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Capturing Practices of Knowledge Work for Information Systems Design

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Abstract

Despite abundant tools and systems claiming support for knowledge work, many have failed to be accepted by users. Designing information systems (ISs) for knowledge work is a challenging task, but results on how knowledge work is actually performed is scarce and so are instruments that help to translate results into artefacts useful for IS design. This paper takes the perspective of work practices and proposes an approach to collaboratively study and analyze practices of knowledge work. The approach uses stereotypes of users, called personas, in order to inform IS design activities. The persona concept is enriched with respect to behaviour concerning practices of knowledge work. Furthermore, a procedure for selecting primary personas out of a set of personas is suggested based on cluster analysis. The approach is illustrated with the case of a collaborative ethnographically-informed study of seven organizations in four European countries. The proposed approach is the more suitable, the more innovative, big and diverse the project, the planned product, the developers and the target group are. User-centered design activities benefit from personas by reduced effort for involving end-users and a continuous focus on characteristics of critical users and their way of performing practices of knowledge work.

Keywords: knowledge management, knowledge work practices, collaborative IS design, persona, qualitative fieldwork

1 INTRODUCTION

With the increasing diffusion of information and communication technologies into workplaces, information systems (ISs) arguably play a pivotal role in the challenge to improve productivity of knowledge work (Drucker 1994), the share of which has risen continuously during the last decades (Wolff 2005). Numerous fragmented tools or systems have been proposed (Alavi and Leidner 2001) and implemented in organizations with the help of knowledge management initiatives (Davenport and Probst 2002). However, many of these failed (Bishop et al. 2008), so that many organizations limited investments into infrastructure for knowledge work. Yet, employees performing knowledge work continue to try IS alternatives for knowledge activities such as producing, integrating or sharing contents, networking and self-directed learning. Questions arise how to coordinate these activities and how to design IS that cater to the needs of employees performing knowledge work.

Despite abundant tools and systems, information on how knowledge work is actually performed in organizations is scarce. In the 1980s and 1990s there were quite a few studies on group behaviour impacted by IS (Suchman 1987; Dennis 1996). Since then, there has been a general lack of workplace studies (Barley and Kunda 2001) also true for studies in organizing the use of IS and even more so for IT-supported knowledge work. An important reason for this is that studying knowledge is difficult due to its metaphysical nature (Schultze 2000). (Blackler et al. 1993) recommend to study knowledge work by focusing on work practices, i.e. on what people do, rather than on what they know.

In this paper we present an approach to capture practices of knowledge work for designing IS that has been successfully applied in a collaborative ethnographically informed study. Challenges of IS design depend, e.g., on factors characterising project, planned product, developers and target group:

- innovation: innovative or R&D projects often have unknown requirements aiming at new functionalities and an unknown target group aiming at prospective rather than actual users,
- size: the larger and more complex a product, the more resources can sensibly be allocated to design activities. Project management is more complex, there are more developers involved which needs more coordination and the target group is larger which complicates their involvement,
- diversity: developers' and users' heterogeneous opinions, backgrounds, professional, geographical or cultural distance result in heightened need for communication, in numerous views on potential users that need to be aligned and in need for adaptable or adaptive ISs reflecting users' diversity.

The more of these factors are at work in a concrete project, the more our approach can help. The paper presents an instrument that guides IS designers in collaborative workplace studies and helps translate their findings into design artefacts. From a methodological perspective, the paper employs a constructivist research paradigm based on the findings of a qualitative empirical study relying on data collected during a six month collaborative ethnographically-informed study in seven European organisations.

2 PRACTICES OF KNOWLEDGE (INTENSIVE) WORK

The increase of knowledge intensity with respect to work, organizations and society refers to, e.g., a high share of highly skilled, creative employees, operations that aim at providing knowledge-intensive products and services, high importance of experiences, high degree of innovations, high need for communication and a high degree of information needs (Starbuck 1992). Knowledge work is an ideal type of work, i.e. an abstraction comprising key characteristics of a wide array of activities in organizations across occupations and industries that create, translate or apply new knowledge. This rather narrow definition is often relaxed with respect to the degree of innovation required for the handled knowledge. Knowledge work is production and reproduction of information, involving specific processes such as generation, interpretation and representation of knowledge (Schultze 2003).

There is much more awareness about the importance of knowledge work (Blackler 1995), of workplace learning (Illeris 2003) or informal learning (Rogers 2006). However, compared to traditional,

predominantly manual, data- or service-oriented work, the unstructured, creative and expertise-driven knowledge work cannot be designed with standardized management approaches and cannot be easily supported by ISs. A key proposition resulting from the study reported here is that knowledge work is sufficiently similar across occupations and industries to allow designing ISs to foster knowledge work independent of occupations or industries. Although this type of work is prevalent in high-tech industries and expert-driven organizations, it can also be found in low-tech industries and organizations run, e.g., as professional bureaucracies. However, knowledge workers are quite heterogeneous with differing needs, work routines and learning styles. Due to their often long-standing experiences in self-guided personalization and composition of workspaces, assumedly there can be a number of "best" practices for each knowledge activity depending on experiences, work and learning style. These observations call for concepts that help organizations to study knowledge work, to distil important findings from an IS perspective and translate these findings into artefacts usable for designing ISs.

