learning patterns and the aspects investigated in sub questions one to four. We shall call these context variables. For this, a variable that can capture the fundamental structure of a learning pattern is needed. Every learning pattern has one trigger and can consist of several solution types-communication medium combinations. As the results above in 3.4.1.2.1.2 show, independent of the trigger, the key patterns for coincidental and task triggered learning are quite similar. Therefore, for this analysis the structure of a learning pattern refers to the combinations of solution type-communication media. The variable chosen to capture this structure is the complexity of a learning pattern. Complexity is operationalised by sequence length.

Learning patterns consist of one trigger and n-tuple combinations of solution type-communication media. The sequence length of a learning pattern is defined as the number of those combinations; the more combinations, the longer the sequence of a learning pattern and the more complex it is. We will use this variable as the key one for characterizing learning patterns in the analysis. By looking at this variable, its relation with several other context variables is investigated to see if they affect the sequence length of a learning pattern.

The context variables included are:

- Success of the learning event
- Learned knowledge type(s)
- Location of learning event
- Frequency of bottlenecks associated with learning events

We will perform the analysis only on the learner events from the learner role data as they constitute the largest part of all events, making statistical analyses meaningful. The frequency of sequence lengths of the learning patterns is shown in Figure 3.2.

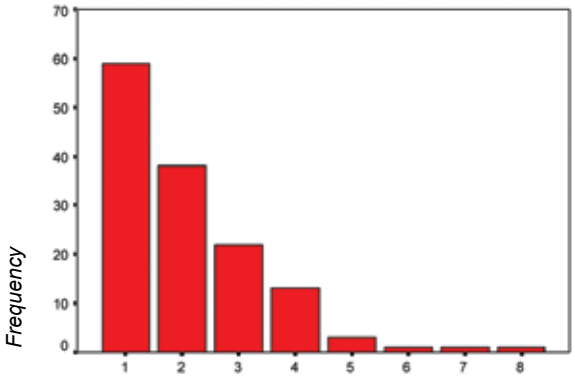


Figure 3.2 Frequency of sequence lengths of the learning patterns

From Figure 3.2 it can be seen that most learning patterns have a sequence length of 1 or 2. Longer patterns are rare. The results in section 3.4.1.2.1.2 also show this. The first issue is whether the success of a learning event is related to the sequence length of a learning pattern. As can be seen from Table 3.8, the distribution of the learning events outcomes types is skewed. Taking the four possible outcomes as the variable will not give meaningful results. A dichotomy (successful – unsuccessful) probably gives an improved (that is, more clear) overview. After dividing the learning events in 1) successful and 2) unsuccessful learning events the distribution is less skewed: 71% is successful and 29% isn't.

Intuitively one expects that short sequence patterns are more likely to lead to success, because failure in the first try will create the need to make other efforts. The average sequence of length is two (mean=2.09, SD=1.3) and 70% of all the learning patterns consist of one or two combinations. Learning patterns consisting of more than four combinations occur rarely.

By means of an analysis of variance[19] we can find out whether there is a significant difference in sequence length between successful learning events and unsuccessful learning events.

The analysis of variance yielded a significant effect ($F=2.493$, $p< .05$): shorter learning patterns are more successful.

The sequence length is related to the knowledge type that is learned ($F=3.676$, $p<.05$): learning facts has a significantly shorter sequence length than learning concepts.

The expectation is that the occurrence of bottlenecks will make the sequence length longer. The results of the variance analysis show that the occurrence of bottleneck indeed makes the sequence length longer ($F=20.328$, $p <.05$): when no bottlenecks occur, the average sequence length is 1.73, in contrast to a sequence length of 2.77 when bottlenecks occur.

The average sequence length for four different locations (computer-based, not computer-based, meeting, outside the office) where self-directed learning can take place is not affected by the location of the learning event ($F=2.193$, $p>.05$).

3.4.1.3 Summary of Phase 1 results

As mentioned in 2.1, the focus of Phase 1 was to collect data about learning patterns, bottlenecks, successes and failure of learning effort, the types of knowledge people acquire and if there are differences in self-directed learning behaviour based on the learning context.

[19] As the distribution of sequence length is skewed the median is a better estimate of central tendency than the mean. This means that a monotone (MONANOVA) analysis of variance would have been better. Unfortunately we had no access to this method. In general however, in skewed distributions the mean underestimates the central tendency compared with the median. This leads to a lower likelihood of finding differences, thus staying at the safe side of making inferences. Post-hoc test is, if applicable, Tukey.

In this section the main results will be summarized and linked to the research questions. For the sub questions that address the social context (differences between learners, groups and experts) holds true that differences are reported in relation to the aspect discussed (that is, learning patterns, bottlenecks etc.). However, it should be noted that as the data set for learner roles is the largest, they were used for nearly all analyses. The analyses performed with the data for expert roles and groups settings is limited as these data sets are smaller, resulting in limitations on performing meaningful analyses.

Learning patterns

The main research question of this chapter addresses self-directed learning patterns of knowledge workers regarding the sources they use to gain knowledge. Results show that most learning events are task triggered and that coincidental learning only occurred in learner role learning events. No interest driven learning events were found. The solution type used most by learners is consulting written material, followed by personal help seeking and practical applications is used the least. For groups holds true that personal help seeking and seeking help from written material occurred in all learning events collected. The frequency of use of face-to-face and digital communication media in learner role events does not differ. Results show that paper based communication media are used the least in learner role learning events and expert role learning events. In expert role learning events face-to-face communication media are used most frequently and digital media follow.

For coincidental learning events, task triggered learning events in learner roles and expert role learning events, different learning patterns were found. However, after a closer analysis three key learning patterns remained, namely:

1. personal help seeking face-to-face,
2. seeking help from digital written material, and
3. patterns consisting of some sequence of personal help seeking and/or seeking help from written material.

The key patterns don't mention consulting paper based written material or practical application (trying things out), because when they appear, they occur often in combination with learning pattern 1 or 2 above. These used learning patterns partly match the factors of the model for cognitive and behavioural learning strategies of Holman, Epitropaki and Fernie. (2001). They found the following three behavioural learning strategies that adults use in a work environment: Personal help seeking, Written help seeking, and Practical application. The key learning patterns personal help seeking face-to-face and seeking help from digital written material are comparable with the two behavioural strategies Personal help seeking and Written help seeking found by Holman, Epitropaki and Fernie. (2001), but practical application is less present.

As shown by the key patterns, one or two step learning patterns dominate; most learning patterns found consist of one or two combinations of a solution type-used medium combination. The average sequence of length is also two.

Types of knowledge

The type of knowledge searched for is addressed in the first sub questions. The learning of facts, procedures and concepts are all present in learning events in substantial amounts, but concepts is the type of knowledge that was learned most frequently by learners and groups. Experts mention they are consulted most for explaining procedures.

Success and failure

The second sub question addresses the success of the efforts undertaken in learning events. In general, most learning events of learners and groups are successful, which indicates that people learn what they want to learn. For both learners and groups, learning events were sometimes not completed at the time the observation/ reporting took place.

Bottlenecks

The third sub question addresses the bottlenecks that are encountered during learning events. Not all learning events were problem-free: in 43% of the learning events bottlenecks were encountered. In learning events from expert roles, the likelihood of experiencing bottlenecks is even higher. In group settings however, bottlenecks occur not so frequently. Most problems that learners experience are related to inefficient providing of information or not being able to search information efficiently. The experts find it difficult when they lack the knowledge or experience to help. Learners and experts both mention frequently not having sufficient time to learn or help as a bottleneck.

Location

The location where learning events take place was also investigated as the fourth sub question addresses this aspect. Most learning of learners and experts occur at a computer-based workplace and fewer of the learner's learning occur at places outside the office. It is not surprising that groups learn most in meeting rooms. It is important to note that these results can be biased as many learning events were collected via Eureka Reports in the diary study and in order to fill in an Eureka Report a computer-based workplace was needed. Therefore, the computer-based workplaces can be overrepresented.

Relation with context variables

The fifth sub question addresses the question if the complexity of learning patterns is related to the searched knowledge type, the success of a learning event, the frequency of bottlenecks encountered in learning events and the locations of learning events. Analyses show that the sequence length (complexity) of a learning pattern is affected by the knowledge type that is learned and the occurrence of bottlenecks. Learning facts results in a shorter sequence length than learning concepts and the occurrence of a bottleneck makes the sequence length longer. Shorter learning patterns are more successful.

3.4.2 Expanding the view on self-directed learning behaviour

This section presents the results of Phase 2. The aim of Phase 2 is to obtain a more general insight into self-directed workplace leaning behaviour. This is done by verifying and generalizing important outcomes of Phase 1. As the design of the questionnaire was strongly influenced by the results of the Phase 1, this design is described first. Next the sample characteristics and the results are presented. A summary and conclusions section is also included. A comparison with the results of Phase 1 is deferred to the next section of this chapter.

3.4.2.1 Design of the questionnaire

The design of the survey questionnaire was driven by the principles listed below:

1. a rather brief questionnaire, because people who volunteer for answering mostly don't like long ones,
2. a preference for questions with closed answer categories which speeds up processing of the data,
3. to be administered through the Internet which allows easy and personal access for respondents,
4. focusing on the main points from Phase 1 that had to be and that can be validated in the survey. It should be noted that the questionnaire focuses not on collecting data on specific learning events, like Phase 1, but more on general learning experiences. In addition, the social context aspects are not taken into account as this was found to be difficult to investigate via an online questionnaire that has to be filled in by individual knowledge workers. Therefore, the main research question of this chapter that addresses self-directed learning patterns and practices regarding is investigated by looking at general triggers of learning, solution types used and communication media used. Also the sub questions that address type of knowledge searched for, experienced bottlenecks, location of learning and the effect of the work context aspects company size, years in current job and type of knowledge work on the practices and patterns are investigated on this level.

We will deal with each of these principles in turn.

Our initial aim was to limit the questionnaire to not more than two pages, but this came into conflict with point 4 above and also to a certain extent with point 2. In the end 25 questions were included, maybe more than optimal, but still within reasonable boundaries. We assumed that ease of access and answering by using an Internet version could compensate for the length. A pilot with the questionnaire showed that answering took on average 20 minutes, which we deemed to be acceptable.

The processing of the data from Phase 1 was time consuming as it entailed a substantial amount of interpretation and coding of relatively unstructured information. For the survey, a more cost-effective approach was needed, which resulted in the use of rating scales and distributing a fixed amount of points over several alternatives. Both allow for a straightforward use of quantitative analysis methods.

Sending and collecting paper based questionnaires is now quickly overtaken by Internet based approaches, which have proved to be better (see Bronner, Tchaoussoglou, & Ross, 2003). Several commercial services are now available and we used SurveyMonkey® because it provided the functionality we needed.

The survey was based on the research questions addressed (see principle 4 in the list above) and insights from the first phase. Also, relevant literature about learning strategies at work was used in the design process of the survey. Although at the start of the survey the analysis of the data from Phase 1 of the study wasn't yet completed, it was clear that the factors of the model of Holman, Epitropaki and Fernie (2001) partly matched the first insights about used learning patterns. Especially those learning patterns that affect the learning behaviour were comparable with two of the three behavioural strategies (that is, Personal help seeking, and Written help seeking) found by Holman, Epitropaki and Fernie (2001). Therefore several statements were used in the survey to identify used learning patterns. Other statements and questions were also added, to address the research questions (see principle 4) and verify other results of the study. Overall the focus was again on identifying behaviour rather than attitudes.

The survey consisted of three types of questions or statements distributed over two parts. In the first part, a number of statements had to be judged using a four-point scale which varied from "completely similar" to "not similar at all". This part also included questions where 100 points must be distributed over several answer categories, the constant sum scale questions. An example of this kind of question is related to the used communication medium in case someone consults a colleague is:

When you consult colleagues, there are different ways to do it.

If you had 100 points, how would you distribute them over the 4 ways listed below?

Please base your distribution on the degree you actually use these ways to consult colleagues in your daily work. The way you use most frequently in these situations should receive most points. It is not necessary to distribute all 100 points.

When I consult colleagues, I do this…

- by asking them face-to-face……. points
- by using e-mail……. points
- by calling them…… points
- by writing a message on paper……. points

In the second part of the survey, some general questions concerning personal information and general information about the organization have to be answered. Figure 3.3 shows a screen shot of the online questionnaire.

Figure 3.3 Screen shot of the online questionnaire

The questionnaire was accessible trough Internet (see before) in the period between October 6th, 2006 and November 3rd, 2006. After a slow start, things gathered speed later on and finally 104 people answered the questionnaire. Of these, seven did not complete the questionnaire for unknown reasons. We removed them from the sample, so the final sample size is 97 persons. See for the sampling procedure section 3.3.2.2.

3.4.2.2 Sample characteristics

As was mentioned before, our sample cannot be seen as a random sample from a population. The best we can aim at is a reasonable distribution over several

characteristics that extend the range of observations we made during Phase 1. In this section we will present data on the sample characteristics.
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), applying knowledge (for example, applying just found knowledge about word processors to a document). Table 3.13 below shows the results.

Table 3.13 Average number of points (out of 100) allocated to three types of knowledge work (constant sum scale)

Type of knowledge work	Average number of points
Developing new knowledge	32
Passing on knowledge to others	32
Applying knowledge	38

As can be seen from Table 3.13, the distribution over the three types is almost equal. This means that our survey covers respondents who are active in every type of knowledge work, excluding a bias to one of the types. We will return to these types later.
We asked the percentage of their time the respondents worked at a computer-based workplace (see Table 3.14).

Table 3.14 Time spent at computer-based workplace (n=97)

Time spent at computer-based workplace	Percentage of answers
0-25%	2%
26-50%	7%
51-75%	32%
76-100%	59%

Table 3.14 shows that the large majority of the respondents spent 50% or more of their working time at a computer-based workplace. However, there could be a bias as respondents could only fill in the online questionnaire when working at a computer: respondents from computer-based workplace could be overrepresented. On the other hand, this is comparable with Phase 1 were most recorded learning events took place at computer-based workplaces.
Phase 1 of the study was mainly conducted at relatively small organizations. Our intention was to broaden the organisational scope of the study in the survey, so we asked for the size of the organization (see Table 3.15).

Table 3.15 Size of company

Company size	Percentage of respondents
Small (<50 employees)	21%
Medium (50-250 employees)	13%
Large (>250 employees)	66%

From Table 3.15 it is very clear that we succeeded: 66% of the respondents came from large organizations. This enables us to investigate whether the results of Phase 1 can be generalised to larger organizations. 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 majority of the respondents (71%) is between 21 and 40 years, most (60%) of them are employed between 1-10 years by the company they are working for, they have spent between 1-10 years in their current job (67%) and males are in the majority (62%). Finally most of them see themselves as experienced (56%) or as an expert (36%). These numbers show an acceptable distribution over the relevant variables: they indicate a sample with reasonably experienced persons. Summarizing this section, we can say that the sample to a very large extent satisfies our initial ideas about how it should look like for making a meaningful comparison with findings from Phase 1. A reason of concern could be the relatively small number of novices as they may constitute a group with specific self-directed learning behaviour. The results of the study at the Dutch Police force (Chapter 2) showed, for example, that source usage is affected by duration of employment. In section 3.4.2.3.6 the influence of job experience on behaviour is further investigated. First, in the next section we will provide the results for the aspects that link it to Phase 1.

3.4.2.3 Self-directed learning behaviour of knowledge workers

The presentation of results follows the same structure as those of Phase 1 as the same research questions have to be answered. However, the data obtained in the survey doesn't give information about separate learning events, so we cannot detect learning patterns in the data[20], but as we asked about general learning experiences characterising learning patterns is possible. Therefore, first we will show the summary data for the three factors or components that constitute a learning pattern in section 3.4.2.3.2. Next the learned knowledge types (section 3.4.2.3.3), the location of learning (section 3.4.2.3.4) and the experienced bottlenecks (section 3.4.2.3.5) are described. For these results, the effect of the type of knowledge work and location size are systematically checked. The effect of job experience on some variables is described in section 3.4.2.3.6. A summary is given in section 3.4.2.4. Before describing the results, a brief description of the data preparation is given.

[20] This is due the fact we asked in the survey about genearl learning experiences. We will return to this issue in section 3.3.

3.4.2.3.1 Data preparation

The seventh, eighth and ninth sub questions address the effect on self-directed learning behaviour of the three aspects “size of the company”, “type of knowledge work” and “number of years knowledge workers work in their current job”. Differences for these three variables will be analysed. The first variable is immediately available in the questionnaire. The second one must be based on the distribution of points over the three types of knowledge work. This question allows a large range of distributions and if we want to classify each respondent uniquely in each category we need a rule. We decided on the following rule: if a respondent gives 50 points of more to one type of work he is classified as being mostly a knowledge worker of that type. The rationale is that when 50 points are given, this is by definition the majority of the points. If none of the three types of knowledge work receives 50 points, the respondent is classified as an all round knowledge worker. Applying this rule to the sample yields four categories:

a) Mainly developing knowledge (n=18)
b) Mainly passing knowledge to others (n=19)
c) Applying knowledge (n=31)
d) All round knowledge workers (n=29)

We will use these categories in the analyses. All analyses will be carried out by using one way analysis of variance with either company size or knowledge work type as the factor and other numerical variables as the dependents. A significance level of .05 will be adopted and Tukey post-hoc analyses were performed.
The third variable mentioned above will be described in a separate paragraph, as it does not make sense to relate it to all variables included for the first two.

3.4.2.3.2 Characterization of each learning pattern factor

Similar to the approach in the first phase of this study, respondents were asked questions related to three aspects of learning patterns: the trigger, the solution type and the used communication media. The results for each aspect will be described below.

Trigger: What triggers learning?

In Phase 1 we distinguished three ways that could drive learning during work: task triggered, interest triggered and learning triggered by coincidence. In the survey we asked participants to distribute 100 points over each category, giving most points to the situation that fits their daily work best (see Table 3.15).

Table 3.15 Average number of points (out of 100) allocated to three types of learning triggers (fixed sum scale)

Type of learning trigger	Average number of points received
Triggered by the task(s) I'm carrying out	50
Triggered by my interest	34
Triggered by coincidence	15

Task triggered learning dominates, but interest triggered learning is more prevalent than in Phase 1. An explanation for this difference is difficult to find, maybe it's due to the presence of a larger number of people from large organizations or of people who are developing new knowledge which seem to be less bound to a specific task than other workers.
There are no significant differences between the knowledge work types for each of the three triggers in Table 3.15. The same holds true for company size.

Solution type
The large majority of the respondents turn for personal help to colleagues (72 points out of 100). There are no significant differences for knowledge work types and company size in the points allocated to personal help from colleagues and help from people outside the organization.
Next we deal with turning to written material. We described a situation in which one wants to use written material to satisfy a learning need and the respondents were asked how similar this situation was to what they experienced in their daily work (see Table 3.16).

Table 3.16 Is turning to written material for help similar to what is experienced?

Similarity	Percentage of answers
Not similar at all	3%
Somewhat similar	22%
Very similar	41%
Completely similar	35%

Turning to written material is overall very similar to situations people experience in their daily work. Again there are no significant differences between similarity of using written material and knowledge work type and company size[21].

[21] The test for this relation depends on the interpretation of the "similarity" question. If one assumes it to be a 4-point rating scale, analysis of variance is the method to be used. Seeing it as an ordinal scale, cross-tabulation with Eta as coefficient is the proper way. In this case both ways did not give significant results.

Communication media

First we will deal with personal help seeking, followed by turning to written material. Table 3.17 shows how the respondents distribute 100 points over different communication media to contact other people for personal help seeking.

Table 3.17 Average number of points (out of 100) allocated to four types of communication media used in personal help seeking (fixed sum scale)

Communication media type	Average number of points received
Face-to-face	45
E-mail	27
Calling	23
Writing a paper message	3

As can be seen from Table 3.17, face-to-face contact is used most frequently, followed by e-mail and calling.

Analysing differences in communication media used for personal help seeking, a significant difference was found for writing paper messages. All round knowledge workers give significant more points to this than other knowledge workers ($F=3.3$, $p<.05$). However, the number of points involved is small (see Table 3.17). Furthermore there is a non-significant but substantial difference in the points given to face-to-face contacts. People mainly passing knowledge to others give on average less points to face-to-face than other knowledge workers (passing average is 37 points, for the other categories 48 points).

Company size shows no overall significant difference for face-to-face, but a post-hoc analysis indicates that people from small companies give on average more points to face-to-face than people from medium sized and large companies. However, this effect is indicative as no overall significance was found. No differences were found for e-mail, but for calling an overall significant effect of company size was found ($F=2.9$, $p<.05$). A post-hoc analysis shows that this is due to a difference between people in small companies and large companies. The former giving less points to calling (average=16.5) than the latter (average=26). The same pattern was found for writing paper messages, though the post-hoc analysis indicates that differences are between large companies at one hand and small and medium sized companies at the other hand, but this is based on a small number of allocated points. As there was no overall significance, these results should be interpreted with care.

We also asked which communication media were used most frequently when turning to written material by distributing 100 points (not necessary to allocate all points, see Table 3.18).

Table 3.18 Average number of points (out of 100) allocated to two types of communication media used in seeking help from written material (fixed sum scale)

Communication medium	Average number of points received
Digital media like websites	69
Paper based media like notes	27

As Table 3.18 shows, digital communication media are by far the most used ones.
For knowledge work type, we did not find an overall significant difference between the number of points given to digital communication media, but a post-hoc analysis indicates that there is a difference between knowledge workers developing knowledge (average=78 points) and all-round knowledge workers (average=64 points). However, this effect is indicative as no overall significance was found. Concerning paper based communication media, we found an almost significant difference between knowledge workers. The post-hoc analysis indicated that there is a difference between all-round knowledge workers (average=35 points) on one hand, and development knowledge workers (average=22 points) and knowledge workers who mainly use knowledge (average=23 points) on the other. However, as no overall significance was found this effect should be seen as indicative. For company size, no significant differences were found.

3.4.2.3.3 Knowledge types learned

As for Phase 1, also in Phase 2 the sub question related to the type of knowledge learned was asked. What people are learning at the workplace (distributing 100 points over 3 types of knowledge, no need to distribute all points) is shown in Table 3.19.

Table 3.19 Average number of points (out of 100) allocated to three knowledge types learned (fixed sum scale)

Knowledge type	Average number of points received
Facts (know what)	32
Procedures (know how)	34
Concepts (know why)	28

Table 3.19 shows a slight preponderance of know-how, but in general all three categories are learned. There were no significant differences between knowledge work types in points allocated to the different types of knowledge in Table 3.19. The same holds true for company size.

3.4.2.3.4 Bottlenecks experienced per solution type

What bottlenecks do knowledge workers experience? First we describe bottlenecks during personal help seeking, followed by bottlenecks when turning to written material.

The respondents could distribute 100 points over these bottlenecks but were not obliged to use all 100 points. See Table 3.20 for the answers.

Table 3.20 Average number of points (out of 100) allocated to three bottlenecks experienced in personal help seeking (fixed sum scale)

Bottleneck	Average number of points received
I often don't know who knows what in our organization	23
Colleagues I consult are often too busy to help me	21
Colleagues often can't help me because of the specific nature of the questions I ask them	27

The differences between the three bottlenecks are small, indicating that the respondents experienced these bottlenecks almost equally often. For the second category in Table 3.20 (busy colleagues), there was no overall effect of knowledge work type, but the post-hoc analysis indicated that there are differences between people who develop knowledge (average=31 points) and people who use knowledge (average=17 points) as well as all-round knowledge workers (average=19 points). No effects were found for the other two categories in Table 3.20.

Company size has a significant effect on the first category in Table 3.20: not knowing what other people know ($F=5.6$, $df=2$, $p<.05$). This is entirely due to the difference between large companies (average=29 points) and small (average=12 points) and medium sized companies (average=12 points). No significant effects of company size were found for the other categories.

The bottlenecks from Table 3.20 can have less or more serious negative impacts on learning during work. The respondents were asked to select from a list one bottleneck that hampers their learning during work most. The third bottleneck from Table 3.20 was selected most frequently (25%), the other ones scoring around 15%. Obviously there is some lack of nearby competence that provides a quick answer to a learning need. No differences in frequency of selected bottlenecks for type of knowledge work and company size were found[22]. In addition, it is interesting to see which bottlenecks/problems in the area of consulting written sources receive most points in terms of frequency of experiencing them (no need to distribute all points, see Table 3.21).

[22] This relation was tested by crosstabulating both nominal variables and computing χ^2

Table 3.21 Average number of points (out of 100) allocated to four bottlenecks experienced in seeking help from written material (fixed sum scale)

Bottleneck	Average number of points received
The information I find is often too general for immediate use	26
I often don't find helpful information in sources from my own organization	22
I often don't find helpful information in sources from outside my own organization	15
Trying to find something in written material often costs me too much time	29

From Table 3.21 one can derive a strong need for more specific information that is delivered relatively fast. At the same time, either the sources in the own organization are insufficient or are not well accessible.

Type of knowledge work does not have an overall significant effect on the first category in Table 3.21, but a post-hoc analysis indicates that there is a difference for category 1 (too general information) between knowledge developers (average=32 points) and knowledge users (average=20 points). Also no significant overall difference was found for category 3 (sources outside own organization), but the post-hoc analysis indicates a significant difference between knowledge developers (average=10 points) and all-round knowledge workers (average=19 points). For category 4 (too much time) no significant differences were found, but people mainly passing knowledge to others (average= 20 points) give less points to this category than the other knowledge workers (average=30 points). Finally no significant differences were found for category 2 from Table 3.21. Also no significant differences were found for company size.

As for serious negative impacts, bottleneck 4 (39%) and bottleneck 1 (23%) from Table 3.21, are most frequently selected as having the most negative impact on learning during work. This stresses even more the need derived from Table 3.21. No significant differences were found for knowledge work type and company size.

3.4.2.3.5 Where do they learn?

The location where knowledge workers learn was asked to see if the results found in Phase 1 are biased, that is, in Phase 1 most learning occurred at computer-based workplaces. The observations took place at the locations where knowledge workers were working, which are not per se the same places where they learn. Phase 1 results also showed that learning is not necessarily limited to one location. It can also occur during meetings and other social occasions. It could have been, nonetheless, that learning events at one of the other locations were underrepresented in Phase 1 as the data collection via Eureka Reports may have overrepresented computer based workplaces. We asked the respondents to distribute 100 points over 4 locations (no need to allocate all points, see Table 3.22).

Table 3.22 Average number of points (out of 100) allocated to four places where learning takes place (fixed sum scale)

Location	Average number of points received
My computer-based workplace	56
Workplaces without computers in the office	12
Meeting rooms	21
Places outside the office	19

Clearly most points are received by computer-based workplaces, which is not too surprising as this is the place where they spend most of their work time. The distribution is quite similar to the distribution found in Phase 1 (56% vs. 62%, 12% vs. 9%, 21% vs. 19% and 19% vs. 10%). This means that the results of Phase 1 can be meaningfully compared with the results of Phase 2.

Type of knowledge work makes no significant difference for computer-based workplaces. For workplaces without a computer there was no overall significant difference, but a post-hoc analysis indicates a difference between knowledge workers who develop knowledge (average=7.5 points) and knowledge workers who use knowledge (average=15 points). Meeting rooms indicate in the post-hoc analysis a difference between knowledge workers who pass knowledge (average=27 points) and all-round knowledge workers (average= 18 points). Finally, for meeting places outside the office no differences were found.

Company size has a significant effect ($F=4.2$, $p<.05$) on the points received by learning at a computer-based workplace. This is entirely due to the difference between small and medium sized companies (averages are 65 and 67 points) and large companies (average=51 points). Almost the opposite was found for meeting rooms ($F=3.3$, $p<.05$) where the post-hoc analysis showed a difference between medium sized (average=15 points) and large companies (average=24 points). For places outside the office, the picture was the same as for meeting rooms ($F=3.3$, $p<.05$), but there was also a significant difference between small (average=13 points) and large companies (average=21 points). No differences were found for workplaces without computers in the office.

We also asked whether learning does occur at all by using the statement “I rarely learn something new in my daily work”. Of the respondents, 72% answered that this was not similar at all to their daily work. No significant differences were found for knowledge work type and company size.

3.4.2.3.6 The effect of job experience on learning

In Chapter 2, results showed that source usage of police men was affected by some work context aspects like duration of employment. Instead of looking at duration of

employment, the eight sub question of this study addresses the effect of the number of years knowledge workers work in their current job on self-directed learning behaviour. In this section we will perform a limited number of analyses with the question "How many years have you spent in your current job" as the independent variable[23]. As dependent variables we focus on those which are associated with learning patterns: personal help seeking (communication medium, bottlenecks), turning to written material (communication medium, bottlenecks). Finally we will look at differences in what is learned. To make the categories of the independent variable "How many years…." more equal in size, we recoded the last two (11-15 years and more than 15 into one category), leaving four categories: less than one year, 1-5 years, 6-10 years, more than 10 years.

Personal help seeking

Number of years in the current job does not lead to overall significant differences concerning the number of points allocated to asking colleagues, though people with more than 10 years experience tend to assign less points than the other categories (average other categories=75 points, average 10 years or more=64 points). No effects were found for asking persons outside the own organization.

Concerning contacting other people face-to-face, no overall significant difference was found, but the post hoc analysis indicates a difference between people less than one year in the job (average=48 points) and people 1-5 year in a job (average=49 points), and people 10 or more years in the job (average=34 points). No significant differences were found for the other ways of contacting people.

The bottleneck "not knowing what other people know" is not significantly related to years in the job, though people less than a year in a job give more points to this bottleneck than the other categories (1 year average=35 points, other category average=20 points). The average number of points is lowest for people 6-10 years in their current job. No effects of number of years in the job were found for the other bottlenecks.

Turning to written material

Number of years in the job does not lead to significant differences in the judgments of respondents about the similarity score for turning to written material (see Table 3.16). For digital communication media there is a significant overall difference ($F=3.1$, $p<.05$). The post hoc analysis shows this to be due to differences between 1-5 years in the job (average=73 points) and 6-10 years in the job (average=76 points), and more than 10 years in the job (average=56 points). No differences are found for paper based communication media. For face-to-face personal help seeking and using digital material people more than 10 years in the job allocate significantly fewer

[23] Clearly number of years in a job and age are related though not perfectly. We take number of years in the job as the best indicator of experience, but technically age is a potential intervening variable we can't filter out properly as it is measured in a different scale (absolute versus relative).

points to them than people less than 10 years in the job. As the respondents were not obliged to allocate all 100 points, this difference can be due to the fact that people longer in the job allocated less than 100 points.
No overall effect was found for the bottleneck of “too general information”, but a post hoc analysis indicates that there is a difference between less than one year in the job (average=29 points) and 6-10 years in the job (average=30 points), and more than 10 years in the job (average=15 points). The category 1-5 years is in between (average=26 points, but not significant). No significant effects were found for the other bottlenecks.

What is learned?
No effects of number of years in their current function were found for facts and procedures. For concepts no overall effect was found, but a post hoc analysis indicates a difference between 6-10 years in the job (average=34 points) and more than 10 years in the job (average=22 points). The general tendency is that the number of points allocated to learning concepts increases with number of years in the job, but sharply drops when one is 10 or more years in the job. However, as no overall significance was found this effect should be seen as indicative.
3.4.2.4 Summary of Phase 2 results
The comparison between the results of Phase 1 and Phase 2 will be done in the next section. This summary will try to pull together the results of the analyses performed in Phase 2. A limitation of these results can be seen in the fact that the unit of analysis was a person instead of a learning event (see also next section).

Learning patterns
The main research question of this chapter addresses the learning practices and patterns of knowledge workers at work. Learning patterns are constructed out of three aspects: the trigger, the solution type and the used communication media. Similar to the approach in the first phase of this study, respondents were asked questions related to three aspects of learning patterns. Task triggered learning dominates, although interest triggered learning and coincidental learning also occurs. For solution type holds true that if the respondents seek personal help, the large majority turns to colleagues and the communication medium face-to-face contact is used most frequently, followed by e-mail and calling. Turning to written material is overall very similar to situations people experience in their daily work. Digital communication media are used most in this situation.

Types of knowledge
As the first sub question addresses the type of knowledge searched for, respondents are asked about the type of knowledge learned. Results show that there is a slight

preponderance of procedural knowledge, but in general all three types of knowledge (facts, concepts and procedures) are learned.

Bottlenecks

Although the success of learning events was not addressed in Phase 2, the bottlenecks experienced during learning were. These results are needed to answer the third sub question. Bottlenecks for personal help seeking and seeking help from written material were presented to the respondents. These bottlenecks were based on the bottlenecks found in Phase 1. For personal help seeking, three different bottlenecks were presented: 1) I often don't know who knows what in our organization, 2) Colleagues I consult are often too busy to help me, and 3) Colleagues often can't help me because of the specific nature of the questions I ask them. The differences found between the three bottlenecks are small, indicating that the respondents experienced these bottlenecks almost evenly. However, lacking nearby competence that provides a quick answer to a learning need was seen as the bottleneck that hampers their learning during work most.

For seeking help from written material, four bottlenecks were presented: 1) The information I find is often too general for immediate use, 2) I often don't find helpful information in sources from my own organization, 3) I often don't find helpful information in sources from outside my own organization, and 4) Trying to find something in written material often costs me too much time. Results show that there is a strong need for more specific information that is delivered relatively fast. At the same time, either the sources in the own organization are insufficient or not well accessible. These needs are confirmed when participants are asked which bottleneck has serious negative impacts: bottleneck 4 (finding costs too much time) and bottleneck 1 (found information is too general) are most frequently selected as having the most negative impact on learning during work.

