MIRЯOR

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Reflective Learning at Work

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9	British Telecommunications Public Limited Company	BT	UK
10	Tracoin Quality BV	TQ	Netherlands
11	Infoman AG	INFOM	Germany
12	Regola srl	REG	Italy
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Executive Summary

During the first year of the project, comprehensive user studies in five testbeds have been carried out involving the target group of the MIRROR Apps. When writing this deliverable, we paid specific attention to the identification of best practices and current needs regarding reflective learning occurring in the five testbeds. This allowed us to improve our understanding of current practices of reflective learning. The present deliverable summarizes and integrates the results from the user and design studies conducted during the first year of MIRROR.

The main research questions driving the integration of the results were the following:

> *Does reflective learning currently take place within the testbeds?*
>
> *Is there currently any support for reflective learning?*
>
> *What are current needs and expectations with regard to reflective learning?*
>
> *Which constraints have to be considered when supporting reflective learning?*

The user and design studies provided a detailed view on reflective learning at the testbeds, showing not only that it occurs but also giving insight into the occasions and triggers, the content and processes, and the outcomes of reflection. In general, reflection is considered to be essential to enhance workplace and organisational learning by both staff and management.

While reflective learning is (more or less) part of daily work in the testbeds, it is not supported systematically. Opportunities to support reflective learning lie in capturing data, provide this data as a basis for reflection, scaffolding reflective learning processes, sharing reflection outcomes, and institutionalising learning outcomes. The design studies have already tapped into the potential of technology to support reflection at the workplace.

During the user and design studies, we also have identified factors that will influence the success of any technology support such as personal factors (abilities and skills, readiness for technology, and attitudes towards reflection), organisational factors (data privacy and trust, organisational culture) as well as infrastructure, data-related factors, and means of introduction and measurement. These factors should be considered when implementing any support for reflective learning.

In general, the user studies provided comprehensive knowledge about reflective learning AS IS at the testbeds, the untapped potential to facilitate reflective learning, the needs and expectations with regard to reflection support, and the constraints that have to be taken into account when implementing reflection support.

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1   Introduction

A major part of learning at work happens outside formal training (Eraut, 2000; Lave & Wenger, 1990). However, in contrast to formal training where IT technology is widely used, informal learning, especially learning from experience (experiential learning), is hardly supported. Employees are often not supported in learning from their daily work experiences. Thus, as learning from experience at the workplace makes up a large part of learning at work and technological support for this kind of learning is scarce, a huge potential for learning at work remains untapped.

Therefore, our vision is to empower employees to learn by reflection on their work practice and their very personal learning experiences. MIRROR aims at assisting employees in capturing experiences and in developing creative solutions for problems that need to be solved immediately. This will be achieved by complementing personal and organisational learning environments with personal MIRROR applications for individual, collaborative, creativity-based, game-based as well as organisational learning through reflection.

In order to support reflective learning adequately, we need first to understand when and how reflection is taking place as a part of daily work practice considering relevant constraints and barriers such as organisational culture and established work practice. For this purpose, the first year of MIRROR was devoted to a thorough examination of reflective practice AS IS. As reflective learning is considered to be highly specific for different organisations, we examined reflective learning in multiple testbeds to generalize our knowledge and to provide recommendations for applications that consider the specific needs and characteristics of each organisation.

Thus, during the first year of the project, comprehensive user studies in five testbeds have been carried out involving the target group of the MIRROR Apps. We paid specific attention to the identification of current challenges and best practices occurring in the five testbeds. This allowed us to improve our understanding of current practices of reflective learning.

The main research questions driving the user studies were the following:

Does reflective learning currently take place within the testbeds?

Is there currently any support for reflective learning?

What are current needs and expectations with regard to reflective learning?

Which constraints have to be considered when supporting reflective learning?

In order to get comparable results across our testbeds, WP1 developed a common methodology for data collection and data analysis. This was done in close cooperation with both the research partners and the application partners (i.e. our testbeds). The resulting Deliverable (D) 1.1 provided 15 research instruments, including questionnaires, interview guidelines, observation schemes, guidelines for pilot studies, and a reflection diary. As reflection about work experiences is a very sensitive topic, we developed a comprehensive data privacy policy and provided guidelines on how to gather and handle personal data (for further considerations on privacy issues see D9.1). The modular, toolbox-like character of the 15 research instruments permitted a deliberate, purposeful selection of research instruments to be made to answer the specific research questions outlined in D1.1. At the same time they could be easily combined to form larger tools (e.g., combining questionnaires that address the same target audience). These research instruments were able to be readily applied in the various user studies as D1.1 provided both templates and specific instructions for implementation. However, we made sure that the templates were open for further

customization, e.g., by including a description of the purpose of the tool and the intended target group.

The user studies conducted by WP3 to WP9 are documented in the first deliverables of each workpackage, i.e., D3.1, D4.1, D5.1, D6.1, D7.1, D8.1, and D9.1. These deliverables document comprehensively what we learned about reflective learning in the testbeds from the specific perspective of each research partner (see Figure 1). The purpose of the deliverable at hand is the summary and integration of these results. By combining the different perspectives we achieve a more comprehensive and detailed picture of reflective learning in the testbeds and achieve a common ground for the future work of the workpackages to effectively support reflective learning via the MIRROR Apps in the testbeds. We will also outline the implications for app development and theory development which can be drawn from our empirical results.

Figure 1: Work Packages Structure

In order to achieve this, we will first summarize briefly the theoretical background for the user and design studies (Chapter 2) and the research methodology (Chapter 3) before describing the testbeds (Chapter 4) and the implementation of the user and design studies - including issues of coordination, customization, and monitoring of the research instruments (Chapter 5). Then we will give an overview on all user and design studies (Chapter 6) and summarize key findings of the various workpackages (Chapter 7). The main contribution of this deliverable is the integration of the results and the outline of implications for technology development (Chapter 8). At the end of this deliverable, we provide a conclusion on insights gained during the user and design studies (Chapter 9).

2 Theoretical Background

For an overview of the shared understanding in the project regarding reflection, see the "Theoretical Background" section that is shared by D3.1, D4.1, D5.1, D6.1, D7.1, and D8.1. We will only give a concise description of the theory here with a focus on the integration work, as the shared understanding was already given in all these deliverables.

Reflection on past experiences is an effective mechanism for both employees' individual and collaborative learning and for organisational learning (Argyris & Schön 1996; Dewey 1933; Kolb and Fry 1975). Daudelin (1996) defines reflection as "*the process of stepping back from an experience to ponder, carefully and persistently, its meaning to the self through the development of inferences; learning is the creation of meaning from past or current events that serves as a guide for future behaviour*". Reflection has the potential to lead to a better understanding of one's own work practice and can guide future behaviour (Järvinen & Poikela, 2001; Moon, 1999).

Boud et al. (1985, p.19) gives a comprehensive definition of reflective learning that builds a major part of the theoretical basis for our work in MIRROR (for the model see Figure 2): "*Reflection in the context of learning is a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations.*" Reflective learning has the potential to lead to more flexible work routines and higher performance in a rapidly changing work context. Accordingly, reflection has the potential to lead to change and development as it leads to insights into work practices and identifies where work routines need to be modified. See Figure 1 for an overview of the model.
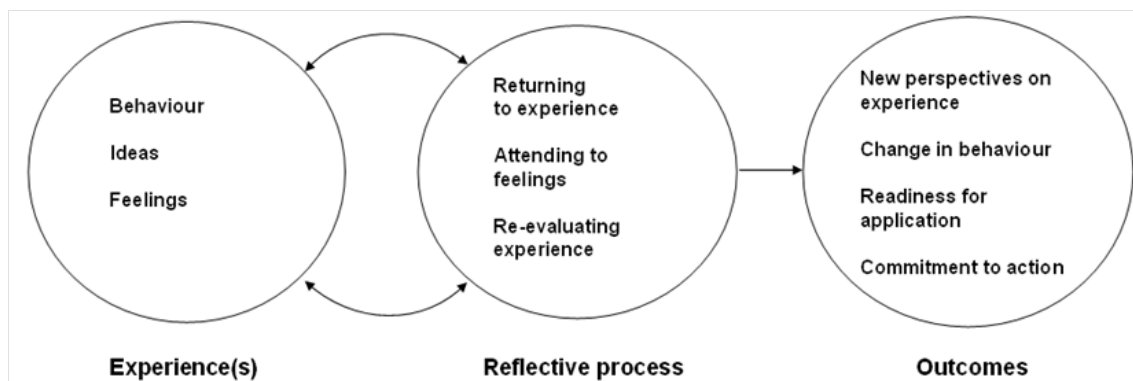
Figure 2: The reflective learning process (Boud et al., 1985)

The state of the art literature, however, fails to specify the content of reflection, typical triggers for reflection, indicators for, and the outcomes of reflection. Especially in the context of workplace learning, there is a need for further specification of the reflection process considering typical triggers for reflection or relevant work-related outcomes such as a change in individual work practice or organisational routines. We consider a comprehensive understanding of reflection for the purpose of workplace and organisational learning as a major prerequisite when tackling the challenge of providing technological support for reflective learning at work. In addition to that, any technology to be designed to scaffold reflection on own work practice must be adapted to the target group's daily work practice.

During the first project year in MIRROR, we thus aimed at a refinement of our understanding with regard to (i) the reflection process itself, (ii) the various scopes of reflection such as individual and organisational learning, (iii) the context in which reflection takes place and (iv) the potential of technology to support reflective learning at work.

3 Research Methodology

3.1 Research Interests

Development of the research methodology for the user studies (see D1.1) allowed us to examine reflective learning at work and to gain insights in the following research areas:

Reflective Learning

The first group of research questions focused on the concept of reflection in its multiple facets. The main goal was to determine *whether*, *when*, and *how* reflection currently takes place in our testbeds. We examined reflective learning on an individual, collaborative and organisational level and thereby looked at the multiple aspects of reflection, i.e., the content, the process, and the outcomes. Furthermore, an important issue was the identification of needs and expectations for both employees' individual and collaborative reflection as well as organisational learning through reflection, especially regarding any tools and data that can be used to (further) support reflective learning at work. We therefore examined the use of existing tools and data that support individual and collaborative reflection, elicited needs and expectations for reflection support, and identified any constraints that have to be considered when supporting reflective learning by technology.

Learning at the Workplace

As we want to support learning at the workplace with reflection, another group of research questions explored the current state of workplace learning as it relates to reflection. We researched the degree to which individual, team and organisational learning takes place within an organisation, established learning practices, the employees' motivation to learn and willingness to change, and to question how personal goals relate to organisational goals. We aimed at specifying the learning objectives within the organisations as these will influence the organisations' needs and expectations for technology development regarding reflective learning.

Work Practice and Organisational Context

Reflection and learning are embedded in the larger organisational context and established best practice. This practice and context strongly influences the use reflection, learning and the use of technology to support reflective learning. Thus, our research interests were also targeting any job demands and typical work processes of the target group, interaction and communication among employees, and the context of the socio-technical solutions that may influence any future technology usage.

Technology Usage and Technology Readiness

Current technology usage might constrain the implementation of any reflection Apps to support reflection. The Apps must seamlessly integrate into the existing IT infrastructure and fit into current business and work processes. Thus, we examined technology usage and the aspects of work for which they are used. Closely intertwined with the tools are the data they store and manipulate, so we also identified any data that is already available within the organisation and that might be used to support reflective learning. Furthermore, we assessed the target group's readiness for technology by examining their experiences of and attitudes towards technology. WP9 also researched the target group's privacy concerns and sharing behaviour with regard to personal data.

3.2 Research Approach

To address our research questions, we combined *onsite* and *offsite* data collections.

First, questionnaires and written self-reports were implemented as *offsite user studies*. Questionnaires can be up-scaled quite easily and allow for data collection from a large sample. We thus partly addressed our research interests by means of questionnaires and written self-reports. Additionally, we asked those responsible for IT to assess the technical infrastructure and available data and managers regarding their impression of the role of reflection.

Second, *onsite user and design studies* required the researcher to visit the testbeds. This was necessary to test technology in vivo, to get rich data from the target group, and to observe daily work practice directly.

This two-fold approach allowed us to get a detailed, multi-faceted impression of the testbeds with regard to our research interests and allowed us to coordinate the data collection in a sensible fashion (see Chapter 5).

3.2.1 Offsite User Studies

3.2.1.1 Staff Survey

Target Audience: Members of Staff

To facilitate data collection and to ensure that we obtained comparable results without repeatedly interrupting the target audience, we integrated all questionnaires that address the target group of the MIRROR Apps into one questionnaire, the *staff survey* which was applied to the testbeds' employees.

The staff survey included the following research instruments:

- **Reflection Questionnaire**
  The Reflection Questionnaire (see D1.1, Part B) addressed our first interest – reflection – directly by assessing the degree of reflection in the testbeds. It included aspects of individual, collaborative and team reflection as well as reflection for the purpose of organisational learning and learning by comparison with colleagues. Reflection attitudes, the need and the opportunities to reflect were also assessed.

- **Learning at Work Questionnaire**
  The Learning at Work Questionnaire (see D1.1, Part B) shed light on the interrelationships of individual, team and organisational learning and assessed the status of learning at the testbeds. It addressed our learning-related research interests and provided information about the degree of individual, team, and organisational learning and the interrelationships between these three levels.

- **IT Attitudes & Usage Questionnaire**
  The IT Attitudes & Usage Questionnaire (see D1.1, Part B) addressed user experiences of and attitudes towards technology and current technology usage and available data by assessing both technology readiness and technology usage of the target group. It covered, for example, attitudes towards and usage of PCs, mobile phones/smartphones, sensors, and serious games.

- **Privacy Questionnaire**
  Finally, the Privacy Questionnaire (see D1.1, Part B) assessed the stance of the testbed employees to privacy issues relevant to our project. This includes general privacy concerns and actual sharing behaviour, trust in team members, trust in management staff, and concerns with regard to the handling of personal data by the organisation they work for. It complemented our staff survey by including privacy concerns and (intended) sharing behaviour.

3.2.1.2 Reflection Diary

Target Audience: Members of Staff

To refine our understanding of reflection content, triggers, and outcomes, we collected instances of reflection by means of the reflection diary (see D1.1, Part B): Employees kept the diary for a minimum of two weeks and recorded any events that made them reflect. Four questions guided the recollection of the event and ensured a detailed description. The reflection diary complements the reflection questionnaire by focusing on a few instances that are captured in greater detail. It gathered lively and concrete examples of reflection at the workplace.

3.2.1.3 IT Checklist and Available Data Checklist

Target Audience: IT Administrators

The IT Checklist and the Available Data Checklist both dealt mainly with the IT infrastructure at the testbeds. Given that the checklists can be filled out like a questionnaire and be answered by a person responsible for the IT infrastructure at the testbed site, the available data checklist was integrated in the IT Checklist. Thus, this combined checklist encompasses:

- **IT Checklist**
  The purpose of the IT Checklist (see D1.1, Part B) was to get a good overview of the available technology in the testbed that might be used for reflection or data collection for reflection. It focused on hard- and software only, e.g., the general technical infrastructure/equipment in regard to PCs, mobile phones, changes in the infrastructure, or connectivity.