Practice is the concept used in this paper to describe, analyze and later on design IS-supported knowledge work (Orlikowski 2000) focusing on commonalities across professions, positions and industries. This resonates well with Blackler's perspective that knowledge should be regarded as something that individuals do rather than as something they possess (Blackler 1995). Knowledge is not only revealed in practice, but also created out of practice (Brown et al. 1989). As most work is a collective, cooperative venture, most dispositional knowledge is inherently collective which consequently has to be analysed on a collective level. Not surprisingly, it is suggested to employ the theory of socially-distributed activity systems as the underlying basis (Engeström 1987). Learning in this context is regarded as active community-based social practice which involves participation, activity and negotiation of meaning. Learning and consequently knowledge work are conceptualized as situated activities. A community is a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities (Lave and Wenger 1991). Practice is the source of coherence of a community due to mutual engagement, joint enterprise and shared repertoire (Wenger 1998). Practices formed by individuals that are part of semi-permanent work groups are examples of how knowledge work can be framed as a social process (Daskalaki and Blair 2002). Knowledge work is characterized by practices such as acquiring, creating, gathering, organising, packaging, maintaining, systemising, communicating and applying knowledge (Holsapple and Whinston 1987; Davenport et al. 1996; Kelloway and Barling 2000) and roles such as data gatherer, knowledge user and knowledge builder (Snyder-Halpern et al. 2001).

However, the practices proposed so far need to be detailed in order to offer starting points for IS design. Schultze identifies informing practices in an ethnographic study of knowledge work in a large Fortune 500 manufacturing firm (Schultze 2000): (1) ex-pressing, i.e. self-reflexive converting of individual knowledge and subjective insights into informational objects that are independent of knowledge workers, (2) monitoring, i.e. continuous non-focused scanning of the environment and the gathering of useful "just in case"-information, and (3) translating, i.e. creation of information by ferrying it across multiple realms and different contexts until a coherent meaning emerges and later adds (4) networking, i.e. building relationships with people inside and outside the company that knowledge workers rely on (Schultze 2003). These four practices result from a certain research focus applied to a single organization and thus it is not surprising that Hädrich found more practices in a series of 31 interviews with knowledge workers building on Schultze's practices (Hädrich 2008):

- Access refers to regular checks of internal and external sources of information. It may be oriented towards the access of codified knowledge as well as towards the use of communication media.
- Collect comprises gathering of potential topics of meetings as well as of meeting registrations. It is relevant for creating an agenda of individual meetings and of a group as a whole.
- Converge is concerned with creating consistent results within a group. It is characteristic for (co-) authoring where individual contributions need to be merged into a coherent whole.
- Coordinate includes communication with co-authors as well as management of shared repositories used for storing preliminary and final versions of joint results.

- Create deals with generation of documented knowledge, i.e. writing activities, e.g., based on templates or similar documents and also editing, annotating and generalising contents.
- Discuss is direct knowledge sharing between one or more individuals, e.g., to resolve a problem related to work tasks. It may involve making appointments or documenting communication.
- Distribute disseminates documented knowledge and comprises classifying, storing, forwarding and releasing contents as well as organising structures and access privileges of storage systems.
- Evaluate is appraisal of knowledge, e.g., through conducting examinations of agent results, help received in support calls or quality of training courses.
- Identify is search and detection of people characterized by required competencies or by interests that make them potential candidates for their invitation into a group.
- Inquire is concerned with identification, retrieval and use of documented knowledge, e.g., digital training units, contents acquired from internal knowledge sources or identified with a Web search.
- Network is establishment and development of contacts with the goal of knowledge sharing. This includes informal socialisation as well as participating in formal meetings.
- Prepare sets up a knowledge action, i.e. specifies criteria and acquires relevant resources, e.g., determining learning goals, required competencies or potential co-authors.
- Request is concerned with getting help and advice. This may involve identification of individuals or opening of support tickets that specify a problem to be solved.
- Review evaluates and enhances documented knowledge. In contrast to "evaluate", it typically is part of authoring and involves requesting feedback about contents and their formal release.

It is highly likely that further practices exist. This list can be used as starting point for identifying practices of knowledge work deemed important in specific organisational situations to be supported by ISs.