Location

The fourth sub question addresses the location where learning takes place. Respondents indicate that computer-based workplaces are the location where one learns most frequently. Meeting rooms are second and with only a small difference places outside the office are third. The location where learning occurs the least is a workplace without a computer.

Influence size of company

One sub question addresses the influence of the size of the company where a knowledge worker works on workplace learning behaviour. In Phase 1 relatively small organisations were involved and results show that in Phase 2 the scope has successfully been broadened as besides small companies also medium and large

organisations were involved. The following significant differences were found for company size:

- Knowledge workers in small companies resort less to calling in personal help seeking than knowledge workers in large companies.
- Knowledge workers in large companies suffer more from the bottleneck “not knowing what other people know” than knowledge workers in small and medium sized companies.
- Knowledge workers in small and medium sized companies learn more frequently at computer-based workplaces than knowledge workers in large companies.
- Knowledge workers in large companies learn more frequently in meeting rooms than knowledge workers in medium sized companies.
- Knowledge workers in large companies learn more frequently in places outside the office than knowledge workers in small and medium sized companies

In addition, the following indicative differences were found:

- Knowledge workers in small companies use more frequently face-to-face personal help seeking than knowledge workers in large companies
- Knowledge workers in small companies use more frequently face-to-face personal help seeking than knowledge workers in medium sized companies
- Knowledge workers in small and medium sized companies use less frequently written messages in personal help seeking than knowledge workers in large companies.

For company size, no differences were found for other important variables (triggers, solution type, communication media used when turning to written material, what is learned). Overall, variation due to company size is small.

Influence of number of years in current job

The influence of the number of years in current job on workplace learning behaviour is addressed by the eight sub question. The majority of the respondents work in their current job between one and ten years. For the number of years in the current job, the following significant difference was found:

- People 1-10 years in the job turn more to digital sources than people more than 10 years in the job

In addition, the following indicative differences were found:

- People less than one year in the job and people 1-5 years in the job turn more frequently face-to-face to other people for personal help seeking than people more than 10 years in the job

- People less than one year and 6-10 years in the job suffer more from the bottleneck of too general information in written sources than people more than 10 years in the job.
- People 6-10 year in the job learn more concepts than people more than 10 years in the job.

Considering these differences, a simple count of how frequently a type of knowledge work is involved in a significant difference shows that variation due to company size is small. Just as with company size, no effects were found for other important dependent variables (triggers, solution type, learning facts or procedures, several bottlenecks).

Influence of type of knowledge work

One sub question addresses the influence of the type of knowledge work a knowledge worker performs on workplace learning behaviour. The results show that on average respondents are active in all three types of knowledge work discerned in this study (that is, developing, passing on knowledge and using knowledge). Therefore, four different types of knowledge workers were identified (abbreviations used in the summary are in brackets):

- Mainly developing knowledge (developers)
- Mainly passing knowledge to others (passers on)
- Applying knowledge (users)
- All round knowledge workers (all-rounders)

The following significant difference was found for different types of knowledge work: developing knowledge, passing knowledge to other, using knowledge and all-round knowledge workers:

- All-rounders use more paper communication media than developers when turning to written material.

In addition, the following indicative differences were found:

- Developers use more digital communication media than all-rounders when turning to written material.
- All-rounders use more paper messages when seeking personal help.

Many of these differences seem to be a result of all-rounders tending to use more “traditional” communication media and developers more digital communication media. The following indicative differences were found for the occurrence of bottlenecks:

- Developers suffer more from the bottleneck of “too busy colleagues” than users.

- Developers suffer more from the bottleneck of “too busy colleagues” than all-rounders.
- Developers suffer more from the bottleneck of “too general information in written sources” than users.
- Developers suffer less from the bottleneck of “not finding helpful information in sources outside the organization” than all-rounders.
- Developers suffer less from the bottleneck of “The information I find is often too general for immediate use” than users.
- Users learn more frequently in workplaces without computers in the office than developers.
- Knowledge passers learn more frequently in meeting rooms than all-rounders.

Given the total number of analyses performed, the number of significant differences found is small. For many important other variables (triggers, solution type, what is learned) no significant differences were found. This seems to warrant the conclusion that variation due to type of knowledge work is small.

Summary work context aspects

The company size, type of knowledge work, and numbers of years in the current job are the work context aspects included in Phase 2. Sub question seven, eight and nine address differences in self-directed learning behaviour related to these aspects. Summarizing the effects of these three work context aspects we can state the points below:

- What triggers learning is independent of work context aspects.
- Solution types (personal help seeking, turning to written material) chosen for learning events is to a large extent independent of the work context.
- What is learned is to a large extent independent of the work context.
- Communication media chosen is to some extent independent of the work context, some local differences were identified for type of knowledge work (developers), company size (large companies versus small and medium sized) and number of years in the current job (people more than 10 years in the current job versus other job categories).
- Where people learn is strongly dependent on company size, large companies learn more frequently outside the computer-based work place than small and medium sized companies.

3.4.3 Comparing results from Phase 1 and Phase 2

In this section we compare results from Phase 1 and Phase 2 of this study. This comparison has to be interpreted with care for several reasons. The most important caveat has to do with the nature of the data. In Phase 1 the unit of analysis is a learning

event. Such a learning event is a unique observed or reported entity which is generated by, but not tied to, a person. The unit of analysis in Phase 2 is a person, a respondent, which does not report about one specific learning event but about general experiences during learning at the workplace. In methodological terms this is a difference between a point (a unique learning event) and a distribution (a collection of learning events over time for one person leading to general experiences). As a consequence, comparisons are formally between not comparable entities and should be taken with care and can be seen as indicative only. On the other hand, the results from Phase 2, based on a distribution of learning experiences, can help in generalizing results from Phase 1 which were not measured in Phase 2. The assumption is that if the outcomes of Phase 2 on some crucial variables are similar to the ones from Phase 1, there is some basis for stating that results found in Phase 1 can be valid for a wider range of organizations and learning situations than included in the data collection in Phase 1. This could hold in particular for the findings for learning patterns, which we could analyze in Phase 1 but not in the same amount of detail in Phase 2. The second reason for being careful in making comparisons is because the way the data are collected is different. In the survey we used self-report questions, while in Phase 1 observations, interviews and reports were used which subsequently were coded. Though we tried to measure the same concepts in both Phases, we can't be sure that different ways of measuring the same concepts yield comparable outcomes. When reading the comparisons made below, these general considerations should be taken into account.

The comparisons are based on the research questions that were investigated in both Phases. From Phase 1 we take the results of the learning events as experienced from the role of learner as the yardstick, as they are most frequent. Also, in Phase 2 no group settings or expert role were addressed. More general conclusions can be found later on.

Characterization of the learning pattern factors

- Trigger: what triggers learning?
  In both phases the most frequent trigger for learning at the workplace is a task someone is working on. In the survey more interest triggered learning is reported.
- Solution type.
  Personal help seeking from colleagues is very frequent in both phases, but also turning to written material is frequently mentioned in both.
- Communication media.
  In personal help seeking, face-to-face is mostly used as a way to contact colleagues in both phases. When learners turn to written material they have a strong preference for digital communication media over paper media.

Summarizing: for most of the learning pattern factors, the similarity between what was found in Phase 1 and Phase 2 is substantial.

Knowledge type
There is some difference between Phase 1 and Phase 2. In Phase 1, learning of concepts is more frequent than learning of procedures and facts. In Phase 2 they are reported almost equally frequent. The main point is that in both phases the three different knowledge types are mentioned quite frequently.

Location
In both phases most reported learning occurs at computer-based locations.

Bottlenecks
In Phase 2 all three mentioned bottlenecks in personal help seeking were present almost equally, which also occurred in Phase 1. The bottleneck having the most negative impact in Phase 2 was the lack of specific knowledge colleagues have, which is also the most frequent bottleneck in Phase 1. When turning to written material, in particular digital material, three out of four bottlenecks are frequently mentioned in Phase 2 as well as in Phase 1: too general information, finding something takes too much time, lack of information in company sources.
In both phases re-use of obtained information and knowledge scored very high, implying that our data indeed reflect learning experiences rather than information search for once-a-time problem solving.

Summarizing: the similarity between what was found about learning patterns and practices in Phase 1 and Phase 2 is major. The difference between what is learned in both phases is not that important as all types of knowledge are present. Pulling things together, we can say that on all important aspects of self-directed learning that were measured in both phases of this study, outcomes are quite similar. Keeping the caveats above in mind, there is evidence that other results obtained in Phase 1 can be valid over a wider range of organizations and learners than the four organisations could provide. In the next section we will investigate what these results imply.

3.5 Summary and conclusions

The main research question of this chapter addresses workplace learning patterns and practices, in particular the information sources knowledge workers use to gain knowledge. The found learning patterns in the two phases show that most self-directed learning is triggered by the tasks people are performing. In our analyses of Phase 1 we observed that most knowledge needs arise when someone is performing

a task and recognizes a knowledge gap. In order to satisfy the knowledge need a search for knowledge begins. The learning is thus strongly triggered by work tasks, but other triggers for learning are also present.
Coincidental learning occurs, for example, when new knowledge is acquired in a spontaneous conversation with colleagues. In this case, no knowledge need was recognized, but the new knowledge can be used in the future. Interest triggered learning wasn't found in Phase 1, but the survey of Phase 2 confirmed that one's own interest can be a reason to learn. For both coincidental and task related learning, the same key learning patterns were found. The key patterns stress the importance of personal help seeking (colleagues) and seeking help from digital written material as used by knowledge workers in self-directed learning. The key patterns are most of the time not very complex, consisting of one or two steps involving either personal help seeking combined with face-to-face contact or turning to written digital material.

Regarding the practices in self-directed learning, the first sub question addresses the type of knowledge learned. Results show that all three knowledge types are learned quite frequently. In Phase 1 concepts are learned most frequently, closely followed by procedures and facts. In Phase 2 procedures are learned most frequently, but the differences between the three learned knowledge types is again small.

The second sub question addresses the success of learning events. Another remarkable finding of Phase 1 is that most learning events, even though bottlenecks are experienced, are successful. Successful means that the knowledge need is solved in a satisfactory way so that the learner can move on in the work. If a learning event wasn't successful, this could be because no knowledge could be found, the learning was postponed or because the learning wasn't finished at the time of the study. Learning is thus overall reasonably successful, though bottlenecks are present.

The third sub question addresses these bottlenecks. Overall, almost half of all learning events encountered one or more bottlenecks. Bottlenecks learners experience most are related to inefficient providing of information (being too much or too general) or not being able to search information efficiently (for example, not knowing what is important). Time also has a constraining influence on self-directed learning, since lack of time is mentioned frequently as a bottleneck by both learners and experts. One of the problems experts bring up most, is not having the specific knowledge or experience about the matter they are consulted about. In Phase 2 the presence of these bottlenecks was confirmed. In addition, the results showed that the process of personal help seeking isn't always problem-free. In Phase 1 the

presence of such problems was already revealed, but in Phase 2 it became clear that people experience two bottlenecks most frequently, namely not knowing who knows what and lack of specific knowledge with colleagues.

The fourth sub question addresses the work locations where learning takes place. In general it can be said that learning at computer-based workplaces is ubiquitous, at least in the way as it was defined in this study. It is important to note that these results can be biased as in Phase 1 many learning events were collected via Eureka Reports for which computer-based workplaces were needed. In Phase 2 using an online questionnaire could have caused an overrepresentation of knowledge workers who work (and thus can learn) at computer-based workplaces.

Differences in self-directed learning patterns and practices related to the searched knowledge type, the success of a learning event, the frequency of bottlenecks encountered during learning events and the locations of learning events is addressed by the fifth sub question. Results of Phase 1 are used to answer this question. The sequence length of a learning pattern, as an indicator of its complexity, is affected by the knowledge type that is learned and the occurrence of bottlenecks. Learning facts results in a shorter sequence length than learning concepts and the occurrence of a bottleneck makes the sequence length longer. Success of learning events, when defined as a dichotomy (successful versus unsuccessful), is influenced by the complexity of a learning pattern (less complex more success).

The sixth sub question deals with differences in self-directed learning behaviour based on social context, that is, between learners, experts and groups. Although most data in Phase 1 was related to the learning of individuals, there seem to be some differences between the learning of a single person and groups. As learners learn most at computer-based workplaces, groups appear to learn most in meeting rooms, which after all is the place where most groups will do their work. Since not many data was collected about group learning, no key patterns for this type of self-directed learning were found. Further research is necessary to understand group learning processes and strategies better. Data about the expert role in self-directed learning also revealed some interesting findings, especially about the bottlenecks. Most learning events in the expert role experience one or more bottlenecks. Not having enough time to help and lacking the knowledge or experience to help are mentioned often. Regarding knowledge types, experts mention that they are consulted most for explaining procedures.

The influence of work context was also investigated as the three last sub questions (seven, eight and nine) address it. In Phase 2 of the study was found that the work

context aspects company size, type of knowledge work and years of experience in current job, have no influence on the triggers of learning. Neither of these variables is directly related to what triggers learning. Phase 2 of the study also showed that work context aspects play a negligible role in choosing between seeking personal help and turning to written material. Only company size had a strong influence on where people learn: knowledge workers from large companies learn more frequently outside the computer-based workplace than those working at small and medium sized companies.

A limitation of this study could be how learning is investigated. The focus was on learning behaviour and learning patterns were used as a way to describe this behaviour. As mentioned in section 1.1, a distinction is made between learning patterns and learning strategies, the latter involving thoughts and behaviours engaged in by the learner while the first focuses on the behavioural part. However, the cognitive element of learning cannot be left entirely outside the considerations. For example, one can only talk about learning when the information or knowledge sought and found is somehow stored in someone's memory and re-used. This definition of learning as used in this study (see Appendix A) also defines learning as the consciously or subconsciously storing knowledge for future use. Results show that in some cases learning events were unfinished and actual (re-)use was not observed. In those cases, the judgments of knowledge workers about the likelihood of reusing the knowledge were taken as indicators of learning; the actual reuse was not observed in those situations. There is still a small risk that some of the data collected reflect information search for once-a-time problem solving instead of learning experiences. In addition, not all knowledge obtained and re-use may have been observed. For example, while searching for knowledge on the Internet, more knowledge may have been gained than just the knowledge sought for to complete the work task. However, the focus of the learning was on acquiring of information to satisfy a specific knowledge need; when approached from this perspective, most knowledge obtained and likely to be re-used was probably captured .
In addition, the possible triggers of knowledge needs defined were triggered by a task , by interest and by coincidence. By separating task triggered from interest and coincidence triggered, a clear distinction between, for example, someone's tasks and interest is made. However, task related knowledge needs and interest related knowledge needs could be interrelated: having a passion for the work you do is not something uncommon. Furthermore, the solution type refers to the kind of solution that is attempted by the knowledge worker (that is, personal help seeking, seeking help from written material and practical application). Not investigated is if there is a difference between the solution type attempted and the solution type that actually provided the solution. Although the key patterns found indicate that there may be a

difference between the solution type attempted and the solution type that provided the knowledge, it was not investigated if these two differed and why they differed.
Another limitation of this study is the fact that most collected data refer to individual learning (events). Though the methods used in Phase 1 were designed to enable data collection about all three social roles defined (that is, learners, experts and groups), results showed that mainly data from individual learning events were collected. As a consequence, not much differences in self-directed learning behaviour based on social context were found. Most results are therefore based on learning and expert advice providing outside groups. The question how communication takes place in this group context cannot be answered by the study.

Chapter 4

4 Predicting source usage for acquiring and sharing knowledge at the workplace: the Media Richness Theory[24]

In the previous chapter self-directed learning behaviour, especially patterns and practices related to the knowledge management episode as mentioned by Holsapple and Joshi (2003) was investigated. This study continues with this line of research, the focus will be on answering research question C as described in Chapter 1. The goal of this study was to obtain more insight into information source usage for acquiring and sharing knowledge at the workplace: based on a specific learning and transfer situation, predictions about the information source used (that is, the source that fits best the characteristics of the learning and transfer situation) are tested. Furthermore, context factors for learning during work are explored in more depth.

To theoretically underpin this research, the main theoretical perspective chosen was the Media Richness Theory. Based on perspectives on media usage from this theory, predictions about the best fitting information sources in certain situations are derived. In addition, one other theoretical perspective is briefly referred to: the Social Influence Model of Technology Use. This theory claims that the Media Richness Theory is incomplete as organisational norms and habits can inhibit or promote the use of communication media, even if these don't fit the task at hand well.

This chapter starts with the description of the theoretical framework and its usage in this study.

4.1 Explaining media use

In this study information source usage for gaining knowledge in learning and transfer situations at the workplace will be investigated. To make sure that the rationale behind the design was well-grounded, theories about information source usage were compared and examined, to find out how they could contribute to relating work and source usage. As this thesis 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

[24] The research in this chapter was carried out in the context of the APOSDLE project, a 6th Framework Program for R&D of the EU. The reference to the original report is: R. de Hoog, J.P. Kooken, T.Ley, B. Kump and S.Lindstaedt (2008). Second workplace learning study. Deliverable D2.5, EU Project 027023 APOSDLE, (120 p.), Know-center, Graz, Austria.

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 is focused on the use of mass media. In this study however, we shall in the first place focus 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, uses and gratifications focuses mainly on the receiver role (users/"audience" of mass media) and in this study the sender role and the receiver role are relevant. This means that the user will be seen as the one who starts the use of media or sources to send information (sender) but also as the one who makes use of available information in sources (receiver). 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 predicts that people will prefer the medium that functions most effectively in work-learn contexts that can differ in uncertainty and equivocality (to be explained below). Using this theory makes it possible to focus on information sources usage to satisfy learning needs in a work context. By using this theory's assumptions, it is possible to predict which source people would *prefer* in a learning and transfer situation. This makes this theory a fitting starting point from a research as well as a practical perspective. Knowing if the Media Richness Theory can adequately predict information sources usage to satisfy learning needs in a work context, can have implications for, for example, designing information sources for knowledge gaining of knowledge workers. For example, for new employees the best fitting source (based on its richness) could be recommended for specific learning and transfer situations known by the organisation. This makes this theory interesting from both perspectives. In the next section the theory is explained in more detail.

4.1.1 The Media Richness Theory

The Media Richness Theory (Daft & Lengel, 1984) was developed in an organisational context. The theory is derived from 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 human understanding in 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 et al., 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 in a time interval (Robert & Dennis, 2005). Uncertainty in 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 location 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 verbal and nonverbal cues, like body language and facial expressions
- provide fast mutual feedback,
- to convey personality traits like personal feelings and emotions,
- to support the use of high variety natural language rather than numbers.

The higher a medium can be classified along this continuum of richness, the richer the medium is. In Figure 4.1 the location of different media on the medium richness dimension, as originally proposed by Daft and Lengel (1984), is shown.

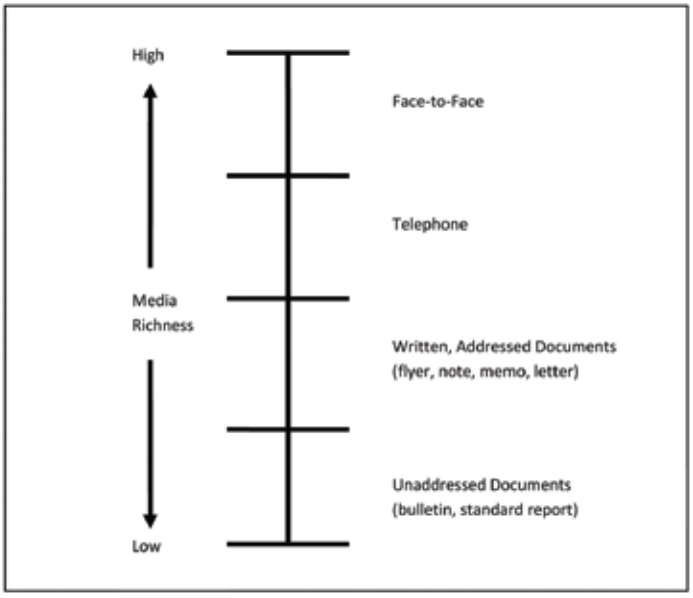


Figure 4.1 The location of different media on the dimension of media richness (Daft & Lengel, 1984)

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, p. 560) also relate the richness of a communication to learning when they state that: *"Communications [via a communication medium] 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 [via a communication medium]."*

To illustrate the theory, Table 4.1 shows the framework of equivocality and uncertainty for information requirements (Daft & Lengel, 1986).

Table 4.1 Daft and Lengel (1986) Framework of Equivocality and Uncertainty for Information Requirements

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

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 (cell 1), 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”.

The Media Richness Theory has been investigated in several contexts; for example, for the design of instructional multimedia in e-learning (Sun & Cheng, 2007; Liu, Liao, & Pratt, 2009), the effect of media on decision quality (Kahai & Copper, 2003), task performance and satisfaction (Suh, 1999) and interpersonal interactions (Connell et al., 2001). The study of Liu, Liao and Pratt (2009) showed, for example, that richer content-presentation types were positively correlated with higher concentration levels. The study of Sun and Cheng (2007) showed that the use of rich media in e-learning should fit the uncertainty and equivocality in content of the course unit under consideration. The study of Suh (1999) did not support the Media Richness Theory as decision quality was not affected by communication media, regardless of tasks. According to Kock (2005), the empirical support for the Media Richness Theory varies: some studies found general support for the Media Richness Theory and other studies only found weak, little or no support.

Concluding, it can be said that the key assumptions of the Media Richness Theory can be used to investigate and predict information source usage for a given task in a work situation. The fit of the Media Richness Theory for predicting this source usage and predictions based on these assumptions (hypotheses) will be tested in this study.

4.1.2 The Media Richness Theory in this study

Before presenting the research question and accompanying hypotheses, the use of the Media Richness Theory in the context of knowledge acquiring at work needs to be described and two issues have to be addressed. The first one is that since the development of the Media Richness theory new media have been developed: these media must be defined. The second one is defining learning and transfer situations. This will be done later on; we will start with the first issue.

As can be seen in Figure 4.1, the definition of “medium” in the Media Richness Theory is a mixture between the communication medium used to transmit the information (for example, the telephone) and the source of the information (for example, a document). Since the publication of Figure 4.1 in 1984, the spectacular rise of electronic communication media like e-mail, has led to many more “points” on the richness continuum than present in Figure 4.1. From this perspective it seems better to explicitly keep source and communication medium 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 shall make a distinction between information sources which are located at the extremes of

the richness continuum: *personal information sources and documented information sources.* The information sources at this level must also be located on the "richness" dimension as shown in Figure 4.1. Three information sources categories are involved: documented sources, a person and a combination of both. This classification is based on judging the information sources on the four aspects that determine "richness" as described in section 4.1.1. It should be noted that this classification has been done by the researchers. This limits its validity to a certain extent, but results of the study will eventually show if and to what extent the classification is correct. The classification is kept relatively simple: a source is classified as either rich or lean. A documented source is classified as a lean information source but a person is a rich information source. The category "both" is a combination the other two categories. When using both types of information sources, the information sources are labelled as rich; the richness of personal contact is not decreased by the documented source while the documented source is "enriched" when combined with a person.

At the second level the medium comes into focus, but this is only relevant when a person is part of the selected information sources: communication between at least two persons takes place[25]. This is the step, where the communication media will have to be selected. The following seven communication media are the currently most used ones:

- 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 4.1. Again the classification has been done by the researchers for those media not present in Figure 4.1, using the four aspects. The original list of media (see Figure 4.1) 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 fast mutual feedback, convey personality traits, and support the use of natural language. 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

[25] In the previous study this distinction was not made. However, communication is now seen as something that can only take place between humans. Human-computer interaction is thus not taken into account.

expressions are visible. Chat is richer that 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.

As mentioned above, apart from media, the context (work and learn) will also have to be classified in terms of uncertainty and equivocality (see Table 4.1). 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 in order 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 and 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 the “tasks” are, as there are work task and learning tasks. The next sections 4.1.3 and 4.1.4 address this issue.

4.1.3 Work Situations

The context for learning 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 information sources and communication media to satisfy learning tasks. An option is to let respondents describe their work situation in their own words, but this will lead to a myriad of widely diverging descriptions that must be classified afterwards by the researchers. The other option is to predefine a set of work situations that cover at a more abstract level the variety that occurs in practice,

and let respondents select a work situation from this predefined list. The latter option was chosen as this greatly reduces the work of coding, but also the arbitrariness that slips into many coding efforts. This leaves the question how this list of predefined work situations should look like.

For this, a conceptualization for work situations was developed using several sources. The general classification of knowledge work in terms of Kelloway and Barling's (2000) conceptualization of knowledge work as discretionary behaviour in organizations was used. These authors differentiate knowledge work into the following four main types of behaviours at the workplace: Creating knowledge, acquiring knowledge, applying knowledge and transferring knowledge. The first three main types of behaviours can be related to self-directed learning in a straightforward way as the role of sources for gaining information is quite apparent. To create knowledge one may need to evaluate (and thus first find) knowledge to see what is needed to be created. Information gaining precedes acquiring knowledge and when information gained is applied this can involve self-directed learning. However, for transferring knowledge, the last main type of behaviour, the link with self-directed learning may not be clear. In the study in Chapter 3 the expert role was addressed. When someone shares his knowledge with another person (being the expert), one transfers (parts of) his knowledge to that person. Transferring knowledge should be seen in this study as similar to the expert role where one is consulted to share his knowledge.

For each work situation, *create knowledge, acquire knowledge, apply knowledge,* and *transfer knowledge*, several scenarios are formulated about situations in which knowledge workers typically find themselves at their workplaces. Additionally, some further dimensions are considered when formulating the scenarios. For *the acquiring knowledge* and *transferring knowledge* scenarios the general learning trigger is 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 difference was noticed during the study described in Chapter 3.

For the *applying knowledge* scenarios, we shall consider two task types that are at the opposite of the spectrum of the Common KADS knowledge intensive task type classification (Schreiber et al., 2000). We picked one synthetic task (design) 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 that will be used in the questionnaire are listed, and categorized into Kelloway and Barling's (2000) four main types of behaviours. The descriptions are 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, for example by giving a presentation or by writing a report (from the learner's perspective: acquire knowledge).
- you were contacted by someone else (a colleague or customer) who asked for advice or instructions in your area of expertise (from the learner's perspective: apply).
- you had to advise a new co-worker in your department or company of how things were being done (from the learner's perspective: acquire knowledge).
- you had to document your expertise for someone else, for example in a project hand-over or because you left the department or company (from the learner's perspective: acquire).
- you were part of a team to develop something new or innovative and you had to extensively exchange knowledge with the other team members (from the learner's perspective: create).

Although it can be argued that explaining and sharing knowledge with another person (transfer situation) also results in learning, another main focus will be taken in this study. The perspective chosen is that the transfer situation starts from the learning task of the other person; that person is the learner who is in one of the five work situations described for the transfer situation. Therefore, the descriptions of the transfer situations are related to either the acquire, create or apply situation. It's about the situation the other person is in; the difference is that the transfer situations will be phrased from the perspective of the person being the expert.

For the work situation categories listed above, the appropriate uncertainty and equivocality will have to be established. Classification has been done by the researchers based on the criteria described in Table 4.1; the theory itself provides criteria and these were applied to the work situations. If time had permitted, this classification could 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. However, we will also ask the respondents about the experienced uncertainty and equivocality of the tasks they reported about. This will provide a second way to investigate the Media Richness Theory.

For the classification of uncertainty and equivocality of work situations the principles of the taxonomy of cognitive learning of Krathwohl and Anderson (2001) are used. Although meant to classify learning and not work tasks, it relates tasks that involve knowledge gaining (for example self-directed learning, which is the focus in this study) with a level of cognitive complexity of learning. Based on this starting point of the taxonomy, the principle that will be applied for the classification is that when uncertainty or equivocality of a task increases, it affects the cognitive complexity the task. In section 4.1.4 a more detailed description of this taxonomy is given.

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 “apply: 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 moderate. For the other two work situations “design” and “create”, the focus is on finding richer knowledge for getting a better interpretation of the situation and the desired results. Therefore, uncertainty and equivocality are high for these situations (see Table 4.2). For the transfer situations holds that the equivocality and uncertainty that the person providing the knowledge experiences is leading; this person cannot know how the person that is in need of the knowledge experiences the equivocality and uncertainty of the work situation.

Table 4.2 Classification of uncertainty and equivocality for work situations

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

A consequence of this classification is that only two cells (2 and 3) from the framework described in Table 4.1 are represented in this study. However, for diagnose and transfer holds true that their level of uncertainty and equivocality can differ from one being low and the other being moderate. However, an exact combination of “high-low” or “low-high” is not present in the classification shown in Table 4.2. Thus limitations regarding the information requirements of the work situations will therefore have to be taken into account when interpreting the results.

4.1.4 Learning tasks

From a learning perspective, knowledge workers 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). Learning tasks in the work situation “transfer knowledge” (see section 4.1.3) refer to the learning task of the other person who approaches the expert for sharing his knowledge. Anderson and Krathwohl’s (2001) taxonomy of human learning will be used here too to describe learning tasks in this study, however, not just its starting point but the description of cognitive processes is used. Anderson and Krathwohl’s taxonomy is a revision of Bloom’s (Bloom, Englehart, Furst, Hill, & Krathwohl, 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)
- 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 (Bloom et al., 1956), they developed a two-dimensional taxonomy: a knowledge type dimension and a cognitive process dimension. The taxonomy classifies different types of 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. This last type of knowledge, meta-cognitive knowledge, will be excluded in this study to keep a consistent approach between the studies, as in the Chapter 3 study the knowledge types facts (factual knowledge), procedures (procedural knowledge) and concepts (conceptual knowledge) were discerned and meta-knowledge was not taken into account. 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):

- 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 in the context this study, a learning task will be described as "a task occurring during work aiming at learning at least one type of knowledge described by Anderson and Krathwohl's taxonomy –excluding meta-cognitive knowledge- and involving at least one of the cognitive processes described by Anderson and Krathwohl's taxonomy".

4.1.4.1 Defining uncertainty and equivocality for learning tasks

The learning tasks defined in the previous section must also be classified, just as work situations, in terms of uncertainty and equivocality. Classification was again done by the researchers based on the criteria described in Table 4.1 and by linking cognitive complexity of the taxonomy of Anderson and Krathwohl (2001) with uncertainty and equivocality (see also 4.1.3). It is assumed that when the mental complexity increases, equivocality and uncertainty increase too as with the increasing of mental complexity higher demands on thinking abilities are posed. For example, remembering information is seen as demanding relatively little from our thinking abilities and equivocality and uncertainty are therefore assumed to be low: the task is clear and easy to understand. However, creating something asks for a whole new way of handling information which results in higher equivocality and uncertainty: the task is not clearly defined and can be interpreted in different ways. If time had permitted, this classification could have been subject to validation by experts or pre-tested within the target group of the study. This could not be done due to time limitations in the preparation time of the study as the study was performed in a project. This implies that the interpretation of the results will be conditional on the validity of this classification. The classification of learning tasks can be found in Table 4.3.

Table 4.3 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	Moderate to High	High
Evaluating	Moderate to High	High
Creating	High	High

As it is assumed that when the mental complexity increases, equivocality and uncertainty increase too, the first three learning tasks remembering, understanding and applying are classified at a relatively low till moderate (for applying) level of uncertainty and equivocality. The focus in these learning tasks is on finding more knowledge.

With increased mental complexity, uncertainty and equivocality becomes higher too. The learning tasks that focus on the last three educational objectives of Anderson and Krathwohl (2001), that is, analyzing, evaluating and creating, are therefore classified as having a moderate till high level of uncertainty and equivocality. 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. As mentioned above in section 4.1.3, the transfer task relates to the learning need of the learner who approaches the expert whom is asked to transfer his knowledge. For the transfer task, the learning task of the learner is the focus. However, when we look at the uncertainty and equivocality of the learning tasks in transfer situations, the expert is the focus. As the expert transfers knowledge that is already known and understood by him, the transfer task focuses more on the first three educational objectives of Anderson and Krathwohl (2001): remembering, understanding and applying and as a consequence the expected uncertainty and equivocality are low to moderate.

4.1.5 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 (Schreiber et al., 2000), provide us with the four factors to consider when formulating the research question and hypotheses for this study:

1. the learning tasks based on the six cognitive processes
2. the knowledge types that have to be learned based on the three knowledge types
3. the work situations that are separated in learning and transfer situations
4. the appropriate media richness at the two levels defined previously: the level of the used information source and the level of a communication medium when a person is the used information source

The first three factors can be linked based on their characterization in terms of uncertainty and equivocality. For example, learning to “remember” something is less equivocal and uncertain than learning to “create” something. The first three factors determine the selection of sources and communication media during learning and transfer situations. In Figure 4.2, the factors are visualised. Every location in this figure is a possible “state” a knowledge worker can be in when he needs to learn during work. In each of these “states” the theory predicts what would be the fitting information source and/or communication medium that should be used when knowledge needs to be acquired by a person. This figure can be seen as a visual “summary” of the conceptual frame for the study. This figure also addresses the richness of the communication media used. The relation between the media and information sources used are further specified in the next section.