- **Available Data Checklist**
  The Available Data Checklist (see D1.1, Part B) had a data-centric view on the available infrastructure. It assessed which data that might be useful for reflection is available at the testbeds and whether the target group is aware of this data.

3.2.1.4 Management Survey

Target Audience: Members of the Top Management, Quality Management, and Business Process Management

The Organisational Reflexivity Questionnaire (see D1.1, Part B) assessed organisational learning and organisational intelligence practice from the management's perspective. The focus was on organisational reflexivity, i.e., whether and how organisational learning and organisational intelligence, knowledge creation and knowledge exchange, and formal and informal organisational learning, take place at the testbeds. It complements the employee perspective captured in the staff survey with the management perspective.

3.2.2 Onsite User and Design Studies

The design studies included both *user studies* with the MIRROR target group and *design studies* to examine the target group's readiness to apply technology to support reflective learning.

3.2.2.1 Job Description Interview

Target Audience: Members of Staff

As any technology support for reflection has to clearly fit the needs of the employees and must assist them in doing their work better. Thus, it is important to understand the work processes. The Job Description Interview (see D1.1, Part B) provided a structured assessment of the job duties and demands with regard to multiple aspects, namely appraisal practices, contacts and communication, collaborative work and coordination of work, knowledge, skills and experience needed, learning in the workplace, and creative problem solving. The Job Description Interview was combined with the observational studies to further examine relevant aspects of daily work.

3.2.2.2 Work Observation Scheme

Target Audience: Members of Staff

The direct observation of daily work provided further, comprehensive information about aspects of work that do not appear typically in self-reports, e.g., because they seem trivial or are easily forgotten. Researchers joined the work at the testbeds for a few days and observed them in vivo. Work observation was guided by the Work Observation Scheme (see D1.1, Part B). Observational studies helped us to get a more complete and data rich picture about current work and reflection practice. When appropriate, the observational studies were combined with in-depth interviews about reflection and the job description interview to achieve a more complete picture.

3.2.2.3 Reflection Interview

Target Audience: Members of Staff

The Reflection Interview (see D1.1, Part B) assessed reflection in the testbeds in a structured way and with regard to multiple aspects. It asked for occurrence, triggers, and outcomes of reflection, participants' inclination to reflect on own work, collaborative reflection, learning through comparison with colleagues, awareness of data/information as the basis for reflection, sustainability of reflection, reflection for organisational learning, and perceived appreciation of reflection by the management. The reflection interview was applied in conjunction with other onsite user studies where appropriate.

3.2.2.4 Needs and Requirements Analysis for Organisational Learning and Intelligence

Target Audience: Members of Staff

The interview guideline Needs and Requirements Analysis for Organisational Learning and Intelligence (see D1.1, Part B) examined any needs and requirements with regard to learning from the employees' point of view. In this interview, practices that support organisational learning, barriers that hinder organisational learning, existing and future technology support, and prior experiences with learning technology were discussed with the participants. This interview was combined with the reflection interview for practical purposes.

3.2.2.5 Organisational Learning Management Interview

Target Audience: Members of the Top Management, Quality Management, and Business Process Management

The Organisational Learning Management Interview (see D1.1, Part B) covered organisational learning and organisational intelligence practices from management's point of view by looking at catalysts of and barriers to organisational learning, existing and future technological solutions for learning, and prior experiences with learning technology.

3.2.2.6 Serious Games Experience with In-Depth Interview

Target Audience: Members of Staff

Given that many people have never encountered Serious Games before, this design study confronted participants with a serious game. An in-depth interview further examined users' experience and needs and requirements for future serious games (see D1.1, Part B). This allowed for a valid assessment of user's readiness for serious games and helped identify needs and requirements with regard to the game the target group would like to use in their work setting.

3.2.2.7 Capturing Pilot Study

Target Audience: Members of Staff

Ideally, data for reflection is collected automatically without requiring much input by the employee. Sensors capturing physical data are thought to be likely to be useful for this purpose, and we thus were concerned with the examination of the specific potential of sensors. As most people are unfamiliar with wearing sensors, a questionnaire might not deliver valid information about actual behaviour, thus the Capturing Pilot Study Guidelines (see D1.1, Part B) were used to conduct a design study to examine the applicability of sensor technology in selected testbeds. Participants have been wearing sensors for some time and answered questions about their usability afterwards. The Capturing Pilot Study assessed both user acceptance and data quality, e.g., regarding the usefulness of the sensor data or regarding any systematic bias of the data.

3.2.2.8 Additional Design Studies

Target Audience: Members of Staff

Some workpackages conducted additional studies to pilot preliminary prototypes of reflection Apps (WP5, WP6). These studies are comparable to the Serious Games Pilot and the Capturing Sensors Pilot. While these design studies already implemented technology solutions, they provided invaluable information and insights about the target group's reflection practices and their readiness to apply technical support for reflection.

4 Testbed Descriptions

Detailed testbed descriptions are provided in D1.1 and extensive workplace descriptions have been developed on the basis of the user studies for Infoman, NBN, and RNHA (see Appendices of Deliverable 3.1, 4.1, 6.1 or 8.1). Therefore, we only give a brief overview of the testbeds here.

The testbeds cover two general areas (IT and health) with differences in the educational level of the employees (e.g., high at NBN, BT and Infoman, low at RNHA), specific challenges (e.g., high turnover at RNHA) and types of work (e.g., volunteer work at Regola, paid work at the other testbeds). Thus the testbeds allow us to look at reflection in different settings to draw comparisons, identify unique aspects, and allows us to develop Apps that rely on the same general processes but are adapted to different work contexts.

4.1 Infoman

Infoman AG is an IT company that consults, sells and personalizes Microsoft Customer Relationship Management Software to help analyse and optimise the marketing, sales and service processes of their customer companies.

People mainly work in small teams of two to three people. Altogether, the company has about 60 employees, most of them based in the headquarters. However, they have a lot of meetings with customers at the customers' site which require internal preparation and post-processing. Daily work is heavily focused on customers' needs which require a high degree of flexibility and the development of individual best practice. Consulting and sales thus involves a high degree of reflection on interaction with the customer. Therefore, knowledge management and sharing is considered to be a major challenge at this testbed.

4.2 Neurological Clinic Bad Neustadt

The Neurological Clinic (NBN) is a large, modern hospital in Germany with approximately 400 full-time equivalent employees (FTE's) dealing with approximately 1000 strokes a year (approx. 2000 emergencies altogether, including severe neurological emergencies other than stroke). The Neurological Clinic has a strong interest in improving their daily business processes. They have both quality and error management processes in place to ensure quality of work.

The Stroke Unit was selected as department for the user studies, as the work in this emergency unit is characterized by high time pressure and stress levels on the one hand, while on the other hand this department is widely regarded in the clinic – by clinic and management staff – as role model for other departments. Employees work in interdisciplinary teams of physicians, care staff, and therapists. Work is organized in shifts, and there are regular, well-structured handovers.

4.3 Registered Nursing Home Association

The Registered Nursing Home Association (RNHA) is an association consisting of 1200 nursing homes in the UK, committed to the provision of high quality services to residents in care homes. A specific characteristic of this application partner is that it comprises multiple, independent homes, which permits support for reflection to be implemented in different homes and across homes to test the applicability of different approaches. High levels of participation within MIRROR have been experienced from amongst the homes that have volunteered to be MIRROR test sites.

For simplicity in writing, we use the term RNHA to refer to one or more care/nursing homes where User Studies were conducted, although RNHA is not the name of a specific home, but the name of the association of about 1200 nursing homes.

A growing challenge for nursing homes is the higher proportion of increasingly elderly residents suffering from dementia when admitted to the homes. This can lead to instances of challenging behaviour where the elderly people are confused and react, sometimes aggressively and irrationally, to their unfamiliar surroundings. This requires high amounts of reflection on the side of the carers and nurses working in the homes, as there is no one-size-fits-all solution when dealing with personalities approaching the end of their lives with their individual and complex life-histories.

Most of the care staff, except for recently qualified nurses, are not educated to degree level and only have National Vocational Qualifications. This means that staff without formal training can be confronted with complex situations to resolve. Work is organized in day and night-shifts with handovers; protocols document every treatment and activity.

4.4 British Telecom

British Telecom (BT) is a large telecommunications company, serving customers in more than 170 countries. BT manages its 1500 large scale, often highly customized and individual, contracts by contract teams.

The target group for MIRROR are the members of these contract teams. Most employees work from home as teleworkers. Teams are dispersed all over the country, and they are managed virtually. Thus, knowledge management and experience exchange is a major issue at this testbed. Work is highly standardized on the project level, i.e. there is a standard business process for contract management. There is a huge range of formal training opportunities, many of them available in the company's e-learning system. Performance management is implemented to ensure quality of work.

Because BT is a fast changing organisation and staff are critical to new applications MIRROR will have to demonstrate the "What is in it for me" factor before implementation. Therefore BT has decided on a phased implementation. BT will implement the MIRROR application first in the learning solutions team where they can prove the added value and "what is in it for me factor". Once this is demonstrated, BT will take it to a larger audience like the contract teams. BT has already identified a number of other possible testbed cases which they can harvest if MIRROR can demonstrate the benefits. Thus, the user studies were conducted with the members of the learning solutions team.

4.5 Regola

Regola is a company which has been active for over fifteen years in the field of Information & Communication Technology (ICT). Thanks to its wide-ranging skills in both the IT and media industries, Regola is able to offer integrated solutions for highly complex projects. Regola's most important dimension is the area of computer solutions for the health and emergency management sector. Support of individual and collaborative (team) reflection in large amounts of volunteers could lead to huge learning gains that are previously untapped.

5 Coordination, Customization and Implementation of the User Studies

5.1 Coordination

To ensure efficient data collection, KMRC took responsibility of coordination of the user studies. In accordance with our research approach, we decided to differentiate between *offsite* and *onsite* data collection. Both types of user studies were coordinated by a different researcher at KMRC to ensure responsive and smooth communication with both research partners and testbeds and to allow for a more detailed monitoring of the data collection.

5.2 Customisation of Tools

It is important to stress that not all onsite research instruments were applied in every testbed. On the one hand the onsite instruments required visits to the testbeds and were very time intensive, on the other hand the resources of the workpackages and the testbed partners (especially the participants) were limited, thus the workpackages focused on specific testbeds. Furthermore, some customisation was necessary with all tools in order to take into account the needs and constraints of the testbeds and the testbeds' staff.

5.2.1 Translation of Research Instruments

The research instruments were created in English (project language). The native language of the target audience in the testbeds differed between English (RNHA, BT), German (Infoman, NBN) and Italian (Regola). Consequently, research instruments that were applied in the German and Italian testbeds had to be translated. The German translation of the research instruments to be applied during the onsite user studies was done by the respective workpackages themselves, while any questionnaires, checklists and the reflection diary were translated into German by KMRC. The Italian translation was accomplished by NTNU. RNHA requested a simplified version of the research instruments which was then developed in close cooperation between KMRC and RNHA.

5.2.2 Adaptation to Requirements of the Testbeds

All offsite research instruments were finalized by KMRC for deployment with regard to layout, introduction texts, logos etc. Additionally, the staff survey, IT checklist, management survey, and the reflection diary were adapted to the practical requirements of the testbeds. This meant creating a web-based version of the staff survey and the manager survey for BT (in English), RNHA (short version again), Infoman (in German), and Regola (in Italian) and combining the research instruments into a paper-and-pencil version for NBN (in German) and RNHA (in simplified English).

5.3 Implementation: Offsite User Studies

Offsite Data Collection started in February 2011 with KMRC distributing the questionnaires and links to the online versions of the questionnaires. KMRC implemented the offsite data collection in close cooperation with contact persons in each testbed.

Data collection at Infoman was mediated by Prof. Anne König who provided the addresses of the employees of the target audience and established the contact. The electronic data was anonymised and made available for distribution to the research partners within the project by KMRC.

At NBN, questionnaires were distributed and re-collected by Dominik Cavael, the local project manager. He also implemented the reflection diary and the IT checklist. Given that all documents were filled out on paper, KMRC transcribed them digitally, anonymised raw data and made them available to all research partners.

The distribution and collection of the questionnaires and diaries to the nursing/care homes was accomplished by Malcolm Rose and Kevin Pudney. Given that all documents were filled out on paper, KMRC transcribed them digitally, anonymised raw data and made them available to all research partners.

At BT, Hans Dirkzwager and Ellen Leenarts distributed the link to the online staff survey questionnaires to the target group. The sample size is rather small as the financial and personnel resources of BT for the user studies are very limited. The electronic data was anonymised and made available for distribution to the research partners within the project by KMRC.

Given a change of the target group at Regola, Michele Biolè gave access to volunteers at Regola for the staff survey instead. The electronic data was anonymised and made available for distribution to the research partners within the project by KMRC.

5.4 Implementation: Onsite User and Design Studies

The research instruments described in D1.1 provided the basis for implementation of the onsite user and design studies. Where necessary, further guidelines for onsite data collection were developed by the researchers themselves, e.g., for Know Center's focus groups at NBN and technology pilots of City University. To coordinate any onsite activities at the testbed sites, KMRC held flash-meetings which included all researchers interested in doing user studies at a respective testbed. During these flash-meetings, any needs and requirements of the researchers, e.g., with regard to the sample, sample size, study duration, and timing, were elicited and discussed. Furthermore, any constraints at the testbeds were identified and discussed to ensure smooth implementation of the user studies. Detailed scheduling of data collection was the responsibility of each testbed as they were most familiar with the constraints. KMRC continuously monitored any onsite activity and collected information about data gathered regularly.

KMRC provided forms and templates for the onsite user studies, namely a participant form and a consent form, and pointed to the data privacy policy for data gathering and handling.

5.5 Data Privacy Policy for Data Storage and Data Sharing

Given the sensitive data requested in some of the user studies all project partners, who were involved in data analysis, signed a confidentiality agreement. They thereby agreed to uphold the standards described in Chapter 9 of D1.1. These privacy guidelines ensure that personal data is treated with the utmost care to ensure privacy of individuals. We took care that results were made available to the testbeds in anonymous and aggregated form only.

5.5.1 Offsite User Studies

While the participants received the questionnaires and checklists via the intermediaries of the testbeds, they had different opportunities to return the filled out questionnaires and checklists:

- When using the digital versions, they were asked to send them directly to the responsible researcher at KMRC.

- When using the survey centre, any communication was encrypted with SSL automatically.

