

5-15-2012

# TOWARDS AN IT SOLUTION TO SUPPORT REFLECTIVE LEARNING AT THE WORKPLACE

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## Recommended Citation

Balzert, Silke; Wessel, Daniel; Kleinert, Thomas; Knipfer, Kristin; and Fettke, Peter, "TOWARDS AN IT SOLUTION TO SUPPORT REFLECTIVE LEARNING AT THE WORKPLACE" (2012). *ECIS 2012 Proceedings*. 70.

<http://aisel.aisnet.org/ecis2012/70>

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# TOWARDS AN IT SOLUTION TO SUPPORT REFLECTIVE LEARNING AT THE WORKPLACE

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## Abstract

*The successful management of learning and knowledge has become a critical success factor for organisations in today's knowledge-intensive business world. Reflection on work practice has been identified as one of the central mechanisms of learning at work. It leads to a better understanding of work-related experiences and can guide future behavior. However, it has not been discussed so far how reflection may help organisations to react to changing conditions and business environments and how this kind of organisational learning may be supported by an appropriate Information System.*

*Based on a well-accepted model in reflective learning theory and key findings from a study, the paper contributes to closing this gap by proposing a solution, which can be used even if no other Information Technology support is available within the corporate environment. Accordingly, the development and the prototypical implementation of two applications supporting reflective learning at the workplace are described in detail.*

*Keywords: reflective learning, organisational learning, capturing experiences, design of IT artefact*

## Acknowledgement

The project MIRROR - Reflective learning at work is funded under the FP7 of the European Commission (project number 257617). Further information can be found at <http://www.mirror-project.eu>. We would like to thank all project members.

# 1 Introduction

The successful management of learning and knowledge has become a critical success factor for organisations in today's knowledge-intensive business world. Accordingly, organisational learning and knowledge creation have received increasing attention in the past decades and have been approached in various disciplines (e.g. Easterby-Smith, 1997) and from various angles or perspectives, e.g. individual learning, process/system, organisational culture, knowledge management perspective, continuous improvement, or radical innovation and creativity (for an overview see Wang and Ahmed, 2003). Back in 1996 already, Argyris and Schön summarised requirements for (learning) organisations, which still apply today: *“it is conventional wisdom that business firms [...] need to adapt to changing environments, draw lessons from past successes and failures, detect and correct the errors of the past, anticipate and respond to impeding threats, [...] build and realize images of a desirable future.”* However, the question remains how an organisation should (re-)act in order to fulfil these requirements, especially regarding learning from experienced successes and failures.

From a theoretical point of view, concepts for reflective learning seem to provide a very promising approach to answer this question. Reflection on one's own work practice has been identified as one of the central mechanisms of learning at work (Schön, 1983; Boud, Keogh and Walker, 1985; Boud, Cressey and Docherty, 2006). Reflection leads to a better understanding of own work practice and work-related experiences, and it can guide future behaviour (Järvinen and Poikela 2001, Moon, 1999). Reflection may lead to more flexible work routines and higher performance in a rapidly changing work context. Accordingly, reflective learning 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 (Knipfer et al., in press). However, it is still an open issue how reflection may help organisations to react to changing demands and conditions, and how reflection for the purpose of organisational learning may be supported by an information system (IS).

The paper takes a design-oriented research approach (cp. the ideas of Hevner et al., 2004, with regard to “design science”) to answer these questions and proceeds as follows. In section 2 the theoretical background and related work will be elaborated. Afterwards, some key findings from studies conducted in three organisations from the healthcare and business consulting sector are presented (section 3). In order to design and evaluate a prototypical information technology (IT) artefact supporting reflective learning at the workplace, the results of these studies are combined with requirements derived from reflective learning theory in section 4. Last but not least, the description of the prototypical implementation and evaluation (section 5) is followed by a summary of the results presented herein and an outlook in section 6.

## 2 Theoretical background and related work

This paper focuses on the design of an IT artefact to support reflective learning at the workplace. A more detailed discussion, why and how the combination of reflective learning and Business Process Management theory provides a very promising approach to support workplace and organisational learning, can be found in Balzert, Fettke and Loos (2011, 2012). To improve readability, we will shortly define the terms and models used with regard to organisational and reflective learning in this paper, and illustrate the need for an appropriate IT support for these activities in the next subsections.