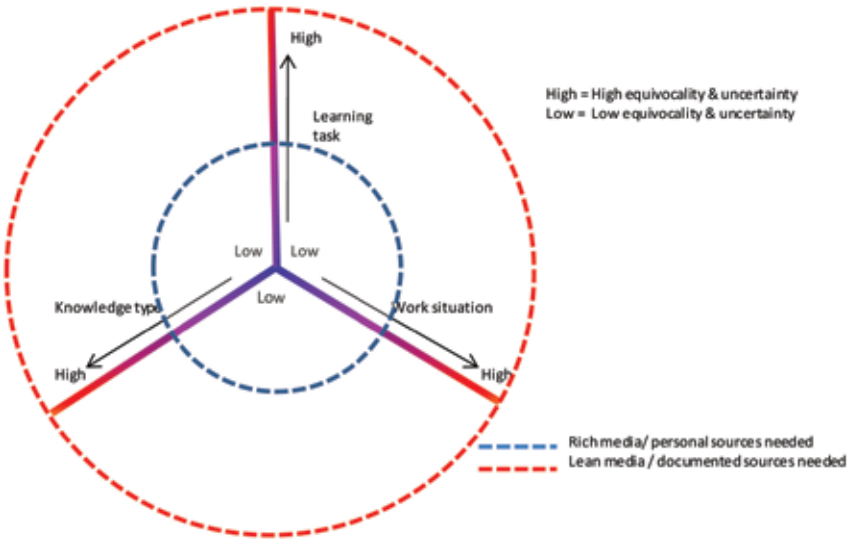


Figure 4.2 Communication Media Richness based on the uncertainty and equivocality of the work situation, learning task and knowledge type

4.1.6 Research question and hypotheses

Every "learning and transfer situation" a respondent will be able to "create" by selecting options in the questionnaire can be described as a triplet <work task scenario><learning task type><knowledge type>. The idea is that for the situation (the triplet) a respondent has created, we will ask respondents which information source for gaining knowledge they actually used when they found themselves in this situation and which information source they would prefer. In total 108 learning and 90 transfer 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 section 4.3.1), conducting analyses for all these situations was not possible. Therefore, a decision had to be made about the research question asked and 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. The research question is:

> *When involved in a learning task at work, can the use of communication media and information sources for acquiring knowledge be predicted by the Media Richness Theory?*

As mentioned earlier, the learning task can refer to either the knowledge that is needed of the person directly involved or the learning task of another person in case it is a transfer situation (see section 4.1.3). To prevent confusion, the first situation is called a learning situation and the second a transfer situation.

4.1.6.1 Formulating hypotheses about media and source usage

Based on the above research question, six hypotheses about *communication media* usage for learning tasks situations and six hypotheses about *information source* usage for learning tasks situations were developed. These hypotheses concretize the research question as they state the specific predictions that follow the research question. Table 4.4 gives an overview of the learning tasks and the accompanying twelve hypotheses. Looking at Table 4.4, it becomes clear that the hypothesized use of media and sources are similar for all learning and transfer situations as learning tasks are either related directly to individual learning or indirectly via transfer situations. For example, from the *expert's perspective* uncertainty and equivocality of all learning tasks in transfer situations are expected to be low to high, which implies use of lean or rich media and sources. When looking at the expected media and source usage in the transfer situations, the perspective of the learner (thus the other person in need of knowledge) is most relevant. That person should receive the knowledge via the medium and source that fits best with his learning task. That is why the expectations of medium and source usage are similar.

Table 4.4 Matching communication media richness and specific media and sources to learning tasks

Learning task	Description in questionnaire (learning need)	Expected communication media richness	Hypothesized communication medium usage in learning and situations	Hypothesized information source usage in learning and transfer situations
Remembering	Learning situation: I was mainly trying to find facts and figures for which it was important that I remembered them well. Transfer situation: He was mainly trying to find facts and figures for which it was important to remember them well.	Lean	H1: lean communication media like text based impersonal documents	H7: Documented sources
Understanding	Learning situation: I was mainly trying to get a good and well founded understanding of the topic I was dealing with. Transfer situation: He was mainly trying to get a good and well founded understanding of the topic about which I was contacted.	Relatively lean	H2: lean communication media like text based impersonal documents	H8: Documented sources
Applying	Learning situation: I was in need of a specific technique, procedure or method that I was seeking to apply. Transfer situation: He was in need of a specific technique, procedure or method that he was seeking to apply.	Lean to moderately	H3: lean communication media like text based impersonal documents	H9: Documented sources
Analyzing	Learning situation: I was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts. Transfer situation: He 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	Learning situation: I was evaluating something and judging it by comparing it with known standards in the field, for example, state-of-the art works. Transfer situation: He 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	Learning situation: I was trying to create something new for which there was no predefined method or procedure. Transfer situation: He was trying to create something new for which there was no predefined method or procedure. I cannot remember.	Rich	H6: rich communication media lace-to-face communication and collaboration	H12:Person

4.1.6.2 An alternative theoretical perspective on media usage: the Social Influence Model of Technology Use

Although this study is based on the theory described above, it might not be possible to explain the results by using this theory only. Literature shows that several other perspectives on explaining media usage are possible. Therefore, the questionnaire 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 et al., 2006). The Social Influence Model of Technology Use was developed by Fulk, Schmitz and Steinfield (1990). This theory explains media choices by relating it with social forces such as work group norms and co-worker and supervisor attitudes and behaviours (Webster & Trevino, 1995).

The study by Turner et al. (2006) focused on investigating the existence of dominant media norms in organizations and describes their influence on, amongst others, the reported media use. Their study shows that the presence of strong organisational norms for instant messaging (IM) and e-mail use and supervisory behaviour may influence employees' use of IM and e-mail.

The concepts used in this study are organisational communication media use and organisational norms about media use. The measures are derived from the measures

used in the study by Turner et al. (2006). Instead of supervisor media use, in this study we measure organisational media use by looking at media use of immediate colleagues. Knowledge workers are often very self-regulating and therefore, in our opinion, more influenced by co-workers' media use than supervisors' media use.
The sub questions is:

> *When involved in a learning task at work, can the use of communication media for acquiring knowledge be predicted by organisational norms and communication media behaviour of colleagues?*

4.2 Design of the study

The research question and accompanying hypotheses will have to be converted into a research design. This section describes the questionnaire, the administering of the questionnaire and the sampling that will be performed.

4.2.1. Testing the hypotheses of information source usage

To test the hypotheses, learning and transfer situations and their specifics must be "composed" by the respondent. In the study a multi-step approach in investigating use of information sources is followed. Each respondent can construct one or two learning and transfer situations from a set of predefined ones. In the first context the respondent is the learner. They have to put themselves back in a learning situation at work and answer the questions with that situation in mind. We will first ask respondents to select a work situation which is similar to the one they were involved in recently and which they can remember well (see for the general work situations section 4.1.3). This provides the work-learn context. After selecting a work situation, they have to specify its task equivocality and uncertainty. Although the equivocality and uncertainty of the work situation and learning tasks are based on the theoretical framework which offered general rules to determine these aspects, the actual experienced uncertainty and equivocality can differ due to the specific case the respondent has in mind. Therefore, we will also measure equivocality and uncertainty by asking the respondents to what extent they agree 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.*

The statements are to be judged on a 5-point rating scale, ranging from strongly disagree (1) to strongly agree (5). Subsequently they must select a learning task (called "knowledge need" in the questionnaire for reasons of understandability). For

example, a learning task is 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 4.1.4). Next, the information sources, either a personal or written source, used for this learning task will have to be selected (see section 4.1.2). Finally, the specific information source and the used communication medium must be selected (see section 4.1.2). This last step, the selection of the used communication medium, is needed to make a direct link to the Media Richness Theory. If the respondent can remember a second learning situation in which he was the learner, the same questions are asked for this second situation.

In addition to this learning situation part, in the second context the respondent is in the role of the expert (that is, the transfer situation) and the same kind of questions and statements are asked. This is a situation in which the respondent was the expert and someone else asked him to provide the knowledge he needed. In the transfer situation, the descriptions of the work situations and learning situations are almost similar to the ones in the learning situation. The difference is that they are now be phrased from the perspective of the person being the expert. For example, the apply situation is formulated as “you were contacted by someone else (a colleague or customer) who asked for advise or instructions in your area of expertise.” There are five (instead of six in the learning situation) work situations; the acquire situation “you were asked to inform someone who was trying to catch up with recent developments in your field of expertise” is seen as irrelevant, as it was assumed that this situation is similar to “you had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, for example by giving a presentation or by writing a report (from the learner’s perspective: “acquire knowledge”.

Also the questions concerning uncertainty and equivocality are asked. There are again six learning task descriptions but they represent the context of the person asking for knowledge (the “learner”). Similar to the role of the learner, the respondent is able to answer the same questions about another situation in which he was the expert too.

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 difference, we will have to figure out whether actual and preferred use are the same, given the same type of learning situation. For this reason respondents are also asked about the source they would prefer to have used in the situations they were in as a learner and an expert.

The second area of interest is related to the alternative explanation of information source usage for acquiring knowledge: the Social Influence Model of Technology Use. Therefore, subsequent to the questions related to the learner and expert role, 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 are included. These questions are 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 can 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 ia carried out at one of the organisations involved in the project 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 is to dovetail as good as possible to the experiences of the target group. Possible errors or ambiguities, such as errors in language, can come to light in the pre-test. A special pre-test version was made available on SurveyMonkey®. The results will be processed and the questionnaire will be adjusted based on these results. The final version of the questionnaire can be found in Appendix 2.

4.2.2 Approaching knowledge workers in Europe: sampling

For this study the same holds true that held true for the study described in Chapter 3: it's next to impossible to draw a random sample of knowledge workers in Europe. Foremost, if they are 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 "snowballing" sample procedure that intends to maximize the response as used in the study described in Chapter 3. This approach entails that organisations from the researchers' network (including organisations involved in the project) will have to get in touch with some of their contacts in different organizations (first step) and ask them to find some suitable respondents (second step). This means that there can be a few contacts that deliver many participants, but there can also be many contacts that each deliver a few participants. It also means that it is not possible to influence the precise number of people who will receive a request to participate, and thus it is not possible to calculate a response rate. The contacts can come from organizations like current or former customers, associations, daughter companies, and so on. The aim of this two-step approach method is to capitalize on personal relations. By approaching the contacts of the network and ask them to look for some participants, relational obligations start

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 is 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 are provided in order to keep the selection of respondents under control. Suitable respondents are 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. The reason for this is that these knowledge workers, who spent at least 60% of their working time at such a workplace, have direct access to all types of sources and media distinguished in this study.

The final version of the questionnaire was made accessible using the SurveyMonkey® service. People willing to participate received an URL to the site via e-mail where they could find the questionnaire. They could fill in the questionnaire anonymously. As use is made of a network of different European companies, the questionnaire was made available in English as well as German. A native German speaker, who is quite familiar with English, was employed to make sure that the questions, and as a consequence the outcomes, are comparable across both language groups.

4.3 Results

4.3.1 Description of the sample

Due to an unexplained problem with the questionnaire in SurveyMonkey® not all people who filled in the questions dealing with learning and transfer 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. Percentages for those variables are based on these 84 cases.

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. 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 4.5 below shows the results.

Table 4.5 Average number of points (out of 100) allocated to three types of knowledge work (constant sum scale)

Types of knowledge work	Average number of points
Developing new knowledge	28
Passing on knowledge to others	32
Using obtained knowledge	40

From Table 4.5 it can be concluded that all types of knowledge work are present in the sample.

We asked the percentage of time the respondents worked at a computer-based workplace (see Table 4.6).

Table 4.6 Time spent at a computer-based workplace

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

Table 4.6 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%. The computer-based workplace, and its available sources, is thus omnipresent in the daily work of the respondents.

The aim was to reach a broad range of organisations, so we asked for the size of the organization (see Table 4.7).

Table 4. 7 Size of company

Company size	Percentage of answers (n=84)
Small (<50 employees)	18
Medium (50-250 employees)	27
Large (>250 employees)	55

From Table 4.7 it is clear that in this sample the proportion of people in large organisations is the highest. More people from medium-sized companies are included than in the Chapter 3 study. This could be due to the fact that the organisations were also approached using the network of one specific organisation, which consists of a fairly large number of medium-sized organisations.

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 majority of the respondents (64%) is between 21 and 40 years, most (70%) 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%) and males are in the majority (65%). 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%) or experienced (34%).

These numbers show an acceptable distribution over the relevant variables: they indicate a sample with experienced persons in their jobs. For the purpose of this study the overrepresentation of experienced persons is maybe less serious than it would have been for the Chapter 3 study. The latter was more directed to obtaining a general overview of learning during work, while the current makes it more likely that a wider variety of learning and transfer situations have been experienced. It also makes it more likely that they can meaningfully remember situations in which they are the expert. Nevertheless, there is reason for some caution, as we can't be sure that the way experts deal with learning and transfer situations at work is similar to the way novices do it. In Chapter 3 it was found that experienced persons were more inclined to use computer-based sources when dealing with an information need.

An issue that was not addressed in the Chapter 3 study, 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 learning situations and the situations in which a person is the expert. The more positive these attitudes, the greater the likelihood that their (self) reports represent situations they actually were involved in. Table 4.8 shows the results for the questions related to attitudes and motivations (Scale from 1(disagree) to 5 (agree)).

Table 4.8 Average judgements (mean scores on a 5-point scale)) for learning attitudes (n=84)

Learning attitude	**Mean**	**SD**
At work, I enjoy to learn	4.69	.47
At work, I learn something new every day.	4.04	.78
Learning is merely a way to increase my career opportunities.	2.52	1.21
I am more confident when I frequently increase my professional knowledge.	4.37	.71
I only learn what is necessary for completing work tasks.	1.81	.87
I organize my learning time carefully.	2.27	.97
When I am working on a new subject matter, I try to work out for myself exactly what is being said.	4.11	.76
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.	3.57	.95

As can be seen in Table 4.8, all participants learn frequently and most also learn something new every day. Based on Table 4.8, we can also 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, and already mentioned in section 4.1.6, to answer a research question related to all different learning and transfer situations and to test the hypotheses and analyze the data for different learning and transfer situations, there should be a sufficient number of respondents (10) in every possible combination of work situation and learning tasks. As a consequence, the focus of the research question is on learning tasks and only the hypotheses from Table 4.4 can be tested with the data set.

4.3.2 Use of information sources and communication media for learning and transfer situations

Before answering the research question and testing the hypotheses, the characteristics (that is, which situation was picked, how was uncertainty judged, etc.) of learning situations that are chosen by respondents are described. Respondents could, in total, fill out in the questionnaire two learning situations (where they are the learner) and two transfer situations (where they are the expert). Because the number of participants that filled in the first learning situation (n=125; this includes the participants that did not filled in the background questions) and the first transfer situation (n=89; this also includes the participants that did not filled in the background questions) are the largest, we focus on these two data sets. The second learning situation and the second transfer situation were filled in by respectively seventeen and six respondents, too few to be usable for more detailed analysis. They could have been added to the set of first learning and transfer situations, but we were not sure if the saliency of the first and second situation are comparable. As the answers rely on the memory of the respondents, it could be the case that this was more reliable for the first than for the second situation, so merging them could lead to answers with different levels of levels of reliability, calling for a separate analysis of the two sets of situations.

First in section 4.3.2.1 learning situations are described by the selected work situations and learning tasks. Next, the perceived uncertainty and equivocality of these learning situations are described in section 4.3.2.1.1. Next, in section 4.3.2.1.2 the six hypotheses are tested: in section 4.3.2.1.2.1 the actual use and predicted use are compared and in 4.3.2.1.2.2 the preferred use of information sources is compared with the actual use of these sources.

In section 4.3.2.2 the transfer situations picked by the respondents are described. The perceived uncertainty and equivocality of these transfer situations are described

in section 4.3.2.2.1. Subsequently, in section 4.3.2.2.2, the results related to testing the six hypotheses of the transfer situations are described. In section 4.3.2.3 the results are summarized and a conclusion about the results is given.

4.3.2.1 Learning situations

A *learning situation* consists of two elements:
1) the selected work situation
2) the selected learning task

We asked respondents if they could select a work situation in which they were involved recently and which they could remember well. In total 125 respondents selected a work situation for the first learning situation. In Table 4.9[26], an overview is given of the selected work situations in which the respondents needed to find information, knowledge or expertise.

Table 4.9 Selected work situations (n=125)

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

Based on Table 4.9, we can conclude that most respondents selected the work situation where they needed to find information, knowledge or expertise when they had to tackle a new assignment or project or because they were new in the company

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

or department and wanting to find out how things were being done. Solving a problem because something had gone wrong or something occurred in an unexpected way was selected least.

After selecting a work situation, respondents had to select the specific learning task[27] they experienced in the above situations (see Table 4.10).

Table 4.10 Selected learning task (n=97[28])

Learning task	Description in questionnaire	Percentage (%)
Understanding	I was mainly trying to get a good and well founded understanding of the topic I was dealing with.	51
Applying	I was in need of a specific technique, procedure or method that I was seeking to apply.	14
Creating	I was trying to create something new for which there was no predefined method or procedure.	11
Analyzing	I was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.	10
Remembering	I was mainly trying to find facts and figures for which it was important that I remembered them well.	8
Evaluating	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 4.10 shows, half of the respondents describe their learning task as “getting a well founded understanding of a certain topic” (51%). Other learning tasks 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%). As we know the work situation selected, it is interesting to see if there is a relation between certain work situations and learning tasks. Analysis shows that the selected work situation is not related to the selected learning task (χ^2=36.93825, p>.05), indicating that they are independent of each other. Therefore, results from analyses carried out for the learning tasks are independent from any effects of the work situations.

4.3.2.1.1 Uncertainty and equivocality of learning situations: work situation and learning task

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. These aspects are derived from the Media Richness Theory. Via two statements, one about each aspect, respondents could judge the extent to which they agreed

[27] 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.

[28] Due to missing data the n is sometimes lower than 125, in this case 97.

or disagreed with the statements. Their judgements also serves as a verification of the classification of uncertainty and equivocality made by the researches as described in section 4.1.3. For uncertainty the statement was: “I felt very uncertain about the things I had to do.” For equivocality the statement was formulated as[29]: “What I had to deliver was very well defined.” 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 4.11 gives the results.

Table 4.11 Average judgement (mean) of uncertainty and equivocality of the selected work situation in learning situations

Work situation	Description in questionnaire		Expected judgement	N	Mean	SD
Acquire knowledge	Were new in the company or department and you wanted to find out how things were being done.	Uncertainty	Low (<3)	26	3.58	1.24
		Equivocality	Low (<3)	26	2.27	1.00
Acquire knowledge	Had to tackle a new assignment or project, and you needed to acquire the most important knowledge.	Uncertainty	Low (<3)	37	2.65	1.09
		Equivocality	Low (<3)	37	2.62	1.21
Acquire knowledge	Were trying to catch up with recent developments in your field of expertise.	Uncertainty	Low (<3)	16	2.44	1.26
		Equivocality	Low (<3)	16	3.06	1.61
Create knowledge	Had to come up with a creative and innovative idea or solution to a problem.	Uncertainty	High (>3)	9	2.89	1.17
		Equivocality	High (>3)	9	2.56	.88
Apply knowledge (diagnose)	Needed to solve a problem because something had gone wrong or something occurred in an unexpected way.	Uncertainty	Low to moderately (<4)	6	3.50	1.23
		Equivocality	Low to moderately (<4)	6	2.67	1.51
Apply knowledge (design)	Needed to design or configure something, like a part of a product, service or method for an internal or external customer.	Uncertainty	High (>3)	11	2.73	1.27
		Equivocality	High (>3)	11	2.36	.92

In Table 4.2, the uncertainty and equivocality of work situations was classified by the researchers. This expected judgement is described in the 3rd column in Table 4.11.

[29] 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.

By looking at the results in Table 4.11, 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). 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.

These results imply that they do not support the expected higher level of equivocality for the work situation (as described in section 4.1.3) 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. It was decided for the analyses to, if possible, continue with both the level of uncertainty and equivocality of work situations based on our classification as well as the levels based on respondents' judgements.

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 4.11 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 can not 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.

The judgement of uncertainty and equivocality of respondents can also be related to the learning tasks, see Table 4.12. The equivocality and uncertainty of a learning task was not measured directly, but derived from the work situation to which the selected

learning task was linked. These judgements are used to verify the classification of learning tasks as described in Table 4.3 in section 4.1.4.1.

Table 4.12 Average judgement (mean) of uncertainty and equivocality of the selected learning task in learning situations

Work situation	Description in questionnaire		Expected judgement	N	Mean	SD
Remembering	I was mainly trying to find facts and figures for which it was important that I remembered them well.	Uncertainty	Low (<3)	6	1.33	.82
		Equivocality	Low (<3)	6	3.50	1.23
Understanding	I was mainly trying to get a good and well founded understanding of the topic I was dealing with.	Uncertainty	Low (<3)	44	2.14	1.31
		Equivocality	Low (<3)	44	2.64	1.16
Applying	I was in need of a specific technique, procedure or method that I was seeking to apply.	Uncertainty	Low to moderately (<4)	12	2.25	1.55
		Equivocality	Low to moderately (<4)	12	3.17	1.12
Analyzing	I was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.	Uncertainty	Moderately to high (>2)	9	2.11	.93
		Equivocality	Moderately to high (>2)	9	3.33	1.50
Evaluating	I was evaluating something and judging it by comparing it with known standards in the field, for example, state-of-the art works.	Uncertainty	Moderately to high (>2)	5	1.80	.84
		Equivocality	Moderately to high (>2)	5	2.20	.45
Creating	I was trying to create something new for which there was no predefined method or procedure.	Uncertainty	High (>3)	10	1.80	.63
		Equivocality	High (>3)	10	3.10	1.10

In Table 4.3, in section 4.1.4.1, the uncertainty and equivocality of learning task were classified by the researchers, which is in the “Expected judgment” column in Table 4.12. Table 4.12 shows that mostly uncertainty and equivocality were not judged to be extremely high but rather to be 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 as described in Table 4.3. Only in case of “facts and figures” the equivocality seems to be higher than average (mean=3.50), but this was not expected. However, the results support the expectation of a low uncertainty (mean=1.33) if the learning task is “facts and figures”. However, also for “evaluating something” (mean=1.80), “analyzing a problem” (mean=2.11) and

"creating something new" (mean=1.80) uncertainty is low: this was not expected. For "technique, procedure or method" the results support the expected low to moderate level of uncertainty (mean=2.25). Like above, it was decided for the supplementary analyses to, if possible, continue with both the level of uncertainty and equivocality of work situations based on theory as well as the levels based on respondents' judgements.

It would be interesting to see if the judgement of uncertainty and equivocality differ for each of the learning tasks. Based on the results in Table 4.12, 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 learning task.

Summarizing these results, it is obvious that the expected uncertainty and equivocality of most work situations and learning tasks are not supported by the results[30]. The uncertainty of most work situation was judged to be moderate, with the exception of acquire knowledge when new in the company and applying knowledge for diagnosing. The equivocality of all work situations was judged to be moderate. The uncertainty of all learning tasks is judged to be rather low, which is not in line with the expected uncertainty. The equivocality is only judged to be high for remembering and low for evaluating; this is in contrast with the expected judgements. The equivocality of the other learning tasks is judged to be rather moderate, which is also not in line with the expected judgements. Implications for answering the research question and testing the hypotheses are explained in the next section.

4.3.2.1.2 Testing the twelve hypotheses for the learning situations

In total six hypotheses about communication media and six hypotheses about information source usage were formulated (see Table 4.4). In this section we test if these hypotheses are accepted or rejected, based on the data from the questionnaire.

Referring to Table 4.12, we can state that the reported levels of uncertainty and equivocality associated with the selected learning tasks, 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 learning task was not measured directly, but derived from the work situation to which the selected learning task was linked. As there is no relation between selected work situation and selected learning task (see remark below Table 4.10), this derivation is open to discussion. Secondly, the hypotheses could still be accepted if we take this judged certainty and

[30] 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.

equivocality instead of the theoretical one as the starting point of the analysis, as they are about source and media usage and not about certainty and equivocality which are given. Therefore, this is also investigated. The testing of the hypotheses could only be carried out with small group sizes, which limited the use of statistics.

4.3.2.1.2.1 Actual use and hypothesized use of information sources and media

The data concerning learning tasks and used information source is shown in Table 4.13.

Table 4.13 Learning tasks and used information sources in learning situations (n=97)

Used information source	**Learning task**					
	Facts and figures	**Well founded understanding**	**Technique, procedure or method**	**Analyzing a problem**	**Evaluating something**	**Create something new**
A person	25%	12%	29%	30%	20%	18%
A documented 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 4.13 is that a combination of information sources, a combination that leads to rich sources, occurs most frequently for satisfying a learning task. This finding confirms the results found in the Chapter 3 study that often personal and documented sources are combined.

The first three learning task relate to three hypotheses about media usage (H1, H2 and H3) and three hypotheses about source usage (H7, H8, and H9). For these first three learning tasks, it was hypothesized that documented sources would be used. Table 4.13 shows that for these three learning tasks, both sources were used most frequently. 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. The hypothesized communication media were moderately rich to lean media. Results show that communication media that were used most in these situations were face-to-face (rich) and email (relatively lean). This is not in line with the hypotheses. The three hypotheses about media usage H1, H2 and H3 and the three hypotheses about source usage H7, H8, and H9, can therefore be rejected, based on these results. However, these results are based on a small amount of data, and should be interpreted with care.

If, as expected, lean information sources, that is documented sources, were used for satisfying the learning task “fact and figures”, a search on the internet was used (13%). For “well founded understanding” 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 learning task was “technique, procedure or method”, a help system or guidebook (50%), documented experiences (25%) or articles and books (25%) were consulted.
Table 4.13 also shows that using only personal sources occurred less frequently than using both sources. In case of “facts and figures” an employee (13%) was consulted[31]. 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 information 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.

For the last three learning tasks “analyzing a problem”, “evaluating something” and “create something new” also three hypotheses about media usage (H4, H5 and H6) and three hypotheses about source usage (H10, H11, and H12) were formulated. It was hypothesized that a moderately rich to rich communication media would be used and that a person would be used as a source. Table 4.13 shows that if these learning tasks were selected, the respondents used both sources in most cases. 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. These were in most cases combined with consulting a known expert, a person someone works with or a colleague. The communication medium that was used most in these situations was a face-to-face conversation (rich). These results are in line with the hypotheses about source and communication media usage in these more complex situations. The three hypotheses about media usage H4, H5 and H6 and the three hypotheses about source usage H10, H11, and H12, can therefore be accepted, based on these results.
If for these learning tasks a documented source was used, 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 the rich medium face-to-face contact, which is similar to the expectations about communication media usage.

[31] Due to unknown data collection problems the results of the other 87% is lost for this specifc case.

All the percentages in this part are based on small data sets, as these learning tasks 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.

As mentioned above, the hypotheses could still be accepted if we take the uncertainty and equivocality as judged by the respondents as the starting point of the analysis, as the hypotheses are about source usage and not about certainty and equivocality which are given. Therefore, this is also investigated for the hypotheses that relate source usage (H7-H12). However, as there are 25 possible combinations of uncertainty and equivocality (5x5 rating scale values) the data set it too small to carry out a meaningful analysis based on all these values. To solve this problem, the judged uncertainty and equivocality of the first learning task are summed and together they form the "MRT value, a kind of combined measure that expresses the "complexity" of the task. This means that, for example, the higher the value the more combined uncertainty and equivocality was experienced. Table 4.14 shows the MRT value for source usage based on respondents' judgements of uncertainty and equivocality.

Table 4.14 MRT value for source usage based on respondents' judgements of uncertainty and equivocality (n=97)

	Used Source			
MRT	**A person**	**A documented source**	**Both**	**None**
Value	**%**	**%**	**%**	**%**
2	100	0	0	0
3	0	58	42	0
4	27	0	73	0
5	22	22	56	0
6	22	19	60	0
7	13	13	75	0
8	33	50	17	0
9	0	50	25	25
Total	**19**	**26**	**55**	**100**

Results show that the value of the MRT is significantly related to sources usage ($\chi 2=46.101$, $p<.05$). However, the results are ambiguous: as the MRT value increases it was expected that a person or both sources would be used more and that documented sources would be used less. So Table 4.14 shows mixed results. These results therefore do not seem to confirm the hypotheses (H7-H12) about source

usage, even if the relation is significant. However, as mentioned earlier, the sample sizes were quite small, thus these results should be interpreted with care.

4.3.2.1.2.2 Preferred use and actual use of information sources and media

In the previous section we investigated the relation between learning situations and actually used information sources and media. As mentioned before, the Media Richness Theory predicts preferred use as it focuses on the optimal fit between task and media. In order to see if preferred use and actual use differ for a similar type of learning situations, additional analyses were performed. Figure 4.4 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.

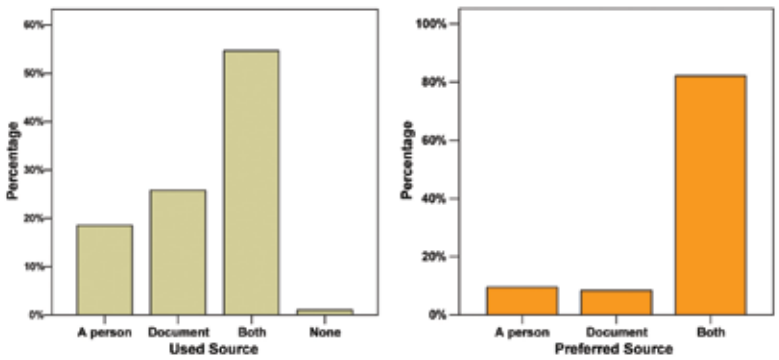


Figure 4.4 Comparing used source and preferred source in learning situations

The result of a Chi-square test shows that the used source is significantly related to the source preferred (χ 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 information sources. Nonetheless, Figure 4.4 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 4.4, it stresses the preference for having a variety of information 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.

4.3.2.2 Transfer situations

The study was not only about information source usage in situations in which the respondent needed to find information or knowledge. One of the four knowledge work behaviours of Kelloway and Barling's types of behaviours (2000) addresses transferring knowledge. Some learning task mentioned in the research question and six accompanying hypotheses relate to these transfer situations. The questionnaire

therefore also addressed situation in which the respondent was asked to share his knowledge because someone else needed information or knowledge. In total 89 respondents selected a work situation for a transfer situation they experienced recently and could remember well (see Table 4.15).

Table 4.15 Selected work situations for the transfer situations (n=89)

Transfer situation description in the questionnaire	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, for example 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, for example 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 Table 4.15 show that respondents were most frequently asked for advice or instructions in their area of expertise and to comprehensively inform a colleague or customer about a certain topic in their area of expertise. Only 2% of the respondents could not remember a transfer situation.

We also asked how the respondents would describe the learning task of the other person in this situation (see Table 4.16).

Table 4.16 Selected learning task for the transfer situation (n=85)

Learning task	Learning task of the other person	Percentage (%)
Understanding	He was mainly trying to get a good and well founded understanding of the topic about which I was contacted.	45
Applying	He was in need of a specific technique, procedure or method that he was seeking to apply.	21
Remembering	He was mainly trying to find facts and figures for which it was important to remember them well.	15
Creating	He was trying to create something new for which there was no predefined method or procedure.	7
Evaluating	He was evaluating something and judging it by comparing it with known standards in the field, for example state-of-the art works.	6
Analyzing	He 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 4.16, respondents were asked most frequently for sharing knowledge with the other person so he could get a good and well founded understanding of a certain topic. In addition, they were consulted the least for sharing knowledge about analysing a problem.

To see if there is a relation between the selected transfer situation and the selected learning task, a Chi-square analysis was performed. Results show that the selected situation in the transfer situation is not related to the selected learning task in the transfer situation (χ^2=21.875, p>.05). Therefore, results from analyses carried out for the transfer tasks are independent from any effects of the work situations.

4.3.2.2.1 Uncertainty and equivocality of transfer situations

The selected transfer 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 the learning situations. The judgements can also be used to verify the classification of transfer situations as described in section 4.1.3.

Table 4.17shows the averages for uncertainty and equivocality for the selected transfer situations.

Table 4.17 Average judgement (mean) of uncertainty and equivocality of the selected transfer situation

Selected transfer situation		N	Mean	SD
Had to comprehensively inform a colleague or customer about a certain topic in your area of expertise, for example by giving a presentation or by writing a report.	Uncertainty	25	2.08	1.29
	Equivocality	25	2.96	1.21
Were contacted by someone else (a colleague or customer) who asked for advise or instructions in your area of expertise.	Uncertainty	26	2.00	1.20
	Equivocality	26	3.00	1.10
Had to advise a new co-worker in your department or company of how things were being done.	Uncertainty	9	1.89	.78
	Equivocality	9	2.89	1.36
Had to document your expertise for someone else, for example in a project hand-over or because you left the department or company.	Uncertainty	10	2.40	1.43
	Equivocality	10	2.20	.92
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	1.15
	Equivocality	16	2.94	1.34

It was expected that uncertainty and equivocality would vary between low to moderate for all transfer situations. Table 4.17 shows that both uncertainty and equivocality do not seem to play a major role in the selected transfer 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 transfer 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 transfer situations.

We can test whether there are significant differences in uncertainty and equivocality between the selected transfer 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 transfer 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, for example by giving a presentation or by writing a report.

For the other transfer 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 was selected.

When we look at the selected learning task, we can ask if the judgement of uncertainty and equivocality differ in relation to this selected learning task. As the expected uncertainty and equivocality of learning tasks are described in section 1.1.4.1, the results are also used to verify this classification. In Table 4.18 the judgements of uncertainty and equivocality are shown.