- When using paper & pencil versions, they could give them to the intermediaries who collected them and send them to KMRC. They could also send them directly to the responsible researcher at KMRC if they had privacy concerns.

Paper questionnaires and diaries were transcribed digitally (to ensure that handwriting could not be recognized) and anonymised. Once at KMRC, the data files containing raw data were further anonymised before they were made available to the research partners. Similarly, the reflection diaries were anonymised by removing any names in the descriptions and replacing the participant ID with a new code that did not use any personal information.

5.5.2 Onsite User Studies

Participants of the onsite user and design studies interacted directly with the research partners. With regard to data collected onsite by the various workpackages, participants were informed about the study objectives and privacy policy, and they were asked to sign a consent form.

There were three types of onsite data:

- personal interviews with staff (protocols or audio recordings)

- observational studies of staff during daily work (minutes and notes)

- App-related activities such as focus groups and technology acceptance testing/pilots (minutes, documents being created during the group activity, log files, notes, audio recordings of sessions).

Raw data like interview protocols and audio files were only shared with partners involved in data analysis. They were not shared with the testbeds to ensure data privacy.

5.6 Data Analysis

Data analysis of the raw data acquired during the user and design studies was conducted by the respective workpackages. KMRC assisted in analysis of quantitative data due to its expertise in empirical research. Some overarching analyses were accomplished for D1.2 that are beyond the scope of the individual workpackages.

5.7 Documentation of the User Studies

The user studies were documented in D3.1, D4.1, D5.1, D6.1, D7.1, D8.1, and D9.1:

D3.1 *User studies, requirements, and design studies for capturing learning experiences*

D4.1 *Results of the user studies and requirements on "Individual Reflection at Work"*

D5.1 *Descriptive framework and capabilities for creative problem solving and reflective learning*

D6.1 *Design studies and specifications*

D7.1 *Games framework*

D8.1 *Results of the user studies, requirements and MIRROR framework for Organisational Intelligence*

D9.1   User studies on privacy needs, privacy model and privacy guidelines

To ensure consistency of structure and content among the different deliverables, KMRC provided guidelines for the documentation of results in the Dx.1 deliverables (a common outline with information of what should be mentioned). These guidelines also ensured that relevant information for the integration of results in D1.2 was provided by the workpackages.

6 Overview of User Studies

This chapter provides an overview on the user studies conducted at the various testbeds. The following sections outline data collection activities related to the *offsite* user studies and the *onsite* user studies.

6.1 Offsite User Studies

Offsite research instruments were deployed widely in the testbeds (see Table 1). Data collection was organized and implemented by KMRC in cooperation with the respective testbed partners (see 5.3).

Table 1: Overview of Offsite User Studies

Testbed	Staff Survey	Manager Questionnaire	Reflection Diary	IT Checklist
Infoman	3 employees*	-	4 employees**	yes
NBN	39 employees	9 managers	3 employees	yes (2)
RNHA	71 employees from 2 homes	7 managers, each from a different home	10 diaries	3 homes
BT	4 employees***	2 managers	none	no
Regola	16 employees	2 managers	none	yes

* Note that Infoman is a very small testbed with only 5 members in the target group, i.e., 60% participated.

** Three regular diaries plus one diary prototype that was tested at Infoman prior to the user studies (see D1.1).

*** Note that the total group size at BT consisted of only 7 people, i.e., 57% participated. BT was – as planned in the DOW – only limited involved in the user studies.

6.2 Onsite User and Design Studies

Onsite user studies were conducted at all testbeds by multiple partners with the exception of BT, as financial resources for the user studies were not allocated in the first project year. Table 2 provides an overview of onsite data collection at the various testbeds (see also 5.4): Each row represents user or design study, indicating the sample and sample size. Whenever two or more interview guidelines from D1.1 were combined or observational or design studies were combined with interviews and thus, the sample was the same, this is one user or design study in the table.

Table 2: Overview of Onsite User Studies

Testbed	Description	Sample
Infoman	Reflection and Needs & Requirements for Learning Interviews	5 members of staff (consultants and sales manager)
	Organisational Learning Management Interviews	2 members of management
	Work Observation and Job Description Interviews	2 members of staff
NBN	Focus Groups with a) Physicians, b) Therapists, and c) Nurses	11 members of staff (3 physicians, 4 therapists, 4 nurses)
	Organisational Learning Management Interviews	6 members of management (medical director, head of administration, head of QM, employee in HR, head and prior head advanced education)
	Reflection and Needs & Requirements for Learning Interviews	7 members of staff (3 physicians, 4 nurses)
	Sensor Pilot Study, Work Observation, and Follow-Up Interviews	7 members of staff (3 physicians, 4 nurses)
	Work Observation and Job Description Interviews	2 members of staff (1 nurse, 1 physician)
RNHA	Work Observation, Job Description and Reflection Interviews	3 members of staff (care staff)
	Job Description and Reflection Interviews	3 members of staff (care staff)
	Technology Pilots	1 - 10 members of staff (care staff and activity coordinator)
BT	-*	-*
Regola	Job Description and Reflection Interview	2 members of staff, 1 member of management
	Work Observation	2 members of staff
	Interview on IT Infrastructure	1 member of IT administration

* Note that BT was – as planned in the DOW –involved in the user studies with limited resources. Beyond a testbed visit in August 2011, no onsite data collection was possible.

WP3 additionally introduced a *Mood Capturing Technology* at the Project's General Assembly in Karlsruhe (May 2011) to examine its feasibility and acceptance. The results of this "Capturing and Visualizing Mood" design study are also discussed in the present deliverable.

7 Summary of User and Design Studies

In the following, we give a concise summary of the workpackages' user studies and their results. Note that the key findings will be elaborated on with more detail in the integration section (Chapter 8).

7.1 WP3: Capturing Learning Experiences

Main Research Interest: The goal of WP3 is to capture experiences that are suitable as a data basis for reflection. The main difficulty here is to assess the relevance of data for reflection. Additionally, the subjectivity of any experience requires the employee to interpret the captured data. Thus, the user studies aimed at determining technologies which can be readily employed to capture the task context (Objective 3.1), the user's physical and emotional stress as context information (Objective 3.2), and finding ways to manage and represent the context information (Objective 3.3).

User Studies: These goals were addressed by conducting a psycho-physiological sensor study in combination with an ethnographically informed study at NBN, and by making use of the survey data of the offsite user studies regarding current technology usage and acceptance of sensors.

Key Findings: Key results of these studies are a set of richly annotated psycho-physiological sensor data and the identification of motivational barriers and drivers of sensor usage.

The captured sensor data sheds light on the difficulties of isolating cognitive from physical activity in analysing the heart rate. While critical stress-related incidents can be recognized, moderate stress levels cannot be distinguished from physical activity. However, this raw data has shown its potential to trigger or support an on-going reflection process.

The acceptance of sensors depends on the one hand on the specific characteristics of the testbed. Factors like privacy, usability and existing experiences must be taken into account. On the other hand, specific target group(s) in a testbed (e.g., nurses vs. physicians at NBN) might require different solutions.

Inter-individual differences, e.g., in existing coping strategies, must also be taken into account, as confrontation with negative experiences during reflection might increase anxiety and lead to aborting of the reflection process. Therefore, the user study at NBN has provided information about existing coping strategies at NBN and developed empirically grounded personas.

7.2 WP4: Learning by Reflection and Observation

Main Research Interest: The goal of WP4 is to support individual reflection. A main research goal is to identify externally observable triggers for reflection. The focus of the user studies was to deepen the understanding of individual reflection at work as it currently happens in the MIRROR testbeds and to show that employees learn by reflection and observing others, identify and categorize reflection sessions and triggers for reflection, and to identify currently used data and tools for reflection and potential for future data and tool use for reflection.

User Studies: These goals were addressed by using the quantitative data from all testbeds (staff survey, partly reflection diaries) and using/conducting reflection interviews and focus groups at RNHA, NBN, and Infoman.

Key Findings: Key findings from WP4's analysis were that learning by reflection occurs at the testbeds, including reflection being based on the observation of other employees. Classification schemes for reflection sessions were developed (e.g., regarding the situation, the content, and the outcomes), and the major triggers for reflection (e.g., difference to baseline, emotion, information input, feedback from stakeholders) were identified. Little evidence for existing reflection support was found. Additionally, barriers and constraints for technology support (e.g., time is critical, excellent integration in work-environment is needed) and specific ideas for a MIRROR app were gathered.

7.3 WP5: Creative Problem Solving

Main Research Interest: The major research interest of WP5 is learning through creative problem solving.

User Studies were conducted at/with: User studies were conducted at RNHA in form of extensive usage trials, which included observation, unstructured and structured interviews with stakeholders, interviews with discipline experts not associated with the testbed sites, contextual inquiry and focus groups.

Key Findings from the User Studies: The user studies led to results regarding the types of creativity techniques that can be successful in the domain, and first evidence for the potential of technology and software uptake to support creative problem solving in the domain, e.g., a Twitter tool for capturing data and reflection results in situ and a problem solving tool to deal with challenging behaviour.

7.4 WP6: Collaborative Reflection

Main Research Interest: The goal of WP6 is to support collaborative reflection and knowledge co-construction from recorded work data. The user studies aim to deepen the understanding on collaborative reflection, specifically to identify the characteristics of collaborative reflection, how collaborative reflection currently happens in the testbeds, how processes of scaffolding can be transferred and adapted to the needs of reflective learning, and to identify the opportunities for collaborative reflection. The results serve as the necessary prerequisites for effective support of collaborative reflection in the workplace.

User Studies: User studies were conducted at Infoman, RNHA, and NBN.

Key Findings: While there is collaborative reflection and its value is recognized, it is often not supported. For example, at Infoman work data is theoretically available digitally, but the data is scattered and mobile access for consultants on the move is not sufficiently supported. Likewise at RNHA where mainly paper is used, employees have to look into recent papers to reflect on past activities. At NBN, as a result of necessary medical and care documentation, there is a lot of recorded data, but collaborative reflection is not based on it. Reflection sessions where participants are at different places (e.g. Infoman) or reflect outside of facilitated meetings (RNHA, NBN) are also not supported. Additionally, reflection outcomes are not transferred to organisational levels of knowledge. Support must also focus on articulation of experiences to provide a basis for collaborative reflection and sustain its outcomes. First tool tests with a digital pen look promising to support such articulation in contexts where computers are neither available nor preferred to be used by staff. In addition, support for collaborative reflection needs to include scaffolds to support collaborative reflection sessions.

7.5   WP7: Creative Learning with Games

Main Research Interest: As reflection is based on experience but not all experiences can always be collected due to many constraints and risks, one important aspect of MIRROR is to support reflection via Serious Games. By experiencing virtual situations participating in simulation games, employees can try out new behaviours and learn from the consequences of their actions in protected environments. Thus, the goal of the user studies of WP7 was to investigate how Serious Games can trigger reflection, with a special emphasis on how to foster motivation of adults to reflect and learn with games.

User Studies: User studies were conducted at RNHA, NBN and Regola, aided by design studies and games application in selected testbeds and with other groups outside of the MIRROR project.

Key Findings: While employees are often unfamiliar with Serious Games, they are in general attracted by the method and motivated to learn with Serious Games, both individually and as teams. The team dimension in a debriefing after the game play facilitates sharing experiences and bridging the gap between virtual and real worlds. Given that SGs offer virtual experiences, one of the key findings was that this case is not covered by the current reflection model, which will have to be extended.

7.6   WP8: Organisational Learning and Intelligence

Main Research Interest: WP8 is concerned with the organisational perspective on reflection and conducted user studies to deepen the understanding of reflective learning at an organisational level. One focus was the development of a conceptual model which intertwines individual and organisational learning.

User Studies: User studies with management interviews and analysis of protocols were conducted at Infoman and NBN. Additionally, the management questionnaire and observational studies by other WPs were used for analysis.

Key Findings: The user studies showed potential to increase awareness about the advantage of using process monitoring and controlling in the two testbeds. Currently, improvement potentials cannot easily be extracted from the existing information systems. Additionally, staff qualification and advanced education lack Information System support. Both for advanced education and for process improvement potential in general, feedback mechanisms are missing or used insufficiently. Available time will likely be the constraining variable for tool use, as it is in short supply. Additional areas of improvement for organisational learning are process transparency, language, time effort and (at NBN) the variety of documentation standards.

7.7   WP9: Privacy

Main Research Interest: The goal of WP9 was to identify concerns and possibilities regarding data protection and disclosure with respect to the applications that will be created within the project. As reflection needs data that must be shared in many cases, which might have risks for the sharing individual, privacy needs, sharing culture and trust are important boundary conditions of what is possible in the project and must be addressed to protect the individual employee.

User Studies: User studies were conducted in all testbeds to assess privacy concerns by addressing sharing behaviour, trust in the organisation, trust in other users, and individual concerns.

Key Findings: The user studies revealed a discrepancy between individual concerns about privacy and real sharing behaviour. Self-reports of concerns might not accurately predict actual sharing behaviour. However, trust in colleagues is an important factor which influences willingness to share data with them and trust in the organisation is related to the willingness to share data with the organisation. Specifically, secondary usage of data by the organisation is strongly opposed. Confidentially and transparency combined with the opportunity to define individual settings are major implications from the user studies.

8 Integration of Results

In this chapter, we will summarize and integrate the results from the user studies of WP3 to WP9 as documented in D3.1 to D9.1. The seven workpackages examined reflective learning at the testbeds from their respective perspective. The integration of the results of their user and design studies as documented in this deliverable allowed us to achieve a more complete understanding of reflective learning at our testbeds, current barriers and future potentials to support reflection - especially by means of technology.

Integration of the user studies results was based on multiple data sources:

- **Deliverables D3.1, D4.1, D5.1, D6.1, D7.1, D8.1, and D9.1:** The deliverables were summarized for the purpose of providing a concise overview of key findings (see Chapter 7). The deliverables were further analysed guided by the overarching research interests (outlined in Chapter 3). After reading the deliverables to get an overview about the content, the deliverables were broken down into their sentences. These sentences were restructured and sorted into an outline guided by the overarching research interests. This process resulted in a collection of relevant information spanning 200 pages. Information was then summarized. Information stemming from multiple deliverables but referring to the same research question was integrated. Given that deliverables D4.1 (individual reflection) and D6.1 (collaborative reflection) and D8.1 (organisational reflection) address more basic aspects of reflection, they appear more prominently in the integration of the results than D3.1 (capturing), D5.1 (creative problem solving), and D7.1 (serious games).

- **Additionally a re-analysis of Reflection Interviews and Reflection Diaries:** To define prototypical examples of instances of reflection for the purpose of this deliverable, we re-analysed the reflection interviews and reflection diaries. We also examined the interviews conducted by KMRC during the testbed visits, as the prototypes used during these visits were similar to the final versions and also delivered useful data. 155 instances were collected, of which 116 were identified as instances of reflection after qualitative analysis. Some of them were used to illustrate the key findings of the user and design studies.