3 CAPTURING WORK PRACTICES USING PERSONAS

Designing interactions of knowledge workers with IS is crucial. A key step in the IS design process in general is the eliciting and identifying requirements and complexity of requirements gathering can represent a major obstacle to successful system development. The requirement gathering process is a socio-technical problem and many projects were seen to be failing due to not recognising the fact that requirements are not only technical issues (Al-Karaghouli et al. 2005). Therefore, interpretive research has become more important in the IS discipline in the last years (Walsham 2006) to help understand human thought and action in social and organizational contexts. It has the potential to produce deep insights into IS phenomena including management of IS and IS development (Klein 1999). Among qualitative and interpretive methods, ethnography most closely involves participants (Walsham 2006). Ethnography has become more popular in the IS domain as it explicitly focuses on the social setting in which the intended system should be used (Hughes et al. 1994). Frequently mentioned examples for ethnographic studies in IS are (Suchman 1995; Myers and Young 1997; Orlikowski 2000). Ethnographic studies provide rich material for understanding of potential users' tasks which is important because tasks of knowledge workers are manifold and can be carried out in many different ways.

Designers need to be aware of users' practices to efficiently support them fulfilling their tasks. The work practice concept helps to capture the essence of activities in need of support by IS. However, designers need an instrument that builds on practices discussed in section 2 in order to describe specific activities of real users and at the same time allows for designing user interaction of a planned IS. The persona concept can provide such a basic instrument. Its origin is a mask used in ancient Greek play (Wiles 2007). Personas are social roles of people in specific contexts (Storr 1997). User modelling was an early application in the IS domain in which user characteristics were clustered, aggregated and called stereotypes (Rich 1979). The persona approach for designing software was introduced by (Cooper 2004) as one of three pragmatic tools for his goal-directed design method. Its goal was to create a precise description of users and what they want to accomplish. Personas represent hypothetical archetypes of such a described user (Cooper 2004) and are defined as fictitious, specific, concrete representations of target users (Pruitt and Adlin 2006). Marketing personas are based on demographics

and distribution channels to stimulate the sales process, whereas design personas are based purely on users to shed light on the development process (Cooper 2004). Marketing personas describe types of persons people want to be and are created around the technology, whereas design personas represent types of persons people actually are and are created as a fulfiller of their goals (Rönkkö et al. 2004). In the following, we will concentrate on personas aimed at design.

A persona can be developed according to a single human being (Cooper 2004) or as a mash up of users with aggregated characteristics (Chang et al. 2008) and should be based on sound empirical fieldwork (Cooper 2004). In any case, descriptions should be consistent and the persona should be understood as one individual whose characteristics are primarily used in communication and design activities (Chang et al. 2008). Personas provide a rich contextual model of a group of target users (Aoyama 2005) describing behavioural patterns and characteristics in much detail. Most of these patterns have ranges with two ends in which the persona should be positioned in one extreme (Goodwin 2002). In order to reach its full potential, personas must come to life in the designers' minds. Therefore, the persona needs to be known to all people involved in design activities (Pruitt and Adlin 2006). Although it seems important to find the right balance in terms of communicating personas to the project, an overrepresentation can cause negative emotions on the developers' side (Gudjónsdóttir and Lindquist 2008). Personas assume a tangible solidity that puts all design assumptions in perspective and aim at ending feature debates. Programmers can talk much easier about needs and routines of a persona than about abstract requirements (Blomquist and Arvola 2002). Personas can be used to examine tasks by evaluating if a design proposal has succeeded in making the persona happy (Cooper 2004). However, personas are only to be used complementary to other approaches like prototyping, mock-ups, scenarios and contextual design and should not stand on their own.

Personas have received some attention since their introduction in the IS field. Large companies like Adobe Systems, Amazon.com, Ford, Microsoft and Staples have included personas into their software and workflow design processes (Pruitt and Adlin 2006). Personas have also been used for designing IS in large-scale scientific projects (Gudjónsdóttir and Lindquist 2008; Dotan et al. 2009). But there is also some criticism in the literature about methodical and practical issues. Methodically, it is difficult or impossible to verify personas' accuracy (Chapman and Milham 2006). There is no sound way to decide whether the chosen persona(s) represent the potential user space appropriately. Personas do not claim to validly represent the user space, but help focusing on user groups and making qualified design decisions (Pruitt and Adlin 2006). Personas cannot be validated, as so far there are no critical tests in the literature. However, the approach applied for persona creation can be validated, e.g., by comparing success of projects using personas with projects that do not use them. They are design tools aiding communication. The more specific a persona is, the smaller the part of the user space it represents. Furthermore, it is difficult to distinguish which characteristics of a persona are indicative of users and which are irrelevant. However, one could argue that personas help to focus on a specific, assumedly critical group of users. Another argument mentioned by (Chapman and Milham 2006) is that using rich qualitative data for creating personas does not allow making qualified assumptions about the percentage of users which may be represented with the personas. On the practical side, personas compete with information about users from many sources, team members using personas may draw different conclusions, they may just be used to justify decisions and they fail if their basis lacks 'strong' data (Pruitt and Adlin 2006). Personas only seem to be appropriate for small projects with a small scope undertaken by a small design team (Randolph 2004). The approach and case presented in this paper helps large design teams with many different opinions to use personas.