Table 4.18 Average judgement (mean) of uncertainty and equivocality of the selected learning task in transfer situations

Learning task	Description of learning task of the other person		N	Mean	SD
Remembering	He was mainly trying to find facts and figures for which it was important to remember them well.	Uncertainty	13	1.62	.51
		Equivocality	13	3.00	1.35
Understanding	He was mainly trying to get a good and well founded understanding of the topic about which I was contacted.	Uncertainty	38	1.89	1.01
		Equivocality	38	2.68	1.19
Applying	He was in need of a specific technique, procedure or method that he was seeking to apply.	Uncertainty	18	2.61	1.72
		Equivocality	18	3.33	1.03
Analyzing	He was analyzing a problem or large body of information by breaking it into constituent parts and by organizing the parts.	Uncertainty	4	3.50	1.29
		Equivocality	4	1.75	.96
Evaluating	He was evaluating something and judging it by comparing it with known standards in the field, for example state-of-the art works.	Uncertainty	5	1.60	.89
		Equivocality	5	3.20	1.10
Creating	He was trying to create something new for which there was no predefined method or procedure.	Uncertainty	6	1.50	.55
		Equivocality	6	3.00	1.27

It was expected that uncertainty and equivocality would be judged as being low to moderate, but can this expectation be verified? The results show that uncertainty and equivocality were overall not high, which seem to support the expectations. However, in case the learner was analyzing a problem, uncertainty is judged relatively high (mean=3.50). In addition, equivocality is judged relatively higher for most of the learning tasks. So concluding, it can be said that these results support most of the expected levels of uncertainty, but not those of the equivocality of the learning task 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 learning task in the transfer situation.

4.3.2.2.2 Testing the twelve hypotheses for the transfer situations

Based on the research question, six hypotheses were formulated about information source usage and six hypotheses were formulated about communication media usage in transfer situations, see Table 4.4. In a transfer situation the person in need of knowledge contacts the 'knowledge provider' via a communication medium. This step is not taken into account. The 'knowledge provider' can use a source to find the sought knowledge. He then uses a communication medium to communicate with the person in need of the knowledge.

In the transfer situations respondents could indicate which source they used to find the information, knowledge or expertise that the other person needed. They could also indicate how they communicated with the person in need of the knowledge. Table 4.19 gives an overview of the used sources in the transfer situation, differentiated for the selected learning task of the other person.

Table 4.19 Learning tasks and used information sources in transfer situations (n=85)

Used information source	**Learning task of the other person**					
	Facts and figures	**Well founded understanding**	**Technique, procedure or method**	**Analyzing a problem**	**Evaluating something**	**Create something new**
A person	15%	8%	11%	0%	0%	0%
A documented 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%**

It was hypothesized for the first three learning tasks that lean media (H1, H2 and H3) and documented sources would be used (H7, H8, and H9). The results in Table 4.19 show that when consulted, most participants used a documented source to find the knowledge, information or expertise that the other person needed. We also asked about the specific documented sources used. 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 learner occurred most via (the rich) face-to-face conversation. This is not in line with the expected use of lean communication media. However, the communication medium used by the learner may have influenced the medium used by the person that had to provide the knowledge. Unfortunately, no data is available about the media used by the learners in these transfer situations, but results from the learning situations indicate that face-to-face communication is used frequently. These results show that the three hypotheses about media usage H1, H2 and H3 are rejected and the three hypotheses about source usage H7, H8, and H9, can be accepted. However, it should be noted that the data set is very small.

If the source “a person” was used as the information 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 person in case of “well founded understanding” was mostly face-to-face. For the other two learning tasks this data is missing. The contact with the learner 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. Results also show 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 other person took place via face-to-face (rich) conversations. This is again not in line with the expected use of lean communication media.

Using no sources happened frequently for the first three learning tasks, especially when it concerned a technique procedure or method (28%).

For the last three learning tasks “analyzing a problem”, “evaluating something” and “create something new”, it was hypothesized that rich media (H4, H5 and H6) and a person as a source would be used (H10, H11, and H12). Table 4.19 illustrates that documented sources were used more often to find the needed information, knowledge or expertise for the other person. 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” existing work results or documented experiences were used.

Most of the communication with the other person took place 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”. Although the data set is very small, these results do not support the three hypotheses about media usage H4, H5 and H6 and the three hypotheses about source usage H10, H11, and H12. They should all be rejected.

No persons were used as a source in case of the last three learning tasks, although both sources were used sometimes till frequently; 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 other person and the contact with the information source “a person” most times took place via (rich) face-to-face communication, although using email (relatively lean) occurred too for “creating something new”. These results provide mixed support for the expectation of using rich media.

Using no sources happened frequently for these three learning tasks, but most for “evaluating something” (40%). The notion of using no sources implies that the knowledge of person consulted was sufficient for satisfying the learning need of the other person. It also means that a rich source was used by the person in need of the knowledge. The results do not support the hypotheses for the last three learning tasks, 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 learning task is not related to the used source (χ^2=12.933, p>.05).

The hypotheses for the transfer situations could still be accepted if we take the uncertainty and equivocality as judged by the respondents as the starting point of the analysis, as the hypotheses are about source usage and not about certainty and equivocality which are given. Therefore, this is also investigated for the hypotheses that relate source usage (H7-H12). However, as there are 25 possible combinations of uncertainty and equivocality (5x5 rating scale values) the data set it too small to carry out a meaningful analysis based on all these values. To solve this problem, the judged uncertainty and equivocality of the first knowledge sharing tasks are summed and together they form the “MRT value”, a kind of combined measure that expresses the “complexity” of the task, just as was done for the first learning situation. This means that, for example, the higher the value the more combined uncertainty and equivocality was experienced. Results show that the value of the MRT is not significantly related to sources usage. These results therefore do not seem to confirm the hypotheses (H7-H12) about source usage. However, as mentioned earlier, the sample sizes were quite small, thus these results should be interpreted with care.

4.3.2.3 Conclusions Media Richness Theory

The aim of this study is to answer the research question if the Media Richness Theory can predict the use of communication media and information sources for acquiring knowledge when involved in a learning task at work. Results show mixed support, which can best be illustrated by looking at the acceptance and rejection of the twelve hypotheses that accompanied the research questions.

Two approaches were taken in testing the hypotheses: testing based on the uncertainty and equivocality of learning tasks derived from a classification by the researchers and testing based on the judgements of participants about uncertainty and equivocality of learning tasks and transfer situations. Unfortunately, because of a small data set per "learning task-used source/medium"-set neither of the hypotheses are neither completely accepted or rejected when starting from the classification made by the researchers; only conclusions as strong as trends can be formulated. The results are simply not convincing enough. However, based on the results, summarized in Table 4.20, we can state that the following trends are found:

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

The hypotheses could still be accepted if the uncertainty and equivocality as judged by the respondents is taken as the starting point. Therefore, the hypotheses are also tested based on the judgements of participants about uncertainty and equivocality of learning tasks and transfer situations. When the hypotheses about source usage were tested this way, results of the learning situations show that the value of a combined value of uncertainty and equivocality is significantly related to source

usage. However, the results are unclear and not easy to interpret unambiguously; they do not seem to confirm the hypotheses (H7-H12) about source usage. However, as mentioned earlier, the sample sizes were quite small, thus these results should be interpreted with care. For the transfer situations the same analysis was carried out, which showed that the value of the combined value of uncertainty and equivocality is not significantly related to source usage. The hypotheses (H7-H12) about source usage were not confirmed.

When looking at these results for answering the research question, two patterns are noticeable. For the learning situations holds true that Media Richness Theory seems to correctly predict the use of communication media and information sources for the three learning tasks that ask relatively the *most* of our thinking abilities: analyzing, evaluating and creating. However, this does not seem to hold for the transfer situations. For the transfer situations, the results seem to indicate that the Media Richness Theory correctly predicts the use of information sources for the three learning tasks that ask relatively the *least* of our thinking abilities: remembering, understanding and applying. An explanation for these patterns is that the correctness of the predictions of communication media and information source usage depend on the complexity of the learning tasks. When looking at learning situations, the predictions are better when the learning tasks become more complex. For transfer situations however, the predictions of information source usage are better when the learning tasks are less complex. Another explanation could be that, independent of the cognitive complexity of learning tasks, for learning situations there is a general preference for using richer media and personal sources. For transfer situations there seems to be a general preference for using lean media or documented sources (with the exception of the sources used in relative simple learning tasks).

Table 4.20 Results of testing the six hypotheses related to matching information source/communication medium richness and specific media to learning and transfer situations (note: n=small)

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

4.3.3 Results related to the alternative theoretical perspective: the social influence model of technology use

As described in section 4.1.6.2, actual use of communication media is probably not only a question of a rational objective matching process between media and tasks, 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. A sub question of this study addresses the influence of organisational norms and communication media behaviour of colleagues on media 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. There are two situations to consider when we look at the influence of norms on media usage: the learning and the transfer situations. 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 differences. If organisational norms about media usage is considered as one variable, variance analysis yields that again there is no significant difference.

It was also investigated if there is a difference in the *preferred* media in the learning situations 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 ($F=4.602$, $p<.05$). The results of the Tukey post-hoc test show that if a documented source is preferred in the learning situation the organisational norms about using discussion forums are more negative (that is, it is appreciated less) then when using both sources is preferred. For organisational norms about media usage and preferred source holds true that no differences were found.

For the used media in the transfer situation the same analyses were performed to see if there was an influence of organisational norms. The analysis of the difference in organisational norms about media *used* in the transfer situations between the individual media usage for each of these media reveal that there is a significant difference for chat ($F=3.179$, $p<.05$) and telephone ($F=5.046$, $p<.05$). The Tukey post-hoc test shows that if both sources were used in the transfer situation the organisational norm about media usage related to using the telephone was more positive (thus appreciated more) than the norms about the other media. The post-hoc test also reveals that if a person was used as a source in the transfer 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 transfer situations shows no significant difference.

Summarizing, results show that the influence of organisational norms about media usage on the used and preferred source in the learning situations only shows itself when preferred source is related to the organisational norms about discussion forum usage. If a documented source is preferred in the learning situations the organisational norms about using discussion forums are lower than when using both sources is preferred. In transfer situations, the influence of organisational norms about media usage on the used media is significant for chat and telephone. Results show if both sources were used in the transfer situation the organisational norm about using the telephone was more positive that the norms about the other media. In addition, the results show that if a person was used as a source in the transfer 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 (organisational media usage). 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 differences. If we compute a new variable from the seven variables (one for each medium) that represents the total organisational media usage, we see that again there is no significant difference in media usage in learning situations based on organisational media use.

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 ($F=3.213$, $p<.05$). The post-hoc test shows that if using a person as a source was preferred in the learning situation, video conferencing was used less by direct colleagues than when a documented source was used. If organisational media usage by direct colleagues is perceived as one variable, the variance analysis shows that there are no significant differences.

For *used* sources in transfer situations there are no significant differences for organisational media usage when we do a variance analysis for each of the seven media[32]. Also if organisational media usage is computed into one variable, no differences are found.

There is an influence of organisational media usage by direct colleagues on the used and preferred source in the learning situations. Results show that if using a person as a source was preferred in the learning situations, video conferencing was used less by direct colleagues than when a documented source was used. No significant influences were found for the transfer situations.

[32] 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 ($F=.755$, $p>.05$)

Summarizing the results for this alternative perspective to answer the sub question, there are only minor effects of organisational norms and communication media behaviour of colleagues on the selection of media. The found effects show that the used or preferred source is sometimes related to organisational norms about media usage, However The Social Influence Model of Technology Use is able to explain only small fractions of the behaviour.

4.4 Summary and conclusions

The main research question of this study addresses the question if the use of communication media and information sources for acquiring knowledge at work can be predicted by the Media Richness Theory. The Media Richness Theory links properties of tasks, uncertainty (about how to perform a task) and equivocality (what should be the results of a task), to information 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 information sources and thus richer communication media, media that can convey more cues, are needed to guarantee an effective transfer of knowledge.
Based on the research question, twelve hypotheses about communication media and information source usage were derived and tested. In addition, the second sub question of this study addresses an alternative perspective on media usage: if the use of communication media for acquiring knowledge can be predicted by organisational norms and communication media behaviour of colleagues. This alternative perspective was derived from the Social Influence Model of Technology Use. It claims that the Media Richness Theory is incomplete as organisational 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 knowledge worker can be in were addressed: a situation where he is the learner (learning situation) and a situation where he is the expert sharing knowledge with someone else (transfer situation). People participating in the research could "construct" a specific combination of a work situation and a learning task (from a predefined list) and report about the information 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, learning tasks and communication media were reported for both situations a person can be in. In the *learning 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

learning task selected most frequently was trying to get a good understanding. This learning task is associated with average uncertainty and equivocality. For the learning task, a combination of personal and documented sources is used the most by far, 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 *transfer 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 learning task of the person seeking assistance, finding a good and well founded understanding of the topic of the transfer, 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 information source used by experts 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 an information source.

Taken together these results confirm to a large extent the major finding from the Chapter 3 study that personal contacts are very important, but are often combined with documented sources in a workplace learning context.

The second set of results is relevant for answering the research question. Two approaches were taken in testing the hypotheses: testing based on the uncertainty and equivocality of learning tasks derived from a classification made by the researchers; testing the hypotheses based on the judgements of participants about uncertainty and equivocality of learning tasks and transfer situations. Unfortunately, for the first approach holds true that because of a small data set per “learning task-used source/ medium” the hypotheses are neither completely true nor false; only conclusions as strong as trends can be formulated. As can be seen from Table 4.20, only a limited subset of the hypotheses derived from the Media Richness Theory could be confirmed when testing them based on the classification by the researchers: three hypotheses are completely rejected and nine are partly accepted. For the three learning tasks in learning situations that ask relatively the most of our thinking abilities (analyzing, evaluating and creating) results indicate that the Media Richness Theory correctly predicts the use of communication media and information sources. For the transfer situations however, the results indicate that the Media Richness Theory correctly predicts the use of information sources for the three learning tasks that ask relatively

the least of our thinking abilities (remembering, understanding and applying). One explanation is that the predictive power of the theory seems to be dependent on the complexity of the learning tasks. Another explanation for these results is that for learning situations richer media and personal sources are generally preferred while for transfer situations a general preference for using lean media or documented sources exists (with the expectance of the sources used in relative simple learning tasks).

The testing based on the second approach, respondents' own judgments, showed that for learning situations the results are unclear and not easy to interpret unambiguously. The conclusion is that they do not seem to confirm the hypotheses (H7-H12) about source usage. However, as the sample sizes were quite small these results should be interpreted with care. For the transfer situations the same analysis was carried out, which showed that the hypotheses (H7-H12) about source usage were not confirmed.

Based on these results, the usefulness of the Media Richness Theory to provide the basis for predicting information source usage in workplace learning and transfer situations must be questioned.

For the alternative theoretical perspective based on the Social Influence Model of Technology Use, it can be said that there are only minor effects of organisational norms and communication media behaviour of colleagues on the selection of media.

When looking at the limitations of this study, the fact that the majority of respondents was experienced may have affected the results. As the Chapter 2 study showed, duration of employment of police men at the police force influences the use of sources. The Chapter 3 study showed that the number of years in the current job has some influence on the use of sources. The fact that these differences in source usage behaviour were found, could have affected the results. For example, results showed that in transfer situations the expected lean media usage for the first three learning tasks was not confirmed. However, as the Chapter 3 study showed that digital sources were used more by people that are relatively new in their current job, they may also used digital communication media more for contacting another person. Also the selected learning task may have been different if less experienced knowledge workers formed a larger part of the sample. Thus, the relation between on the one hand job experience and experience within an organisation and on the other hand media and source usage needs to be explored in more detail.

In addition a limitation could be that the uncertainty and equivocality of transfer tasks were measured in terms of how the expert (knowledge provider) experienced them. Knowing how the learner experienced uncertainty and equivocality in the transfer situations could have given more insight in the 'fit' between media richness demanded by the learner, the richness experienced by the expert and media and sources used. This insight is now missing, although the results from the learner roles provide some insight in this relation. However, the Chapter 3 study showed that one

of the bottlenecks learners experience when consulting experts for knowledge is that experts lacks the knowledge or experience to help. This raises the question how well they can understand the learning task of the learner and thus how well they can judge the uncertainty and equivocality that learners experience for their learning task.

Chapter 5

5 The effect of source characteristics on choosing sources for learning

In the previous chapters, the focus was on investigating *what* information sources are used by knowledge workers when they gain knowledge at work (question B as formulated in Chapter 1) and *when* and *why* they use these information sources (question C as formulated in Chapter 1). The study described in this chapter aims to obtain an answer to the question *why* certain information sources are used in these knowledge seeking situations (question C as described in Chapter 1). Based on the knowledge management episode as described by Holsapple and Joshi (2003), the focus is on the moment between the recognition of a knowledge need and the gaining of the knowledge via the available information sources.

The first section starts with an overview of results of the previous studies. This overview identifies the lacking knowledge that is investigated in this study. Subsequently, the theoretical framework and the research questions are described.

5.1 What do we already know?

The Chapter 2 study showed that, in case of a knowledge need, policemen consult personal and digital sources most often. Written paper based sources are consulted the least. In the Chapter 3 study it was found, amongst other things, that personal sources, especially face-to-face contact with colleagues, are important in self-directed learning during work. The Chapter 4 study showed again that personal communication is important when learning during work. The results of these two last studies, moreover, indicate that personal sources are very important in both learner situations *and* knowledge sharing situations, but that knowledge workers often feel that they must be combined with written sources.

In the studies mentioned above, the design of the studies allowed participants to choose the source(s) they preferred to use. For example, participants in the Chapter 4 study were free to choose one or two types of sources that helped them most in a certain learner or knowledge sharing situation. Knowing that knowledge workers tend to combine both personal and written sources, raises the question why they don't exclusively choose to use one. From a theoretical point of view, for example, based on the media richness theory (Daft & Lengel, 1984), one source can be sufficient to satisfy a knowledge need. According to this theory, one medium can facilitate understanding if the uncertainty and equivocality level of the task at hand (for example, the search for knowledge) matches the richness of a medium. This theory was also the main theory that informed the design and formulation of the research question and hypotheses in the Chapter 4 study.

Somehow, using just a single source is often not satisfying the needs of the knowledge seeker, or, in answering a question, the knowledge seekers tended to be on the safe side and intended to use as many sources as possible. This leaves the question open why each of these sources is chosen and what the reason is for choosing a certain source if they are limited to choosing only a single source. Do they have a function for the knowledge worker, maybe one that reaches beyond learning purposes only? Several reasons why these personal or written sources are used can be thought of: first of all these sources provide knowledge that satisfies the knowledge need of the knowledge worker. In addition, there could be practical reasons, because, for example, a colleague is easy to approach, because it is a habit to use a certain source, because it is an organisations' (unwritten) policy to use a certain source, because no other sources are known, because a certain source is trusted most or because the knowledge provided in the source fits best with the knowledge workers' professional vocabulary.

In our research, the Chapter 4 study chose a perspective that looked at the relation between context and content independent source characteristics (in particular richness), including personal as well as written sources, and task features. These two aspects were used to predict source usage. Results of this study showed that source usage, in this specific workplace learning context, could not be very well predicted by using these aspects of sources and tasks.

Therefore, in this study, another perspective on source usage for knowledge seeking is chosen. The aim is to have a perspective that focuses on the why behind the practices and preferences of knowledge workers regarding the use of sources for knowledge gaining in the context of their workplace (research question C as described in Chapter1). Instead of looking at social relations, task features and source features that can be determined independent of a person's intrinsic traits, the attitudinal and contextual normative features related to the knowledge worker's behaviour towards sources is chosen as the starting point. A well known theory amongst behavioural scientists that addresses attitudes and subjective norms is the Theory of Reasoned Action. This theory is derived from the field of information integration theory. In addition, one other factor that was also part of our previous studies is included: work context. This work context fits the perspective that focuses on the knowledge worker and his work context, as addressed by the main research question in Chapter 1. This factor will be explained in more detail in section 5.1.4. In the next section the TRA theory, the accompanying model and its usage in this study is elaborated.

5.1.1 The Theory of Reasoned Action

As mentioned above, this thesis aims to investigate practices and preferences of knowledge workers. Practices refer to actual behaviour and preferences refer to individual attitudes about favouring one thing over another thing. In several theories of

human behaviour, the behavioural intention is a concept used to predict an impressive range of behaviour (Sheeran, 2002; O'Keefe, 2002). The behavioural intention can be defined as an individual's decision or motivation to perform particular actions (Sheeran, 2002). Several social-psychological models have in common that they suggest that the most immediate and important predictor of a person's behaviour is his intention to perform it (Sheeran, 2002). Based on the assumption that the behavioural intention indeed is the most immediate and important predictor of a person's behaviour, it was decided to investigate knowledge workers' behavioural intention and preferences towards source usage. Preferences are often used in the meaning of "attitude" (Phillips, Johnson, & Maddala, 2002). A model that addresses both the behavioural intention and attitudes is the Theory of Reasoned Action (Fishbein & Ajzen, 1980; Fishbein & Ajzen, 1975). Many studies show evidence that behavioural intentions are predictable from the attitudinal and normative components as described in this theory (O'Keefe, 2002). A meta-analysis of the model showed that it has a strong predictive power (Sheppard, Hartwick, & Warshaw, 1988). This attitude-behaviour model probably represents the most influential and well-documented model of attitudes and decisions (Peters, 2007). In this study, this theory is used as another way to describe source usage preferences. First, the Theory of Reasoned Action will be presented. Next, the use of the behavioural intention in this study will be explained. Finally, the research questions will be formulated.

Information integration theory focuses on an individual's attitude formation and attitude change through integrating (for example, accumulating, organising, combining) new information with existing cognitions and thoughts about persons, objects, situations and ideas (Littlejohn & Foss, 2005). An attitude is seen as an accumulation of information about an object, person situation or experience. This new information could come, for example, from one's own experiences or from other sources, like other people. Within the field of information integration theory, Fishbein (Fishbein & Ajzen, 1975) developed the expectancy value theory. This theory centres on the formation and change of attitudes by describing the relation between beliefs and attitudes. An attitude consists of a number of beliefs. According to Fishbein, beliefs can be divided in two types. The first type of belief is "belief in" a thing; this is believing that something exists. The second type of belief is the "belief about" a thing and this refers to a person's sense of the probability that a particular relationship exists between two things. In short, this theory poses that the attitude toward an object (for example, a person, object, situation or idea) is equal to the sum of each belief about that object multiplied with the evaluation of that belief. An attitude can thus be seen as a function of a complex combination of beliefs and evaluations (Littlejohn & Foss, 2005). In an algebraic form, it is represented as follows:

$$A_o = \sum_{i}^{N} B_i a_i \qquad (1)$$

In this formula, Ao stands for the attitude toward the object o, Bi is the salient belief that performing the behaviour leads to some consequence i, ai is the evaluative aspect of Bi (that is how good or bad the consequence is judged) and N is the number of salient[33] beliefs.

Although originally focused on predicting attitude change and formation, the theory also specifies that attitudes are related with behaviour toward the attitude object (Littlejohn & Foss, 2005). For this study this is an important aspect of the theory, as workplace learning behaviour toward the "attitude objects" (i.e., information sources) is at the centre of attention. However, the expectancy value theory cannot be directly used to predict behaviour. The behavioural aspect is worked out in later work of Fishbein. Together with Ajzen he developed the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975, 1980).

This theory states that an important predictor of actual behaviour is behavioural intention. The primary assumption of the TRA is that the behaviour of an individual is determined by his intention to perform the behaviour. That is, the stronger the intention the more likely it is that a person will perform the actual behaviour. Fishbein's earlier work on attitudes is integrated into the TRA. Behavioural intention is determined for one part by the attitude toward the behaviour. The other part consists of the subjective norm. The subjective norm represents a person's general perception of whether important others desire the performance or non-performance of the behaviour (Fishbein & Ajzen, 1975, 1980). In the TRA, the subjective norm can be described by the following formula:

$$SN = \sum_{j}^{N} NB_j MC_j \qquad (2)$$

In this formula, the subjective norm is described as the perceived normative belief regarding referent j's expectations as to whether the individual should or should not perform the behaviour (NBj) multiplied by a person's motivation to comply with each of these referents j (MCj) and N is the number of salient referents (Fishbein & Ajzen, 1975, 1980). The subjective norm is determined by the total set of accessible normative beliefs concerning the expectations of important others.

The behavioural intention is thus determined by personal attitudinal judgements and by social-normative considerations. This theory can be described by the formula:

$$BI = A_B W_1 + (SN) W_2 \qquad (3)$$

[33] In a more recent article, instead of the original formulation of salient beliefs about the attitude object the term accessible beliefs is used as this fits better with currently favoured terminology (Ajzen & Fishbein, 2000).

In this formula BI is the behavioural intention towards an object, AB is the attitude toward the object, SN is the subjective norm, W1 is the empirically derived weight of the attitudinal component and W2 is the empirically derived weight of the normative component (Fishbein & Ajzen, 1975, 1980). This formula shows that, according to the TRA, the behavioural intention is a function of the attitude toward the behaviour times the strength or weight of that attitude plus what others think times the strength of their opinion. An important notion is that with the TRA behavioural intention can be predicted, but not the actual behaviour; people do not always do what they intend to. There may be intervening factors, like time, that inhibit to behave the way one indented to.

Nevertheless, the TRA offers a good starting point for investigating the use of sources to satisfy knowledge needs in a workplace learning context from the perspective of factors mainly bound to individual preferences. In the following paragraph the use of the theory in this study will be detailed.

5.1.2 From the TRA to this study

The previous section outlined the TRA by describing the components of the formula used to represent the theory. The formula shows that the behavioural intention is determined by an attitudinal component and a normative component. The attitudinal component consists of the attitude toward the object and its weight. Moreover, the attitude toward the object is in itself considered as a function of the sum of each belief about the object multiplied with the evaluation of that belief. The normative component consist of the subjective norm, which is considered to be a function of the sum of accessible normative beliefs concerning the expectations of important others and one's motivation to comply with these others. To make the study fit these TRA concepts, the components should be given a specific meaning that allows an empirical investigation of the properties of the model. Looking at formula (3) it becomes clear that the attitude toward the behaviour (A_B in formula (3)) is one of the components that must be operationalised. The beliefs (B_i in formula (1)) must be made explicit: where do they refer to? If it is clear where the beliefs refer to, the meaning of the formula for this study, that is the observable and measurable units that must be brought into play, can become apparent. In this study, the beliefs of the attitude part of the TRA-formula are information source characteristics. The attitude toward source usage is defined by the beliefs about information source characteristics.

An information source, either personal or written, can be seen as an object, as something a person can form an attitude about: someone can have a positive attitude toward, for example, the face-to-face communication medium. The expectancy value theory says that an attitude is a function of beliefs and the evaluations of these beliefs. In this case, beliefs are a person's sense of the probability (or improbability)

that an information source has certain characteristics. The evaluation of these beliefs include this person's evaluation of each of the characteristics, thus if he finds a characteristic good, bad, important etc. Translated into an algebraic form, this is model (1). With this formula a person's attitude toward an information source can be described by collecting data about a person's beliefs and evaluations of beliefs regarding information source characteristics.

The normative part of the TRA will *not* be taken into account in this study. Why not? The focus is on information source usage behaviour of knowledge workers and therefore the choice was made to focus on the attitudinal part. The attitudinal part is directly related to the knowledge worker. The subjective norm refers to norms of others and the perceived pressure to comply with them. It is less directly related to the knowledge worker than to his own attitudes. In the Chapter 4 study, the effect of norms on media usage was already investigated. In that study, the social influence theory of technology use was used (Fulk, Schmitz, & 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. Results of the Chapter 4 study showed only minor effects of organisational norms and communication media behaviour of colleagues on the selection of media. In addition, several studies show that the attitudinal component has been more strongly associated with the behavioural intention than the normative component, even if both are significant (Hale, Householder, & Greene, 2002).

Therefore, this study focuses on this first part of the TRA. If the results show that the operationalisation of the attitudinal part fits with the TRA model, the next step can be to investigate the normative part in a subsequent study.

The behavioural intention is thus investigated by looking at the attitude a person has toward using an information source with certain characteristics. The formula of the TRA (3) is reduced to formula (1) for this study. In this formula AB is the attitude toward using the information source. A_B refers to the expectancy-value theory (model (1)). In this study the expectancy value theory will be operationalised as follows: Ao refers to the attitude toward an information source o. B_i is the strength of belief *i* that a characteristic x is present for information source o. The probability that information source o is associated with characteristic x, hence the evaluative aspect of this belief Bi about information source o, is the operationalisation of a_i. N is the number of salient beliefs. The other parts of the TRA are not included in this study. As the subjective norm is not included, the weight of the attitudinal component in model (3) is not relevant anymore as this weight is relative towards the weight of the normative component.

5.1.2.1 The model fitting approach

Instead of a *theory fitting* approach, like in the Chapter 4 study, a *model fitting* approach is used in this study. The aim is to investigate if the observed behavioural intention to use information sources fits the additive combination of beliefs as described in formula (1). Often, the theory of the TRA is taken as a starting point and the study and measurements are developed in a similar way. For example, data about the attitudinal components of an individual toward a certain behaviour are collected via statements with seven-point scales in a questionnaire. In this way, the belief components of the TRA are directly translated into measurable entities. Based on these measurements, the behavioural intention is predicted which is measured by directly asking the individual what his intention is towards the object(s). An example of this approach can be found in a study by Peters (2007) who empirically examined the expectancy-value judgment model of uses and gratifications in the context of mobile phone use. The expectancy-value judgment model of uses and gratifications is based on the TRA and the theory of planned behaviour[34]. To measure the expectancy-value judgments in the belief components of model (1), respondents evaluated a number of items on seven-point bipolar scales. In addition they had to indicate the probability that using a mobile phone would provide each of the 12 gratifications (beliefs) on seven-point scales. The expectancy-value judgments scores were computed from the product of the two seven-point scales and compared with the expressed intention and actual behaviour of the participants. The better model (1) predicted these intentions and actual behaviour, the better the fit between model and behaviour or intention. However, predictive validity of a model is not the same as descriptive validity of a model. Quite often a wide range of different models can predict the same behaviour with more or less similar precision. From a descriptive validity point of view, the question is not so much if one can predict behaviour, but if the observed behaviour fits the assumptions underlying the model. This is the approach chosen in this investigation, which requires a specific set up of the data collection methods and methods of data analysis.

5.1.3 Investigating the expectancy value part of the TRA

The theoretical elaboration in the previous section, determines the design, data collection and data analysis of this study. Most importantly, the framework is crucial for the formulation of the central research question and associated sub questions. The main research question of this chapter is:

> *When searching for knowledge to complete a work task, can the behavioural intention of knowledge workers toward information sources be described by the expectancy value part of the Theory of Reasoned Action?*

[34] The theory of planned behaviour can be seen as an extension of the TRA, adding perceived behavioural control (Ajzen,1991)

Besides this main research question, there are also several sub questions, like sub questions related to a work related factor that can influence the behavioural intention. These sub questions are introduced, explained and formulated in the subsections below. First, the determination of model fit is introduced, explained and formulated in section 5.1.3.1. Second, the sub questions regarding information source characteristics and the work context will be described in respectively section 5.1.3.2 and 5.1.4.

5.1.3.1 Determination of model fit

The expectancy value theory, as formulated in model (1), states that the attitude toward an object is a function, more specifically the sum, of different beliefs and their evaluations. Each belief has its own impact on the attitude toward the object; together they form the attitude but their contribution can be calculated separately. This sum function implies that the beliefs as formulated in the expectancy value theory are independent. In slightly different words: model (1) can only be accepted as a valid description of behavioural intention if the beliefs in model (1) are shown to be independent of each other. If each of the beliefs is independent, they can be considered to be additive. In measurement theory this is called additive independence (Krantz, et al., 1971).

In this study, beliefs are information source characteristics. The number of information source characteristics involved is three. The three information source characteristics are Accessibility, Network and Terminology. For a detailed explanation and argumentation for this choice, see 1.4.2.

Additive independence in case of three aspects or beliefs (in our case: information source characteristics) is covered by Keeney and Raiffa (1976). They developed a measurement theory and framework for decision analysis. In this type of analysis the value trade-offs and uncertainties that are always at the centre of multiple-objective decisions are addressed (Keeney & Raiffa, 1993). In their theory, they refer to preference instead of behavioural intention. However, the difference between preference and behavioural intention is seen as relatively small as overlap between the two concepts exists. Preference is defined as a “greater liking for one alternative over another or others” (Oxford online dictionary, n.d.). This preference, which can be seen as the accumulation of different attitudes, influences decisions and thereby also behaviour. The behavioural intention is seen as a direct antecedent of behaviour, determined partly by attitudes. Therefore the theory of Keeney and Raiffa (1976) is taken as the equivalent of model (1) from a measurement theory point of view. They describe preferential independence, which exists if the decision maker’s preference evaluation of an object on an attribute does not depend on the decision maker’s fixed preference values on other attributes. This is similar to the condition of additive independence. In addition, Keeney and Raiffa (1976, p. 105) also define

pairwise preferentially independence for specific situations where three attributes are involved. They define it as follows: “If each pair of attributes is preferentially independent of its complement, the attributes are pairwise independent”. Thus, in the case of three or more attributes pairwise preferentially independence replaces single independence as a condition for an additive representation. This can be made clear by the following illustration. Let x, y and z be three attributes and let v be a function of the additive form. In this case, if x, y and z are pairwise preferentially independent, than $v(x, y, z)=v_x(x)+v_y(y)+v_z(z)$ (Keeney & Raiffa, 1976, note that this is formally equivalent to model (1)), if, and only if, the following three conditions are satisfied:

(a) {X, Y} are preferentially independent of Z
(b) {X, Z} are preferentially independent of Y
(c) {Y, Z} are preferentially independent of X

For this particular study, v stands for the attitude towards an information source and x, y, and z represent the beliefs about information source characteristics and evaluations of these beliefs. To be precise, for the attitude towards a information source,

(a) beliefs and evaluations of beliefs about a information source with certain characteristics of {Accessibility and Network} is preferentially independent of beliefs and evaluations of beliefs about a information source with certain characteristics of Terminology
(b) beliefs and evaluations of beliefs about a information source with certain characteristics of {Accessibility and Terminology} is preferentially independent of beliefs and evaluations of beliefs about a information source with certain characteristics of Network
(c) beliefs and evaluations of beliefs about an information source with certain characteristics of {Network and Terminology} is preferentially independent of beliefs and evaluations of beliefs about an information source with certain characteristics of Accessibility.