- **Additionally a re-analysis of the quantitative data:** Quantitative data from the questionnaires (staff survey and management questionnaire) was already used for the Dx.1 deliverables. To address issues that go beyond the scope of the work packages, we re-analysed the quantitative data. We used the quantitative data to validate findings of the Dx.1 deliverables.

The reader should consider the following two points that might limit the generalizability of our results: First, although user studies were conducted in all testbeds, the focus of most research partners was on Infoman, RNHA, and NBN. As we integrate the findings from the workpackages, we will also place our main emphasis on these well-examined testbeds. However, our findings converged and underlying similarities were discovered, thus it is likely that these similarities will also be applicable to other testbeds. Second, as participation in the user studies was voluntary and use of tools within the context of the design studies was self-determined, self-selection with regard to the sample is likely to have occurred: Participation might correlate with general motivation of the employee to learn or to reflect. While motivation will also be a major issue in reflection at the workplace in the future, the reflection process itself should be the same for all employees.

In the following, we will first look into reflective learning, its occurrence, triggers, process, and outcomes, before we report on findings regarding current barriers and future potential to facilitate reflective learning. Last, we will report on findings with regard to the potential of technology to enhance reflective learning.

8.1 Reflective Learning AS IS

8.1.1 Does Reflective Learning Currently Take Place?

All work packages found indicators that reflection does happen in all testbeds. Figure 1 illustrates the agreement to the reflection questionnaire indicating that there is a high degree of reflective learning at all testbeds.
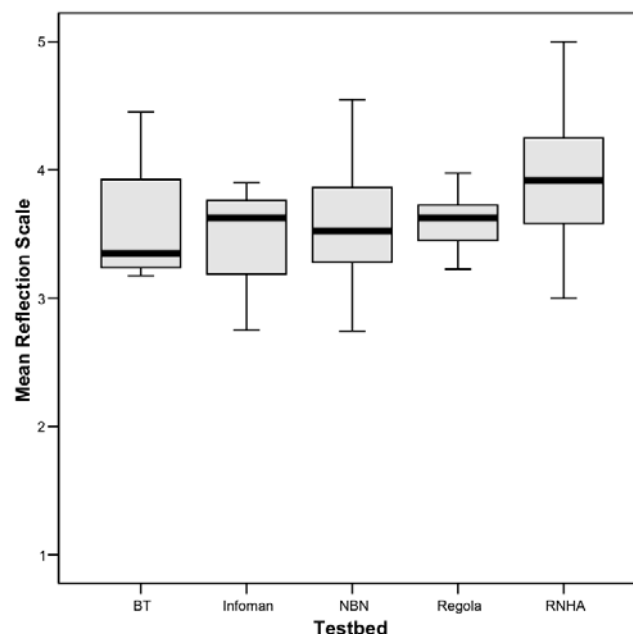
Figure 3: Agreement to the Reflection Questionnaire. The higher the values (range 1 to 5) the more reflection is done at the testbeds. Thick black lines indicate the median, the boxes the 25 to 75-percentile, the lines the range (min/max; two outliers at Regola were removed). Number of participants: BT: 4, Infoman: 3, Regola: 17, NBN: 39, RNHA: 71. Please note that RNHA had an adapted version of the questionnaire.

Furthermore, qualitative data from interviews, observation, and the reflection diaries convincingly show that reflection is an inherent part of work. At NBN, for example, participants told us explicitly that there is a culture of reflection (D6.1). We also encountered various examples of reflective instances in interviews or the reflection diary such as the following:

> *One day I […] looked at the projects I had done. I mapped them onto our process map and tried to see which parts I have covered with my projects, where have I collected experience? What is missing? Doing this, I have learned again a lot, realized what I had achieved so far […] and then I could say concretely that on the following three issues I really want to work on.* (Infoman, Reflection Interview, see D4.1).

Reflection at work is considered to be a voluntary and self-determined activity, not subject to work appraisals or part of formal job duties. This might be one reason that interindividual differences in reflection were found: Qualitative analyses by WP3 supported by findings of

WP6 point to interindividual differences in reflection. Interindividual differences regarding reflection are also visible in the statistical variance in reflection in the quantitative data. For example, reflection practice of employees at NBN differs strongly among staff. This led us to the conclusion that support for reflection must be adapted to individual preferences in the target group (see Chapter 8.3). This conclusion also led to the development and refinement of personas in the reflective learning process (see D3.1 and D1.3).

As the sensor studies of WP3 show this does not only apply to reflection itself but also to the use of sensor data as a basis for reflection: Individuals differ regarding their interest in their physiological data which is probably due to self-protection against information they (think they) cannot act upon and to uphold their established coping strategies (see p. 53 and D3.1).

8.1.2   What are Typical Occasions and Triggers for Reflection?

The workpackages (cp. D4.1, D6.1) found that reflection happens...

> ...during task performance
> ...in team meetings and handovers
> ...during informal talks and during breaks
> ...when meeting colleagues outside work
> ...in informal learning groups
> ...on the way to or from work
> ...at home.

Very salient occasions for reflection are regular meetings or formal handovers. For instance, at NBN, they have frequent x-ray meetings where the (chief) physician shows MRT/CT images, the neurologist presents patients, the radiologist shows x-rays; sometimes, unclear medical evidences are discussed, sometimes the process of diagnosis is reflected on, and alternative ways of diagnosis are being elaborated. Similarly, at Infoman, *"in the weekly team meeting, the supervisors are informed about things which work well, or not so well with customers"*, and the team discusses how to proceed in the future. There, there are also *"best practice meetings"* to discuss different approaches to handle projects in order to develop a shared best practice – *"but it depends on the team how this is handled"*. These team meetings are the occasion to *"share success stories within the organisation"* (all examples stem from Interviews during the Testbed Visits in August 2010).

At NBN, recreation time with colleagues is a typical occasion to share experiences and to reflect on work practice: *"We talk with our colleagues about our work during lunchtime"*. There, the participants reported that *"even at private meetings, we do 'doctors blathering'"* (Testbed Visit Interviews).

That is, in all testbeds, we encountered both spontaneous, informal and unintentional reflection, as well as pre-scheduled, intended, and structured reflection. However, we found differences with regard to the inclination to reflect among the testbeds, too. This holds especially true when it comes to reflection outside work: Physicians at NBN did not want to reflect outside work, while carers at RNHA did not show a strong aversion against reflecting outside of work (see D4.1). Context factors (see Chapter 8.3) might explain these differences and point to factors that have to be considered when supporting reflection.

Despite the different work contexts, the triggers for reflective learning seem to be quite similar in all testbeds. We found the following triggers of both individual and team reflection (cp. D4.1 and 6.1):

- working with clients (this includes preparation, monitoring, and evaluation of interaction with clients/patients/customers)
- encountering a new problem, facing a challenging task, or taking over new responsibilities
- working alongside others, observing more experienced peers
- collaboration/team work
- information input from other people and artefacts
- being supervised or coached
- facilitation in meetings
- emotional aspects (surprising successes/losses)
- self-evaluation and personal development
- identification of opportunities by gaining new knowledge on the market or domain
- receiving feedback from stakeholders or line managers
- encountering critical incidents and complex problems
- deviations from routines and disturbances
- experiencing emotionally demanding situations

For instance, during the testbed visit at BT, the interviewee said that *"if we lose a contract, it may be the case that we have internally a big workshop trying to analyse why we lost the business"*. Similarly, supervision sessions with a coach or mentor are settings that most likely provoke reflection on own performance. Typical triggers for reflection include regular performance appraisal interviews with a line manager (D4.1, D6.1, and D8.1): *"Personal development goals are defined together with the supervisor, and after one year, it is tested whether the goals were achieved"* (Testbed Visits Interview).

However, it became clear that reflective learning does not automatically occur during the course of daily working routines. Reflection arises from the flow of experience prompted by any cue that draws attention to a concrete instance of experience. Looking at the specific instances mentioned by WP4 and WP6 it becomes clear that triggers for reflection are unexpected situations, e.g., disturbances and perception of uncertainty, but also positive situations like surprising success.

At RNHA, for example, reflection typically happens *"if care is not delivered how it should be, e.g. [...] in a hurry"* (Testbed Visits Interview). This kind of reflection is also often shared within a team of nurses whenever a single staff member could not find a solution to a challenging situation: *"We had a female checking the windows every day around four, five o'clock in the evening [...]; it turned out that she was a head mistress in a big school and one of her jobs, once everyone had left school was to lock all the windows; So once we found this out, went with her; she was quite happy then"* (Testbed Visits Interview). While of course also positive instances (e.g., unexpected success) are conceivable as triggers, reflective instances were mostly reported following negative events such as disturbances in routine or failure (see D4.1).

Mediating artefacts might serve both as triggers for reflection and as reference object during reflection establishing common ground and serving as boundary objects between different occupational groups (D3.1, D4.1, D6.1). A prime example is the "curve" at NBN — the patient's information folder where remarks and documentation of treatment is provided (D6.1).

All typical triggers for reflection that we found have in common that they elicit a state of *discrepancy*. This discrepancy can arise from experiencing a knowledge or skill gap, the mismatch of an individual's expectation and the actual experience, experiencing contradicting information, differences in individual understandings, a change in work processes, etc. In general, reflection might be triggered by an external event or agent (external trigger/incident) or might develop from one's own thinking of a whole series of occurrences over time (internal trigger/inner need to reflect).

8.1.3   What is Reflected Upon?

WP4 classified the content of reflection according to three dimensions (see D4.1):

- *Type of experience:* Single experience or set of experiences
- *Content of experience:* Task-centred activity, interaction with colleagues, interaction with clients, or own reaction
- *Origin of experience:* Individual experience, vicarious experience, or shared experience

WP6 complements the dimensions identified by WP4 by the scope of the reflection content:

- *Scope of reflection content:* comprehensive, case-based, or episodic

The scope of reflection includes the following levels (D6.1):

Comprehensive (long term / organisational) topics deal with standards and business processes, ward organisation, or dealing with emotional stress. This requires more generally applicable knowledge, preparation, and scaffolding.

Case-based (crosscutting) topics are reflected upon whenever similarities between different instances are found. This level requires a broader view on the situation which can usually be achieved by easily available documentation.

Episodic (short-term, task-related) topics concern events that have recently happened mostly brought forth by those to whom the instance happened. They require articulation of experience and sharing of individual experience.

This differentiation is particularly relevant for collaborative and organisational learning. The bottom-up aggregation of episodic and case-based topics is helpful for identification and contextualization of comprehensive topics. The discussion of comprehensive topics and the dissemination of corresponding reflection results in turn benefit from being linked to case-based or episodic topics (D6.1).

For all testbeds, the content of reflection is typically related to the primary business objective of the testbed, e.g., patient health at NBN, customer satisfaction at Infoman, or resident well-being at RNHA. Improving job performance is a shared goal at all testbeds; therefore the content of reflection is often related to job performance and task mastery. This is also a

reason for our key findings that triggers for reflection may be evoked in situations where comparisons take place on an individual or collaborative level. Thus, the content of reflection is work related — we focus on the employees' own work-related experiences with the subject matter of reflection likely to be their own practice. At NBN, typical content of reflection is therefore patient treatment and any critical incidents that might impact patients' health negatively (D4.1, D6.1). Similar, we found that residents' treatment and any challenging behaviour of residents are often reflected upon at RNHA (D5.1, D6.1). At Infoman, interaction with customers is a major content of reflection (D4.1, D6.1).

8.1.4 How Does Reflection Look Like?

8.1.4.1 Individual Reflection

Individual process indicators were not analysed by the testbeds, although examples of reflection captured support the general process outlined by Boud et al. (1985): Reflection is retrospective contemplation of an experience and includes generation of a learning outcome that can guide future behaviour or thinking. The reflection process typically includes specification of the concern, analysis, (re-)evaluation of the experience and drawing conclusions/making generalizations.

> *A senior business consultant is responsible for holding the in-house training for a specific software used regularly throughout the company. During one of these trainings, she feels that many participants are somehow unhappy with the course. Some participants do not even understand the basics; others are obviously working on correspondence or paper work for their projects. In the lunch break, she asks for some informal feedback. She learns that for many participants, the training is too general for them to see how they could make use of this software in their daily work. Other participants could hardly follow the instructions, as they had no prior knowledge or experience with similar software. This feedback encourages the consultant to think over the content and structure of the workshop.* (Infoman, Reflection Interview)

Participants at Infoman reported for example that they often examine past interaction with customers to improve future customer contact. Thereby, reflection involves examination of past or current experiences for the purpose of guiding future behaviour (see D4.1):

> *A woman from the sales department is working on customer acquisition. To plan an upcoming event she has to invite potentially interested parties and does so by sending out email invitations. A high rate of these emails did not elicit a response or addressees already had other appointments for the scheduled date. She reflects about reasons that could explain the low response rate. She considers whether it depends on the topic of the event, the point of time, or on the fact that her addressees, i.e., managers, are highly busy. As a consequence she now starts send out invites earlier and she tries to switch to phone calls to reach them.* (Infoman, Reflection Interview)

Reflective learning also happens while working alongside others or while observing others. At NBN, participants reported that there is a culture of learning from each other. For example, at Infoman and NBN, learning by observation is regarded as an integrated part of work, and it is usually reciprocal, even when working with senior staff (see D4.1 and D6.1):

> *When you start as a care assistant you usually shadow somebody so you usually follow somebody around.* (NBN, Reflection Interview, D4.1)

> *I am often scheduled to work with new nurses; they have a period of three to four weeks for vocational adjustment. When they are with me, they know they learn.* (NBN, Reflection Interview, D4.1)

We also found that reflection can involve comparison with other people for the purpose of evaluation of own performance and re-evaluation of own experience. As WP4 showed reflection might also be based on relevant *others*' experience (vicarious experience) as long as it is relevant for making sense of one's own experience.

> *Currently, I often work along senior colleagues so that I think I can learn more from them than vice versa, but feedback is going in both directions.* (Infoman, Reflection Interview, D4.1)

At RNHA, comparative reflection was found only for inexperienced staff (D6.1) who report that they often compare themselves to others and try to learn from more experienced colleagues. Experienced staff stated that they had more or less found their own way of working, which in their view only differed minimally from that of others and that they did not compare themselves to others.

Reflective instances reported by our study participants did hardly tackle the emotional dimension of reflection as included in the reflective learning process by Boud et al. (1985). Attending to feelings was not mentioned explicitly as being part of reflection. Instead, strong emotions were mentioned as typical triggers for reflection (see above, D4.1). This validates the specific role of emotions for reflection for our study participants again.