It is important to define a main concept which personas are built around. Cooper proposes to identify and consolidate personas based on goals (Cooper 2004) assuming good design has only meaning in the context of a person using it for some purpose. A practice could provide an intermediate concept for achieving a goal that has implications for user interaction, would be easier to observe and take into account that a user can perform practices for the same goal in different ways, depending on the specific usage scenario and context. Therefore, we concentrate on practices personas perform.

4 APPROACH FOR USING PERSONAS

We have argued so far for using personas extended by descriptions of their behaviour in practices as design artefacts in order to support IS design for complex situations such as the ones found in knowledge work. A mixed method approach (Teddlie and Tashakkori 2009) integrates qualitative and quantitative evaluation of data collected from observing or, better, immersing into and reflecting real-world practices of knowledge work. Figure 1 presents a procedure model for the proposed approach.

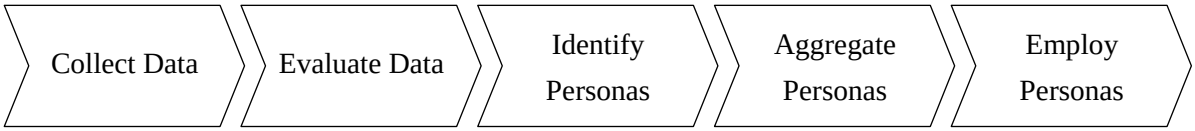

Figure 1. Procedure model for using personas in IS design

In sections 4.1 to 4.5 each of the five phases is described in detail. We also illustrate the model's successful application in MATURE (www.mature-ip.eu), a joint project aiming at developing software for collaborative knowledge work we have been engaged in. Special attention is paid to a detailed explanation of how personas can be aggregated which is the more important, the larger, more diverse and innovative project, product, developer and target group are (section 1).

4.1 Collect Data

Characters represented by personas must be believable. If personas are not founded on real data, they are less accepted (Pruitt and Adlin 2006). Personas should be based on real-world data in order to represent real users. In order to increase trustworthiness, it is proposed to employ inductive, qualitative approaches to investigate selected users' current work situations (Rönkkö 2005).

In our project, a collaborative ethnographically informed study was conducted in seven European organisations (Germany, Spain, Switzerland and the UK) operating in the fields of health care, IT, IT services, professional services as well as telecommunications. The study was realized by six teams of altogether 18 ethnographers including the authors who had established relationships with the organisations and participated in the daily work life of 31 closely studied knowledge workers between May and October 2008. Time allocated to each company was limited to four weeks divided into three periods. Firstly, ethnographers selected a convenient sample of knowledge workers and studied them during one week of ethnographic fieldwork. For the next two weeks, ethnographers stayed in IM, email or telephone contact with participating knowledge workers who were asked to report about well-defined topics. Finally, the ethnographers returned to the organisation for another week, doing more fieldwork, discussing topics of self-reporting and thus gaining a richer and reflected picture of knowledge work practices. This approach was chosen as traditional ethnographic studies are too time-intensive, costly, unfocused and too inflexible for the fast changing IS domain. Results of the intensive field work comprise qualitatively rich descriptions of work practices which form the basis for persona creation.

4.2 Evaluate Data

Coding is an established procedure for analyzing qualitative data (Patton 2002) which should be performed by those researchers who collected the data, as they are able to link text phrases back to experiences made during data collection. Identifying interesting aspects in a systematic way can be achieved by purely inductive coding procedures, but coding with an initial set of codes derived from theory or partially inductive coding approaches seem more efficient. Knowledge work practices found in previous empirical studies (section 2) form an ideal starting point for coding together with context factors such as goals, outcome, time, persons involved, division of labour, media or tools.

We applied a version of content analysis described by (Patton 2002). Concepts like knowledge practices were used to establish an initial set of codes which we recommended to all researchers who

coded their field data individually using a software tool. The authors of this paper actively participated in the coding process, fostered the exchange of codes between researchers and moderated teleconferences and workshops in which codes were intensively discussed. Results were aggregated and integrated and common analysis patterns were agreed which were then used for identifying personas.

4.3 Identify Personas

Personas should be described in a specific, hypothetical and precise and not necessarily accurate way. It is more important to describe personas richly than precisely representing the real world (Cooper 2004). The identified routines and characteristics should be overdrawn and positioned in extremes (Goodwin 2002). Thus, personas become more unique and can be better remembered. Furthermore, this overdrawing should be used to create personas which represent typical groups of users, not only one single user. This is important as intended software should be useful for a larger audience.