The above conditions can be combined in one condition d:

> *(d) $v(x,y,z)=v_x(x)+v_y(y)+v_z(z)$ iff {X, Y} is preferentially independent of Z, {X, Z} is preferentially independent of Y and if {Y, Z} is preferentially independent of X*

For the information source characteristics to be pairwise preferentially independent, condition d should hold true. If condition d holds true, model (1) can be accepted

as a valid description of attitudes toward information sources. Therefore, pairwise preferential independence of the information source characteristics is determined by empirically investigating condition d as stated above.

In model (1) the attitudinal component has an evaluative aspect a_i. If the independence conditions hold true, the evaluative aspect of each of the information source characteristics, that is their relative contribution to the attitudinal component, can be determined. This evaluative aspect of each information source characteristic specifies their relative weight in shaping the behavioural intention. Thus the main research question of this study can be made more specific, which is done in this first sub question:

> *Do the observed preferences towards information sources satisfy the independence conditions that are implied by the additive structure of model (1)? If yes, what is the relative weight of each of the information source characteristics in shaping the behavioural intention?*

5.1.3.2 Determination of information source characteristics

Besides the independence aspect of the information source characteristics, another aspect has to be specified. Finding out if condition d holds can only be done if the information source characteristics are given a meaning. An attitude toward an information source can only be present when the information source characteristics are known; this way the beliefs and evaluations of these beliefs that shape the attitude can be formed. In section 5.1.3.1 the three source characteristics were already mentioned, however, a more detailed explanation and argumentation why these information source characteristics were chosen is needed.

Due to practical constraints, not all possible information source characteristics can be taken into account in this study because this would lead to an unmanageable amount of comparisons needed for checking condition d. Therefore, we focus on two dimensions of the information source involved in the search for knowledge: the social aspects that people assign to information sources and the accessibility of the information source. First, the social dimension will be explained. A concept related to these social aspects, that can be found in literature, is the notion of the social–technical gap (Ackerman, 2000). This is the divide between what we know we must support socially in computer supported cooperative work (CSCW) and what we can support technically. Ackerman (2000) argue that there is an inherent gap between the social requirements of CSCW and its technical mechanisms. These social requirements have three dimensions, which they base on the three dimensions of social capital (according to Nahapiet & Ghoshal, 1998), namely:

- A structural dimension, like informal networks which makes it possible for individuals to identify others with potential resources

- A relational dimension, which refers to personal dynamic between individuals in the network like trust, reciprocity, identification, and norms
- A cognitive dimension, referring to common context and language, like shared terminology, shared stories and using shared common objects and artifacts

Although the concept of the social-technical gap originates from a CSCW perspective and not from the (individual) self directed learning perspective, it describes differences between analogue (personal) information sources and digital (written) information sources. The social part of the social-technical gap refers to personal information sources; the technical aspect of the gap refers to a large part of the written information sources found in the Chapter 3 and 4 studies. This theory of the social-technical gap could explain why one information source is not sufficient to satisfy the knowledge seeker's needs: although a written information source may contain all the knowledge needed, having a face-to-face conversation may also shows trust or maintain someone's social network, something that cannot be done by only searching a document on the World Wide Web.

Research by Cross and Sproull (2004) on information seeking by accessing people (personal information sources) shows that often some combination of five different benefits are gained when seeking information this way, namely 1) solutions; 2) meta-knowledge (pointers to databases or people); 3) problem reformulation; 4) validation of plans or solutions; and 5) legitimation from contact with a respected person. In addition, Cross, Rice and Parker (2001) also investigated the influence of organisational and social structures on obtaining one (or more) of these five benefits. The results of this study showed that task interdependence[35] is the strongest and most consistent predictor (see also Rice, Collins-Jarvis, & Zydney-Walker, 1999), especially for solutions. In addition, the results showed that social relations are a weaker predictor, especially when looking at friendship and trust. Based on these results, Cross and Sproull (2004) conducted a study to investigate information relationships for actionable knowledge, that is, knowledge that leads to immediate progress on a current assignment or project. Results of this study showed that 95% of the participants received all five benefits of actionable knowledge from their three most important personal contacts. Results also showed that the relationship with these contacts seems to be richer than with other contacts and that different attributes of the information source, relationship or knowledge seeker seem to be important for receiving each of the five benefits (Cross & Sproull, 2004).

[35] Although the authors did not define task interdependency, it was measured by the extent to which certain persons provide someone with inputs necessary to do their job and/or to whom they distribute outputs from their work.

These studies of Cross and others refer to the information relationship, that is, to the relational function/aspects of the knowledge seeking action for the knowledge seeker. The studies investigate use of information sources from a Social Network analysis perspective. Social network analysis looks at actors (social units like persons) and the direct and indirect ties between them. Describing the structure and patterns of social relationships of actors in a certain social system and trying to understand this, is the fundament of Social Network analysis (Gillespie & Glisson, 1992).

The studies of Cross and others and the Social Network analysis approach show the importance of someone's network at work for gaining information during work. Other studies argue the same. Abrams et al. (2003) state that both applied and scholarly research has made it clear that relationships are critical for knowledge sharing and that ineffective relationships can block knowledge transfer. One of Skule's (2004) seven conditions for informal learning during work refers to having extensive professional contacts. These examples of studies all point toward the relevance of the structural dimension for usage of information sources. Therefore one aspect from this dimension will be taken into account.

The cognitive dimension can also be related to usage of information sources. The study of Rice et al. (1999) described above, showed that for obtaining solutions, task interdependence is a strong predictor. Task interdependence requires some sort of work relation like collaboration or cooperation. A study by Krauss and Fussell (1990) showed that having a shared understanding of contexts, jargon, and assumptions is an essential factor in successful organizational collaboration: without some sort of dependency it seems harder to create, for example, a shared understanding. One type of networks at work are communities of practice; informal networks of people who do the same or similar kinds of work (Manville & Foote, 1996). The people in a network often have their own jargon, they share the same language. Daft and Lengel (1984), for example, state that different groups in organisations have their own shared frames of reference and jargon.

Based on these studies that point toward the relevance of the structural and cognitive dimension, in this study the following social aspects, based on the social-technical gap concept, will be included:

- From the cognitive dimension: terminology; how well does the information source fit to the knowledge seekers' terminology?
- From the structural dimension: networks; does someone know the information source from their network or not?

No aspect from the relational dimension is taken into account. In the study described in Chapter 4, the Social Influence Model of Technology Use was taken into account (Fulk et al., 1990). Only minor effects of organisational norms on the selection of

media were found. In addition, it was assumed, that, for example, trust is strongly related to social networks: the better you know someone the more you will trust him. Nahapiet and Ghoshal (1998, p. 243) also recognise this interrelationship between the dimensions when they state that *"Although we separate these three dimensions analytically, we recognize that many of the features we describe are, in fact, highly interrelated."* These interrelationships between information source characteristics are to be avoided as independence of information source characteristics is needed for condition d to hold. Therefore, only elements from the structural and cognitive dimensions will be taken into account.

In addition to these, an aspect of another dimension will be taken into account: ease of access to an information source. In the study described in Chapter 3, many bottlenecks encountered could be related to the ease of access to an information source. For example, the three bottlenecks that were encountered most were finding only too general information, finding the information takes too much time and a lack of information in company sources. Studies by O'Reilly (1982) and Culnan (1983) show that the choice of information sources is greatly affected by information source accessibility. This dimension relates to another characteristic of the information source, namely the aspect:

- Accessibility; can the information source be accessed easily or not?

These three aspects are all characteristics of an information source; they refer to the fact if an information source is written in the same terminology the knowledge seeker uses (Terminology), if the information source is a person or is written by someone the knowledge seeker knows (Network) and if the information source is easy to access or not (Accessibility). These characteristics give a potential user of an information source information about characteristics of the information source. This information is assumed to contribute to the formation or adjustment of the attitude a person has toward using the information source.

5.1.4 Investigating the work context

The TRA assumes that the attitude and subjective norm are the two constructs that describe the behavioural intention. This study is done in the context of knowledge gaining at work. This specific context raises the question if there could be another factor than the evaluation of characteristics of information sources alone, as included in model (1), that can affect the behavioural intention of information source usage for knowledge gaining. Malhotra (2005) states that there are variables that moderate the effect of attitude and behavioural intention on behaviour. According to Malhotra (2005), several moderators have been identified like motivation and ability, experience, prior knowledge, and mere exposure. One factor that could affect the behavioural intention instead of the attitude and subjective norm is considered in this study: work context. This will also help to answer the main research question (A) as

formulated in the Chapter 1. The work context has, as will be elaborated below, five aspects. These aspects are not included in the information source characteristics as they are basically the same for each information source, but can affect the evaluation of the selected information source characteristics. For example, if one works in an environment where knowledge is rapidly changing, this could affect the evaluation of a personal information source, but it will in general not affect, for example, if the information source is in the individual's network or not. Thus these work context aspects are used to investigate if attitudes or behavioural intentions differ between different work contexts. If these work context aspects don't affect them, it can be assumed that the attitude of knowledge workers towards information sources is primarily determined by their evaluation of the characteristics of the information sources, as predicted by the expectancy value part of the TRA.
This leads to the second sub question:

> *When searching for knowledge to complete a work task, is the behavioural intention of knowledge workers towards information sources affected by aspects related to their work context?*

If the answer is "no", then the characteristics of the information sources are the main determinants of the behavioural intention. If the answer is "yes", model (1), using the three selected characteristics of information sources, is incomplete if one wants to predict behavioural intentions (or attitude), though it still can be descriptively valid if the independence conditions are met.

The first aspect included is "the dynamic of knowledge". This aspect is not based on results of previous studies; it is a new concept. This aspect, in short, refers how fast knowledge changes in a knowledge area. Within a knowledge domain where the dynamic of knowledge is low, knowledge doesn't change fast and a knowledge worker could therefore apply the same knowledge for a relatively long period. In a knowledge domain where the dynamic of knowledge is high, knowledge changes fast and knowledge workers have to adapt to the changing knowledge quite frequently. It is assumed that the aspect of "dynamic of knowledge" can affect the behavioural intention to use sources with certain information source characteristics for knowledge gaining at work.
The other four work context related aspects refer to several specific employment-related characteristics of knowledge workers. The following aspects, also addressed in the other studies, are taken into account: size of location, rank of work, duration of employment and duration of employment in current function.
These aspects will be explained in more detail in the next two sections.

5.1.4.1 Dynamic of knowledge

The concept of dynamic of knowledge refers to the speed with which knowledge changes in a knowledge area. In a knowledge domain where the dynamic of knowledge is high, knowledge workers must create, learn and/or apply new knowledge relatively frequently, and the opposite holds true for a knowledge domain with low dynamic.

As mentioned above, it is assumed that the factor "dynamic of knowledge" affects the behavioural intention to use sources for knowledge gaining at work. The assumption that lies behind the concept of dynamic of knowledge is that, if the speed with which knowledge changes within a knowledge domain is relatively high, people prefer to use personal sources over written sources because personal sources are more up-to-date. This results in a different use of sources for employees from areas with high and low dynamic of knowledge. It also affects the role each of the source characteristics plays in the choice making process.

Why? For as good as any written source holds true that before the information is accessible, time is needed for, for example, collecting the data, interpreting it, remembering it, writing it down, editing it (for example, improving and validating it) and diffusing it throughout the organization. For personal sources this process is much faster, as a personal source in essence only has to collect the data, interpret the information and remember it before it can be made accessible. In fact, the processes needed to retrieve information from personal sources are the first steps in the process for written sources. Keeping the information and thus the knowledge up-to-date, by adjusting the information, in general can be done faster with personal sources than with written sources. Therefore, based on the assumption that personal sources are more up-to-date and that when the dynamic of knowledge is high, people need up-to-date knowledge more frequently, and personal sources are assumed to fit better with the needs of this knowledge domain and a group of knowledge areas where the knowledge is most dynamic. They will therefore use personal sources more often than the employees of the knowledge domain and group of knowledge areas where the knowledge is least dynamic.

The third sub question is therefore:

> *When searching for knowledge to complete a work task, is the behavioural intention of knowledge workers toward sources affected by the dynamic of knowledge in a knowledge domain and/or a group of knowledge areas?*

5.1.4.2 Four other work context aspects

The main research question (A) described in Chapter 1 addresses the influence of the work context on the practices and preferences of knowledge workers regarding the use of information sources for knowledge gaining in the context of

their workplace. Research indicates that various other work context aspects can be related to the use of sources. In this study, participants will also be asked for several work context aspects.

In the Chapter 2 study it was found that when a police officer is longer employed they use written (digital) sources, like PKN, more frequently. Leckie, Pettigrew and Sylvain (1996) state that both different work roles of engineers (rank of work) and different career stages (student, junior, senior; also rank of work) are associated with different information needs. Participants will be asked for the number of years they are working in their current function, the type of work they do and the number of years they are working in their current field of expertise. Although these work context aspects do not directly specify rank, it can be assumed that the longer someone is working in the current function and in the current field of expertise, the higher in rank they are. In addition, a study by Gesthuizen and Dagevos (2005) shows that work experience is one of the determinants of mobility (promotion) and that duration of employment are often used as indicators of work experience.

The fourth, fifth and sixth sub questions therefore are:

> *When searching for knowledge to complete a work task, does the duration of employment of a knowledge worker in his field of expertise affect the behavioural intention of this knowledge worker to use a personal information source or a written information source?*
>
> *When searching for knowledge to complete a work task , does the duration of employment of a knowledge worker in his current function affect the behavioural intention of this knowledge worker to use a personal information source or a written information source?*
>
> *When searching for knowledge to complete a work task, does the rank of the work of a knowledge worker affect the behavioural intention of this knowledge worker to use a personal information source or a written information source?*

The size of the location where participants work could also play a role in the use of sources. The typology of organisations proposed by Mintzberg describes the communication in organisations. In his structure of fives, Mintzberg describes five basic configurations of organisations (Mintzberg, 1980). The typology has a relation with the size of the organisation: the larger the organisation the more formal the communication is and thus the more frequently written sources are used (Reijnders, 2006). This means that the size of an (of the location of an) organisation can be related to the use of sources. The seventh sub question is:

When searching for knowledge to complete a work task, does the size of the location of an organisation where the knowledge worker is employed, affects the behavioural intention of this knowledge worker to use a personal information source or a written information source?

In order to investigate the research questions, first a suitable organisation had to be found. In that organisation the concepts mentioned above, like knowledge areas for the dynamic of knowledge need to be operationalised in order to carry out the study. This and the design of the investigation, including the questionnaire and the selection of participants will be described in the next section.

5.2 Operationalisation and method

5.2.1 Finding a suitable organisation: Tauw

Investigating the research questions requires finding a suitable organisation where the study can be performed. Tauw, a large Dutch engineering consultancy company, which has six locations in the Netherlands and more than 800 employees, is chosen. Tauw is a knowledge intensive organisation where usage of information sources and workplace learning are essential to the daily practice of the knowledge workers. The main “product” of Tauw depends on its employees’ knowledge as they offer knowledge as a process, for example, in the form of consultancy. Tauw is a professional bureaucracy (Mintzberg, 1980), which means that the primary processes are performed by professionals. Tauw consists of six different knowledge domains called sectors. Each sector refers to a specific knowledge domain of consultancy, which can be used to answer the third sub question of this study about the effect of dynamic of knowledge.

Furthermore, two sub questions about the work context variables must be specified. Sub question six addresses the rank of a knowledge worker. As an organisation which can be typified as a professional bureaucracy, Tauw can be considered as a relatively flat organisation with few hierarchical levels. However, since differences in rank between employees do exists, an alternative will be used as an indicator of someone’s rank The type of work one is performing is an indicator of someone’s position in Tauw. Participants will be able to select the following options: Inspection and measurements, Functional leadership, Design, Specialisation, Study and advice or Supervision. These types of work are based on the function columns that are used in Tauw. These work types must be ranked for answering sub question six. For this, an expert in Tauw is asked to order the six types of work according to their hierarchical rank. Highest in rank is Functional leadership, followed by Study and advice, Specialisation, Design, Supervision and Inspection and measurements.

The seventh sub question addresses the size of a location. Tauw is located at six different sites in the Netherlands and one special division which is distributed over different locations The size of the locations differ; Deventer is the largest site with 275 employees, and Eindhoven is the smallest site with 37 employees (see Table 5.1).

Table 5.1 Size of location (only looking at sector employees) for Tauw

Location	N	%
Deventer	275	38.1
Utrecht	134	18.6
Rotterdam	105	14.5
Assen	63	8.7
Amsterdam	58	8.0
Purple Blue	50	6.9
Eindhoven	37	5.1
Total	**722**	**100**

As the location of a knowledge worker will be asked and their size is known in advance, it will be possible to identify differences in preference for information sources. Within Tauw, the same information sources are available at all locations.

5.2.2 The TRA factor

In this study a model fitting approach is used for answering the main research question of this chapter which concerns the TRA model. The attitudinal component of the behavioural intention, more specifically the expectancy value part as shown in model (1), will be investigated in this study. In sections 5.2.2.1 to 5.2.2.4, the methods that will be used to collect data for this main research question are described. In the next section, 5.2.3, the data collection regarding the work context is briefly described. In section 5.2.4 the approach concerning the sampling of participants and the followed procedures are presented.

5.2.2.1 Testing the independence conditions

The first sub question of this study addresses if the observed preferences towards information sources satisfy the independence conditions. In the model fitting approach, data must be collected which reveal the behavioural intention as described in the model (1) of the TRA. In this study beliefs are operationalised as information source characteristics; the attitude is formed by the beliefs about information source characteristics and evaluations of these beliefs. Model (1) requires that these information source characteristics are independent, as shown in condition d. To test if condition d of pairwise preferentially independence as stated by Keeney and Raiffa (1976), holds true for the three information source characteristics, data of a specific

type is needed. The data must enable the testing of condition d; written and personal sources that differ on information source characteristics will have to be compared. The set-up of the questionnaire should thus let participants choose between pairs of sources. In addition, as mentioned in 5.1.3.1, since preferential independence is tested and because this term is quite similar to behavioural intention, in this context the term preference instead of behavioural intention is used.

Two types of information sources will be distinguished in this study: personal sources and written sources. Personal and written sources are not scalable: a source is either personal or written. However, source characteristics are scalable: a source can be, for example, more or less accessible. For each information source the three information source characteristics introduced above are taken into account, namely Accessibility, Network and Terminology. Each information source characteristic is present with two levels, which are the extremes, for example, for "Accessibility" these are easy to access (can be reached fast/without much effort) and *difficult to access* (reaching it is time-consuming/with much effort). Combining each information source type with each of these three characteristics results in eight combinations per information source type, which should all be compared pairwise.

5.2.2.1.1 Pairwise comparison of choices

To if test if condition d holds, pairwise comparisons of statements must be performed. Condition d requires that, for example, condition a holds, which is true if $(x_1,y_1,z') \geq$[36] (x_2,y_2,z') then (x_1,y_1,z) (x_2,y_2,z) (Keeney & Raiffa, 1976, p. 101). Important to notice is that the direction of the preference should be consistent; if it is $\geq$ in the first part of the comparison it should be $\geq$ in the second part too, or the reverse. Thus, translated to this study, this means that if a person prefers a information source which is accessible (x_1), is in Network (y_1) and has shared Terminology (z') above a information source that is difficult to access (x_2), is not in Network (y_2), and has shared Terminology (z') *then* that person should also prefer a information source which is accessible (x_1), is in Network (y_1) and doesn't share Terminology (z') above a information source that is difficult to access (x_2), is in Network (y_2), and doesn't share Terminology (z'). This requirement, which can be seen as a prediction based on model (1), can be tested by comparing pairs of statements. In principle, checking of condition d should be done for every individual, as model (1) describes preferences of an individual. However, as will be shown below, this and the need to calculate weights of source characteristics, will lead to an amount of paired comparisons for every individual that is too large. Therefore, checking of condition d will be based on the percentage difference score between the preferences for the first pair of preferences and the second pair of preferences across individuals who made a choice between the

[36] $\geq$refers to "is preferred or indifferent to".

relevant pairs. If there is a large difference, this indicates that a condition is not satisfied, and pairwise independence should be rejected. If there is a small difference score, this indicates that a condition is satisfied and pairwise independence can be accepted, thus confirming a prediction from model (1). For example, let's say the joint independence of Accessibility and Network toward Terminology is tested. Let's also say that the results show that 75% of the participants prefers a written information source with characteristics (+++, that is all of them are positive), and 25 % prefers a personal information source with characteristics (--+, the first two are negative, the last one is positive), 72% prefers (++-), 28% prefers (---), 23% prefers (+-+), 77% prefers (-++), 21% prefers (+--) and 79% (-+-). In addition the results state that 98% prefers (-++), 2% prefers (+-+), 100% prefers (-+-), 0% prefers (+--), 13% prefers (--+), 87% prefers (+++), 15% prefers (---) and 89% prefers (++-). Then the following comparisons for checking a condition must be made:

1) (+++) (--+) iff (++-) (---)
   75 25 72 28
2) (+-+) (-++) iff (+--) (-+-)
   23 77 21 79
3) (-++) (+-+) iff (-+-) (+--)
   98 2 100 0
4) (--+) (+++) iff (---) (++-)
   13 87 15 89

The difference score for the first pair of statements is three (75 versus 72 and 25 versus 28), the difference score for the other pairs of statements is two (23 versus 21, 77 versus 79, 98 versus 100, 2 versus 0, 13 versus 15 and 87 versus 89). In this example, all the absolute difference scores are small which indicates independence of Accessibility and Network from Terminology. Taken together, checking condition d requires checking if attributes Accessibility and Network are joint independent of Terminology , if attributes Network and Terminology are joint independent of Accessibility and, finally, if Accessibility and Terminology are joint independent of Network. Written down in formula form, this means:

Joint independence of Accessibility-Network of Terminology requires:

1) (+++) (--+) iff (++-) (---)
2) (+-+) (-++) iff (+--) (-+-)
3) (-++) (+-+) iff (-+-) (+--)
4) (--+) (+++) iff (---) (++-)

Joint independence of Network-Terminology of Accessibility requires:

1) (+++) (+--) iff (-++) (---)
2) (+-+) (++-) iff (--+) (-+-)
3) (++-) (+-+) iff (-+-) (--+)
4) (+--) (+++) iff (---) (-++)

Joint independence of Accessibility -Terminology of Network requires:
1) (+++) (-+-) iff (+-+) (---)
2) (++-) (-++) iff (+--) (--+)
3) (-++) (++-) iff (--+) (+--)
4) (-+-) (+++) iff (---) (+-+)

The conditions and checks above refer to the usual case. In the usual case, if joint independence holds true also single independence holds true. However as we have objects (information sources) with similar values on an attribute this has to be checked additionally. In all additional comparisons below the first item is a written information source and the second a personal information source.

Joint independence of Accessibility-Network of Terminology, the special case.
For this to hold true 4 conditions must be checked:
1) (+++) (+++) iff (++-) (++-)
2) (+-+) (+-+) iff (+--) (+--)
3) (--+) (--+) iff (---) (---)
4) (-++) (-++) iff (-+-) (-+-)

Joint independence of Network-Terminology of Accessibility, the special case.
For this to hold true 4 conditions must be checked:
1) (+++) (+++) iff (-++) (-++)
2) (+-+) (+-+) iff (--+) (--+)
3) (+--) (+--) iff (---) (---)
4) (++-) (++-) iff (-+-) (-+-)

Joint independence of Accessibility-Terminology of Network, the special case.
For this to hold true 4 conditions must be checked:
1) (+++) (+++) iff (+-+) (+-+)
2) (++-) (++-) iff (+--) (+--)
3) (-+-) (-+-) iff (---) (---)
4) (-++) (-++) iff (--+) (--+)

Summarizing: model (1) can be accepted as a valid description of the preferences

(or behavioural intention) of the knowledge workers in Tauw, if all the 24 conditions above are satisfied.

5.2.2.2 Relative weight information source characteristics regarding BI

The first sub question of this study addresses not only the independence conditions implied by the additive structure of model (1), it also addresses the relative weight of each of the information source characteristics. The relative weight of each of the information source characteristics with regards to the behavioural intention can be determined. The method used to estimate the relative weight of the information source characteristics as formulated in formula (1), is based on the procedure for swing weighting as defined by Von Winterfeldt and Edwards (1986). To assess swing weights, two hypothetical alternatives are described. One alternative (read: information source) has best levels on all attributes (read: information source characteristics), and the other alternative has the worst levels on all attributes. Next the decision maker (read: knowledge worker) is stuck with the hypothetical alternative that has all the attributes at their worst levels. The decision maker is asked to move one attribute to its best level. Next the decision maker is asked to choose an attribute change from the worst to the best level which he considers to be the second most desirable improvement. This procedure is continued with all the remaining attributes. A 100 point difference should be assigned to an attribute that is selected as the first choice for improvement from worst to best. No difference should be assigned to an attribute which shows no difference if it moves from worst to best. Next all other differences are expressed as percentages of 100. For example, in Figure 5.1 a scale from zero till 100 is shown. No points refer to the attribute that makes no difference (ND), 40 points to an attribute that makes a little difference (ALD), 80 points are given to the attribute that makes some difference and the attribute that makes the most difference (MD) is given 100 points.

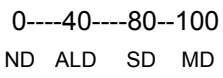


Figure 5.1 Example swing weighing procedure

This procedure establishes the rank order of weights (Von Winterfeldt & Edwards, 1986). This procedure is slightly modified in our case; instead of assigning points, participants will make a forced choice between the two alternatives. In addition, not only the best and worst alternatives will be presented to participants, but all possible combinations of alternatives. This means, for example, that both sources (personal and written) could have the same characteristics. Using these data, comparisons of statements can be made. The reference point taken for each computation of the

difference score is the situation where both information source types have the same information source characteristics. The swing weighing score will be based on the difference in the choices of participants described by percentages. Subsequently, three comparisons can be made: each time one information source characteristic of the second information source type is changed with respect to the first information source type which stays constant. This results in six swings per information source type. In total 24 comparisons per information source type can be made which will result in swing weighing scores (i.e. +++ versus ++- etc). Table 5.2 outlines this method.

Table 5.2 Example comparisons relative weight information source characteristics

	Constant information source type	**Changing type**	**Results constant information source type (%)**	**Results changing information source type (%)**	**Swing weighing difference %, reference to first pair**
Swing 1	+++	+++	60	40	-
	+++	++-	54	46	6
	+++	+-+	68	32	8
	+++	-++	62	38	2
Swing 2	---	---	78	22	-
	---	--+	77	23	1
	---	-+-	62	38	15
	---	+--	71	29	6

In Table 5.2, the first round is Swing 1. Characteristics of the constant information source type, for example, a written information source type, don't change, characteristics of the changing information source type, for example a personal information source type, are changed stepwise for every characteristic.

If the swing weighing scores are high, this is seen as an indication that the influence (the swing weight) of the changed information source characteristic is relatively large. If the % difference scores are low, this is seen as an indication that the relative influence (the swing weight) of the changed information source characteristic is relatively small. The same procedure will be applied to Swing 2, but starting from negative start values. In Table 5.2 one can see that for Swing 1, changing the second attribute from "+" to "-" makes a differences of 8 when compared with the base pair (+++), while the first and third attribute lead to respectively 6 and 2 changes. Based on this, it can be derived that, in this example, the second attribute has the largest weight, followed by the first and third attribute. As mentioned, in total six swings per information source type will have to be determined; each information source type has either the role of constant or changing information source type.

5.2.2.3 Statements

In order to perform the above comparisons, all possible pairs of two sources and three characteristics must be investigated to see if condition d holds, as condition d should hold for all relevant pairs of the two information source types and three information source characteristics, and to derive the relative weights of the source characteristics. This set-up with two information source types and three information source characteristics, leads to 64 paired comparisons. In the questionnaire, each paired comparison will have to be described in a statement. In Table 5.3 an overview of the 16 choice option statements that are used to construct the 64 paired comparisons of information source types is given. Each row in the column of information source type "personal information source" can be combined with each row in the column of information source type "written information source".

Table 5.3 Overview of the 16 elements (8 per information source type) used to construct the 64 paired comparisons of information source types

Personal information source	**Written information source**
Easy to access-In Network-Terminology shared (+++)	Easy to access-In Network-Terminology shared (+++)
Easy to access- In Network-Terminology not shared (++-)	Easy to access- In Network-Terminology not shared (++-)
Easy to access-Not in Network-Terminology shared (+-+)	Easy to access-Not in Network-Terminology shared (+-+)
Easy to access-Not in Network-Terminology not shared (+--)	Easy to access-Not in Network-Terminology not shared (+--)
Difficult to access-In Network-Terminology shared (-++)	Difficult to access-In Network-Terminology shared (-++)
Difficult to access-In Network-Terminology not shared (-+-)	Difficult to access-In Network-Terminology not shared (-+-)
Difficult to access-Not in Network-Terminology shared (--+)	Difficult to access-Not in Network-Terminology shared (--+)
Difficult to access-Not in Network-Terminology not shared (---)	Difficult to access-Not in Network-Terminology not shared (---)

A questionnaire containing 64 paired comparisons is very time-consuming for a participant and may result in concentration difficulties or ending the questionnaire without finishing it. Therefore, four different questionnaires will be developed, each version containing 16 statements that each describe one of the 64 possible pairs. An online tool is developed which allocates randomly each paired comparison to one of four groups of statements. This way, four versions of the questionnaire will be formed. One important consequence of the set-up of the online questionnaire is that comparisons of

pairs of statements as described in 5.2.2.1.1 and 5.2.2.2 can only be done on a global level and not on the individual level, as was already mentioned above.

In addition to these statements, the questionnaire will also include an introduction explaining the two types of sources and the set-up of the questionnaire.

5.2.2.3.1 The presentation of the statements

The presentation of the statements will be based on the design that was previously used for investigating the theory of "The cost of not knowing" (De Hoog & Kooken, 2006). Using this existing question design to sketch work situations where people search for knowledge to complete a work task, makes it possible to formulate the work situations in a clear and relatively concise way because the three characteristics, which could affect the decision making process for an information source used to find knowledge, can be applicable to several general knowledge seeking situations. Figure 5.2 shows an example of a statement, thereby revealing the statement design that will be used in this study. Each statement will start with the same introduction describing a work situation where someone has to search for knowledge to complete a work task. In this text a reference to the table below is made. In this table the characteristics of the two sources are shown. Colours are used to emphasize the value of the characteristics: negative values (that is, difficult to access, not in network, terminology not shared) are purple and positive values (that is, easy to access, in network, terminology shared) are blue. Next, the question which information source someone would choose is asked. Below the table the participants can click on the information source of their choice. The Tauw employees were familiar with filling-in this type of question in online questionnaires of the Tauw University. To strengthen this association with the Tauw University, as can be seen in Figure 5.2, the layout theme of the "Tauw University" is used. Only one situation (that is, one paired comparison) is displayed per screen. At the bottom of each screen the three characteristics are defined, which is meant to help the participants to clarify possible confusion about the meaning of the three characteristics. To improve the quality of the questionnaire, a pre-test of the questionnaire is carried out at Tauw Deventer.

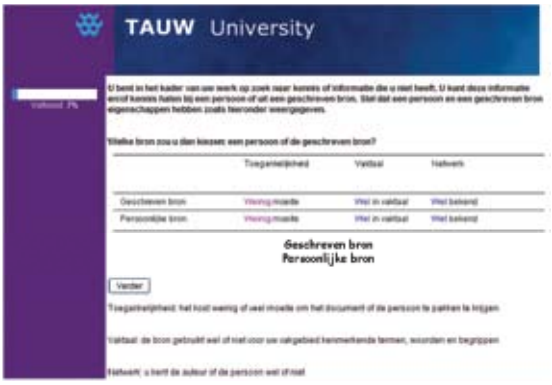


Figure 5.2
Example of statement design used in this study (in Dutch only)

5.2 2.4 Collecting additional data about behavioural intentions

Testing of model (1) to answer the main research question of this study and the first sub question of this study primarily focuses on the independence conditions and assessing the relative weights. However, this sheds limited light on the reasoning of participants related to the attitudinal component of the behavioural intention and the role each of the three information source characteristics play. A follow-up interview will be carried out which provides open ended data about these topics. It is also used to see if the selected information source characteristics are really the ones that matter when deciding for an information source, as the tests of condition d are contingent upon the relevance of these characteristics.

At the end of the online questionnaire, participants will be asked if they want to participate in a short interview of approximately 30 minutes. The goal of this interview is to talk about the reasoning behind the choices for a written or personal information source in the statements. The following questions were asked:

Questions per statement

- **Questions about the information source chosen**
  - o Do you remember why you chose this personal/written information source in this situation?
  - o For each information source three characteristics are described: accessibility, terminology and network. Did you take all these three characteristics into account when you made the choice? If yes, can you explain which considerations you made? If no, which characteristics did you take into account and can you explain which considerations you made
  - o Were there, besides these three information source characteristics, any other factors that influenced your choice?
  - o Personal sources can refer to different persons and written sources can refer to different sources, like documents. Who or what did you had in mind when you chose the written/personal information source?

General question

- **Allocating points**
  - o In total an information source can have six characteristics. Can you please distribute 60 points over the six possible characteristics of the sources? The more you value a characteristic, the more points it should get. You should allocate all points.