8.1.4.2 Collaborative Reflection

The process of reflection can also be accomplished collaboratively by a team/working unit or (loose) group of individuals:

> *Well, the seniors are always there, so mostly the girls go up to the senior and say 'Oh I've got a problem' or 'Come and discuss this'. And so we'll take them aside and discuss it and hopefully deal with it* (RNHA, Reflection Interview, D6.1)

> *If two of us have been at a customer, we are discussing on our way back what went well, how did we do things, how the other saw things; The other one serves as a "mirror".* (Infoman, Testbed Visit Interview)

Collaborative reflection may be on shared experience (team work experience), individual experience or on a collection of comparable (individual) experiences like in a 'Community of Practice'.

For collaborative reflection, WP6 refers to the theory by van Woerkom and Croon (2008) and examined indicators of reflection like *critical opinion sharing, challenging groupthink, asking for feedback, experimenting with alternatives and openness about mistakes* (D6.1). They did find critical opinion sharing and asking for feedback in all testbeds, e.g., at Infoman as essential part of retrospective sessions to describe individual views and share perspectives on past events the group experienced together and at RNHA and NBN for example in the case of more inexperienced employees asking others for feedback. Likewise, challenging groupthink was present in the testbeds. However, staff tended to mention problems but not consider themselves as responsible for the solution. Experimenting with alternatives was often observed in the studies, e.g., at RNHA about alternatives on how to order hygienic pads. Openness about mistakes was considered to be crucial and was found in all testbeds. WP6 also stresses that collaborative reflection involves individual reflection, sharing individual pre-understandings, establishing a shared understanding and construction of knowledge (see D6.1). Thus collaborative reflection involves the individuals' own reflection, sharing of preliminary individual understandings and discussion/negotiation for the purpose

of establishing a shared mental model of the experience, i.e., there are cycles of individual and collaborative reflection processes.

WP6 points out that if reflection happens collaboratively, participants have different roles in the reflection process. Identified roles by WP6 are (D6.1):

- *Initiator*: starts a reflection session by articulating a topic and is owner of the topic until ownership is passed on
- *Participant*: shares the same context with the initiator and may provide own experiences and viewpoints
- *Helper*: supports the reflection process with more passive role such as coach, mentor or facilitator
- *Sparring partner*: temporary reflection participant asked for re-assurance and short-term reflective feedback, e.g. in the case of critical incidents or uncertainty
- *Executive* ("Go to guy"): responsible for follow-up actions and implementing results from collaborative reflection, usually the hierarchy level above the reflection participant
- *Session preparer and topic aggregator*: responsible for the preparation of meetings by gathering topics for the meeting agenda and remembering stories about positive and negative issues and bringing them up in a meeting

The specific support of these different roles is considered to be an important aspect for app development. WP6 also points out that a single person can have multiple roles.

Furthermore, individual characteristics of participants in collaborative reflection were also found to be relevant (D6.1). For example, a reflection initiator can choose reflection partners; WP6 points to a wide variety of factors that influence choice of reflection partners, e.g., perceived competence and experience, social proximity or trust in conversation skills.

Individual and collaborative reflection seems to be balanced at Infoman, with supervised reflection being less important (D4.1). Studies at NBN show that the mode of reflection (individually vs. collaborative) depends on the content of reflection. Interaction with colleagues, patients, or relatives is reflected upon individually, whereas physicians reflect on the care for patients collaboratively (D4.1).

8.1.4.3 Organisational Reflexivity and Organisational Learning

WP8 identified areas where organisational learning is especially important in the testbeds, focusing on NBN and Infoman:

- staff qualification and vocational training
- on-boarding and mentoring of employees
- process monitoring, controlling, documentation and sharing
- guidance of reflection and creative problem solving
- feedback to the organisational level

The user studies show that organisational learning often evolves by cumulating learning through reflection of individuals and groups/teams within the organisation (bottom-up learning):

Patients at NBN who have to wear long-term ECG (24h) must not wear it during a magnetic resonance tomography. The person who is responsible for fastening the long-term ECG does not know whether the patient will have an MRT later on that day. Many times patients are fastened an ECG that must be taken off shortly afterwards for MRT. A nurse noticed this faulty procedure and thought about ways to modify this procedure. She came to the conclusion that it would be much better to ask the nurses whether a MRT is scheduled that day or not before fastening the ECG. In case an MRT is scheduled that day, the long-time ECG could be fastened after the MRT. The nurse broached this issue in the next ward meeting. It was decided to implement this new routine in the whole unit. (NBN, Reflection Interview)

Sharing of employees' work-related experiences and/or externalization of their reflection outcomes was found to be a prerequisite for organisational learning and knowledge creation.

How financial and medical aspects of a patient are monitored from admission to final discharge and are further used for improvement of organisational routines at NBN (D8.1) shows that organisational learning can also be the result of reflection of a responsible on the accumulation of work practice experiences of several employees (top-down learning):

At NBN "Stroke Angel" was introduced to track the time from patient admission to computer tomography. By using Stroke Angel it became obvious that the whole procedure takes too much time. A senior physician used this data in a conversation with his supervisor to argue for a change in the procedure. The management conducted a thorough data analysis o the business process to find out how to improve it. In the end, various things were modified: The chief physician does not join the CT anymore – he just gives the order via telephone today. They now implemented to leave out ultrasound and urinary catheter in diagnosis to reduce door-to-lyse-time. (NBN, Reflection Interview)

8.1.5 What Is Being Learned By Reflection?

An important aspect of reflection is that some resolution is a core part of the reflective process. This constructive element of reflection differentiates it from rumination. The outcome of reflection can include cognitive, affective, and/or behavioural consequences. In the user studies multiple examples for this were found, e.g., the improvement of communication style, new perspectives on clients' behaviour, or new insights on challenging behaviour of residents.

A salesman conducted a presentation to demonstrate complex software. Feedback by a listener and questions by other customers indicated that there were difficulties understanding his presentation. He discussed the presentation with a colleague later, during which he remembered an IT handbook he had read. It used a metro map as metaphor for software structure. They decided to use this metaphor for any future presentations. (Infoman, Reflection Interview)

In the hospital a single sheet of paper at the patients' bed is used to schedule the appointments of this patient for the day (diagnostic, therapy). These sheets are replaced by the night service, which is regarded as very time consuming. A staff member took this as a challenge to come up with a better solution. She designed a plan that covers five days instead of one. The plan was tested, accepted and got integrated in the quality management handbook. (NBN, Reflection Interview)

The findings from the user studies support the major outcomes outlined by Boud et al. (1985), namely change in behaviour, new perspective, application of learning, and action. Reflection often led to a new/better understanding of the experience and allowed for deriving implications, conclusions or 'lessons learned'.

When analysing the instances of reflection mentioned during the interviews or documented in the reflection diaries, however, we found that there are also many reflective instances where

there is a lack in specification of the learning outcome. This might be due to the fact that reflective learning often results in tacit knowledge, or it points to the need to support the generation of lessons learned. Furthermore, many reflection outcomes reported include intentions to change work practice in the future or plans to do something different in similar situations, which are not necessarily voiced or shared with others. Thus, for evaluation of any intervention, we must consider that there are implicit and explicit learning outcomes.

8.1.6 How Do Individual and Collaborative Reflection Lead to Organisational Learning?

While the outcome of reflection can be individual learning, team learning and organisational learning, the sustainability of individual reflection outcomes at the organisational level seems to depend on employees' job control: On one end of the continuum, we have highly standardized work tasks where every step needs to adhere to quality assurance regulations or other standards, and must be documented comprehensively. This is the case at the neurological clinic where "*everything is very structured*", and "*there are many standard forms that have to be filled in*". This is similar at the nursing home; however, care staff seem to have more flexibility in their procedures. On the other end of the continuum, workers have quite a lot of flexibility in doing their work. This is the case, for example, at the software consultancy, where "*a typical work day is an untypical work day*" (all examples from Testbed Visit Interviews)

Reflection at Infoman has an individual scope mainly as the interviewed persons seem to have much freedom of choosing the way to work, while at NBN the process usually starts with an individual noticing an unsatisfactory work process, then validating that it really is unsatisfactory for more than this person and finding solutions via collaborative reflection in a team, then giving it to the relevant manager to implement the change in work procedure (D4.1).

Thus, the freedom to change individual work practice seems to be inversely related with the need to affect changes on an organisational level: If individuals can implement the reflection outcomes themselves because there are no strict organisational routines that guide behaviour, reflection outcomes can easily be implemented individually and do not have to be shared. As sharing might be experienced as additional effort, most individual and team reflection outcomes are probably unshared at Infoman. Employees at NBN on the other hand usually have to share the reflection outcomes as there are strict procedures and routines due to medical best practice and legal/insurance reasons. Individual change thus often requires organisational change in this testbed.

8.1.7 Is There Any Support For Reflective Learning?

It was striking to find that despite the frequency and the perceived importance of reflection, systematic support for reflection was not found in the testbeds. WP4 found for Infoman, NBN, and RNHA that there are no (technology) means to support reflection (D4.1). On the other hand, WP4 found data or data sets, which are created during work, and IT tools, which are used during work, as well as reflective practices. We conclude that these data and tools can serve as starting point for the development of further reflection Apps of MIRROR, i.e., for reflection support.

Thus, while Infoman, NBN and RNHA do have a lot of data that can be used for reflection, efficient use of this data for reflection is currently not supported. Neither is the reflection process guided. Thus, if technological support can be introduced that efficiently supports reflection, huge gains in individual, collaborative and organisational problem solving will be the likely result.

8.2 Reflective Learning TO BE

In the following chapter, we summarize findings with regard to the opportunities and potentials to enhance reflective learning. We base this elaboration on both employee's (or managements) explicit statements during interviews and focus groups but include also recommendations and suggestions derived from observational studies. As elaborated in the project proposal, innovative technology that is specifically developed to support reflection can tap into the potential opportunities for reflective learning at the testbeds. In the following, we will also elaborate on our experiences when introducing technology prototypes (design studies) and findings from the focus groups of WP4, which examined user's needs and expectation with regard to reflection support.

8.2.1 Issues for Reflection

The user studies highlight that participants experience a need to reflect more often or more thoroughly on several issues. Especially, WP3, WP4, WP5, WP6, WP7, and WP8 all found multiple examples where *task performance* is reported to be a major issue. Ways to address this issue by reflection will be addressed in the future more systematically. This includes:

- *time management and organisational routines* (e.g., nurses at NBN and carers at RNHA dealing with patient/resident requests and unforeseen interruptions that take time, D7.1)
- *training of challenging dialogues or dealing with difficult situations* (e.g., physicians at NBN having serious conversations with relatives, D6.1, D7.1, care staff at RNHA dealing with challenging behaviour of residents, D5.1, or sales manager at Infoman dealing with demanding customers, WP4)
- *stress management* (e.g., burn-out being a huge problem at NBN and RNHA, D6.1; motivation to use sensors for monitoring physiological parameters that indicate stress, D3.1)
- *specific issues of the testbed,* e.g., at RNHA devising stimulation for residents or making sure that the non-challenging residents are not overlooked because the challenging residents naturally take up all the time and attention (D5.1)

Regarding the specific aspects that should be in focus, WP4 recommends to "focus on domain-specific knowledge and self-organisation capabilities, as well as the communication with clients, patients or residents" (D4.1). Main goals should be to embed "support for reflection within the (technical and social) work environment of the target users" (D4.1). A special challenge related to staff qualification is on-boarding and mentoring of employees. WP8 points out that the transfer of tacit knowledge is not supported by Information Systems (D8.1). Note that mentoring, practiced at Infoman, NBN, and RNHA, is not limited to new employees. For example, assistant physicians at NBN apparently feel the need to ask a

senior physician in difficult cases but cannot do so if no senior physician is on duty (e.g., during night shifts, see D6.1). Positive events should be highlighted to prevent a negative connotation of reflection, impeding motivation to reflect (D3.1).

8.2.2 Augmentation of the Reflection Base

We encountered the needs to have more data available as a basis for reflection. Technology could easily be used to capture new data on own work practice and to provide available data purposefully to the learner. In the following, we will elaborate on these two potentials of technology to augment the reflection base.

8.2.2.1 Data Capturing

The process basically begins with the need for visibility of behaviour and insights into behaviour, i.e., an employee's work must become visible by other colleagues, thereby providing a different perspective. This can be achieved either directly through observation or via artefacts (e.g., records/documentation). In many cases — and necessary for collaborative reflection — clear demonstration of individual knowledge through articulation and externalized artefacts is needed (see D6.1). Artefacts can also be produced automatically, e.g., via PC log files or automatically recorded sensor data (see D3.1). Capturing data is also necessary to monitor the effect of changes, i.e., to evaluate interventions for their effectiveness and their effect on the whole organisation (see D8.1). Serious Games (see D7.1) are especially interesting for making data available, as all interactions with the simulated environment can be logged and the user can be confronted with different perspectives and visualisations.

Participants at RNHA wish for a tool that really sounds magical (D4.1):

> *Something […] that sees what I see maybe or something that can hear me or see what I'm doing all the time [...] use the data to just re-run it really, to see how I handled a situation. Then I could decide if and what I could do better next time maybe. (RNHA, D4.1)*

However, automatic capture of data is indeed possible, and some user studies explored its potential with regard to the use of photos/videos (D4.1) and (bio-)sensors (D3.1):

Photos and Videos: Regarding photos and videos, focus groups at NBN conducted by WP4 show that "users clearly see video or audio trails of their work as a good potential basis for reflection" (D4.1). While physicians would rather have videos of rare cases, therapists would like videos of workflows, and nurses preferred one photo showing all the relevant information in the situation (D4.1), photo/video capturing was seen as beneficial in this testbed. Similarly, sales representatives at Infoman also can see the value of external (video) recordings to reflect on their behaviour, as do carers at RNHA. However, videos and photos do not capture only the ones who want to do reflection and thus come with legal and privacy constraints (see p. 54).

Biosensors: More private are biosensors, which provide rich data yet are unobtrusive and have become usable enough to deliver accurate data about the affective state, especially stress (D3.1). In particular, sensors seem highly suitable for stress management. In a pre-study on capturing technologies WP3 identified "a combination of heart activity, especially

the heart rate, with accelerometers" as practical and useful for reflection. The data can illustrate trends in stress levels and be used to help identify personal stress factors (D3.1). Tests at NBN by WP3 showed the advantages of capturing physiological data. This data can be used intra- (e.g., to see their reaction on stressful days) and inter-individually (e.g., to compare oneself with colleagues and find suitable role models). It is also useful to remember instances, as acknowledged by all participants at NBN. This data is not only a basis for reflection, it can also trigger it. In line with the triggers of reflection (see p. 33) a comparison of the sensor data with the employee's expectation can lead to reflection about work. For example, WP3 quotes a nurse at NBN: "*I thought I was calm (...) but now I see it I wasn't*" (D3.1). However, as WP3 points out, physiological data has to be annotated to become useful for reflection. While physicians at NBN were generally very sceptical of biosensors, probably because they did not see that they could change anything about it (see p. 53), reactions by nurses were generally positive, as were reactions of therapists. Additionally to biosensors, WP3 analysed different kinds of sensors (e.g., proximity sensors to capture social relationships), however, due to legal/privacy concerns, biosensors seem to be the best way to unobtrusively capture relevant physiological data.