We repeatedly discussed different types of employees and their characteristics regarding knowledge work within the group of ethnographers. Key personas turned out to be very valuable for ongoing design activities. Thus, participants of our study were investigated in detail based on the field notes. Some were considered very good representatives for groups of employees. The characteristics of these key employees were used as template for characterizing all personas. The scope of description was developed inductively keeping the studies' objectives and the intended system in mind. Creation of personas was strongly influenced by the coding performed in parallel. Developing the template for describing personas was a cyclical process involving the whole team of ethnographers. 17 characteristics and behavioural patterns were identified which can be mapped to the dimensions from (Pruitt and Adlin 2006) extended to cover aspects of knowledge work practices including, e.g., name, motto, task management, roles, professional background, style of learning, communication strategy, approach to knowledge sharing, problem solving and motivation. The template turned out as critical for collaborative persona creation. The teams of ethnographers created 21 personas using the shared template, each representing a type of users applying different routines or performing routines differently which can be traced back to one or more real-world persons.

4.4 Aggregate Personas

The larger, more diverse and innovative project, product, developer and target group are, the more likely it is that a large number of personas are identified. It seems not uncommon that initially up to 30 personas are developed (Gudjónsdóttir and Lindquist 2008). However, personas must come to life in designers' minds. Personas' characteristics and work practices need to be considered when taking design decisions. Hence, it is suggested to keep the number of personas small, e.g., three to five (Pruitt and Adlin 2006). Two iterative steps can be identified to reduce the number of personas: (1) amalgamating similar personas, i.e. whenever two personas pursue similar goals, they can be collapsed (Cooper 2004) and (2) selecting primary personas, if amalgamation based on goals does not lead to a manageable number. Whereas amalgamation is closely related to creation based on qualitative data, selection requires a decision detached from the data that directly influences the design of the product, e.g., it might determine the number of interfaces and services. Despite the strong influence of primary personas on project outcomes, the procedure of selecting primary personas is sometimes only sparsely described (see, e.g., Gudjónsdóttir and Lindquist 2008; Dotan et al. 2009). The problem can be characterized from a data-driven perspective as selecting primary personas that best represent created personas or from a goal-driven perspective as selecting primary personas that best inform prospective design activities. Balancing these two perspectives is important in negotiations between ethnographers, designers, developers and user representatives which might be overlapping groups. The authors employed hierarchical cluster analysis to support selecting primary personas. The procedure was focused on how personas perform work practices and helped to increase traceability and to reduce dangers inherent in group decision processes that might negatively affect persona selection.

Step 1 - Set up attributes for evaluation: Attributes for assessing similarity of personas are critical as resulting clusters highly depend on them (Aldenderfer and Blashfield 1996). Attributes should best represent the concepts of similarity under which the study operates and at best can be related to a theory supporting the classification. Attributes should be assessable at an ordinal level, such as frequency of occurrence or deemed importance of a single work practice, or whether the persona is inclined to perform one or another of two opposing work practices. This step results in n attributes described in order to create a shared understanding and agreed on by all involved project members.

In our project, attributes were grounded in (a) qualitative data from a collaborative ethnographically informed study, based on an initial set of codes consisting of Schultze's and Hädrich's knowledge practices (section 2) and (b) theory, i.e. phases of the knowledge maturing model described in (Maier and Schmidt 2007). Three attributes were determined using a three-point Likert scale representing a continuum between two end-points: (1) standardisation vs. guidance and visionary; (2) learning by formal vs. learning by informal artefacts and (3) learning in isolation vs. learning via networking. Each end-point represents a rich conglomerate of work practices and corresponding context factors grounded by two primary knowledge practices as well as one primary phase of the knowledge maturing model (table 1). For example, the end-point 'learning by formal artefacts' primarily relies on the two work practices inquire, i.e. identification, retrieval and use of documented knowledge, and access, i.e. regular checks of internal and external sources, which are pivotal for the formalizing phase. This does not mean that other practices are not needed in this end-point, it just reflects that these practices and knowledge maturing phase is distinctive in characterizing this end-point.

end-point	**primary knowledge practices**	**phase of knowledge maturing**
standardization	evaluate, distribute	standardization
guidance and visionary	coordinate, converge	guidance
learning by formal artefacts	inquire, access	formalizing
learning by informal artefacts	identify, request	ad-hoc training
learning in isolation	collect, review	expressing & appropriating ideas
learning via networking	network, discuss	distribution in communities

Table 1: Association of end-points with practices and phases of knowledge maturing

Step 2 - Evaluate personas: Personas are evaluated according to predetermined attributes. In our case, this step was jointly performed by four project members. Assessing self-created personas is straightforward as one can relate back to experiences made during fieldwork. Rich descriptions are needed when assessing personas created by others. Based on these lessons learned, two procedures can be suggested: (1) each persona is evaluated by its creators or (2) each persona is evaluated by all project members who took an active part in prior phases of the procedure model (see figure 1). If the first alternative is employed, those who best know the personas conduct the assessment resulting in one evaluation for each persona which requires relatively little work effort. The second alternative requires more effort as it results in a number of evaluations for each persona, so that potential contradictions need to be sorted out. However, this procedure leads to raised awareness among project members about all personas which might also impact conceptualizations of "their" personas. Also, this procedure can help motivate project members to develop rich persona descriptions to ease assessment and also ensures that they are understood by developers not previously involved in persona development.