A data recording (tape recorder) tool will be used during the interviews and the researcher will make notes of the participant's answers.

As the interview takes place after the questionnaire, participants' choices in each of the situations described in the questionnaire are known. A list with participant's

choices for statements discussed in the interview will be made available to each participant. Only six of the 16 statements will be discussed with each participant. These statements will be selected after the pairwise data are collected as follows: two statements where most of the respondents of a version have chosen a personal information source, two statements where most of the respondents of a version have no clear preference for a written information source or personal information source, and two statements where most of the respondents of a version have chosen a written information source. As it turned out, the following statements are selected for the interview (W= written information source, P= personal information source):

- Version 1: preference personal information source statements W(-+-) versus P(+++) and W(-+-) versus P(++-), no clear preference statements W(+--) versus P(-++) and W(-+-) versus P(-+-), preference written information source statements W(-++) versus P(---) and W(++-) versus P(---)
- Version 2: preference personal information source statements W(--+) versus P(+++) and W(---) versus P(+++), no clear preference statements W(-++) versus P(+--) and W(---) versus P(---), preference written information source statements W(+++) versus P(--+) and W(+++) versus P(---)
- Version 3: preference personal information source statements W(+--) versus P(+++) and W(-+-) versus P(+-+), no clear preference statements W(--+) versus P(--+) and W(-+-) versus P(--+), preference written information source statements W(+++) versus P(-++) and W(+-+) versus P(--+)
- Version 4: preference personal information source statements W(---) versus P(++-) and W(--+) versus P(+-+), no clear preference statements W(+--) versus P(+--) and W(-++) versus P(-+-), preference written information source statements W(+-+) versus P(---) and W(+++) versus P(+--)

5.2.3 The work context

The work context involves five aspects, addressed in the sub questions three till seven of this study, that together could affect the behavioural intention. One of these aspects, addressed in sub question three, is the dynamic of knowledge, which needs a bit more detail. The method that will be used to collect data for this aspect is described in section 5.2.3.1 Data about the other four aspects will be collected via the final part of the online questionnaire, as described in section 5.2.2.1. It will contain one question about each of the work context aspects: sector, size of location, rank of work (that is: type of work, see section 5.2.1), duration of employment and duration of employment in one's current function. Almost all questions will be closed questions. The questions will also be included in the questionnaire that is tested in the pre-test (see section 5.2.2.3.1).

5.2.3.1 Assessing the dynamic of knowledge

As mentioned above, sub question three addresses the effect of the dynamic of knowledge on the behavioral intention. The dynamic of knowledge refers to the speed with which knowledge changes in a certain consultancy area. In a consultancy area where the dynamic of knowledge is high, knowledge workers must create, learn and/or apply new knowledge relatively frequent. This raises the question how to determine the dynamic of knowledge of the six sectors? A study will be carried out to see if the six sectors could be separated based on their dynamic of knowledge. The goal is to end up with two extremes: a consultancy area where the dynamic of knowledge is high and a consultancy area where the dynamic of knowledge is low.

There is not an objective method available to determine the dynamic of knowledge in a certain domain. Therefore, a subjective method will be used. Some experts from Tauw will be asked to determine the dynamic of the six different consultancy areas. Based on their opinion, the dynamic of the sectors can be identified, that is, their opinion is seen as a reliable assessment of the dynamic of knowledge.

For this, a digital form will be developed. This form will contain an explanation of this study, an explanation of the concept of "dynamic of knowledge" and the question to list the six sectors in order of their degree of dynamic of knowledge. The experts will be approached via email. This email will contain the digital form. Three experts from Tauw will be selected to participate. They will be selected by a Tauw University contact that has a good overview of the persons whose judgments can be relied on.

5.2.4 Participants and procedure

An important question concerning participants is how many participants are willing to take part in the online questionnaire that collects data for the model fitting approach and the work context aspects. In order to be able to check the conditions and assess weights, each version of the questionnaire should have at least 20 participants. In addition, only knowledge workers will be involved in the study. The reason for involving only knowledge workers is that they were also the target group of the previous three studies, and this study can be considered as a follow-up of those studies. In order to be able to compare the results of these studies, it is important to involve a similar type of participants. Within Tauw, mainly employees working in one of the sectors, these are consultancy areas, can be seen as knowledge workers. In total there are six sectors, namely

1. Water
2. Soil remediation
3. Environmental management
4. Water engineering
5. Spatial planning and infrastructure
6 Civil engineering and infrastructure[37]

[37] The Dutch names of the sectors is Water, Bodem, Milieumanagement, Waterbouw, Ruimte en Civiel.

In total 725 sector employees will be approached to take part in this study. By using an online tool, all participants will be distributed randomly over the four versions, leading to an average of about 181 participants per version.
The participants will be approached via an invitation per email in which they will be asked to participate. This email will contain a link to the online questionnaire. After completing the questionnaire, some participants will be contacted for a short interview to talk about the reasoning behind their choices (see section 5.2.2.4). The questionnaire was available from January 6th 2009 onwards. A reminder email was sent to participants who have not completed the questionnaire on the 20th of January 2009. The data collection via the questionnaire ended at the 3rd of February 2009. The follow-up interviews took place in the period between March 12th and 13th 2009.

5.3 Results

In this section the results of the study are presented. First, in section 5.3.1 the characteristics of the sample are described. In section 5.3.2, the results investigating the TRA factor are presented. These include the checking the independence conditions, the weight of the information source characteristics regarding the behavioural intention, the overall behavioural intentions and the considerations of the participants in the interviews.
Next, in section 5.3.3 the results of investigating the work context are described. In this section it is investigated if the work context affects the description of the behavioural intention of knowledge workers toward sources.

5.3.1 Characteristics of the sample

In total 725 employees were approached to take part in the online questionnaire and results show that 389 employees filled in the questionnaire. Two participants were removed from the list as they did not belong to a sector. So having 387 respondents means an overall response rate of 53.4%. The response rates for the four questionnaire versions are as follows:

- Version 1: 94 participants = 52.2% of the approached group
- Version 2: 92 participants = 50.6% of the approached group
- Version 3: 98 participants = 54.1% of the approached group
- Version 4: 103 participants = 56.6% of the approached group

This shows that the non-response rate was not too different for the versions. As a consequence, there will be sufficient paired comparisons available to test the independence conditions and assess the weights of the information source characteristics.

The distribution of the participants over the six Dutch locations is compared with the distribution of all employees over the six different Dutch locations, see Table 5.4. As Deventer is the main location, it is no surprise that most participants are located in this location (38.5%). Purple Blue is a special part of Tauw, which focuses on juridical and financial consultancy and is located in Deventer and Utrecht. Purple Blue participants are the smallest group (3.6%). There is no location bias in the data, because the distribution of the participant group over locations is quite similar to the distribution of all sector employees over all locations in Tauw, see Table 5.4.

Table 5.4 Location of sector employees that participated compared with location of all sector employees

Location	N	%	# of participants	% participants
Deventer	275	38.1	149	38.5
Utrecht	134	18.6	76	19.6
Rotterdam	105	14.5	60	15.5
Assen	63	8.7	37	9.6
Amsterdam	58	8.0	29	7.5
Eindhoven	50	6.9	22	5.7
PurpleBlue	37	5.1	14	3.6
Total	**722**	**100**	**387**	**100**

To see if the sample shows variance on all work context aspects, data was collected about these aspects.

Most participants work in the sector Soil remediation (25.1%), followed by Civil engineering and infrastructure (24.5%), Water (14.7%), Water engineering (11.6%), Spatial planning and infrastructure (9.6%) and Environmental management (9 %). In case the answer “Other, namely” was chosen by 5.4%, this often were participants who indicated that they are working in more than one sector.

The number of years participants work at Tauw differs; they are distributed over different levels of experience at Tauw. The major part of the participants works one to five years at Tauw (42.6%) or six to ten years (23.3%). These participants are followed by those who work at Tauw more than fifteen years (15.5%), less than one year (10.3%) and eleven to fifteen years (8.3%).

Participants were asked what type of work they do. Participants are distributed over all possible work types. The work types “Study and consultancy” (32.8%) and “Functional leadership” (25.8%) were chosen by a bit more than half of the participants. The smallest group of participants comes from “Inspection and measurements” (4.9%). The type of work of the other participants is “Design” (15.5%), “Specialisation” (12.1%) and “Supervision” (8.8%).

The experience of the participants in their current function varies. Most participants

work in a function since one to five years (53.5%) or six to ten years (21.4%). Approximately 10% of the participants work in a function more than eleven or fifteen years (respectively 4.4% and 6.2%). The other participants work in their function less than one year (14.5%).

In addition, the experience of the participants in their field of expertise varies too. Most participants work one to five years (30%) or six to ten years (27.4%) in their current field of expertise. Almost one fifth of the participants (19.9%) works more than fifteen years in their current field of expertise. In addition, 17.1% of the participants works eleven to fifteen years in their current field of expertise. Approximately 6% of the participants is relatively new to their current field of expertise and works less than one year in their area.

The above characteristics of the sample show sufficient variance on all work context aspects that together constitute the work context. Therefore, they enable testing the effect of this work context on the behavioural intention and the descriptive validity of model (1).

Interview

As it turned out, relatively many participants, (79 participants, 20%), wanted to take part in the interview, but due to time constraints not all participants were approached for an interview. Ten participants were selected, two from each sector, with the exception of the sector Spatial planning and infrastructure, which is the smallest sector in Tauw and for which no participants were available during the period of the interviews. The participants that agreed to take part in the short interview received an email with a suggestion for a date. It was intended to let the interview take place not later than two months after the end of filling in the online questionnaire.

5.3.2 Results TRA factor

The main research question of this study is if the behavioural intention of knowledge workers towards sources can be described by the expectancy value part of the TRA. The first sub question of this study specifies this by addressing if the preferences towards sources satisfy the independence conditions implied by model (1) and what the relative weights of each of the source characteristics is. In this section, the results concerning the TRA factor, as present in the expectancy value formula (1), are described. First, in 5.3.2.1 the outcome of testing the pairwise preferential independence of the information source characteristics is presented. Next, the results of assessing the weight of the information source characteristics are described in 5.3.2.2. In 5.3.2.3 the behavioural intention is investigated by reporting about the overall results of the statements in the questionnaire. This section ends with 5.3.2.4 where participants' considerations with regard to the information source characteristics are discussed.

5.3.2.1 Testing Pairwise preferential independence

The pairwise preferential independence of the three information source characteristics is investigated via two methods: explorative multidimensional unfolding and the testing of the independence condition d and its associated sub conditions.

5.3.2.1.1 Multidimensional unfolding

Because in this study three information source characteristics are assumed to play a role in shaping the attitude toward using either a personal or a written information source to satisfy a knowledge need, the expectation is that each characteristic will show itself as a separate dimension in a three-dimensional space. Moreover, as model (1) assumes independence of the characteristics, it is expected that these dimension are orthogonal, that is perpendicular to each other, signifying no interaction between the dimensions. No specific assumptions are made regarding the location of the points (sources) on the dimensions. The only assumption made is that each characteristic is visible in the three-dimensional space as a separate orthogonal dimension (and thus indicating independence of each other).

Usually, multidimensional unfolding is used for describing relations between stimuli and respondents. In this case however, it is used for describing relations between stimuli (personal information source with three different characteristics) and stimuli (written information source with three different characteristics) from different sets. The preferences of the respondents for one of the two information source types in a knowledge seeking situation are translated into distances between sources which are represented in a multidimensional space. The stronger the preference for an information source type versus another information source type, the larger the difference score between the two information source types is and the more distance there is between them in the three dimensional space. A multidimensional unfolding analysis (PREFSCAL) was performed to find a common space where the relationships between the characteristics of the two types (the dimensions) of sources are shown visually and thereby could be examined.
For the analysis an 8x8 matrix was constructed, see Table 5.5.

Table 5.5 Relative difference scores between personal sources (labelled P) and written sources (labelled W). See 5.2.2.3 for the meaning of the + and – signs.

	Relative difference scores							
	W(+++)	**W(++-)**	**W(+-+)**	**W(+--)**	**W(-++)**	**W(-+-)**	**W(--+)**	**W(---)**
P(+++)	39.2	19.2	28.2	69	85.8	77.6	89.2	93.4
P(++-)	76.6	19.2	14.2	41.8	34.8	76	67	87.2
P(+-+)	82	28.6	22.4	38.8	22.4	54.4	85.8	78.6
P(+--)	100	84.4	57.4	16.6	10.6	24	41.8	76

Relative difference scores

	W(+++)	W(++-)	W(+-+)	W(+--)	W(-++)	W(-+-)	W(--+)	W(---)
P(-++)	88.8	44.8	41.4	10.6	26.2	18.4	54.4	78.8
P(-+-)	100	95.8	93.8	28.6	56.6	8.6	10.2	65
P(--+)	93	68	86.4	36.2	63.8	27.6	50	41.8
P(---)	95.6	96.2	93.6	89.4	85.4	68	53	26

In Table 5.5, the personal sources are the row objects (labeled P) and the written sources are the column objects (labeled W). The matrix was filled with the relative difference scores for each cell in the matrix (computed as described in 5.2.2.2). For example, for the combination written information source “difficult to access, in network, terminology shared” (W (-++)) and personal information source which was “easy to access, in network, terminology shared” (P (+++)),92.9 % of the respondents would use a written information source and 7.1 % would use a personal information source. Table 5.5 shows that the relative difference score therefore is 85.8. This means that, in this case, the respondents had a strong preference for the written information source. If the difference score had been small, this would have meant that there was not a clear preference. This is the case for, for example, the combination written information source “easy to access, not in network, terminology not shared” and personal information source “difficult to access, in network and terminology shared”. Here the relative difference score is 10.6 as 55.3% of the respondents would use a written information source and 44.7% would use a personal information source. The relative difference score can be seen an estimator of the strength of preference for one information source type with specific characteristics above the other information source type. In the example above, this means that in a common space the first pair will be more distant from each other than the second pair. Table 5.5 was entered as input data for the PREFSCAL analysis.

The results of the PREFSCAL analysis show that the analysis accounts for all dispersion in the data. In addition, all variance in the data could be explained by the analysis and the proportion of correctly recovered preference orders is .85, which means that approximately 85% of preference orders is correctly reproduced by the order of the distances. The normalized stress is 0.00, which indicate that the badness of fit is low. Thus, the distances on the dimensions have a (almost) perfect fit with the original input data.

Figure 5.3 shows the joint plot of the common space in which the personal sources (labeled I) and the written sources (labeled W) are placed in a two dimensional space. The joint plot (to be more precise: the coordinates of the sources in the joint plot) allows for an interpretation of the dimensions.

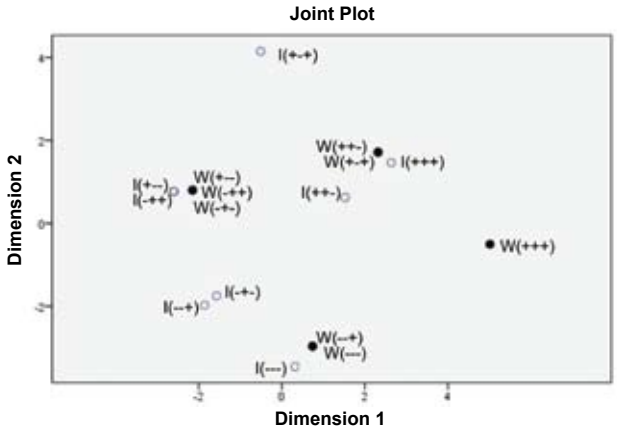


Figure 5.3 Joint plot as a result of the multidimensional unfolding analysis (PREFSCAL solution obtained with the dissimilarity data from Table 5.5)

Instead of the expected three dimensions, only two dimensions are extracted. This means that at least one information source characteristic does not seem to be independent of the other two as it doesn't show up as a separate dimension. In order to find out which dimension is not present, the two extracted dimensions need to be analysed. This is done by looking at the extreme coordinates on each dimension. In Table 5.6 the extremes for the first dimension are shown, which shows that dimension 1 can be characterized by on the one hand positive values (+++) and on the other hand accessibility as this is the only information source characteristic that is positive or negative (with the exception of (-+-).

Table 5.6 Extreme scores on dimension 1

Information source type	Highest score	Lowest score
Personal	(+++)	(+--)
Written	(+++)	(+--) (-++) (-+-)

The extremes for dimension 2 are shown in Table 5.7. Dimension 2 is characterized by on the one hand network as this is the only information source characteristic with a negative value (with the exception of (++-)). On the other hand this dimension is formed by negative values (with the exception of (--+), which does has opposite values when compared with (++-).

Table 5.7 Extreme scores on dimension 2

Information source type	Highest score	Lowest score
Personal	(+-+)	(---)
Written	(++-) (+-+)	(--+) (---)

Although conclusions depend on a somewhat subjective interpretation of the results, the conclusion that can be drawn is that the dimension of Terminology seems to be missing. Apparently, this information source characteristic is not independent like the other two, but is dependent on at least one of the other two.

5.3.2.1.2 Testing the independence conditions

The independence conditions implied by model (1) are summarized in condition d: if condition d holds true; conditions a, b and c should all hold true. An indication that it is very plausible that the information source characteristics are pairwise preferentially independent occurs if the absolute difference scores are minimal (see 5.2.2.1.1). A total of 24 t-test on the proportional differences with n=95 and p<.05 show that two of the differences are significant. The decision rule followed is that a proportional difference should be either significant or involve a preference reversal (or both). Table 5.8 shows the overall results of testing the independence conditions; the number in the cells refers to the number of violations of condition d.

Table 5.8 Overall results independence conditions
(total n=387, # of respondents varies from 92 till 103 per statement)

Overall	**Accessibility-Network/ Terminology**	**Network-Terminology/ Accessibility**	**Accessibility-Terminology/ Network**
Usual case	0	2	0
Special case	0	0	0

The significant differences concern the joint independence of Network-Terminology of Accessibility in the normal case comparisons. The two significant difference scores are found in the following comparisons:

(++-) (+-+) iff (-+-) (--+)
43 57 55 45 → Difference score: 12
(+--) (+++) iff (---) (-++)
0 100 7 92 → Difference score: 7/8

In both cases Accessibility of both information source changes from easy to access into difficult to access (for example, (++-) to (-+-), (+-+) into (--+) for the first comparison and (+--) into (---) and (+++) into (-++) for the second comparison). Thus, changing Accessibility from positive to negative seems to result in a greater preference for the written information source at the cost of the preference for a personal information source. In addition, the personal information source does stay the most preferred information source type. It should be noted that in the first difference score not only the difference is significant, but also a reversal occurs as

the preference in the first pair is different from the preference in the second pair. Although these two tests are significant, the majority of the tests are not significant. Therefore, the conclusion is that condition d holds true for all information source characteristics. This means that Accessibility and Network are independent of Terminology, Network and Terminology are independent of Accessibility and Accessibility and Terminology are independent of Network.

Summarizing, results from multi-dimensional unfolding show that one dimension, which should be shaped by the information source characteristic Terminology, doesn't show itself as a dimension. However, the pairwise comparisons of choices shows that almost all information source characteristics are independent, as the majority of the tests performed are not significant.

5.3.2.2 Assessing the weight of the information source characteristics

Another aspect of model (1) are the relative weights of the information source characteristics. In Table 5.2 the principles for assessing the weights were explained. When all difference scores for each information source characteristic are added and are dived by the number of occurrences (sixteen), the mean difference score of each characteristic is known. The higher the mean score, the more influence an information source characteristic has on participants' choices. The mean swing weight for Terminology is 22.69. In between qua swing weight is the information source characteristic Network: the mean swing weight for Network is 30.56. The mean swing weight for Accessibility is 42.88. Besides the general mean swing weighing score, the mean swing weighing scores of each characteristic per information source type is computed to see if the relative weights differ from the weights based on data from both information source types. If the order of the weights doesn't differ much, it confirms the overall results. If there are differences however, this indicates influence of information source type on the behavioural intention which could indicate that information source type interferes with the three information source characteristics, which is not in line with the way model (1) is tested in this study. For this, all difference scores per constant information source type and for each information source characteristic are added and are dived by the number of occurrences (eight). An overview is given in Table 5.9.

Table 5.9 Overview means and standard deviations of swing weighing scores divided per characteristic per information source type

Information source characteristic	Personal information source mean	Sd.	Written information source mean	Sd.
Terminology	21.63	7.09	23.75	5.47
Network	28.75	8.17	32.38	5.63
Accessibility	40.50	9.93	45.25	10.40

There are only some small differences in Table 5.9 between the information source types, that is, for a written information source the means are slightly higher than the overall ones and the standard deviation differs. For a personal information source the means are almost the same as the overall ones and the standard deviation differs. As the order of the mean weights is the same and the differences are small, the conclusion is that relative weights of source characteristics do not depend on source type. The order of swing weights is therefore Accessibility, Network and Terminology, implying the order of the relative contribution of each characteristic to the behavioral intention.

5.3.2.3 Overall behavioural intention towards the sources

Apart from the independence conditions and the weight of the characteristics, the left hand part of model (1) focuses on the intention of participants to use either a written or personal information source in case of a knowledge seeking situation at work. Some surprising results, that is, results that are seen to be remarkable because of the preferences participants have towards information sources, will be described below.

Only in one paired comparison (1.56%), the participants do not have a clear common preference for an information source they would choose. This is when Accessibility and Network are negative for both sources, and the fact that Terminology is shared for the personal information source and not for the written information source doesn't have a clear discriminating effect on the behavioural intention across the respondents.

In several paired comparisons (15.63%), almost all respondents (that is more than 87%) would choose a written over a personal information source. Remarkable here is that the main difference between the written information source and the personal information source is that the first is easy to access. Differences in the other two characteristics do not seem to make a difference. There is no case where all participants would choose a written information source over a personal information source. In several paired comparisons (23.44%), most of the participants (that is more than 87%) clearly would choose a personal information source. In two cases even 100% of the participants would use a personal information source. For most of these paired comparisons where most participants would choose a personal source holds true that a personal information source is characterised as easy to access, seems to make the difference, no matter what the other characteristics of both sources are.

In Table 5.10 the behavioural intention is specified for all possible information source type-information source characteristic combinations (ST-SCC).

Table 5.10 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC)

ST-SCC	N times chosen by participants	% of total	Difference with previous Combination (%)
P(+++)	712	11.33	-
P(++-)	595	9.47	1.86
P(+-+)	570	9.07	.40
P(-++)	436	6.94	2.13
P(+--)	401	6.38	.56
P(-+-)	310	4.93	1.45
P(--+)	248	3.95	.98
P(---)	147	2.34	-
Total (P)	**3419**	**54.43**	
W(+++)	584	9.30	-
W(++-)	482	7.67	1.63
W(+-+)	556	8.85	1.18
W(-++)	356	5.67	3.18
W(+--)	324	5.16	.51
W(-+-)	242	3.85	1.31
W(--+)	228	3.63	.22
W(---)	91	1.45	-
Total (W)	**2863**	**45.57**	
Total	**6282**	**100**	

The results in Table 5.10 show that personal sources were chosen over written sources in 54.43% of the cases and that written sources were chosen over personal sources in 45.57% of the cases. The overall preference for a personal and written information source differs (9%); it appears that the type of information source has some effect on the behavioural intention. The behavioural intention however seems to be affected most by the information source characteristics. The results also make clear that when a personal information source has the same information source characteristics as the written information source, it is chosen by more participants. In addition, the results show that the more positive formulated characteristics an information source type has, the more the sources were chosen. Or in other words: the more negative formulated information source characteristics an information source type has, the less it was chosen. Participants thus prefer information source types with positive formulated characteristics (which is not too surprising), and if characteristics are the same, they have a slight preference for a personal information source over a written information source.

5.3.2.4 Participants' considerations: cross validating the pairwise comparison data

The above analyses indicate that the three information source characteristics are most likely pairwise preferentially independent. However, in order to know if each of the information source characteristics really matter for participants' choices and to know more about the reasoning of participants related to the behavioural intention, additional data were collected via the follow-up interview. This helps to get insight in a less contrived way into the presence of other important information source characteristics that could also affect the behavioural intention. In section 5.3.2.4.1, the participants that participated are described briefly. In section 5.3.2.4.2 the results will be discussed.

5.3.2.4.1 Participants

Although, as planned, ten participants were selected, eight participants cooperated with the interview. Due to specific circumstances, two of the selected participants could not cooperate and as there was a time constraint, no more participants were selected. They were all male. They came from the sectors Soil remediation (three persons), Civil engineering and infrastructure (two persons), Environmental management, Water and Water engineering (each 1 person).

5.3.2.4.2 Choice related considerations

Factors influencing participants' choices

Only once a participant explained his choices simply by the fact that one of the two alternatives only had more positive values when compared to the other information source. In this case, he didn't have any specific considerations referring to the nature of the characteristics for his choice. In most cases participants could clearly describe the information source characteristics specific considerations for their choice. In Table 5.11, a global overview of participants' considerations is given, based on the frequency of mentioning the three information source characteristics and/or other considerations. For example, if a participant explained that the characteristics Accessibility and Terminology played a role together with one or more other characteristic(s), this was labeled as "Other in combination with Accessibility and Terminology".

Table 5.11 Factors influencing the choice for an information source type as mentioned by participants

Consideration	Personal information source		Written information source	
	Yes	No	Yes	No
Accessibility	2		1	
Terminology	0		1	
Network	0		0	
Accessibility and Terminology	3		0	
Accessibility and Network	2		0	
Terminology and Network	1		1	
Accessibility, Terminology and Network	0		1	
Subtotal	**8**		**4**	
Other considerations	3	2	5	4
Other considerations in combination with Accessibility	2		6	
Other considerations in combination with Terminology	4		0	
Other considerations in combination with Network	2		1	
Other considerations in combination with Accessibility and Terminology	0		1	
Other considerations in combination with Network and Accessibility	4		0	
Other considerations in combination with Network and Terminology	2		3	
Subtotal	**19**		**20**	
Total	**27**		**24**	

Table 5.11 shows that if participants chose a personal information source, for example, two times the Accessibility of the personal information source was the only decisive characteristic and two times the information source characteristic Network combined with other considerations formed the decisive characteristic. Twice participants that chose a personal information source gave arguments that explained why they didn't choose the written information source. For the written information source this occurred four times.

When a participant chose a personal information source, considerations related to "other" (5) and considerations related to "other" in combination with Network and Accessibility (4) or Terminology (4) were mentioned most frequently. In addition, the table shows that for a written information source "other" related considerations (9) and "other" in combination with Accessibility (6) were mentioned most to support this choice.

When looking at the occurrence of a specific information source characteristic when related to personal sources, Accessibility occurs thirteen times, Terminology occurs ten times and Network occurs eleven times. For written sources holds true that Accessibility was mentioned nine times, Terminology seven times and Network six times. Furthermore, the 'other considerations' (as can be seen in Table 5.11) for personal sources are less limited to a specific kind of consideration than those for written sources.

Table 5.11 only gives a global overview of the considerations participants made. The results show that the reasons for choosing a personal or written information source were not limited to the three information source characteristics; other considerations, often in combination with one or more of the three information source characteristics, were mentioned quite frequently. Does this mean that the three information source characteristics were relevant or not? A more detailed analysis, that is a more content oriented analysis where the specific arguments given are analysed, was performed. This could give more insight in the role the three information source characteristics play.

Other considerations of participants

If the information source characteristic Network was mentioned, colleagues are seen as the most important connections in participants' network. In addition, in general these colleagues are seen as willing to share their knowledge. The reliability of information obtained via a personal or written information source is also often seen as higher if you know the information source although the opposite is also true according to some people. In case Accessibility is mentioned, the phrase "time is money" illustrates why participants choose the information source which costs the least effort because it is accessible. They choose the information source which is easy to access and call the main reason the "laziness principle" or "the ease". One participant mentioned that a time limit can also play a role when choosing the information source which is accessible. If Terminology was the information source characteristic mentioned, participants mentioned that besides ease of understanding the information immediately, it was also seen as a sign of expertise and thus quality or reliability if the information obtained was expressed in a shared terminology.

Other considerations participants mentioned varied. Some participants just have a general preference for an information source type or say that the information source they want to use depends on specific details of the question they have to answer. For personal sources holds true that participants appreciate the interaction aspect of a conversation and the extra information or reference you get from a personal information source. Written sources are sometimes found to be too theoretical by some people. Others, however, prefer written sources as they just search the web.

Also, sometimes written sources can provide all the information needed and some prefer this information source type for technical information. Sometimes information source characteristics were connected. For example, being in your network and being easy to access or being in your network and sharing terminology were for some participants closely related.

Summarizing, it is clear that the three information source characteristics played a role in the decision making process that shaped the behavioural intention and that they were often accompanied by other consideration. Those other considerations, for example, the quality of the information or reliability of the information, are intertwined with one or more of the three information source characteristics. However, overall the conclusion is that the three chosen information source characteristics are relevant.

Preferences for source characteristics

The relative swing weights were described in 5.3.2.2. However, participants in the interviews were also asked to distribute 60 points over the six possible characteristics of sources; these six characteristics were in fact the two states an information source characteristic could be in. When they give more points to a characteristic this means they value this characteristic more. It is interesting to see if this preference order differs much from the swing weights.

When an information source is in a network this is on average valued most (19.7 points) and after that the ease with which an information source can be reach is valued most on average (17.8 points), see Figure 5.4.

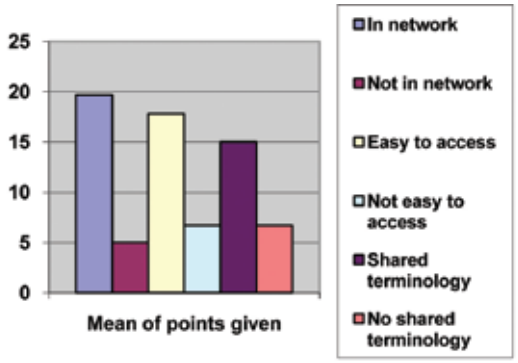


Figure 5.4 Points given to information source characteristics

On average, one fourth of the points (15 points) are given to shared terminology. The three characteristics that define absence of a characteristic together get almost one fourth of the point that could be divided: 18.4 points. When an information source is not in a network this is valued the least with a mean of 5 points. Both not sharing the same terminology and not being easy to access have a mean of 6.7 points.

The preference order shown here, in network first and easy to access second, differs from the swing weights order. However, the swing weights were computed over one information source characteristic taking into account the range of all situations and were not computed via the allocation of points to a state of an information source characteristic by a few persons. So these results may be more representative for the opinion of all respondents that participated in the questionnaire.

Summarizing this section, the results for the main and first sub question of this study show that the reasons for choosing a personal information source type or written information source type were not limited to the three information source characteristics. However, frequently at least one of the information source characteristics was mentioned in combination with alternative considerations. Furthermore, the results show that considerations for personal information source types are more distributed over different kind of considerations than those for written information source types. The results for the overall preference for specific information source characteristics show that when an information source type is in your network this is valued most. This information source characteristic is closely followed by accessible information source types and information source types having shared terminology.
The conclusion is that mainly contextual workplace oriented considerations and specific information source characteristics affect participants' choices. Social-normative, contextual workplace oriented normative, personal or other normative considerations are not mentioned. This is indicative that the social normative part of the Theory of Reasoned Action may not be relevant in the context of the behavioural intention of knowledge workers toward information sources and that the behavioural intention could be described by the expectancy value part of the Theory of Reasoned Action.

5.3.3 Results work context

The second sub question of this study addresses the effect of work context, which includes five aspects, on the behavioural intention. For each of these aspects, the joint preferential independence of the information source characteristics is investigated, and if and how each of these affect the behavioural intention or not. Each aspect is also related to a sub question in this chapter (respectively sub question three, four, five, six and seven). In addition, the swing weighing scores are computed for all work context aspects by using the method mentioned in Table 5.2 because they can also indicate if there are differences attributable to these work context aspects.
The multidimensional unfolding analyses are not carried out for the work context aspects because they cannot be compared meaningfully. The configuration of the information sources, just as in Figure 5.3, of the different groups for each work context factor would be constructed independent of each other. As the orientation of the axes

in the resulting (three) dimensional space is arbitrary, but the spatial arrangements (the distances) are invariant for reflecting the axes, one is allowed to "flip" each dimension in each of the configurations, leading to different, mirrored configurations. For a single group the (three) dimensional spaces can be interpreted, but when comparing configurations between groups, this "flip" aspect makes it hard to arrive at a sensible interpretation. Therefore, comparing results between two groups using multidimensional unfolding is not performed[38].

In section 5.3.3.1 to 5.3.3.5 each of the work context aspects and the results of the analyses are described. For each work context aspect the independence conditions of the information source characteristics and its effect on the behavioural intention is investigated. In 5.3.3.6 a summary is presented. This section starts with the dynamic of knowledge factor

5.3.3.1 Dynamic of knowledge

The concept of dynamic of knowledge, mentioned in the third sub question, refers to the speed with which knowledge changes in a knowledge area. The dynamic of knowledge could affect the behavioural intention to use sources for knowledge gaining at work. The idea behind the concept of dynamic of knowledge is that, if the speed with which knowledge changes in a knowledge domain is relatively high, people prefer to use personal information sources that provide up-to-date information. This results in a different use of sources for employees from areas with high and low dynamic of knowledge. It also affects the role each of the information source characteristics plays in the choice process.

Table 5.12 shows the results of the preliminary study investigating the sectors which have the most and least dynamic knowledge. The results show that the sector "Soil remediation" is seen as the sector where the knowledge is most dynamic. The sector "Spatial planning and infrastructure" is seen as the sector where the knowledge is least dynamic. As only three experts gave their opinion, these results serve only as an indicator of the dynamic of knowledge of the sectors.