Besides automatic capturing there are the more effortful but more controlled manual ways of capturing data. If it is done manually, the action of data capturing itself might already lead to reflection.

Mood Map: WP3 and WP4, for example, explored the use of information on affective states in form of a mood map. The advantages of a mood map lie in gaining knowledge about others, influence others, and hedonistic value, and adds two benefits found in the interviews at NBN, namely gaining knowledge about one's own body and benchmarking with colleagues (D3.1). Using mood for reflection was tested by MIRROR project members at the General Assembly in Karlsruhe using the "Mood Map App" developed by FZI and the TimeLine App developed by NTNU, with either mood bar visualisation as a map or as a Nabaztag rabbit. Participants found it suitable for collaborative reflection with minimal involvement and anonymous collection and aggregation of information. It was interesting, fun, and used — and heated discussions corresponded with increased use.

WP4 points to the concerns regarding mood as trigger for reflection based on their focus groups at NBN: "All participants have the tendency to be sceptical regarding mood as a trigger for reflection, or as an entry point to more data about a situation. A general feeling seems to be (explicitly voiced by nurses and therapists) is, that people know their own mood anyway and don't need to record it" (D4.1). Professional distance in the sense that mood must not influence work behaviour was also voiced as a concern. However both concerns seem to be more grounded in the context factors of reflection, especially the ability to change one's own environment or one's reaction to it (see p. 53) and in a possible misunderstanding that noticing mood means immediately acting according to/on it or that mood must be negative to be useful for reflection. There might be ways to use mood in a way that does not undermine professional integrity (see p. 53). WP3 also points to the value of using mood information as indicators to quickly find the crucial moments during a day that are useful for reflection and to use mood to gain more information about the progress of a reflection session (d3.1). It is an open question whether mood information becomes more valuable

(and valid) if it is collected over a period of time to make trends salient and to highlight critical incidents.

Note Taking: Quick and easy logging of information by making notes (via typing or voice recognition) is another way to capture data that was explored by WP3, WP4, WP5, and WP6. WP6 points out that "Episodic topics need to be documented shortly after the corresponding episode occurred. Therefore, there is a need to document them on the fly, e.g. with a simple (mobile) solution allowing voice input or by using the pen and paper technology (D6.1) while WP4 highlights the need of automatic capturing of discussions and collecting notes after a meeting (D4.1). WP3 points to the tools available for mobile phones that can serve as a starting point for MIRROR Apps, while WP5 conducted a design study in which they used Twitter as a capturing app.

Twitter was used in situ to capture reflective instances just-in-time (D5.1). To make it easy for the carers to record information, Dragon Dictation was used as voice recognition software. The character limitation of 140 characters was used as an advantage to encourage reflection. The design studies showed that Twitter can be used to capture information about residents' behaviour and can already lead to reflection (D5.1). Twitter was used after contact with the customer (the resident at a RNHA home) and when the carer had a moment of time alone to think, showing the importance of having a reflection space (D5.1, see also context factors on p. 55). About $1/5^{th}$ of the information twittered can be used for reflection, despite the fact that users did not follow the guidance of observation followed by reflection and were not familiar with the usual abbreviations used on Twitter to keep the messages short. Thus, using Twitter or a similar tool to capture episodic events in situ seems to be suited to use the potential in the testbeds, especially considering the additional benefits of having the information immediately available via Tweet Deck so that managers (Senior Care Staff) can get a detailed view on occurrences at their organisation.

An *information exchange platform* was desired by the physicians, nurses, and therapists at NBN (D4.1), allowing for information exchange via short notes about all issues concerning the patient, written in a language that can be understood by nurses, physicians and therapists (no jargon). It would also provide easy access to workflow plans. Similarly, carers at RNHA would like to have a resident event tool that helps record, remember and reconcile events about residents, similar to the life history about the resident that is wanted by RNHA (D5.1). The need to include mobile employees or those located at other places at Infoman would also be met here, if mobile access were to be possible. The Twitter tool by WP5 is probably a good first step in that direction.

WP6 tested a *digital pen* that can be used like any ordinary pen but captures all written information digitally. Reactions at NBN and RNHA were positive. WP6 states that "[a]ll participants welcome the availability of automatically digitalized forms and had ideas about where else this might simplify their work" (D6.1). Although there were open issues like the thickness of the pen or the lack of colour coding, which is important at NBN, these issues can be resolved.

The use of Twitter and the digital pen are also relevant for making data available, as the specific advantage is not only to capture data for oneself but to make it available to colleagues or supervisors (e.g., via Tweet Deck for Twitter).

8.2.2.2 Data Availability and Accessibility

The user studies showed that a lot of data is already recorded at the testbeds. To become useful for reflection, the data has to be made available to the employees. This includes raising awareness of which data is available at all. For reflection to succeed organisational wide, employees need to have access to relevant data "to produce a big picture at different levels, gaining understanding of an issue and its different perspective as well as sustaining results" (D6.1). Without awareness of what data is available and easy access to it, reflection is not based on all the facts and is correspondingly suboptimal.

For example, at RNHA the unique resident's history must be known to the carer to efficiently interact with the resident - new information about the resident is learned each day (see D5.1). If, as found in the testbeds, the information is hard to access (e.g., IT infrastructure is limited or observations are noted on paper), and carers are not informed about updates, important information for reflection remains unused. While exceptional cases are probably well remembered, gradual changes become very hard to notice, which is a crucial problem at RNHA, requiring "effective action and [a change in] the care provided" (D5.1). Similarly, at Infoman, WP6 reports that "a lot of data on work [is] available digitally, [but] such data is scattered and access is not sufficiently supported when consultants are on the road, which is an important part of their work". At NBN, where much information is captured in the Quality Management Handbook, "a large part of the information is obsolete for the nurses because they have fully internalized their every day work processes" (D8.1). Additionally, specific or exceptional cases are not documented (D8.1) and it is hard to find relevant information in the QMH (D8.1). Consequently, the QMH is not seen as a knowledge management tool and remains insufficiently used. Additionally, a complete overview about actual work and performance, patient transfer, or educational status of the employees is difficult, as the information is not available in an aggregated fashion or in one system. A lot of data is bound to paper and/or to systems accessible only at certain locations (e.g., the patients' beds), which makes using it for reflection difficult. Thus, transparency of the information available (and thereby of the processes in the organisation) and access to relevant information is a problem and offers huge scope for improvement in all testbeds. One way to address this issue regarding employee information is by implementing the user profiles proposed by WP4 (D4.1), "which contains an adequate summary of an individual's work history" and which can be converted "into a "usable" representation that supports individual reflection" (D4.1).

Availability does not only refer to documents. In collaborative reflection, building of a common ground (see Content of Reflection on p. 35) is a crucial activity, often taking up significant amounts of time. For example, WP6 reports that context re-building happens at the beginning of reflection sessions by telling stories or existing aggregated information (D6.1). For example, "[a]t Infoman consultants present cases verbally and support this with slides in order to inform the others about the context, at NBN issues are first discussed spontaneously and then picked up in a meeting based on an agenda, and at care homes, all of this is done verbally and administrated by a senior carer." (D6.1). While this can be facilitated by artefacts (documents, e.g., the curve at NBN being a prime example), as written in the previous paragraph, this information is usually not easily available see (D6.1). Thus, improving visibility and availability of existing data also supports reflection in general, whether it is spontaneous or scheduled, individual or collaborative. Relevant data could be

specifically logged to support reflection about selected topics in the future. For example, WP6 noticed that when the break length was discussed at NBN, recollection of concrete situations where break length was an issue was difficult, highlighting the needed for specific data capture and scaffolding during the session. Care must be taken that existing documentation does not narrow down the view on this information only, for which WP6 suggests "closely binding any additional information gathering – if it is to be done explicitly by people – to existing documentation" (D6.1).

Employees should be aware of the data that is available and should have easy access to any data as a basis for reflection, especially for spontaneous reflection. Even at a testbed with a sophisticated IT infrastructure and highly educated employees, "the necessary overview about all available resources is missing" (D6.1). WP4 concludes that an all-in-one IT system would be beneficial here. This would, however, require standardization as employees "are free to choose their note taking platform it can become difficult to find them again after some time has passed" (D6.1). On the other side, testbeds without sophisticated IT infrastructure like the care homes at RNHA have a huge amount of paper based workflows (D6.1) which results in information being "fixed to one location at a time and complex and time-consuming procedures are needed for handling, exchanging and altering paper documentation" (D6.1). The digital pen tested by WP6 can address this issue at RNHA. It not only digitalizes the information but employees can also use a form at the bottom of the page to indicate with whom the note should be shared. The digital information can then be accessed with other systems, e.g., PCs or mobile devices (D6.1). The digital pen can also be useful at NBN (and was also tested there by WP6) for the same reasons: much of the workflow is paper based. While this is partly due to legal reasons, participants in the user studies wished for an electronic medical record (D4.1). For example, one iPad for each physician would provide the physician with all information about the patient while an iPad at each patient's bed to insert all information on the fly would be very useful. While this is beyond the scope of the MIRROR project, it shows the need and desire for easy information exchange and availability in the testbeds.

Making information available has implications that go beyond individual and collaborative reflection. Decoupling information from the tools is the first step to aggregate and connect information from different sources (D6.1), which "can provide new perspectives on experiences and offer new abstraction levels" (D3.1, albeit referring to physiological data). It allows employees and management to see the 'big picture', monitor work practices and performance over time which is especially helpful to evaluate effectiveness of changes of organisational routines. In NBN it would allow management to monitor the whole process from admission to exit and look for improvements from a medical and financial point of view (D8.1). The wish of all testbeds "for tools (i) that support information collection, with a focus on capturing more data and integrating more data sources than current IT does and (ii) that provide data analytics functionality" (D4.1) requires easy access to data. Tweet Deck as it was employed by senior carers at RNHA (D5.1 design study, see p. 44) is a first step in this direction.

In general, data analytics functionality regarding the information that can be accessed (see previous section) is needed in all testbeds. Employees do not only need access, they need access in a way that helps them make sense of the data, e.g., a decision support system

(D8.1). While the concrete content varies depending on testbed (e.g., data per patient or resident at NBN/RNHA, customer-/project-/organisation-wise at Infoman) the wish to make sense of the data is present in all testbeds.

8.2.3   Scaffolding Reflection and Creative Problem Solving

Besides augmentation of the reflection base, a major potential of technology lies in scaffolding the reflection process itself. This includes prompting reflection and guiding the reflection process.

8.2.3.1   Reflection Prompts

As reflection often does not happen automatically, support is needed that points employees to possible situations for reflection. This might be done like with the sales support tool suggested at Infoman that asks sales persons on demand, mobile, and automatically whether they could have been more polite or convincing to the customer (D4.1), likewise, a senior carer at RNHA could be encouraged to review recent cases of challenging behaviour at a nursing home (D6.1).

WP3 points out that if data can be aggregated (synchronized) as described in the previous section, e.g., via a time stamp, only one kind of data is needed to highlight a possible instance of reflection. With aggregation of different data types there is redundancy built in, and one kind of data may serve as a marker pointing to the relevant aspects in time and space in vast amounts of recorded information (D3.1).

WP5 concludes from their design study at RNHA that "[h]aving the mobile devices on hand during care work with easy-to-access software Apps provided important reminders to the care staff to undertake tasks designed to encourage reflective learning. However, the analysis of the actual data collected from 8 care staff over a first four-day trial period revealed that, although much of the data collected is useful in terms of what to reflect on, the care staff provided few concrete reflections. More support, in the form of training, process guidance and direct application support – ideally integrated into the tool – will be needed to encourage effective reflective learning" (D5.1). For this purpose, a tool (function) that highlights possible triggers of reflection may be useful (D4.1), to point employees to a discrepancy that might be worth resolving.

If reflection is done collaboratively, an important first step is to motivate employees to articulate their thoughts and provide context information, e.g., to establish a common ground (D6.1). This can either be done beforehand by capturing the relevant information and making it available digitally, or in the situation itself. Annotating information with relevant tags and easy selection of information would probably be helpful here, although sometimes access to meeting rooms with flat screens to develop or discuss in teams of two or three people new ideas or thoughts (D4.1) is sufficient.

8.2.3.2   Reflection Guidance

*Creative Problem Solving: P*roblem solving is an important part of the reflection process aiming at "help[ing] identify new issues, problems or opportunities for further exploration with creative problem-solving, as well as providing opportunities for learning" (D5.1). First insights of the creativity workshops of WP5 were that there are creativity techniques that can be

easily taught and thus can help employees during reflection to come to a conclusion (D5.1). This was assessed in the testbeds in the design studies by WP5 where a software app (*Carer*) to support creative thinking in care homes was tested (not to be confused with the other app tested by WP5 at RNHA, where resident behaviour was twittered, see p. 44). The aim was to share information how to deal with challenging behaviour, but not only to share solutions to challenging behaviour (this would be the topic of the next section) but to pre-select the three most relevant similar cases regarding challenging behaviour or (arguing with analogical reasoning) cases solved successfully in other domains (policing and teaching). The tool had a high recall (81%, retrieving *all relevant* cases) but a low precision (58%, retrieves *only* relevant cases). While the tool was received with enthusiasm, usage was low for WP5's design study. However, looking at the information twittered with the other tool tested by WP5 at RNHA, recordings of challenging behaviour were low in general: "Interestingly, only a small percentage of information packets described challenging behaviours. Reasons were unclear, and more research into the frequency of encountered challenging behaviours needs to be researched further" (D5.1).

WP5 concludes "that such a major change to care practices cannot be made using a software app alone. Processes, reward mechanisms and training, all need to be adapted for such case-based creative problem solving to be effective" (D5.1). Other possible explanations would be that carers do not have the resources left to twitter about challenging behaviour when or after it occurs, or that challenging behaviour is very salient and important but rare. The availability heuristic[1] would indicate that such behaviour is overestimated in frequency and it would make this behaviour very difficult to learn to deal with it. This makes them even more challenging and more amendable to Serious Games (see p. 48). Thus we concur with general conclusion of WP5 that the issue needs further research and WP5 is currently spearheading a challenging behaviour task group to do so.

Serious Games: Serious Games offer potential for reflection, as they allow employees to try out new behaviour in a safe setting and learn from the reactions of the simulated environment. Serious Games additionally make it easy to capture data and make it available when the user needs it, thereby allowing training sessions of varying difficulty to improve users' reflection skills and to lead to learning. Game prototypes allow participants to remember critical incidents easily. They also included a reflection session at the end of the game to stimulate learning from the gaming experience, too. WP7 concludes that Serious Games have a high potential to support reflective learning, especially as "the possibility to self-evaluate their own behaviours as well as the possibility to re-live the story with in addition the thoughts of the counterpart were considered as the major elements able to trigger reflection in the users" (D7.1).