### 2.1 Organisational learning and necessity for interdisciplinary research in the context of reflective learning at the workplace

Since its emergence, the concept of organisational learning (and the related concept of the learning organisation) has been widely discussed and studied by various academic disciplines like psychology, organisation theory, or management sciences. As a consequence, many different approaches were

developed with little integration of the corresponding concepts or models (Lähteenmäki, Toivonen and Mattila, 2001). In general, an organisation learns on a number of levels, ranging from the individual over the team to a company-wide level. In addition to this internal point of view, organisations also learn on an inter-organisational level (Busch, 2008).

It is still an open issue in the scientific discussion how to distinguish organisational learning from mere individual or team-based learning without further implications for the organisation (for a similar argumentation see Argyris and Schön, 1996). In this paper, we follow the approach of Argyris and Schön, understanding organisational learning as “*an organization’s improvement of its task performance over time*” including the “*learning to change the values that define ‘improvement’*”. In this context “*organisational learning occurs when individuals within an organisation experience a problematic situation and inquire into it on the organization’s behalf. [...] In order to become organisational, the learning that results from organisational inquiry must become embedded in the images of organization held in its members’ minds and/or in epistemological artefacts (the maps, memories, and programs) embedded in the organisational environment*” (Argyris and Schön, 1996).

Argyris and Schön’s convenient classification indicates two types of memory that are indispensable for organisational learning: “*images of organization held in its members’ minds*” and “*artefacts ... in the organisational environment*”. Particularly with regard to IS, this classification can be considered a line of demarcation between the organisational environment, where IT is well-established, and the human mind, which is at best a black box from an IT point of view. Nonetheless, an IS providing support for organisational learning by reflection must deal with both of these memory types and integrate them in a methodical approach for IT-supported organisational learning by reflection.

Reviewing these findings in the light of the many organisational IT systems that already exist, the central question is: How can an organisational IT landscape be extended so that organisational learning by reflection is well supported with respect to the inner workings of the human mind? From the perspective of IS science, the blind spot is obviously the lack of a model of the human mind. This makes this topic necessarily an interdisciplinary one, since such a model cannot be provided by IS science. Moreover, while studying the literature about reflection, it becomes obvious that this topic in itself is interdisciplinary as well. Similar to the concept of organisational learning, little integration between the different sources was done (here: emanating from disciplines like philosophy, psychology and education; see Moon, 1999). Therefore it is necessary to define a central model which integrates the numerous concepts, allowing reflection-related IS design to make use of the different theory bases. The well-accepted model of the reflection process by Boud, Keogh and Walker (1985a) is chosen as basis. It is described in the next section and further refined by applying it in section 4.

## **2.2 Boud, Keogh and Walker’s model as the basis for reflective learning at the workplace**

In management development, experiential learning is now considered the dominant theory (Reynolds, 1998). Experiential learning theory is strongly influenced by previous work of scholars, who considered experience as a central aspect of human learning. In this context, learning is defined as a process of knowledge creation through transformation of experience (Kolb and Kolb, 2005). The development of experiential learning theory was stimulated by a publication of Kolb, in which he introduced a model known as the experiential learning cycle (Kolb, 1984). Although Kolb identified reflection as an important component of learning from experience in this model, he did not discuss in detail what is meant by this component he called ‘Reflective Observation’ (cp. also Boud, Keogh and Walker, 1985b).

In contrast to Kolb’s work, other authors focus more precisely on the process of reflection in experiential learning (see Moon, 1999, for examples). The theoretical assumptions guiding the understanding of the reflective process in this paper can be traced back to a model introduced by Boud, Keogh and Walker in 1985(a), which is considered to be the most comprehensive model of

reflective learning. This refers mainly to the inclusion of the role of emotions in reviewing an experience but also to the clear notion of a 'resolution', i.e. a learning outcome as part of the reflective learning process. Furthermore, this model is well-suited to derive requirements for an appropriate IT support (for details see section 4).