Table 5.12 Results of the preliminary study

Sector	Dynamic of knowledge (n=3)	Total number of points
Spatial planning and infrastructure	5 6 5	16
Civil engineering and infrastructure	6 1 6	13
Environmental management	1 5 4	10
Water engineering	4 2 3	9
Water	2 4 2	8
Soil remediation	3 3 1	7

[38] Another, even more technical, argument is that also the orientation of the axes is arbitrary.

Based on these results, two groups concerning the dynamic of knowledge in the six sectors are formed. The first is the group with the least dynamic ones: Spatial planning and infrastructure, Environmental management, and Civil. In total 43.1% of the participants belong to this group. Compared to the other three sectors the speed with which knowledge changes in these fields of consultancy is relatively low. The second group is the group with the most dynamic knowledge: Soil remediation, Water engineering and Water. In total 51.4% of the participants belong to this group[39]. Compared with the other three sectors the speed with which knowledge changes in these sectors is relatively high.

5.3.3.1.1 Testing the independence conditions

Comparisons of statements are carried out to examine if condition d about pairwise preferentially independence, as implied by the expectancy value model (1), holds true for the two dynamic groups (see 5.2.2.1.1). Table 5.13 and Table 5.14 show the overall results for the conditions with the number of significant t-tests (for the most dynamic sectors with n=50 and p<.05; for the least dynamic sectors with n=41 and p<.05), indicating violations of the conditions, in the cells.

Table 5.13 Overall results independence conditions for participants of the most dynamic sectors (n=199, # of respondents per statement varies from 48 till 52)

High dynamic	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	1	0
Special case	1	1	1

Table 5.14 Overall results independence conditions for participants of the least dynamic sectors (n=167, # of respondents per statement varies from 40 till 43)

Low dynamic	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	0	0
Special case	0	0	0

From Tables 5.13 and 5.14 it emerges that the low dynamic group satisfies all conditions, while the high dynamic groups show some violations. The most conspicuous one is for the joint independence of Network-Terminology from Accessibility. However, given the number of comparisons the number of violations is still small.

[39] 5.4% of the participants indicated that they do not belong to one specific sector, as they answered "Other" in the questionnaire.

Taken together there is a minor difference between the two groups for the independence conditions, the low dynamic group having a better fit with model (1) than the high dynamic group.

5.3.3.1.2 Assessing weight of the information source characteristics for the dynamic of knowledge groups

If for each group all difference scores for each information source characteristic are added and are divided by the number of occurrences (sixteen), the mean swing weighing score of each characteristic is known. The higher the mean swing weighing score, the more an information source characteristic contributes to participants' choices. An overview is given in Table 5.15 .

Table 5.15 Overview means scores and standard deviations swing weighing scores

Information source characteristic	Most dynamic mean	Least dynamic mean
Terminology	22.69	23.37
Network	29.31	32.87
Accessibility	43.69	41.12

Looking at the mean swing weighing scores for both dynamic of knowledge groups, the conclusion is quite clear: Accessibility has most influence, followed by Network and Terminology. The conclusion is that no large differences are found between the two groups as the order of the means corresponds.

5.3.3.1.3 Effect of dynamic of knowledge on behavioural intention

In Table 5.16 and Table 5.17 the behavioural intention is specified for all possible information source type-information source characteristic combination per dynamic of knowledge group. Table 5.16 shows the results for the behavioural intention of the most dynamic sectors and Table 5.17 for the least dynamic sectors. To make comparisons possible, the information source type-information source characteristic combinations are ordered first from most till least positively formulated information source characteristics and on a second level by the frequency it was chosen by participants.

The personal information source type was chosen by participants from the most and least dynamic group in respectively 54.46% and 55.58% of the cases. There does not seem to be much difference between the dynamic of knowledge groups on this point. When the information source characteristics of both information source types are similar, a personal information source type is chosen most frequently by participants of both groups. The results for both dynamic of knowledge groups also show that the more positive formulated characteristics an information source type has, the more the information source type was chosen. Participants thus prefer information source types with positive formulated characteristics.

Overall, the behavioural intention of both sector groups seems to be quite similar. To see to what extent this is correct, the behavioural intentions of both groups were compared using the correlation coefficient. A correlation analysis between the number of times a certain information source type-information source characteristic combination was chosen per sector groups shows that the correlation between the two groups (P-W versus P-W) is significant and very strong ($r=.978$, $p<.05$). The correlation specified per information source type (P-P and W-W) also shows very strong correlations (for P: $r=.977$ $p<.05$ and for W: $r=.996$, $p<.05$). These results lead to one conclusion: no differences are found concerning the behavioural intention of both dynamic of knowledge groups. Thus, the work context aspect dynamic of knowledge does not seem to affect the behavioural intention.

Table 5.16 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for the most dynamic sectors (n=199, # of respondents per statement varies from 48 till 52)

ST-SCC	**N times chosen by participants**	**% of total**	**Difference with previous combination (%)**
P(+++)	372	11.76	-
P(++-)	299	9.45	2.31
P(+-+)	296	9.36	.09
P(-++)	214	6.76	2.60
P(+--)	202	6.38	.38
P(-+-)	157	4.96	1.42
P(--+)	109	3.45	1.51
P(---)	74	2.34	1.11
Total (P)	**1723**	**54.46**	
W(+++)	303	9.58	-
W(++-)	252	7.96	1.62
W(+-+)	244	7.71	.25
W(-++)	188	5.94	1.77
W(+--)	165	5.21	.73
W(-+-)	132	4.17	1.04
W(--+)	106	3.35	.82
W(---)	51	1.61	1.74
Total (W)	**1441**	**45.54**	
Total	**3164**	**100**	

Table 5.17 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for the least dynamic sectors (n=167, # of respondents per statement varies from 40 till 43)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	301	10.98	-
P(++-)	260	9.48	1.50
P(+-+)	247	9.01	.47
P(-++)	195	7.11	1.90
P(+--)	174	6.35	.76
P(-+-)	141	5.14	1.2
P(--+)	145	5.29	.15
P(---)	61	2.22	3.07
Total (P)	**1524**	**55.58**	
W(+++)	253	9.23	-
W(++-)	203	7.40	1.83
W(+-+)	195	7.11	.29
W(-++)	151	5.51	1.60
W(+--)	144	5.25	.26
W(-+-)	96	3.50	1.75
W(--+)	91	3.32	.18
W(---)	37	1.35	1.97
Total (W)	**1218**	**44.42**	
Total	**2742**	**100**	

Summarizing the effect of the first work context aspect, dynamic of knowledge, it can be concluded that there are not many substantial differences between the high and low dynamic groups. Only minor differences were found for the model conditions, with the low dynamic group showing a better model fit than the high dynamic group. Differences for weights and behavioural intentions are almost non-existent. Based on this the conclusion seems to be warranted that there is only a minor effect of this aspect.

5.3.3.2 Duration of employment

As the fourth sub question in this study addresses the effect of duration of employment on the behavioural intention, two groups were created: participants who work at Tauw recently as they work five years or less (53% of the participants) and participants who work at Tauw longer as they work longer than five years (47% of the participants).

5.3.3.2.1 Testing the independence conditions

The independence condition implied by the expectancy value model (1) as summarized in condition d are tested to see if the information source characteristics are pairwise preferentially independent (see 5.2.2.1.1). The pairwise preferentially independence tests, all 24 comparisons, were carried out for both groups (for the group working at Tauw recently with n=52 and p<.05; for the group working at Tauw longer with n=47 and p<.05). Table 5.18 and Table 5.19 show the overall results of the comparisons for the conditions with the number of significant t-tests, indicating violations of the conditions, in the cells.

Table 5.18 Overall results independence conditions for participants working recently at Tauw (n=205, # of respondents per statement varies from 49 till 54)

Employment recently	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	1	0
Special case	0	0	0

Table 5.19 Overall results independence conditions for participants working at Tauw longer (n=182, # of respondents per statement varies from 40 till 54)

Employment longer	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	1	0
Special case	1	0	2

Table 5.18 and Table 5.19 show that in the group working relatively recently at Tauw one violation is present and that in the group working relatively long at Tauw three violations are present. Accessibly-Terminology from Network has most violations in this last group. However, given the number of comparisons, the number of violations is small. Taken together there is a minor difference between the two groups for the independence conditions, the group working relatively short at Tauw having a better fit with model (1) than the group working relatively long at Tauw.

5.3.3.2.2 Assessing weights of the information source characteristics

In Table 5.20 the principles for assessing the weight were explained. By adding per group all difference scores for each information source characteristic and dividing this by the number of occurrences (sixteen), the mean swing weighing score of each characteristic is computed. The higher the mean swing weighing score is, the more an information source characteristic contributes to participants' choices. Table 5.20 gives an overview of the means for both groups.

Table 5.20 Overview means scores and standard deviations swing weighing scores

Information source characteristic	Participants working at Tauw recently mean	Participants working at Tauw longer mean
Terminology	21.50	24.00
Network	31.69	30.06
Accessibility	44.00	41.88

Looking at the mean swing weighing scores for both groups, the conclusion is quite clear: Accessibility has most influence, followed by Network and Terminology. A high degree of correspondence is noticeable as the differences between the means are small. The conclusion is that no large differences are found between the two groups.

5.3.3.2.3 Effect on behavioural intention towards the sources

In Table 5.21 and Table 5.22 the behavioural intention is specified for all possible information source type-information source characteristic combinations. Table 5.21 shows the results for the behavioural intention of the group working recently at Tauw and Table 5.22 shows it for the group working longer at Tauw. To make comparisons possible, the information source type-information source characteristic combinations are ordered first from most till least positively formulated information source characteristics and on a second level by the frequency it was chosen by participants.

A personal information source type was chosen in respectively 54.91% (recently) and 55.60% (longer) of the cases, also there was only a little less preference for the written information source type that was chosen 45.09% and 44.40% of the cases. If a personal information source type and a written information source type have the same information source characteristics, a personal information source type is preferred. Furthermore, results of both groups show that the more positive formulated characteristics an information source type has, the more the sources were chosen. No differences between the behavioural intentions of both groups are present.

The correlation analysis confirms that there is much similarity between the two groups. A very strong and significant correlation between the two groups is found (P-W versus P-W): $r=.987$ ($p<.05$). The correlations specified per information source type (P-P and W-W) also shows very strong correlations (for P: $r=.988$, $p<.01$ and for W: $r=.985$, $p<.05$).

Overall, no differences between the behavioural intentions of the two groups exist. The duration of employment therefore does not appear to effect the behavioural intention.

Table 5.21 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for participants working at Tauw recently (n=205, # of respondents per statement varies from 49 till 54)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	369	11.26	-
P(++-)	321	9.79	1.47
P(+-+)	301	9.18	.61
P(-++)	225	6.85	2.33
P(+--)	211	6.44	.41
P(-+-)	163	4.97	1.47
P(--+)	143	4.35	.62
P(---)	67	2.04	2.31
Total (P)	**1800**	**54.91**	
W(+++)	317	9.67	-
W(++-)	255	7.78	1.89
W(+-+)	231	7.05	.73
W(-++)	191	5.83	1.22
W(+--)	171	5.22	.61
W(-+-)	137	4.18	1.04
W(--+)	122	3.72	.46
W(---)	54	1.65	2.07
Total (W)	**1478**	**45.09**	
Total	**3278**		

Table 5.22 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for participants working at Tauw longer (n=182, # of respondents per statement varies from 40 till 54)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	343	11.78	-
P(++-)	274	9.41	2.37
P(+-+)	269	9.24	.17
P(-++)	211	7.25	1.99
P(+--)	190	6.52	.73
P(-+-)	147	5.05	1.47
P(--+)	105	3.61	1.44
P(---)	80	2.75	.86
Total (P)	**1619**	**55.60**	

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
W(+++)	267	9.17	-
W(++-)	227	7.80	1.37
W(+-+)	233	8.00	.20
W(-++)	165	5.67	2.33
W(+--)	153	5.25	.42
W(-+-)	105	3.61	1.64
W(--+)	106	3.64	.03
W(---)	37	1.27	2.37
Total (W)	**1293**	**44.40**	
Total	**2912**	**100**	

Summarizing the effect of the work context aspect duration of employment, it can be concluded that there are not many substantial differences between the two groups. Only minor differences were found for the model conditions; the group working recently at Tauw has a better fit with model (1) than the group working longer at Tauw. Differences for weights and behavioural intentions are almost non-existent. Based on this the conclusion seems to be warranted that there is only a minor effect of this aspect.

5.3.3.3 Duration of employment in current function

As the fifth sub question in this study addresses the effect of duration of employment in current function on the behavioural intention, two groups were created: participants who work in their current function recently, that is, five years or less (68% of the participants) and those who work longer in their current function, that is, longer than five years (32% of the participants).

5.3.3.3.1 Testing the independence conditions

If condition d (see model (1)) holds true, than the information source characteristics are pairwise preferentially independent (see 5.2.2.1.1). The pairwise preferential independence tests, all 24 comparisons, were carried out for both groups (for the group who work in their current function recently with n=67 and $p<.05$; for the group who work longer in their current function with n=30 and $p<.05$). The main results for the conditions with the number of significant t-tests in the cells are described in Table 5.23 and Table 5.24, the number in the cells of the tables refers to the number of violations of condition d.

Table 5.23 Overall results independence conditions for participants working in their current function recently (n=263, # of respondents per statement varies from 63 till 71)

Current function recently	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	2	0
Special case	0	0	0

Table 5.24 Overall results independence conditions for participants working longer in their current function (n=124, # of respondents per statement varies from 29 till 32)

Current function longer	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	0	0
Special case	0	1	2

Table 5.23 and Table 5.24 show that in the group working recently in their current function two violations are present for Network-Terminology from Accessibility. In the group working longer in their current function three violations are present. Accessibility-Terminology from Network has most violations in this last group. However, given the number of comparisons the number of violations is small. Taken together there is a minor difference between the two groups for the independence conditions, the group working recently in their current function having a slightly better fit with model (1) than the group working longer in their current function.

5.3.3.3.2 Assessing weights of the information source characteristics

By adding per group all difference scores for each information source characteristic and dividing this by the number of occurrences (sixteen), the mean swing weighing score of each characteristic is computed. The higher the mean swing weighing score is, the more an information source characteristic contributes to participants' choices. Table 5.25 gives an overview of the means for both groups.

Table 5.25 Overview means scores and standard deviations swing weighing scores

Information source characteristic	Participants working in their current function recently	Participants working in their current function longer
	mean	mean
Terminology	19.13	30.38
Network	30.88	30.19
Accessibility	43.00	42.69

Looking at the mean swing weighing scores, the conclusion is that for both groups Accessibility has most influence. Although the means for Network are almost similar,

the mean of Terminology is higher in the group working longer in their current function. For this group holds true that Terminology has substantially more influence than Network. This result contrasts with the group of employees working in their current function recently; here Network has clearly more influence than Terminology. The conclusion is that the length of employment in current function affects the relative importance of the information source characteristics Terminology and Network.

5.3.3.3.3 Effect on behavioural intention towards the sources

In Table 5.26 and Table 5.27 the behavioural intention is specified for all possible information source type-information source characteristic combinations. Table 5.26 shows the results of the behavioural intention for the group working in their current function recently and Table 5.27 shows it for the second group who's working in their current function longer. To make comparisons possible, the information source type-information source characteristic combinations are ordered first from most till least positively formulated information source characteristics and on a second level by the frequency it was chosen by participants.

Similar to previous results, personal information source types were chosen in respectively 56.23% (first group) and 53.35% (second group) of the cases and written information source types in respectively 43.77% and 46.67% of the cases. There are no important differences between the two groups. On the whole, if the characteristics of a personal information source type and a written information source type are the same, the personal information source type is preferred by both groups. In addition, the more positive formulated information source characteristics an information source type has, the more it was chosen by both groups.

The correlation analysis shows very strong and significant correlations between the two groups (P-W versus P-W): $r=.976$ ($p<.05$). The correlations specified per information source type (P-P and W-W) also shows very strong correlations (for P: $r=.989$, $p<.05$ and for W: $r=.980$, $p<.05$).

The above results show that the behavioural intention to use a certain information source type with specific characteristics is not affected by the duration of employment in a certain function. On a detailed level a difference exists, this holds true for the preference of a certain information source type in case the information source characteristics are the same. The conclusion is that this work context aspect does not seem to affect the behavioural intention.

Table 5.26 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for participants working in their current function recently (n=263, # of respondents per statement varies from 63 till 71)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	482	11.48	-
P(++-)	415	9.88	1.60
P(+-+)	387	9.22	.66
P(-++)	303	7.22	2.00
P(+--)	285	6.79	.43
P(-+-)	220	5.24	1.55
P(--+)	164	3.91	1.33
P(---)	105	2.50	1.41
Total (P)	**2361**	**56.23**	
W(+++)	394	9.38	-
W(++-)	316	7.53	1.85
W(+-+)	299	7.12	.41
W(-++)	233	5.55	1.57
W(+--)	217	5.17	.38
W(-+-)	171	4.07	1.10
W(--+)	142	3.38	.69
W(---)	66	1.57	1.81
Total (W)	**1838**	**43.77**	
Total	**4199**		

Table 5.27 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for participants in their current function longer (n=124, # of respondents per statement varies from 29 till 32)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	230	11.59	-
P(++-)	180	9.07	2.52
P(+-+)	183	9.23	.16
P(-++)	133	6.70	2.53
P(+--)	116	5.85	.85
P(-+-)	90	4.54	1.31
P(--+)	84	4.23	.31
P(---)	42	2.12	2.11
Total (P)	**1058**	**53.35**	
W(+++)	190	9.58	-
W(++-)	159	8.01	1.57
W(+-+)	165	8.32	.31
W(-++)	123	6.20	2.12
W(+--)	107	5.39	.81

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
W(-+-)	71	3.58	1.81
W(--+)	86	4.33	.75
W(---)	25	1.26	3.07
Total (W)	**926**	**46.67**	
Total	**1984**		

Summarizing the effect of the work context aspect duration of employment in current function, it can be concluded that there are some differences between the two groups. Only minor differences were found for the model conditions with the group working recently in their current function having a better fit with model (1) than the group working longer in their current function. Differences for weights were found too; the duration of employment in current function seems to affect the relative weight of Network and Terminology substantially. Differences in the behavioural intentions are almost non-existent. Based on this the conclusion seems to be warranted that there is only a minor effect of this aspect.

5.3.3.4 Rank: type of work

As the sixth sub question in this study addresses the effect of rank of the work on the behavioural intention, two groups were created: participants whose type of work is considered highest in rank (Functional leadership and Study and advice, 58.6% of the participants), and those whose type of work is not judged to be highest in rank (Specialisation, Design, Supervision and Inspection and measurements, 41.3% of the participants).

5.3.3.4.1 Testing the independence conditions

If condition d holds true, the information source characteristics are pairwise preferentially independent (see 5.2.2.1.1). The 24 comparisons needed to tests pairwise preferential independence were carried out for both groups (for the group highest in rank with n=57 and p<.05; for the group not highest in rank with n=39 and p<.05). The most important results for both groups, the number of significant t-tests in the cells, indicating violations of the conditions, are in Table 5.28 and Table 5.29.

Table 5.28 Overall results independence conditions for participants high in rank (n= 227, # of respondents per statement varies from 53 till 61)

High rank	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	0	0
Special case	2	0	1

Table 5.29 Overall results independence conditions for participants not high in rank (n=160, # of respondents per statement varies from 33 till 45)

Low rank	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	1	0
Special case	0	1	0

From Table 5.28 and Table 5.29 it emerges that the group high in rank does not satisfy all conditions; Accessibility-Network from Terminology is most important here. For the group not high in rank some violations show too; two are found for Network-Terminology from Accessibility. However, given the number of comparisons the number of violations is small. Taken together there is a minor difference between the two groups for the independence conditions, the group relatively low in rank having a slightly better fit with model (1) than the group relatively high in rank.

5.3.3.4.2 Assessing weights of the information source characteristics

By adding per group all difference scores for each information source characteristic and dividing this by the number of occurrences (sixteen), the mean swing weighing score of each characteristic is computed. The higher the mean swing weighing score is, the more an information source characteristic contributes to participants' choices. Table 5.30 gives an overview of the means for both groups.

Table 5.30 Overview means scores and standard deviations swing weighing scores

Information source characteristic	Participants high in rank mean	Participants not high in rank mean
Terminology	20.88	24.94
Network	30.13	31.88
Accessibility	43.00	42.44

Looking at the order of the mean swing weighing scores for both groups, the conclusion is quite clear: the same order is found. Accessibility has most influence, followed by Network and Terminology. The conclusion is that no large differences are found between the two groups.

5.3.3.4.3 Effect on behavioural intention towards the sources

In Table 5.31 and Table 5.32 the behavioural intention is specified for all possible information source type-information source characteristic combinations. Table 5.31 shows results for the behavioural intention of the group working in functions ranked high and Table 5.32 shows this for the group working in functions that are not ranked high. To make comparisons possible, the information source type-information source

characteristic combinations are ordered first from most till least positively formulated information source characteristics and on a second level by the frequency it was chosen by participants. On the whole a written information source type is preferred less than a personal information source type but both groups show similar results. A personal information source type was chosen in respectively 55.63% (high rank group) and 54.88% (low rank group) of the cases and a written information source type in respectively 44.37% and 45.12% of the cases.

If the characteristics of personal information source types and written information source types are the same, personal information source types are preferred more by both groups. The more positive formulated characteristics an information source type has, the more the sources were chosen by both groups.

The correlation analysis shows very strong and significant correlations between the two groups (P-W versus P-W): r=.970, p<.05. The correlations specified per information source type (P-P and W-W) also shows very strong correlations (for P: r=.954 p<.05 and for W: r=.992, p<.05).

Thus, on the level of the behavioural intention the choices of participants differing in rank are very similar as only one difference was found. The conclusion is therefore that type of work of a participant (the rank) does not seem to affect the behavioural intention to use a certain information source type.

Table 5.31 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for participants high in rank (n= 227, # of respondents per statement varies from 53 till 61)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	410	11.29	-
P(++-)	372	10.25	1.04
P(+-+)	321	8.84	1.41
P(-++)	255	7.02	1.82
P(+--)	247	6.80	.22
P(-+-)	193	5.31	1.49
P(--+)	127	3.50	1.81
P(---)	95	2.61	.89
Total (P)	**2020**	**55.63**	
W(+++)	338	9.31	-
W(++-)	287	7.90	1.41
W(+-+)	263	7.24	.66
W(-++)	202	5.56	1.68
W(+--)	190	5.23	.33
W(-+-)	146	4.02	1.21

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
W(--+)	134	3.69	.33
W(---)	51	1.40	2.29
Total (W)	**1611**	**44.37**	
Total	**3631**	**100**	

Table 5.32 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for participants not high in rank (n=160, # of respondents per statement varies from 33 till 45)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	302	11.85	-
3.10			
P(++-)	223	8.75	
P(+-+)	249	9.77	1.02
P(-++)	181	7.10	2.67
P(+--)	154	6.04	1.06
P(-+-)	117	4.59	1.45
P(--+)	121	4.75	.16
2.71			
P(---)	52	2.04	
Total (P)	**1399**	**54.88**	
W(+++)	236	9.26	-
W(++-)	195	7.65	1.61
W(+-+)	201	7.86	.21
W(-++)	154	6.04	1.82
W(+--)	134	5.26	.78
W(-+-)	96	3.77	1.49
W(--+)	94	3.69	.08
W(---)	40	1.57	2.12
Total (W)	**1150**	**45.12**	
Total	**2549**	**100**	

Summarizing the effect of the work context aspect rank (type of work), it can be concluded that there are not many substantial differences between the two groups. Only minor differences were found for the model conditions with the group relatively low in rank having a better fit with model (1) than the group relatively high in rank. Differences for weights and the behavioural intentions are almost non-existent. Based on this the conclusion seems to be warranted that there is only a minor effect of this aspect.

5.3.3.5 Size of location

As the seventh sub question in this study addresses the effect of size of location of an organisation on the behavioural intention, two groups were created: participants who work at the two largest locations (Deventer and Utrecht, 58.1% of the participants) and those who work at the smaller locations (Amsterdam, Assen, Eindhoven, Rotterdam or Purple Blue, 41.9% of the participants).

5.3.3.5.1 Testing the independence conditions

If condition d holds true, the information source characteristics are pairwise preferentially independent (see 5.2.2.1.1). The 24 comparisons needed to tests pairwise preferential independence were carried out for both groups (for the group of the larger locations with n=56 and p<.05; for the group of the smaller locations with n=38 and p<.05). The most important results for both groups are described in Table 5.33 and Table 5.34 for the conditions with the number of significant t-tests, indicating violations of the conditions, in the cells.

Table 5.33 Overall results independence conditions for participants of the larger locations (n=225, # of respondents per statement varies from 51 till 62)

Large location	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	1	0
Special case	2	0	2

Table 5.34 Overall results independence conditions for participants of the smaller locations (n=162, # of respondents per statement varies from 30 till 47)

Small location	Accessibility-Network/ Terminology	Network-Terminology/ Accessibility	Accessibility-Terminology/ Network
Usual case	0	1	0
Special case	0	0	0

From Table 5.33 and Table 5.34 it emerges that the group working at the larger locations does not satisfy all conditions; Accessibility-Network from Terminology and Accessibility-Terminology from Network are most important here. For the groups working at the smaller locations one violation was found; Network-Terminology from Accessibility. The number of violations for the first groups is relatively large when compared with the other group. Taken together there is a more substantial difference between the two groups for the independence conditions, the group working at the smaller locations having a much better fit with model (1) than the group working at the larger locations.

5.3.3.5.2 Assessing weights of the information source characteristics

The same terms as used in Table 5.2, that explains the principles for assessing the weight, are used here. By adding per group all difference scores for each information source characteristic and dividing this by the number of occurrences (sixteen), the mean swing weighing score of each characteristic is computed. The higher the mean swing weighing score is, the more an information source characteristic contributes to participants' choices. Table 5.35 gives an overview of the means for both groups.

Table 5.35 Overview means scores and standard deviations swing weighing scores

Information source characteristic	Participants working at larger locations mean	Participants working at smaller locations mean
Terminology	24.13	21.31
Network	29.06	33.44
Accessibility	42.94	42.56

Looking at the order of the mean swing weighing scores for both groups, the conclusion is quite clear: Accessibility has most influence, followed by Network and Terminology. The conclusion is that no large differences are found between the two groups.

5.3.3.5.3 Effect on behavioural intention towards the sources

In Table 5.36 and Table 5.37 the behavioural intention is specified for all possible information source type-information source characteristic combination per location-based group are shown. Table 5.36 shows the results for the behavioural intention of the group working at the larger locations and Table 5.37 shows this for the group working at the smaller locations. To make comparisons possible, the information source type-information source characteristic combinations are ordered first from most till least positively formulated information source characteristics and on a second level by the frequency it was chosen by participants.

Personal information source types were chosen in respectively 53.90% (larger location group) and 57.34% (smaller location group) of the cases and written information source types in respectively 46.10% and 42.66% of the cases. A difference between the two groups in preference for a certain information source type is present, but small. The personal information source type is preferred somewhat more than the written information source type. For most paired comparisons holds true that if the characteristics of a personal information source type and a written information source type are the same, the personal information source type is preferred more.

Similar to results of the other work context aspects, results show that the more positive formulated characteristics an information source type has, the more the information source type was chosen by participants from the larger and smaller locations.

Correlation analysis shows a very strong and significant correlation between the two groups (P-W versus P-W): r=.970 (p<.05). The correlations specified per information source type (P-P and W-W) also shows very strong correlations (for P: r=.985, p<.05 and for W: r=.972, p<.05).

On the level of the behavioural intention the choices of participants of the larger locations and smaller locations of Tauw are very similar. In this study, only one difference on a more detailed level are found for this work context aspect. The conclusion is therefore that size of the location a participant does not seem to affect the behavioural intention.

Table 5.36 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for participants who work the larger locations (n=225, # of respondents per statement varies from 51 till 62)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	417	11.62	-
P(++-)	324	9.03	2.59
P(+-+)	327	9.11	.08
P(-++)	247	6.88	2.23
P(+--)	222	6.19	.69
P(-+-)	177	4.93	1.26
P(--+)	133	3.71	1.22
P(---)	87	2.42	1.29
Total (P)	**1934**	**53.90**	
W(+++)	344	9.59	-
W(++-)	292	8.14	1.45
W(+-+)	270	7.53	.61
W(-++)	216	6.02	.51
W(+--)	206	5.74	.28
W(-+-)	122	3.40	2.34
W(--+)	148	4.12	.72
W(---)	56	1.56	2.56
Total (W)	**1654**	**46.10**	
Total	**3588**	**100**	

Table 5.37 The behavioural intention specified per information source type-information source characteristic combination (ST-SCC) for participants who work at the smaller locations (n=162, # of respondents per statement varies from 30 till 47)

ST-SCC	N times chosen by participants	% of total	Difference with previous combination (%)
P(+++)	295	11.39	-
P(++-)	271	10.46	.93
P(+-+)	243	9.38	1.08
P(-++)	189	7.30	2.08
P(+--)	179	6.91	.39
P(-+-)	133	5.14	1.77
P(--+)	115	4.44	.70
P(---)	60	2.32	2.12
Total (P)	**1485**	**57.34**	
W(+++)	240	9.27	-
W(++-)	190	7.34	1.93
W(+-+)	194	7.49	.15
W(-++)	140	5.41	2.08
W(+--)	118	4.56	.85
W(-+-)	108	4.17	.39
W(--+)	80	3.09	1.08
W(---)	35	1.35	1.74
Total (W)	**1105**	**42.66**	
Total	**2590**	**100**	

Summarizing the effect of the work context aspect size of location, it can be concluded that there is at least one substantial difference between the two groups. This is for the model conditions with the group working at the smaller locations having a much better fit with model (1) than the group working at the larger locations.
Differences for weights and the behavioural intentions are almost non-existent. Based on this the conclusion seems to be warranted that there is some effect of this aspect.

5.3.3.6 Summary work context

Results show that there is some influence of the five work context aspects on the joint preferential independence of the information source characteristics, as some work context categories have a better fit with model(1) than other ones. This applies in particular to the size of a location, smaller locations have a better fit with model (1) than larger locations. However, these differences are considered not to be of such a size that they result in a conclusion that condition d does not hold. Overall, taking all

significant difference scores into account, condition d holds, therefore the work context aspects don't have a substantial effect on the fit of model (1).

A comparison of the relative weights of each of the information source characteristics show that duration of employment, rank or the type of work, the size of the location and the dynamic of knowledge of the sector a participant works in have no influence on the order of the relative weights of the information source characteristics. Accessibility has the largest weight, followed by Network and Terminology. However, in case the work context aspect duration of employment in current function is taken into account, differences in the order of the weights are found. In case a participant works longer than five years in his current function the relative weight of terminology is slightly larger than that of network. Thus, experience in a function affects the relative weight of terminology as the importance of this information source characteristic increases when someone's experience grows. An explanation could be that as someone's experience grows in a function, his professional knowledge and vocabulary grows also and in parallel his knowledge of, and capability to deal with, sources when communicating using professional terminology.

The results of investigating the effect of the work context aspects on the behavioural intention show that there are no work context aspects that affect participants' choices substantially. Although small differences in the behavioural intention on a detailed level are present, all correlation analyses show a very high degree of similarity between the preferences of the groups investigated.

Summarizing these results for sub questions two till seven, it is clear that when searching for knowledge to complete a work task the behavioural intention is most of the times not affected by the work context, with the exception of the relative weights of Network and Terminology that seem to be affected by the work context aspect duration of employment in current function.

5.4 Summary and conclusions

In this study the role of information source characteristics on the choice of sources for acquiring knowledge during work was investigated. The reason for performing this study was to obtain insight into why certain information sources are used in knowledge seeking situations at work (question C as described in Chapter 1). The Theory of Reasoned Action (TRA) forms the theoretical basis and starting point of this study. The main research question was if the behavioural intention of knowledge workers toward information sources can be described by the expectancy value part of the Theory of Reasoned Action model. The analyses carried out to investigate pairwise preferential independence of the three information source characteristics Accessibility, Network and Terminology show that these three information source characteristics are almost certainly pairwise preferentially independent, the necessary condition for

accepting the expectancy value part as a valid description of the behavioral intention towards information sources. In addition, interviews show that the social normative part of the Theory of Reasoned Action may not be relevant in the context of the behavioural intention of knowledge workers toward information sources. Also, the computation of the weights of each of the involved information source characteristics shows that Accessibility has the highest relative weight, followed by information source characteristics Network and Terminology. Thus, the use of an information source in a knowledge seeking situation is determined most by easy access of the information source type. The results can be summarized in a formula based on model (1). Let v be the attitude towards an information source (either personal or written) and a, n, and t represent the beliefs about information source characteristics Accessibility (a), Network (n) and Terminology (t) and evaluations (relative weights) of these beliefs, leading to v(a, n, t) = 43(a)+31(n)+23(t).

Besides the TRA factor, the effect of the work context on the behavioural intention of knowledge workers towards information sources was examined as sub question two addressed this. This work context includes five aspects, each related to a sub question (sub question three till seven): the dynamic of knowledge, size of location, rank of work, duration of employment and duration of employment in current function. Overall, taking all significant difference scores into account, results show that condition d holds; the work context aspects don't have a substantial effect on the fit of model (1), maybe with the exception of the size of a location as smaller locations have a better fit with model (1) than larger locations. Results also show that the five work context aspects do not affect the behavioural intention. Concerning the relative weights of the source characteristics it was found that if a participant works longer than five years in his current function the influence of Terminology becomes slightly larger than that of Network. A growing experience in a certain function therefore affects the relative influence of terminology as the importance of this information source characteristic grows when someone's experience grows.