Step 3 - Perform cluster analysis: Cluster analysis (Aldenderfer and Blashfield 1996) maximises similarity of objects in the same cluster while similarity to objects in other clusters is minimized. The data set has to be described as a matrix X_D consisting of p personas (rows) and n attributes (columns). Each variable $x_{i,j}$ represents the assessment of persona i $(i = 1, 2, \dots, p)$ with regard to attribute j $(j = 1, 2, \dots, n)$ on an ordinal scale. If each persona is assessed by multiple team members, X_D can be created by using, e.g., mean values of all assessments.

$$X_D = \begin{pmatrix} x_{1,1} & \cdots & x_{1,n} \\ \vdots & \ddots & \vdots \\ x_{p,1} & \cdots & x_{p,n} \end{pmatrix}$$

In our case, attributes were measured on the same ordinal scale. If this is not the case, attributes need to be standardised. Before cluster analysis, outliers were examined, but there was no need for corrective action. There are several methods for cluster analysis (Aldenderfer and Blashfield 1996). It might be helpful to compare the results of different clustering methods performed on the same set of data. We relied on a solution gained by hierarchical agglomerative cluster analysis performing Ward's method using squared Euclidean distance. This method was chosen because it is applicable to the sample data, creates clusters of relatively equal sizes, performs well as long as there are no outliers and is widely used (Punj and Stewart 1983; Aldenderfer and Blashfield 1996). A small number of clusters should be identified as one primary persona is selected in each cluster. We created a graph showing the number of clusters against the agglomeration coefficient (Aldenderfer and Blashfield 1996). The graph indicated two, three and four clusters as possible solutions. The three-cluster solution was deemed most appropriate: (I) communication & serendipitous; (II) routinized & isolationist and (III) aggregation & combination.

Step 4: Validate clusters: All cluster solutions should be subjected to a discussion. Researchers who created the personas should analyse whether the respective cluster solutions make sense. The cluster solution that best represents perspectives of personas on work practices should be the basis for selecting primary personas. In our project, two solutions with five and seven clusters were proposed by two teams of researchers participating in phases one to three of the procedure model (figure 1). The three cluster solutions closely matched each other. The project team finally relied on a five-cluster solution.

Step 5 - Select primary personas: One primary persona is chosen for each of the clusters deemed to best represent its members. In our case, researchers split into as many teams as clusters. Each team was composed of project members with heterogeneous backgrounds in order to balance the process of selecting one primary persona representing the cluster they were assigned with.

4.5 Employ Personas

Within user-centred design, users should be involved in every prototyping loop. Due to the extensive effort for users resulting from that procedure, it is not feasible in many cases and certainly it is rarely possible to directly involve users continuously in design and development. Personas can bridge this gap. Direct user involvement is preferable, though. Personas are helpful for designers during the time between user involvement and approximate target groups of users. Each primary persona needs a separate and unique interface (Cooper 2004). Our main focus was on practices rather than interfaces. Personas should be supported individually by arrangements of services for their prominent practices.

Scenarios and use cases were created on the basis of persona descriptions. These scenarios contained rich descriptions on, e.g., problem situation, motivational aspects and triggering events. Due to the number of scenarios created, they were grouped based on the primary activity they dealt with. These groups of scenarios would be evaluated from the standpoint of the personas resulting in utterances like "Igor would never do that, he would rather ..." or "Sally would think this is great, because ..." which greatly enriched stories behind use case descriptions and helped to tease out the essence of context and motivation needed to successfully appropriate the system.

5 CONCLUSION AND OUTLOOK

Traditional design methods are of limited help in IS design activities for little researched, complex, dynamic and innovative knowledge work activities. This paper presented an approach for collaborative, user-centred IS design. It argued for ethnographically-informed fieldwork integrating qualitative and quantitative methods. Personas elaborated from a practices perspective are suggested to help designers capture richly described critical users' appropriations of IS for practices of knowledge work.