First design studies by WP7 with CLinIC, which "aims to improve the nurses' ability of reflect on and learn from past behaviour, particularly dedicated to the topic of reflection around difficult dialogues" (D7.1), are promising, as the game takes a holistic perspective and includes the affective aspects. Focus groups at NBN revealed that a workflow training game and a neurological simulator would be helpful to augment reflective learning and to improve

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[1] "A strategy for making judgments on the basis of how easily specific kinds of information can be brought to mind" (Baron, Byrne, & Branscombe, 2006)

work practice. In general, the focus groups conducted by WP4 showed an interest in Serious Games for time management and for training difficult dialogues and dealing with critical incidents (D4.1). Serious Games were also found to be promising for RNHA, which identified "virtual reality (serious) games" and "help with challenging behaviour" as business needs (D5.1). At RNHA the serious game 'Think better CARE' (a sister game to "CLinIC") was also evaluated generally positive, although areas for improvement were identified, as for example, more challenge, better feedback, more user friendly mood maps, and higher realism. Adaptation was an important need, as different contents and options for different kind of users are expected by users (D7.1). As stressed by WP7, Serious Games are also a very useful tool for Regola, as "there are very limited occasions for organised training of volunteers due to the lack of regular working hours and the limited time that volunteers can use" and "there are limited occasions to experience some of the possible situations given the nature of the work, e.g. help to the population during an earthquake" (D7.1).

Scaffolding Collaborative Reflection: WP6 points out that articulation, scaffolding and guidance as well as synergizing have to be supported explicitly. As collaborative reflection requires the coordination of multiple persons, they found the need to support collaborative reflection in the testbeds with the "provision of adequate material and means for communication, sharing and linking data, keeping the interaction transparent and alive as well as prompting to possible next steps and tools, providing guidelines and questions, preparing individual participants, composing a suitable group and making results sustainable in order to make collaborative reflection beneficial" (D6.1). WP6 concludes that we might make use of established means to support collaborative learning (such as scripting and prompting of interaction) for facilitating reflective learning. Furthermore, WP6 identified further potential for support such as orchestrating a collaborative reflection session: The right people need to be available for a collaborative reflection session which is often difficult to achieve, especially when part of the relevant people work in different sections of the building (e.g., therapists at NBN, D6.1) or are in the field (e.g., sales representatives at Infoman, D6.1). As group composition is a promising but under-explored area (D6.1), guidance in selecting the 'right' people might also lead to improved results. WP6 states that "[t]his needs to be done on two levels: First, by supporting a session preparer or reflection initiator to bring together a group starting with collaborative reflection and second, by enabling a group to identify additional people to join the group to provide input needed" (D6.1). Likewise, employees should also be supported or guided in fulfilling the roles they have or helping them change these roles (see p. 38, D6.1). In any case, the necessary support through guidance and scaffolding will have to be role-specific (D6.1).

Scaffolding Organisational Learning through Reflection: Guidance was also identified as helpful on the organisational level by WP8, e.g., at Infoman in the form of a decision support system. More generally, support, e.g. aggregation, is needed to achieve transitions between the topical levels identified by WP6 (see p. 35). This is need for transitions from episodic to case-based to comprehensive to affect changes in a highly-structured environment like NBN (D6.1) and vice versa, e.g., when comprehensive issues need to be solved that require episodic (detailed) information "to shed light on it and make it understandable from different perspectives" (D6.1).

8.2.4 Documentation and Sharing of Reflection Outcomes

Without documentation, reflection outcomes can only be shared verbally or picked up by observation - if the outcome is visible behaviour (D6.1). Furthermore, without documentation or anchoring outcomes in the organisational culture, it is not possible to build on these outcomes and continuously improve work practice. Thus, finding means to document and share outcomes of individual and collaborative reflection flexibly and unobtrusively is considered to be a major issue in all testbeds (D6.1). This is especially difficult for some modes of reflection, as in spontaneous reflection, where there is hardly any time and often not the right equipment available to do so.

To be sustainable, reflective learning outcomes should be documented and shared among staff and with the management. WP6, however, noted at Infoman, NBN, and RNHA that results from reflection were not documented systematically. Similarly, WP5 observed that at RNHA, sharing of identified triggers for challenging behaviour and reflection outcomes "during and between shifts is not systematic and not supported by the electronic care system" (D5.1). WP6 also noticed this potential and remarked that "although knowledge on residents was perceived as a valuable asset for carers and should therefore be spread among them explicitly" (D6.1) is was not done so and pointed to several interviews, where carers used other (coping) strategies to deal with the stress "by talking to close family or by diary writing" instead of making sure the triggers are understood and widely known among the carers, thereby *preventing* this stress in the first place. Even at Infoman, where the CRM provides a lot of information, many reflection outcomes are not documented in the system (D6.1).

We found that sharing of reflection outcomes becomes more difficult whenever various organisational units are involved, whether it is other homes at RNHA or other wards at NBN (D6.1). However, it is not only necessary to improve interpersonal (and interdisciplinary) communication (e.g., among physicians, nurses, and therapists), but also the identification and transfer of good practice (D6.1). For example, the Stroke Unit at NBN is regarded as a role model, and much knowledge could be transferred for the benefit of the organisation (clinic) as a whole. Likewise, practices in other wards might provide stimulation for continuous improvement at the Stroke Unit. At RNHA, learning by observation was seen as more important for inexperienced carers, as senior carers seem to converge on the same 'best practice' (see p. 37). However, other homes probably face the same problems (e.g., challenging behaviour) and they might have come to a different way of working (D6.1). Thus, WP6 concludes "that there is huge potential in connecting carers from different homes to each other in order to exchange experiences". Similarly, at Infoman, sharing between the company headquarters and its other offices has a huge potential for improvement.

Ideally, sharing of reflection results is part of the same capturing process that is used for data in general (see above), e.g. reflection outcomes are twittered with the Twitter tool tested by WP5 at RNHA, or part of the infrastructure for general sharing as the information exchange platform wished for at NBN (see D4.1).

8.2.5 Support for Organisational Learning through Reflection

In all testbeds, management was very interested in getting more feedback from its staff. However, detailed monitoring of the work processes is not possible even where an

information system is available (NBN, Infoman), thus "management cannot see what barriers occur in the execution of these processes" (D8.1). This becomes crucial for reflection when there are "insufficient mechanisms for feedback from the process participants to the administration/management" as found at NBN and Infoman. If reflection outcomes cannot be realized by the employees themselves, e.g., because they need the help or agreement of management, and they do not think that their reflection outcomes are heard, reflection becomes an activity that leads to frustration (see D8.1).

Another aspect is participation, as at RNHA, junior staff seems to dislike reflection about the organisation of daily work and processes and do not take part in discussions (see D6.1).

Feedback from the management level is also important, as "the strategic goals set by mangement [sic] are often not transparent enough for the employees. The observational studies at NBN e.g. revealed that employees are aware of personal goals and general paradigms like 'the patients wellbeing' as strategic goals, but no further details on strategic direction are known." (D8.1)

Like documentation and sharing of reflection outcomes, the same processes that are used for capturing data and making them available to the employees can be used to give feedback to the management. For example, biosensors can be used to show management how stressful the work is (D3.1). Thus, feedback to and from the organisational level is mostly a question of capturing the relevant data and making it available.

8.3 Constraints for Implementation of Technology to Support Reflection

So far we have only looked at technology from the perspective how it could be used to support reflection. However, not all technology can be implemented in every testbed nor is it useful for each employee in that testbed.

We have clustered factors affecting reflection that were mentioned in the user studies in

- *personal factors:* cognitive abilities and literacy, readiness for technology, attitudes towards reflection
- *organisational factors:* trust/privacy concerns and the organisational culture
- *infrastructure factors:* non-IT- infrastructure and IT-infrastructure
- *data-related factors:* use of data for reflection and awareness of discrepancy,
- *introduction and measurement*

We have differentiated between organisational and infrastructure factors as physical factors such as infrastructure can be changed more easily and with different means that the organisational culture that is lived in an organisation and that is hard to change.

8.3.1 Personal Factors

8.3.1.1 Abilities and Skills

General factors to be considered are visual literacy (the ability to "read" and understand images) and media competency. Visual literacy is relevant when new visualizations are introduced, as employees in the testbeds are not scientists used to dealing with abstract

information and information visualizations. For example, WP3 identified potential to improve the mood map.

Media competency is an issue when new media are introduced like Twitter at the testbeds. WP5 states after its tests at RNHA that the language of micro-blogging was not used (reducing "Lady in room three is staying in bed she doesn't feel very well and has a sore throat" to "3 staying in bed w/sore throat", D5.1), likely because employees were unfamiliar with the tool. Thus, whenever employees did not choose the tool themselves (and became socialized in its typical use), media competency has to be addressed. Also, few smartphones are used in the testbeds (D3.1).

Factors specific for testbeds include multiple nationalities work at NBN (and also at RNHA), thus different languages and different local dialects can become barriers in multiple scenarios (see D8.1), low literacy levels at RNHA (personal communication with the testbed representative based on employment data), and low IT skills at RNHA (see D3.1). Thus, the tool must fit the testers' language level and skills.

8.3.1.2 Readiness for Technology

While the current skills might be low in some testbeds, even in rather non-technological testbeds like RNHA care homes, WP5 has identified positive attitudes towards mobile devices. Thus, attitudes towards technology do not seem to be a problem. Attitudes toward sensors were (surprisingly) positive in all testbeds and at NBN; all participants stated that they would use the system. While some issues have to be addressed (e.g., discomfort is the most common reason for not wanting to use a sensor, D3.1), sensors seem to be very useful for reflection in the testbeds. Similarly, attitudes towards Serious Games are generally positive, despite lack of first-hand knowledge. Once encountered, reactions at NBN, RNHA, and Regola were also generally positive. WP7 concludes that serious games seem to be a new technology that needs to be disseminated and explained much more. Notwithstanding this, serious games are perceived as an attractive and motivating tool, potentially useful and efficient to learn and reflect in working environment (D7.1). Attitudes towards the digital pen were more mixed, although WP6 is confident that issues can be resolved (D6.1).

A challenge is the existence of a face-to-face culture, e.g., at RNHA (D5.1). Technology must be carefully introduced here to uphold the positive aspects of the existing culture and support the aspects related to reflection. Finally, availability is also an issue here. WP8 reports that the need for a "knowledge management" system shows that existing systems are not salient.

WP3 and WP7 elaborate specifically on the role of motivation using technology to support reflection considering the use of sensors (D3.1) and serious games (D7.1). However, all WPs stressed the crucial role of time and effort at the testbeds. Whether it was at NBN, RNHA or Infoman, employees are usually taxed to capacity and simply do not have the time and effort left to do superfluous tasks or any task that takes up large resources. For example, employees at Infoman were particularly averse to redundant data entry (D4.1). Thus, as WP4, WP6, and WP8 state, tools must be must be effortlessly integrated in workflow, and usability is a critical aspect – which WP8 considers including easy usage, intuitive interfaces, well-performing and stable infrastructure, necessary information, easy access and specific functionalities such as information search.

WP6 referred to the technology acceptance model (Davis, 1993) and identified the following topics in their design study (see D6.1):

- *system quality/features:* Which features are good, which are missing? What could be enhanced from a handling point of view?
- *information quality:* Are there things that might be useful for you or anyone else in the future?
- *use:* How often did you use the pen? If not, why? Where could it be used in addition? Are there things you would share with others on a regular basis?
- *user satisfaction/perceived ease of use:* Are you satisfied with the technology? Did it worked as expected? What was good/bad about it?
- *individual and organisational impact:* Would you recommend the technology? Why or why not? To whom?

Automatic data capture and use of existing information should always be used when possible to relieve the employees (D3.1).

8.3.1.3 Attitudes towards Reflection

Reflection is not a goal in itself but is only instrumental for reaching a (work) goal in most cases. In all testbeds employees were able to mention such a goal, for example, professional improvement or career advancement at Infoman, and delivering excellent care at NBN and RNHA. Reflection Apps must convincingly help the employee to reach this goal faster, easier, and more comfortably than competing, currently used strategies.

Concerns about profitably of workplace learning (D8.1) became concrete in the user studies as reflection is not rewarded or paid for. Short and mid-term benefits of reflection must be highlighted to increase staff's motivation to use technology for reflection (D6.1). Immediate feedback whenever possible (D3.1) and the opportunity to compare own values with others' values should be implemented. Of course, changes in the reward system (employees are currently not being rewarded or paid for the time necessary to reflect on the job, D8.1) are also possible. Motivation must also be kept alive when reflection outcomes are proposed to the management (D8.1).

While reflection was generally seen as something positive in all testbeds, some topics and time frames seem to be a taboo — at least at NBN. While at RNHA a strong aversion towards thinking of work outside work was *not* observed (D4.1), staff at NBN do not regard reflection outside work as desirable (D4.1), although it often happens. We can refer to WP3s consideration of established coping strategies, e.g., a clear separation between work life and private life that was linked to symbols, like changing clothes (D3.1), and stressing that "there is resistance to more reflection as this might lead to rumination after work, which could result in negative emotional effects. This has to be taken into account when addressing affective aspects" (D3.1). WP6 also reported that some employees feared to take home negative impressions (D6.1).

This aversion to reflection was also apparent for dealing with emotions, at least for the physicians at NBN. Emotions are considered to negatively affect treatment of the patient as it undermines the professional distance. "It is important for their professionalism that they treat all patients in the same way: with professional distance, friendly, neutral and fair" (D4.1).

Similarly, there is an "aversion in business environments to emotions" (D3.1), which can make attending to feelings (cf. Boud et al., 1985) as an important aspect of reflection difficult (and exemplified by the physicians at NBN, see p. 43). A major challenge here would be to develop employees' skills to deal with emotions adequately. It is crucial that reflection is guided to lead to better results than current (maybe dysfunctional) coping strategies. The awareness that mood impacts work practice (e.g., burn-out/health problems) and that mood can assist the work (cp. cognitive behavioural therapy) has to be established first. An additional focus on positive emotions is also relevant for reflection and necessary to prevent an association of reflection with negative mood (D3.1).

Multiple workpackages address the fact that participants differ in their need and inclination to reflect (e.g., WP3, WP4). The concrete demands differ strongly among participants and thus cannot be addressed by a single app (yet). This is a strong argument for the proposed AppSphere that allows users to pick and choose suitable Apps, as there is no one-size-fits-all reflection app.

8.3.2 Organisational Factors

8.3.2.1 Data Privacy and Trust

Privacy concerns are an important aspect whenever data is captured and shared. WP9 looked at privacy regarding sharing behaviour, trust in organisation, trust in other users, and individual concerns. Privacy and trust are complicated issues where behaviour does not follow logically from trust or attitudes, for example, individual concerns about privacy are not directly related to real sharing behaviour.