These results lead to the conclusions the characteristics of the information sources are important and relevant contributors to the behavioural intention as described in model (1), although the relative weight of each of the information source characteristics is somewhat affected by the work context (in particular by duration of employment in current function). However, model (1) still is descriptively valid as the independence conditions are met. This answers the main research question of this study: the behavioural intention of knowledge workers toward information sources can be described by the expectancy value part of the Theory of Reasoned Action. In addition, when looking at *why* certain information sources are used in knowledge seeking situations at work (question C as described in Chapter 1), the conclusion is that the source characteristic Accessibility is most important when compared with the characteristics Network and Terminology.

The aim of this study was to investigate why specific sources are used for gaining knowledge at work. Using model (1) as the theoretical perspective for the study design is just one way to investigate this. Some researchers consider as one of the limitations of the TRA that it assumes that behaviours are under volitional control (Hale et al., 2002) and that it excludes, for example, behavior that is spontaneous, impulsive, habitual, the result of cravings, or simply scripted or mindless. This aspect, if the choice for an information source type with specific characteristic is a conscious decision at all, was not investigated in this study. By presenting participants with a situation where they had to choose, thus using a forced choice approach, they were stimulated to think about which information source with which characteristics they preferred, as these characteristics were conspicuously present in the questionnaire. However, the results of the interviews show that a few times a source was chosen just because it was someone's habit to do so; habitual behaviour was thus not very frequent. Therefore, it seems that these non volitional factors do not have a large effect on the results. On the positive side, by using this set-up participants could not choose the golden (happy) mean; they had to choose. This limited fuzzy results and lead to results that show the behavioural intention in its purest form. Nevertheless, this approach can be seen as a limitation, as some behaviour was not captured. For example, if someone would have preferred not to use any source at all, which was not an option in our study. This additional insight in the context of why sources are used for acquiring knowledge is missing as participants had to pick one source. Other ways to test the influence of each of the information source characteristics can be thought of, for example by using the media naturalness theory as formulated by Kock (2005). Media naturalness refers to the degree of similarity to the face-to-face medium. Like media richness (used in Chapter 4), media naturalness can be linked to implications for the selection, use, and deployment of media. However, for this study the theory of Reasoned Action and its Expectancy Value part were used to test the influence of each of the information source characteristics.

The operationalisation of each of the information source characteristics in this study was quite straightforward. For example, accessibility was formulated as "easy to access" and "difficult to access". However, it can be argued that each information source characteristic needs a far more complex operationalisation. As, for example, Carlson and Davis (1998) state accessibility entails concepts like convenience too. In addition, Fidel and Green (2004) argue that the concept of accessibility is ambiguous and that it was given various interpretations by both researchers and engineers. The same can be argued for the other information source characteristics in this study, but the decision what exactly constitutes a separate characteristic is far from easy. The notion of convenience, mentioned above, could be seen as separate characteristics as well In order to make comparisons between respondents, defining characteristics in an unambiguous way is mandatory, leading to a preference for those that are least likely to cause confusion.

The results of this study show that the three information source characteristics chosen, Accessibility, Network and Terminology, play a role in information source selection as they clearly affect the attitudinal component of the behavioural intention. This was supported by the fact that other results showed that the investigated work context did not influence the behavioural intention to use certain sources. However, it cannot be ruled out that other aspects, such as other information source characteristics or work context features could also play a role in the process of information source selection for gaining knowledge. As a consequence, the descriptive validity of the TRA model only holds true for the characteristics and work context aspects included in this study.

The knowledge workers investigated at Tauw are mostly engineers. The process of information seeking by engineers was investigated by Leckie, Pettigrew and Sylvain (1996). They described that engineers prefer oral sources and that they rely heavily on co-workers' and supervisors' knowledge. In the current study, this strong preference for oral sources was found in case a written and personal source have the same characteristics: in those cases the personal source is preferred. However, the results also show that the behavioural intention to use personal information source types (which are comparable with oral sources) or written information source types is as good as equal when the characteristics differ. This difference (not finding this unconditional strong preference) can be caused by the difference in research focus: in this study the focus was on knowledge gaining and not on information seeking in general; participants were confronted with a knowledge seeking situation to complete a work task not an information seeking situation in general. However, the question is also if the participants could make this distinction when selecting a source; understanding the difference between information and knowledge may not have been completely clear for the participants. By describing the knowledge seeking situation, it was attempted to make clear that they had to use a source for acquiring knowledge. However, participants were not asked about how they understood the difference between information and knowledge. Another explanation could be the growth of competition for oral sources: nowadays there is a larger variety in the availability of organisational written information source types than at the time Leckie, Pettigrew and Sylvain (1990) carried out their study. Moreover, Hertzum and Pejtersen (2000) found that the nature of the information an engineer needed determined whether a personal or written information source was sought; each information source type provides a different type of information. This means that information source type could be a less relevant aspect of information seeking, as often the first used information source type is used as an intermediary step to get information from another information source type. For example, a colleague who is an expert in a certain topic is contacted to get the best book available about that topic.

Chapter 6

6 Conclusion and general discussion

6.1 Conclusion

This dissertation has as its goal to investigate the way workers in an organisation acquire new information and knowledge during work using a range of information sources. The studies were framed within the context of informal self-directed workplace learning. In this dissertation, self-directed learning refers to self-directed exploration and application of knowledge by workers with the purpose of explicit or implicit advancement in a learning domain. Within this overall frame, information source usage during learning at work, that is, learning that is directly related to doing one's work tasks (the learning domain) was the main focus. The knowledge management episode of the knowledge ontology of Holsapple and Joshi (2003), which describes the period between the recognition of a knowledge need and meeting it, was used for setting up the four studies in this dissertation. However, in the studies not all activities that occur during a knowledge management episode are relevant. As the focus in the four studies was on behaviour and not on the individual mental processes involved, those knowledge manipulating activities that include aspects of this behaviour were investigated.

In addition, the search behaviour and the use of knowledge were analysed on two of the three levels that Choo describes (1998): the affective level and the situational level. In order to place knowledge needs and usage of information sources for gaining knowledge in a learning at work context, two theories from communication science (besides the social influence model of technology use) were used in two studies: the Media Richness Theory (Daft & Lengel, 1986) and the Theory of Reasoned Action (Fishbein & Ajzen, 1980).

The overall research question (A) investigated in this dissertation is:

> *What are the practices and preferences of knowledge workers regarding the use of information sources for knowledge gaining in the context of their workplace and do the organisational context and individual characteristics of knowledge workers affect these practices and preferences of knowledge workers?*

As the overall research question refers to practices and preferences, two accompanying sub-questions were formulated. The part of practices is covered by one sub-question; the part of 'preferences' is covered by the second sub-question. The answers to these two sub questions will be discussed first, later on the second part of the main research question (the effect of organisational context and of

individual characteristics of knowledge workers) will be described. The first sub question (B) is:

> *What information sources are used by knowledge workers if they gain knowledge at work? (B)*

In the Chapter 2 study this question was partly addressed, as the use of sources for gaining knowledge by policemen was investigated. The actual use of sources and the position of a relative new information source (PKN) for gaining knowledge among available sources was investigated. Results show that both digital and non-digital sources are used, but not with the same frequency: personal and digital sources are used more than written sources. The results also show that the knowledge needs that drive the use of sources, are mostly task triggered, although interest triggered knowledge needs occur too. Regarding the use of the relative new information source PKN, it was found that although PKN is not used much, its support is valued positively.
Additionally, Chapter 3 describes a study that addressed this question by investigating actual workplace learning behaviour of knowledge workers, especially their use of information sources. The findings in this study confirm the findings of the Chapter 2 study: the key learning patterns found stress the importance of personal help seeking (colleagues) and seeking help from digital written material as used by knowledge workers in self-directed learning. It was also again found that most knowledge needs are triggered by work tasks, but coincidental and interest driven learning were also present.

The part of preferences is translated into sub question (C):

> *When and why do knowledge workers use these information sources if they gain knowledge at work? (C)*

In Chapter 4 a study is described related to the “When” part of the question as it takes into account the context of use of information sources for knowledge gaining. The goal of this study was to obtain more insight into the relation between work situations, learning situations and the information sources and communication media people use to acquire the knowledge needed to perform tasks at hand better and gain knowledge about the related topics. In this study, the Media Richness Theory was used to predict the usage of information sources by knowledge workers in certain work-learn situations. Results regarding in which work situations knowledge workers use sources for gaining knowledge show that, for *learning situations*, acquiring new knowledge when starting a new assignment and finding out how things are done in

the company when you are new were selected most frequently. The specific learning task selected was trying to get a good understanding. For the *transfer situation*, the most frequently selected work situations were 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. The learning task of the person seeking assistance selected most frequently, finding a good and well founded understanding of the topic, is in line with what was found for the learner situation. Regarding the predictive power of the Media Richness Theory, the results show that the usefulness of the Media Richness Theory to provide the basis for predicting information source usage in workplace learning and transfer situations must be questioned: although in learning situations the predictive power was found to be rather strong, the overall support found was not very strong.

In the final study, described in Chapter 5, the “Why” question is addressed as it investigated the trade-offs knowledge workers make when they are confronted with a choice between different information sources with different characteristics. The focus in this study was on investigating the influence of shared terminology, social networks and accessibility on the decision of knowledge workers to use a source. This question was addressed by investigating if the use of sources during knowledge gaining behaviour at the workplace can be described by Theory of Reasoned Action. Results show that the behavioural intention of knowledge workers toward information sources can be described by the expectancy value part of the Theory of Reasoned Action. The three characteristics of the information sources are important and relevant contributors to the behavioural intention to use a source and the source characteristic Accessibility is the most important one, when compared with the characteristics Network and Terminology. The relative importance of each of the information source characteristics is somewhat affected by the work context, in particular by duration of employment in current function leading to an almost equal importance of Network and Terminology.

This leads us to answering the last part of the main research question: the effect of organisational context and individual characteristics of knowledge workers. In all studies work context was taken into account when investigating information source usage practices and preferences. Results show that overall some effects were found for work context. For example, results of the Chapter 2 study showed that career phase affects the type of knowledge need experienced. However, overall only minor effects of work context on the behaviour and preferences were found, thus suggesting that work context is not very decisive when workers choose information sources when engaged in self-directed learning activities during work

6.2 General discussion

Carlson and Davis (1998) point to the fact that despite the growing interest of researchers in the subject of media selection in organizations and the growing complexity of the models used in the last 50 years (like complex social interaction theories), the ability to understand and predict media selection has not improved much. In this dissertation the focus was on obtaining more insight into how knowledge workers acquire new information and knowledge during work using a range of information sources. Theories from communication science were combined with theories from learning science (for example, the taxonomy of cognitive learning of Anderson and Krathwohl, 2001) in order to expand the understanding of organisational communication. In addition, besides looking at micro level influences on workplace learning such as individual preferences, macro level influences on organisational communication, like work context, were addressed too.

In the studies described in Chapter 4 and Chapter 5 two theories were used: the Media Richness Theory and the Theory of Reasoned Action. Both theories assume that humans are reasonable beings who, in deciding what action to take, systematically process and utilise the information available to them. Focusing on this dimension of behaviour, other dimensions that could affect the behavioural intention are not addressed. Kippax and Crawford (1993) argue that the TRA is primarily a-social and individualistic, that is, although it recognizes the importance of social norms in the normative component, it limits their measurement to consideration of individual perceptions of these phenomena. In other words, although the subjective norm is part of the theory, representing a social aspect, the influence of important others ends in including beliefs and evaluation of these beliefs: still a mainly cognitive approach. They also argue that the process of receiving, processing and making sense of information occurs in conjunction with others, a person will act in terms of the shared understanding reached. This disagreement is a good example of the strands in media selection research which can be categorised into two main streams (Guthrie, 2002). One stream refers to trait based theories of media selection and the other refers to social interaction theories (Carlson & Davis, 1998). The main theories used in the studies are related more to the trait based theories. However, the social aspect has been taken into account as alternative explanations of behaviour (Chapter 4). Yet, little influence of these social forces on source usage behaviour was found in the Chapter 4 study. In addition, by taking into account the effect of work context on source usage behaviour throughout all studies, the view on source usage behaviour was broadened, but this did not lead to many differences in source usage. As a consequence, the studies performed in this dissertation appear to support the trait based theories more than the social interaction ones.

6.3 Recommendations for future research

The studies performed focussed to some extent on the behaviour of specific knowledge workers; police men and engineers. Although some aspects of their behaviour were investigated in more than one study (for example, triggers of learning), other aspects were only investigated in one organisation. For example, the position of a relatively new knowledge database and the effect of source characteristics were only investigated in specific organisations. As studies like those of Leckie, Pettigrew and Sylvain (1996) point out that source usage behaviour can be different for different occupations, more research on the use of sources for acquiring knowledge in a wider range of occupations is needed.

In addition, a learning pattern, as a behavioural scheme, was defined as a time ordered structure of activities consisting of a trigger, a solution type and communication media used during a learning event. Although ordered in time, the actual time it took to find the knowledge was not investigated. It would, however, be interesting to see if the complexity of a learning pattern relates to, for example, the time it takes to complete it. In addition, a wider range of learning patterns and strategies also needs to be included. For example, cognitive patterns related to the cognitive level of search behaviour and the use of knowledge as described by Choo (1998) could be taken more into account. Furthermore, instead of looking at more passive ways of receiving information, more active ways like cooperation processes and group processes could be investigated. In order to get a rich view on these patterns, it is recommended to use more than one data collection method, as in this dissertation the combination of methods turned out to give valuable insights. What people say they do, that is, self-reporting, is just not always similar to their actual behaviour.

Another option for further research is to check if the results found in the studies can be generalised to knowledge workers from other levels of the organisation like the management level. In fact, social influence researchers have suggested that the perceptions of media may not be uniform throughout the organization (Carlson & Davis, 1998). Also the generality of the situations presented to the participants, in particular in Chapter 4, could have affected the results. The knowledge gaining situation was not specified for each participant's own situation. The results of the studies therefore do not reach further than general abstracted (that is, content/domain independent) knowledge seeking situations. It can be argued that in more specific content related situations, other information source types with other information source characteristics could be preferred.

Finally, the (manipulative) skills of the employee, that is their ability to apply one's knowledge effectively and readily to execution and performance of tasks, are important

for a productive use of information sources (Holsapple & Joshi, 2003). When these skills are inadequate, the probability that the completion of a knowledge management episode creates value for an organization or results in learning decreases. These skills were not addressed in the studies. In the Chapter 2 study was, for example, found that more experienced police men use PKN more than police men who are employed more recently. An explanation was sought in the Media Richness Theory: as experience increases, interpreting the information found in lean information sources, such as PKN, leads to less ambiguity and equivocality as these police men have more rich contextual knowledge available which they accumulated during their work experience. However, there could also be a relation with knowledge handling skills too as, due to experience, longer employment often goes together with better skills in using information sources. Giving attention to these skills in relation to usage of sources for gaining knowledge at work is therefore recommended.

Nederlandse samenvatting

In deze dissertatie is gekeken naar het gedrag van kenniswerkers in organisaties bij het verwerven van nieuwe informatie en kennis tijdens het werk en het gebruik van informatiebronnen daarbinnen. In het eerste hoofdstuk is de literatuur rondom leren op het werk en het gebruik van informatiebronnen beschreven. Daaruit komt voort dat de studies in deze dissertatie zijn uitgevoerd binnen de context van informeel zelf-gestuurd leren. Zelf-gestuurd leren verwijst in deze dissertatie naar de zelf-gestuurde exploratie en toepassing van kennis met het doel om impliciet of expliciet vooruitgang te boeken in een bepaald leerdomein. Binnen deze context stond informatiebrongebruik tijdens het leren op het werk centraal omdat daarbij, in tegenstelling tot een meer schoolse leersituatie, geen kant en klaar leermateriaal beschikbaar is. Dit houdt in dat de nadruk ligt op het leren en zelf zoeken van kennis en informatie direct gerelateerd aan de werktaken van een medewerker (het leerdomein); het gaat om kennisbehoeften die ontstaan tijdens de uitvoering van het werk. Om de vier studies beschreven in deze dissertatie op te zetten is voor het theoretisch kader de kennismanagement episode uit de kennisontologie van Holsapple en Joshi gebruikt. Een kennismanagement episode beschrijft de periode tussen het herkennen van een kennisbehoefte en het oplossen daarvan. Diverse kennismanipulerende activiteiten, zowel mentale processen als gedrag, kunnen plaatsvinden binnen zo'n kennismanagement episode. Aangezien de focus in deze dissertatie ligt op gedrag en niet op individuele mentale processen, zijn de mentale processen niet onderzocht.

Wanneer er wordt gekeken naar het gedrag en het gebruik van communicatiemiddelen daarbinnen, zijn bij de analyses twee van de drie niveaus van Choo met betrekking tot

het zoekgedrag naar kennis en het gebruik van kennis meegenomen. Choo spreekt over drie niveaus: het cognitieve, affectieve en situationele niveau. Het affectieve niveau is meegenomen door te kijken naar affectieve elementen zoals preferenties voor bronnen. Het situationele niveau is meegenomen door te kijken naar de relatie tussen werktype en brongebruik.

Naast dit algemene theoretische kader, zijn in een aantal studies aanvullende theoretische perspectieven toegepast, zoals een theorie die ingaat op de invloed van inter-persoonlijke motivaties op het gebruik van informatiebronnen (het Social Influence Model of Technology Use). In twee studies is het gedrag onderzocht door gebruik te maken van twee theorieën uit de communicatiewetenschap: de Media Richness Theory en de Theory of Reasoned Action.

Hoewel elke studie zijn eigen onderzoeksvragen heeft, is het doel van de vier studies het beantwoorden van de overkoepelende onderzoeksvraag (van deze dissertatie):

> *Wat is het gedrag en wat zijn de preferenties van kenniswerkers ten aanzien van het gebruik van informatiebronnen voor het vergaren van kennis in de context van hun werkplek en hebben de organisatorische context en individuele eigenschappen van kenniswerkers invloed op dit gedrag en de preferenties van kenniswerkers?*

In deze overkoepelende onderzoeksvraag is een onderscheid gemaakt tussen gedrag aan de ene kant en preferenties aan de andere kant. Elk aspect is vertaald in een subvraag. De eerste subvraag is:

> *Wat voor informatiebronnen worden gebruikt door kenniswerkers wanneer ze kennis vergaren op het werk?*

In de studie beschreven in Hoofdstuk 2 wordt deze “wat”-vraag deels beantwoord door het gebruik van informatiebronnen voor het vergaren van kennis door politiemedewerkers te onderzoeken. Tevens is het gebruik van informatiebronnen en de positie van een relatieve nieuwe informatiebron voor het vergaren van kennis (Politie Kennis Net, PKN) tussen de reeds beschikbare bronnen onderzocht. Daarbij is gebruik gemaakt van observaties, een online vragenlijst en interviews. De data is verzameld in drie opeenvolgende fasen, waarbij resultaten uit eerdere fasen zijn meegenomen naar de volgende fase. Resultaten van deze studie laten zien dat zowel digitale als analoge (niet-digitale) informatiebronnen worden gebruikt, maar niet met dezelfde frequentie. Persoonlijke en digitale bronnen worden vaker gebruikt dan geschreven bronnen. Het gebruik van de bronnen wordt het meest gedreven door taakgerelateerde kennisbehoeften. Interessegedreven gebruik van

informatiebronnen blijkt echter ook voor te komen. Ten aanzien van het gebruik van de relatief nieuwe informatiebron PKN lieten de resultaten zien dat deze niet vaak gebruikt wordt. De geleverde ondersteuning van PKN wordt echter wel gewaardeerd.

Hoofdstuk 3 beschrijft een studie die de eerste subvraag ook beantwoordt door het gebruik van informatiebronnen binnen de context van zelf-gestuurd leren door kenniswerkers op het werk te onderzoeken. Er is onder andere gekeken naar leerpatronen. Dit zijn combinaties van een trigger (wat leidt tot de kennisbehoefte: taak, interesse of toeval), een oplossingstype (zoekt men de oplossing bij een persoon, een geschreven bron of gaat men zelf dingen uitproberen) en het gebruikte type communicatiemedium (face-to-face, geschreven of digitaal). Er zijn in totaal vijf methoden gebruikt om data te verzamelen. In de eerste fase van het onderzoek zijn observaties, interviews, simulaties en online dagboeken gebruikt. De dataverzameling vond hier plaats bij vier organisaties. In de tweede fase, waarin de belangrijkste resultaten van de eerste fase geverifieerd werden, is een online vragenlijst gebruikt. Resultaten van deze studie bevestigen de bevindingen van Hoofdstuk 2: de belangrijkste gevonden leerpatronen benadrukken het belang van persoonlijke bronnen (zoals collega's) en digitale geschreven bronnen tijdens het zelf-gestuurd leren op het werk. Wederom bleek dat het gebruik van bronnen het meest gedreven is door taakgerelateerde kennisbehoeften. Echter, naast het taak- en interessegedreven gebruik werd in deze studie ook gebruik gedreven door toeval geconstateerd.

Naast het gedrag, ging de overkoepelende onderzoeksvraag ook in op preferenties. De tweede subvraag is daarom:

> *Wanneer en waarom gebruiken kenniswerkers deze informatiebronnen als ze kennis vergaren op het werk?*

Hoofdstuk 4 bevat een studie die ingaat op het "wanneer"-gedeelte van deze vraag. In dit onderzoek is de context van informatiebrongebruik voor het vergaren van kennis onderzocht. Dit is gedaan door te kijken naar de relatie tussen enerzijds werk- en leersituaties en anderzijds de informatiebronnen en communicatiemiddelen die kenniswerkers gebruiken om kennis te vergaren die nodig is om de taak waarmee ze bezig zijn beter uit te voeren en om informatie te vergaren over gerelateerde onderwerpen. De Media Richness Theory is benut om het gebruik van informatiebronnen in bepaalde werk-leersituaties te voorspellen. De gebruikte methode in deze studie is een online vragenlijst. Resultaten laten zien dat voor werksituaties geldt dat in het geval van leersituaties (iemand moet zelf kennis vergaren) het vaakst gekozen is voor de situaties "nieuwe kennis vergaren wanneer je begint met een nieuwe opdracht" en "uitvinden hoe dingen worden gedaan als

je nieuw bent in het bedrijf". De specifieke leertaak die het vaakst gekozen is, is het verkrijgen van een goed begrip. Voor de transfersituatie (je kennis delen met een ander die daarom vraagt), zijn de werksituaties "benaderd worden door iemand die vraagt om advies in jouw expertisegebied" en "een collega of klant uitgebreid informeren in jouw expertisegebied door het geven van een presentatie of het schrijven van een rapport" het meest frequent gekozen. Er is ook gevraagd naar de leertaak van de persoon die de kennisbehoefte had (de vrager). Deze leertaak komt overeen met eerdere resultaten voor de leersituaties: het verkrijgen van een goed begrip. Resultaten laten zien dat de voorspellende kracht van de Media Richness Theory wanneer het gaat om het voorspellen van informatiebrongebruik in leer- en transfersituaties op het werk niet ondubbelzinnig valt aan te tonen is: voor leersituaties bleek de voorspellende kracht redelijk sterk, maar in het algemeen bleek dit niet zo te zijn. Er is ook een alternatieve theorie betrokken in de analyses, het Social Influence Model of Technology Use. Het blijkt dat wanneer er wordt gekeken naar de invloed van organisatorische normen en gedrag van collega's ten aanzien van communicatiemedia op de selectie van informatiebronnen, er slechts kleine effecten gevonden zijn.

In Hoofdstuk 5 is de "waarom"-vraag onderzocht door te kijken naar de afwegingen (trade-offs) die kenniswerkers maken wanneer ze geconfronteerd worden met een keuze tussen verschillende typen informatiebronnen die verschillen op enkele eigenschappen. Het doel was om de invloed van gedeelde terminologie, sociale netwerken en toegankelijkheid op de keuze voor een bron te onderzoeken. Dit is gedaan door te kijken of het gebruik van informatiebronnen tijdens het vergaren van kennis op het werk kan worden beschreven door de Theory of Reasoned Action. Om het op die wijze te kunnen beschrijven, moeten de broneigenschappen paarsgewijs preferentieel onafhankelijk van elkaar zijn. Er is in deze studie gekozen om een online vragenlijst te combineren met interviews. De resultaten van dit onderzoek laten zien dat de gedragsintentie van kenniswerkers met betrekking tot het gebruik van informatiebronnen kan worden beschreven door het Expectancy Value gedeelte van de Theory of Reasoned Action. De analyses laten zien dat aan de voorwaarde van paarsgewijze preferentiële onafhankelijkheid zo goed als zeker voldaan wordt. Bovendien laten de analyses zien dat in deze context (informatiebrongebruik tijdens het vergaren van kennis op het werk) het sociale normatieve gedeelte van de Theory of Reasoned Action waarschijnlijk niet relevant is. De drie informatiebroneigenschappen leveren een belangrijke en relevante bijdrage aan de gedragsintentie om een bron te gebruiken.

In vergelijking met gedeelde terminologie en sociale netwerken, is de broneigenschap toegankelijkheid het meest belangrijk. Het relatieve gewicht van elk van de broneigenschappen wordt enigszins beïnvloed door de werkcontext, vooral wanneer er gekeken wordt naar duur van de tijd doorgebracht in de huidige functie. Wanneer

iemand langer in zijn huidige functie zit, blijken de eigenschappen sociale netwerken en gedeelde terminologie een vrijwel gelijke invloed te hebben terwijl in het algemeen sociale netwerken meer invloed heeft dan gedeelde terminologie.

Het laatste deel van de overkoepelende onderzoeksvraag, dat betrekking heeft op het effect van de organisatorische context en individuele eigenschappen, dient echter nog beantwoord te worden. In alle studies is de werkcontext (als concept dat organisatorische context en individuele eigenschappen combineert) opgenomen bij het onderzoeken van het gedrag omtrent en de preferenties voor informatiebronnen. Uit de resultaten van de studies bleek dat werkcontext soms invloed heeft. Bijvoorbeeld, in de studie beschreven in Hoofdstuk 2 komt voort dat de carrièrefase het type kennisbehoefte dat voorkomt te beïnvloeden. Echter, wanneer alle resultaten in ogenschouw worden genomen is de slotsom dat er slechts enkele effecten zijn gevonden. Dit leidt tot de conclusie dat werkcontext geen cruciale rol speelt wanneer het gaat om de keuze voor informatiebronnen tijdens zelf-gestuurd leren op de werkplek.

Samenvattend kan geconcludeerd worden dat op basis van het onderzoek in deze dissertatie blijkt dat de keuze voor informatiebronnen tijdens zelf-gestuurd leren op de werkplek hoofdzakelijk wordt bepaald door eigenschappen van informatiebronnen en in veel mindere mate door de organisatorische context waarin dit werk plaatsvindt en de individuele eigenschappen van kenniswerkers.

Short Biography

José Kooken was born on April 21, 1982 in Apeldoorn. She studied Communication Studies at the University of Twente and she graduated in 2005. In her master thesis she investigated user related bottlenecks in the internal communication sources at a Dutch consulting and engineering company: Tauw. After her graduation, she stayed at the University of Twente, Faculty of Behavioural Sciences, Department of Instructional Technology (IST). As researcher she participated in a study that investigated the use of an internal knowledge system of the Dutch Police Force (Police Knowledge Net, PKN).

In February 2006 José became a PhD-student at the same department. Part of her research was conducted in the context of the APOSDLE-project, a European 6th Framework funded Programme for Research and Technological Development (FP6). This project focused on supporting learning at the workplace by developing an Advanced Process-Oriented Self-Directed Learning Environment. Her research in this project focused on the practices and preferences of knowledge workers regarding the use of information sources for knowledge gaining in the context of their workplace. In addition, she also worked on several teaching tasks in the master course ‘Knowledge Management in Learning Organizations’.

The first child of José and Jeroen, a daughter, was born on July 22, 2009. She was named Vera Anna-Paula. In July 2010 her contract at the University of Twente ended.

In August 2010 Jose started as knowledge manager at the company were she did her master thesis study, Tauw bv. Investigating knowledge management practices and developing a vision and accompanying roadmap for the future is her current task

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Appendices

Appendix 1

Definitions

Workplace

A central concept in this dissertation is a workplace. The dictionary Wordnet (Workplace, n.d.) describes a workplace as '*a place where work is done*'. This definition is too broad. In order to have a narrower and operational understanding of the workplace, the following definition is used: '*a physical location, a time and the nature of the workplace (computer based or not). It is in fact a micro world in which an employee works*'.

Learning

Besides a definition of a workplace, it is also necessary to understand what is defined as learning. As one cannot observe learning directly, an operational definition is needed that relies on other cues. In addition, measuring learning results in a work context via, for example, pre- and post tests is not possible as it is not inherent to the way people work (it is not a formal school setting). Therefore, for pragmatic reasons, a definition was chosen that focussed on the judgement of the knowledge worker about the likelihood of reuse of knowledge. In fact, formulating it this way decreases the likelihood of too strong associations with formal learning; as most knowledge workers do not like to be called a learner (Boud & Solomon, 2003). The use of information is considered as learning *if the information or knowledge is stored consciously or subconsciously for future use*. Learning is thus related to information use, but there is one important difference between learning and information gathering. The result of the first one is newly gained knowledge that can be reused in the future and of the second one the result is that information is used only once.

Self-directed learning

In this dissertation this is described as '*self-directed exploration and application of knowledge by learners with the purpose of advancement in a learning domain*'.

Knowledge worker

A knowledge worker is described as *someone who has been schooled to develop, use, and/or transfer knowledge, rather than using mainly physical force or manual skills*.

Knowledge types

Furthermore, knowledge workers can search for different type of knowledge. Three different knowledge types were discerned, based on Merrill's Component Display Theory (1983). Their definitions are:

- Facts (knowing what) - logically associated pieces of information. Some examples are names, dates, and events. An example is knowing a particular section of a law.
- Concepts (knowing why) - symbols, events, and objects that share characteristics and are identified by the same name. Concepts make up a large portion of language and understanding them is integral to communication. An example is knowing the interpretation of a law.
- Procedures (knowing how) - a set of ordered steps, sequenced to solve a problem or accomplish a goal. An example is like knowing how to run a court session.

Appendix 2

Online questionnaire Chapter 4 study

The next pages contain the questionnaire used in the Chapter 4 study. 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 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.aposdle.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 chose to answer the survey for 1 or several learning and knowledge sharing situations you have experienced. Depending on how many you chose two 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 your 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!

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 ...

I was under very strong time pressure.	1	2	3	4	5
I felt very uncertain about the things I had to do.	1	2	3	4	5
There were serious negative consequences if I could not find the knowledge.	1	2	3	4	5
What I had to deliver was very well defined.	1	2	3	4	5
I was very new to the company or department I was working in.	1	2	3	4	5
I was an expert in the topic.	1	2	3	4	5
I was working in a team setting.	1	2	3	4	5
I was working alone.	1	2	3	4	5

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 ofinformation 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

E-mail

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

E-mail

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 e-mail)

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

E-mail

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 e-mail)

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

E-mail

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 advise 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 ...

I was under very strong time pressure.	1	2	3	4	5
I felt very uncertain about the things I had to do.	1	2	3	4	5
There were many consequences if I did not find the knowledge.	1	2	3	4	5
What I had to deliver was very well defined.	1	2	3	4	5
I was very new to the company or department I was working in.	1	2	3	4	5
I was an expert in the topic.	1	2	3	4	5
I was working in a team setting.	1	2	3	4	5
I was working alone.	1	2	3	4	5

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 e-mail)

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

E-mail

Chat

Discussion Forum

A written letter or memo

Video conference tool

Other (please specify)

Used bothsources 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

E-mail

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

The questions are similar to those of the first learning situation.

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

The questions are similar to those of the first transfer situation.

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

A face-to-face conversation	1	2	3	4	5
Telephone	1	2	3	4	5
E-mail	1	2	3	4	5
Chat	1	2	3	4	5
Discussion Forum	1	2	3	4	5
A written letter or memo	1	2	3	4	5
Video conference tool	1	2	3	4	5

Organizational norms and media use

Please indicate the extent to which your organization appreciates the use of the following communication media.

1 = Does not appreciate at all
5 = Appreciate very much

A face-to-face conversation	1	2	3	4	5
Telephone	1	2	3	4	5
E-mail	1	2	3	4	5
Chat	1	2	3	4	5
Discussion Forum	1	2	3	4	5
A written letter or memo	1	2	3	4	5
Video conference tool	1	2	3	4	5

Please indicate the extent to which your direct colleagues use the following media during a typical work week.

1 = Never
5 = Very frequently

A face-to-face conversation	1	2	3	4	5
Telephone	1	2	3	4	5
E-mail	1	2	3	4	5
Chat	1	2	3	4	5
Discussion Forum	1	2	3	4	5
A written letter or memo	1	2	3	4	5
Video conference tool	1	2	3	4	5

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

At work, I enjoy to learn.	1	2	3	4	5
At work, I learn something new every day.	1	2	3	4	5
Learning is merely a way to increase my career opportunities.	1	2	3	4	5
I am more confident when I frequently increase my professional knowledge.	1	2	3	4	5
I only learn what is necessary for completing work tasks.	1	2	3	4	5
I organize my learning time carefully.	1	2	3	4	5
When I am working on a new subject matter, I try to work out for myself exactly what is being said.	1	2	3	4	5
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.	1	2	3	4	5

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
21-30 hours
31-40 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
consultant
specialist/professional
researcher
analyst

designer
administrative worker
manager
teacher/trainer
service/help desk worker
sales worker
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%
26-50%
51-75%
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.