Creation of personas has to be based on a sound empirical basis and collected data should be validated according to authenticity, plausibility and criticality (Schultze 2000). Focus and aim of the intended system should be considered during data analysis and creation of personas. Dimensions characterizing

personas help focus coding on persona development and speed up data analysis. A structured approach is suggested for selecting primary personas out. As few personas are selected and others neglected, part of the context potentially relevant for design may be lost. Grouping personas critically depends on clustering method and attributes. Attributes should be grounded in qualitative data and related theories. Resulting clusters need to be checked whether they make sense to inform design. Ethnographic data are highly contextualized, thus interpretations of gathered data and strictly speaking also of personas should be performed by the original ethnographers. However, as personas need to be understood by all project members, assessing personas, checking clusters and selecting primary personas should be joint efforts of ethnographers and designers not involved in creating personas.

Our approach is the more suitable, the more innovative, large and diverse project, planned product, developers and target group are. User-centred design activities benefit from personas by reduced effort for end-users and a consequent focus on characteristics of critical users and the way they perform practices of knowledge work. Ethnography focuses on user's needs by analyzing work practices in their natural environments in contrast to often not reflected opinions gathered with questionnaires or interviews. However, personas are only one in a portfolio of user-centred design instruments and the effort for ethnographic fieldwork should not be underestimated. Avenues for future work are from a theoretical perspective to more closely integrate personas and practices into user-centred design activities and from a practical perspective to speed up persona identification, description and aggregation while keeping the momentum created by interpreting rich material describing personas.

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References

Al-Karaghouli, W., S. Alshawi and G. Fitzgerald (2005). "Promoting requirement identification quality Enhancing the human interaction dimension." Journal of Enterprise Information Management **18**(2): 256-267.

Alavi, M. and D. E. Leidner (2001). "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues." MIS Quarterly **25**(1): 107-136.

Aldenderfer, M. S. and R. K. Blashfield (1996). Cluster Analysis. Newbury Park, Sage.

Aoyama, M. (2005). Persona-and-Scenario Based Requirements Engineering for Software Embedded in Digital Consumer Products. IEEE International Conference on Requirements Engineering, Los Alamitos, CA, USA, IEEE Computer Society, pp. 85-94.

Barley, S. R. and G. Kunda (2001). "Bringing Work Back In." Organization Science **12**(1): 76-95.

Bishop, J., D. Bouchlaghem, J. Glass and I. Matsumoto (2008). "Ensuring the effectiveness of a knowledge management initiative." Journal of Knowledge Management **12**(4): 16-29.

Blackler, F. (1995). "Knowledge, Knowledge Work and Organizations: An Overview and Interpretation." Organization Studies **16**(6): 1021-1046.

Blackler, F., M. Reed and A. Whitaker (1993). "Epilogue - An Agenda for Research." Journal of Management Studies **30**(6): 1017-1020.

Blomquist, A. and M. Arvola (2002). Personas in action: ethnography in an interaction design team. Proceedings of the second Nordic conference on Human-computer interaction, ACM.

Brown, J. S., A. Collins and P. Duguid (1989). "Situated Cognition and the Culture of Learning." Educational Researcher **18**(1): 32-42.

Chang, Y.-n., Y.-k. Lim and E. Stolterman (2008). Personas: from theory to practices. Proceedings of the 5th Nordic conference on Human-computer interaction, Lund, Sweden.

Chapman, C. N. and R. P. Milham (2006). The Persona's New Clothes: Methodological and Practical Agruments Against a Popular Method. Proceedings of the Human Factors and Ergonomics Society 50th Annual Meeting.

Cooper, A. (2004). The inmates are running the asylum - why high-tech products drive us crazy and how to restore the sanity. Indianapolis, Sams.

Daskalaki, M. and H. Blair (2002). Knowing as an Activity: Implications for the Film Industry and Semi-Permanent Work Groups. Proceedings of the 3rd Conference on Organizational Knowledge, Learning and Capabilities, Athens.

Davenport, T. H., S. L. Jarvenpaa and M. C. Beers (1996). "Improving Knowledge Work Processes." Sloan Management Review **37**(4): 53-65.

Davenport, T. H. and G. J. B. Probst (2002). Knowledge Management Case Book. Weinheim, Wiley.

Dennis, A. R. (1996). "Information Exchange and Use in Group Decision Making: You Can Lead a Group to Information, but You Can't Make It Think." MIS Quarterly **20**(4): 433-455.

Dotan, A., N. Maiden, L. V. and L. Germanovich (2009). Designing with Only Four People in Mind? - A case study of using personas to redesign a work-integrated learning support system. Proceedings of INTERACT 2009, Uppsala, Sweden.

Drucker, P. F. (1994). "The Age of Social Transformation." The Atlantic Monthly **274**(5): 53-80.

Engeström, Y. (1987). Learning by Expanding: An Activity-theoretical Approach to Developmental Research. Helsinki.

Goodwin, K. (2002). "Getting from Research to Personas: Harnessing the Power of Data." Retrieved 15.01.2010, from http://www.cooper.com/journal/2002/11/getting_from_research_to_perso.html.

Gudjónsdóttir, R. and S. Lindquist (2008). Personas and Scenarios: Design Tool or a Communication Device? Proceedings of the 8th International Conference on the Design of Cooperative Systems, pp. 165-176.