Privacy also came up as an issue in other WPs, for example, care staff at RNHA expressed concerns regarding the privacy of observations recorded with the mobile devices (D5.1) and were concerned regarding Twitter, even when resident identifiers (instead of names) were used. Given that they were worried and hesitant in recording information and that this likely influenced usage, unresolved privacy concerns have serious consequences for technology usage.

However, WP9 points out three important aspects for dealing with privacy (see D9.1)[2]: *First*, secondary usage of data must be prevented, as this is seen strongly negative by the testbeds. *Second*, there is a need for transparency which data is available as well as what it is used for. *Third*, given the interindividual differences there is a need for individual settings. Other identified solutions were, for example, the aggregation of data to prevent the identification of individuals (see D3.1).

Concerning trust between staff and their management, WP9 reports that all testbeds seem to have a good climate of trust between employees and employers (see D9.1). At RNHA, the positive relationship to the management was specifically stressed, with more senior carers discussing issues openly with the management (D6.1) and improvement being supported by

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[2] In some testbeds, privacy concerns for technology cannot be resolved easily, as they affect legal issues. For example, at NBN and RNHA, legal constraints have to be taken into account. This is especially relevant for any sensors where capturing cannot be controlled, e.g., cameras or proximity sensors, or access to legally protected information, e.g., patient data. Given that NBN deals with emergencies who cannot sign a consent form (having just experienced a stroke, D4.1), some technology that would be great for providing a data basis for reflection cannot be used.

the management (see D6.1). At Infoman, management is very interested in getting feedback from their employees (see D8.1), who have the freedom to try out new things for themselves.

8.3.2.2 Organisational Culture

Other aspects of organisational culture do not relate directly to reflection (reflection is seen positive for most issues in all testbeds, see p. 32) but to its prerequisites. Specifically relevant are the culture of documenting to create (and use) the necessary database for reflection, and dealing with risk and mistakes when it comes to realizing reflection outcomes that lead to different, untested behaviours.

While documentation can be triggered by Apps prompting for input (D6.1), establishing a culture of documentation requires more than creating documents. For example, WP6 found that at NBN there is a culture that requires physicians to have all the data about a patient readily in mind (D6.1). Thus, the QMH was rarely used, because frequently used practices were "known" and did not need checking. While this is efficient (depending on the accuracy of the memories), it prevents reflection outcomes from being shared if changes are not noticed because no one consults the documents. Thus, documentation and use of documentation must be integrated into daily work.

At RNHA, WP5 found that constant surveillance by the Care Quality Commission which might punish perceived breaches of quality standards might result in bad reports and correspondingly to a loss of business. Thus, carers are rather risk-adverse. WP5 stresses that staff must recognize that risk-taking is a normal part of life (D5.1).

However, as can be seen in Figure 2, managers report high levels of organisational reflexivity indicating that there is a culture of organisational learning at all testbeds.
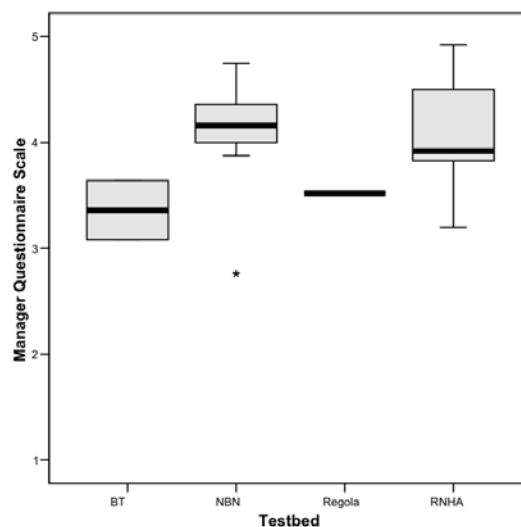

Figure 4: Organisational Reflexivity (Manager Survey). Scale from 1 to 5, the higher the better for reflection. Note that due to the flat hierarchy, RNHA applies to different care homes, so it shows the difference between homes, while NBN relates to the same organisation, so it shows the differences within an organisation. Sample sizes differ widely with BT: 2, NBN: 9, Regola: 1, RNHA: 7 homes, no data for Infoman.

8.3.3 Infrastructure

The design studies of WP5 at RNHA showed the importance of having confidential rooms that give the necessary privacy to think about interactions with the resident and to record

observations and reflection outcomes. Carers used, for example, the resident's room after the resident was in the day room. Carrying a mobile device is an issue in this testbed as the required uniforms do not have pockets, thus "a permanent means of carrying the mobile devices during care shifts need to be found. Possible solutions include, arm straps, hanging the device around the neck, belts and bum bags" (D5.1).

Infrastructure differs strongly in the testbeds, especially regarding IT equipment and allowed devices. Reviewing the IT checklists, WP3 stresses the "huge differences between testbeds regarding their IT infrastructure" (D3.1), with IT centric testbeds like Infoman equipping every employee with a PC, while PCs are scarce or not available at RNHA. In NBN, access differs regarding the target group within the testbed, as PCs are scarce to nurses but available to physicians. However, as WP6 points out, both extremes pose challenges: In testbeds with an established IT infrastructure, new tools will likely have to integrated smoothly with the existing systems to be accepted by the employees. In testbeds with hardly any infrastructure, there is little to build on and users might not accept technology in the setting and reject the tool (D6.1). Additionally, work processes are likely to be established that can be done effectively without technology, making it difficult for technology to surpass established solutions and become accepted. If paper is predominantly used, a digital pen (D6.1) might allow to continue writing on paper but making the data available simultaneous in a digital format. IT infrastructure might also be different for subgroups in the same testbed, for example, nurses at NBN rarely work on the computer, while physicians use it more frequently.

Biosensors (D3.1) pose some specific challenges with fit being a crucial determinant of usage. As allergies prevented the use of sensors in two out of eight participants, this might also be an issue. Accuracy can become a problem when physical activity is involved, which is frequent for nurses at NBN and likely also be high in other health-related testbeds. WP3 stresses the unpredictability of relevance (it is unclear which information will later become relevant for reflection) and the subjectivity and need for interpretation (interindividual differences, focus only on physiological data that can be the result of different stimuli) as critical issues to establish the context needed for reflection. However, with suitable visualisation, the use of multiple data sources and guidance resolution may be possible. Biosensors are also currently in a phase of rapid development, so technical improvements over time may render some issues obsolete.

The design studies by WP5 at RNHA supported available literature that text entry on mobile devices is difficult. Voice recognition was not accurate enough in the trial, partly because the software could not be trained to the individual user in the short time, but partly also due to context factors like disturbances by voices in the room. Another issue was the fear of being overheard by other residents (D5.1), which is critical for private reflection outcomes about residents in an intimate setting. Voice input might also be inferior to text entry because "care staff were not experienced at verbalizing their observations and some expressed a concern that it felt like speaking into an answering machine and felt under pressure" (D5.1). Text entry with a "keyboard gave more of a sense of having time to think, reflect and edit" (D5.1), which is very much in line with the goals of the intervention (D5.1). WP5 concludes that training of the voice recognition software and less typing and more choosing might resolve most issues.

8.3.4 Data-related Factors

Regarding the use of data for reflection, WP3 stresses the need to find meaningful aggregation that does not remove information by, for example, "hiding important changes in an average" (D3.1). Also, shared data has to be understandable by others. Especially with short or "immature" data (D3.1) this might be an issue that has to be addressed. WP6, focussing on collaborative reflection, points out that data must often be combined, as "a variety of articulations do not make sense if they are not related to other articulations or artefacts" (D6.1).

When it comes to data as possible trigger for reflection, WP3s conclusion about the Nabaztag rabbit at the General Assembly in Karlsruhe should be heeded: "The visualization [of the Nabaztag rabbit] itself doesn't trigger reflection. Reflection happens when something triggers it, for instance a change in the pattern or a new type of visualization" (D3.1).

Data that is collected to trigger reflection must provide the feeling of discrepancy (see p. 35). However, if the data is available, it should be simple to find conflicting information, e.g., anonymously highlighting individual data that deviates from the group mean.

8.3.5 Introduction and Measurement

As technology is used to change a social system, some general effects of technology must be taken into account. First, any technical change in a social system changes behaviour. Even observation can have an influence on the work processes. With many applications a newness effect will occur that goes along with high interest but is unlikely to endure. Hints of this can be found regarding the sensors at NBN: "On the one hand, we noticed a general interest at NBN in one's own data to gain knowledge about one's own body. On the other hand, participants that already use heart rate monitors for sport showed less interest in this data. They have already developed an understanding of their body and the captured data is not as surprising as for others. They only see the difference between sports and work. Others showed higher interest but this might change over time" (D3.1). Thus, time will test if an intervention works or not. It is probably best to first conduct an adaptation phase of new applications and to evaluate its effectiveness over longer timeframes. Care must be taken to allow the target group enough time to adopt and adapt the technology and that the tool helps the employees sustainably in order to prevent it to be used just because they are new and tempting.

9 Conclusion

In conclusion, the user studies showed that the project proposal addressed relevant aspects of reflection at work. In all testbeds, employees reflect, but probably far less than they would if the available data was to be fully used and the processes were fully supported. Importantly, there are currently unsolved issues that the technology can address.

The following statements summarize the key findings of the user studies:

1. Reflective learning is an inherent part of work at all testbeds.

2. We encountered both spontaneous, informal and incidental reflection and pre-scheduled, intended, and structured reflection. However, we found differences with regard to the inclination to reflect among the employees.

3. Reflective learning does not automatically occur during the course of daily working routines. Reflection might be triggered by an external event or agent (external trigger/incident) or might develop from one's own thinking of a whole series of occurrences over time (internal trigger/inner need to reflect). Typical triggers for reflection are unexpected situations, e.g., disturbances and perception of uncertainty. Despite the different work contexts, the triggers for reflective learning seem to be quite similar in all testbeds.

4. The content of reflection is often related to job performance. In general, the content of reflection is work related — it is about employees' own work-related experiences with the subject matter of reflection likely to be their own practice. The content of reflection can be own individual experience, experiences of comparable others, and shared team experience.

5. Reflection includes specification of the concern, analysis, (re-)evaluation of the experience and drawing conclusions/making generalizations. It involves examination of past or current experiences for the purpose of guiding future behaviour. Reflection can involve comparison with other people for the purpose of evaluation of own performance and re-evaluation of own experience. Reflection is also based on relevant others' experience as long as it is relevant for making sense of one's own experience.

6. The process of reflection is often accomplished collaboratively by a team/working unit or (loose) group of individuals. Collaborative reflection may be on shared experience (team work experience), individual experience or on a collection of comparable (individual) experiences as in a 'Community of Practice' for example. Collaborative reflection involves the individuals' own reflection, sharing of preliminary individual understandings and discussion/negotiation for the purpose of establishing a shared mental model of the experience.

7. Organisational learning often evolves by cumulating learning through reflection of individuals and groups/teams within the organisation (bottom-up learning). Organisational learning can also be the result of reflection by a manager on the accumulation of work practice experiences of several employees (top-down learning). The freedom to change individual work practice seems to be inversely related with the need to affect changes on an organisational level.

8. The outcome of reflection can include cognitive, affective, and/or behavioural consequences. Reflection often led to a new/better understanding of the experience

and enabled implications, conclusions or 'lessons learned' to be derived. The outcome of reflection can be individual learning, team learning and organisational learning. We found, however, that there are also many reflective instances where there is a lack in specification of the learning outcome.

9. Task performance is reported to be a major issue. Ways to address this issue by reflection will be addressed in the future more systematically. IT support for reflection was virtually non-existent in the testbeds. Finding means to document and share outcomes of individual and collaborative reflection flexibly and unobtrusively is considered to be a major issue in all testbeds.

10. While the testbeds differ in domain (health services vs. IT consulting), conditions, and the particular work, these differences are only on the surface level. Using the areas where organisational learning is especially important in the testbeds identified by WP8, combined with the insights of WP4 and WP6, we found that Infoman, NBN and RNHA essentially need the same underlying aspects. For example, all testbeds need easier access to available data, especially for employees who are "on the move", which can mean a consultant on a business trip at Infoman, a nurse who is not at the nurses' stations at NBN, or a carer who is not in the room where the Elderly Care System is located at an RNHA home.

The user studies advanced our understanding of reflection at the workplace beyond the state of the art. We were able to specify the content of reflection, the typical triggers for reflection, indicators for, and the outcomes of reflection. We could also specify the reflection process in more detail and consider typical triggers for reflection and relevant work-related outcomes of reflection. Thus, the user studies gave us a more complete understanding of the testbeds and reflection at the workplace in general. Results of this work will feed into the development of the theoretical framework on reflection at the workplace (D1.4). Implications for theory development are:

- the role of personas, highlighting interindividual differences regarding reflection (WP3, WP6, WP9)
- the classification of data sources for their potential to support reflection regarding availability, impact on reflection, applicability on sharing and aggregation (WP3)
- the classification of the reflection session (WP4)
- the classification of occasions leading to possible triggers (WP4)
- the classification of the reflection content in frequency, type/topic, origin of experience, and scope (WP4 and WP6)
- the relationship of reflection with creative problem solving (WP5)
- the differentiation in the episodic, case-based, comprehensive level of reflection (WP6)
- the importance of roles in collaborative reflection, the specific support needed for each role and the influence of a role on the reflection process (WP6)
- the factors of group composition and the effect of group composition on reflection (WP6)
- the insight that the conceptual difference between artefacts and communication should be softened (WP6)

- the need to enhance the theory to include experiences in simulated environments (WP7)
- the identification of the issue to keep the difficult balance between preserving flow and establishing phases of reflection (WP7)
- the identification of the shortcoming of current BPM approaches lacking bottom-up processes (WP8)
- the work on an organizational perspective on reflection (WP8)
- the work on privacy and its relation to reflection (WP9)

The results of the User Studies will also serve as an important building block in developing Apps that serve the reflection needs of the users in the testbeds, match their skills, and show immediate benefits by supporting reflection at the workplace. D1.3 specifies the specific needs and requirements for technology to enhance reflective learning based on the user and design studies results and the storyboards developed together with the testbed partners.

Furthermore, the user studies went beyond the existing literature. For example, the user studies showed that existing work on reflection is neither sufficient to derive a complete understanding of collaborative reflection nor for deriving requirements and design principles for developing applications that support collaborative reflection.

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Deliverables

D3.1   User studies, requirements, and design studies for capturing learning experiences

D4.1   Results of the user studies and requirements on "Individual Reflection at Work"

D5.1   Descriptive framework and capabilities for creative problem solving and reflective learning

D6.1   Design studies and specifications

D7.1   Games framework

D8.1   Results of the user studies, requirements and MIRROR framework for Organisational Intelligence

D9.1   User studies on privacy needs, privacy model and privacy guidelines