Hädrich, T. (2008). Situation-oriented Provision of Knowledge Services. Information Systems. Halle(Saale), Germany, University of Halle-Wittenberg. Ph.D-Thesis.

Holsapple, C. W. and A. B. Whinston (1987). "Knowledge-based Organizations." The Information Society **5**(2): 77-90.

Hughes, J. A., V. King, T. Rodden and H. Andersen (1994). Moving out of the control room: ethnography in systems design. ACM conference on Computer supported cooperative work, Chapel Hill, USA ACM, pp. 429 - 439.

Illeris, K. (2003). "Workplace Learning and Learning Theory." Journal of Workplace Learning. **15**(4): 167-178.

Kelloway, E. K. and J. Barling (2000). "Knowledge Work as organizational behavior." International Journal of Management Reviews **2**(3): 287-304.

Klein, H. (1999). "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems." Management Information Systems Quarterly **23**(1): 67-94.

Lave, J. and E. Wenger (1991). Situated learning: legitimate peripheral participation. Cambridge, Cambridge University Press.

Maier, R. and A. Schmidt (2007). Characterizing Knowledge Maturing. A Conceptual Process Model for Integrating E-Learning and Knowledge Management. 4th Conference on Professional Knowledge Management. Experiences and Visions, GITO-Verlag, pp. 328-333.

Myers, M. D. and L. W. Young (1997). "Hidden Agendas, Power, and Managerial Assumptions in Information Systems Development: An Ethnographic Study." Information Technology & People **10**(3): 224-240.

Orlikowski, W. (2000). "Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations." Organization Science **11**(4): 404-428.

Patton, M. Q. (2002). Qualitative Research & Evaluation Methods. Thousand Oaks, Sage.

Pruitt, J. and T. Adlin (2006). 'The Persona Lifecycle, keeping people in mind throughout product design. San Francisco, Kaufmann Publisher.

Pruitt, J. S. and T. Adlin (2006). The Persona Lifecycle: Keeping People in Mind throughout Product Design. Amsterdam, Elsevier.

Punj, G. and D. W. Stewart (1983). "Cluster Analysis in Marketing Research: Review and Suggestions for Application." Journal of Marketing Research (JMR) **20**(2): 134-148.
Randolph, G. (2004). "Use-Cases and Personas: A Case Study in Light-Weight User Interaction Design for Small Development Projects." Informing Science **7**(1): 105-116.
Rich, E. (1979). "User modeling via stereotypes." Cognitive Science **3**(4): 329-354.
Rogers, A. (2006). Informal learning in lifelong learning. Informal Learning and Digital Media: Constructions, Contexts and Consequences. Odense, Denmark, Danish Research Centre on Education and Advanced Media Materials.
Rönkkö, K. (2005). An Empirical Study Demonstrating How Different Design Constraints, Project Organization and Contexts Limited the Utility of Personas. Proceedings of the 38th Annual Hawaii International Conference on System Sciences.
Rönkkö, K., M. Hellman, B. Kilander and Y. Dittrich (2004). Personas is not applicable: local remedies interpreted in a wider context. Proceedings of the eighth conference on Participatory design. Toronto.
Schultze, U. (2000). "A confessional account of an ethnography about knowledge work." MIS Quarterly **24**(1): 3-41.
Schultze, U. (2003). On Knowledge Work. Handbook on Knowledge Management 1 - Knowledge Matters. C. W. Holsapple. Berlin, Springer**:** 43-58.
Snyder-Halpern, R., S. Corcoran-Perry and S. Narayan (2001). "Developing Critical Practice Environments Supporting Knowledge Work of Nurses." Computers in Nursing **19**(1): 17-23.
Starbuck, W. H. (1992). "Learning by knowledge intensive firms." Journal of Management Studies **26**(6): 713-740.
Storr, A. (1997). The Essential Jung. Princeton, Princeton Univ Press.
Suchman, L. (1987). Plans and situated actions : the problem of human-machine communication. New York, Cambridge University Press.
Suchman, L. (1995). "Making Work Visible." Communications of the ACM **38**(9): 56-64.
Teddlie, C. and A. Tashakkori (2009). Foundations of mixed methods research. Integrating quantitative and qualitative approaches in the social and behavioral sciences. Los Angeles, Sage.
Walsham, G. (2006). "Doing interpretive research." European Journal of Information Systems **15**(3): 320-330.
Wenger, E. (1998). Communities of Practice. Learning, Meaning, and Identity. Cambridge, Cambridge University Press
Wiles, D. (2007). Mask and Performance in Greek Tragedy: From Ancient Festival to Modern Experimentation. New York, Cambridge University Press.
Wolff, E. (2005). "The growth of information workers." Communications of the ACM **48**(10): 37-42.