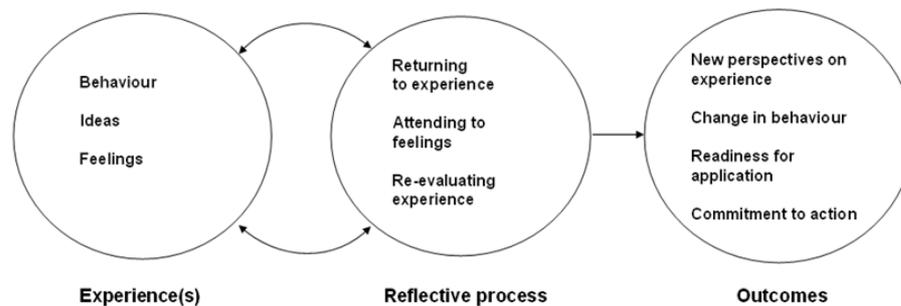


Figure 1. The reflection process in context (according to Boud, Keogh & Walker, 1985a)

The model of Boud, Keogh and Walker is focused on *experience-based*, deliberate learning, presupposing a *learner who intends to learn* in order to *achieve a specific goal*. Reflection in this context “is an important human activity in which people recapture their experience, think about it, mull it over and evaluate it.” (Boud, Keogh and Walker, 1985a). The reflection process (see Figure 1) is based on the total *experience* of a learner (first circle: behaviour, ideas and feelings). The *reflective process* (second circle) can be composed of three main elements: (1) Returning to experience, (2) attending to feelings, and (3) the re-evaluation of experiences. As already mentioned before, the model presupposes the reflection process to be executed intentionally, aiming at a specific objective. Therefore, the possible *outcomes* of reflection (third circle) include new perspectives on experience, a change in behaviour, the readiness for application, or a commitment to action.

### 3 Empirical findings for reflective learning at the workplace

In order to gain a better understanding about the current state of reflective learning at the workplace as well as insights regarding the special needs and requirements for an IT artefact supporting such reflective activities, we gathered empirical data in three organisations. The next subsections provide a short overview of the aim and scope of these studies, and highlight some important results that relate to the design of an IT artefact supporting reflective learning at the workplace. An in-depth description of the study design and the corresponding results can be found at Wessel and Knipfer (2011).

#### 3.1 Aim and scope of the studies

Studies were conducted in three organisations (one from the business consulting sector, two from the healthcare sector) in order to gain insights into reflection at the workplace. These organisations were rather heterogeneous. In one healthcare organisation, we looked at an emergency unit that is widely regarded as role model of this clinic. In the other healthcare organisation, we looked at different care/nursing homes, which often deal with residents suffering from dementia. The business consulting organisation was represented by the sales department of a small software company. Thus, the organisations differed in size, amount of group work, area, and even language, providing us with a multifaceted picture of reflection at the workplace. The staff received questionnaires regarding reflection, learning at work, IT attitudes and usage, and privacy. Furthermore, interviews were conducted to examine reflection practices and staff's needs and requirements for learning. Observational studies and, in one organisation, focus groups complement data gathering on current reflective learning practices and needs and requirements for its support. To gain insights about the management perspective, managers in two organisations answered questionnaires and were interviewed about current organisational learning and intelligence practices. In total, 113 staff surveys

were filled out, 12 interviews with staff were conducted and 8 managers were interviewed. Quantitative and qualitative data was analysed and aggregated to answer the following questions:

- Does reflective learning currently take place within these three organisations?
- 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?

### 3.2 Results and implications

In general, reflection does happen in all three organisations and it happens on different levels – on the individual, collaborative, and organisational level. It is an inherent part of work, although voluntary and self-determined activity. It is typically related to a primary business objective, e.g., patient health or customer satisfaction. It can occur, for example, during task performance, in team meetings and handovers, during informal talks and during breaks, when meeting colleagues outside of work, in informal learning groups, on the way to or from work, and at home. However, there are large inter-individual differences in reflection, and reflection does not automatically occur during the course of daily work routines. An important issue for reflection are organisational routines.

Regarding the *outcomes*, our findings support the major outcomes outlined by Boud, Keogh and Walker (1985a), namely *change in behaviour, new perspective, application of learning, and action*. Reflection often led to a new or better understanding of the experience, and allowed for deriving implications, conclusions, or ‘lessons learned’. However, there were striking differences with regard to the effects of individual reflection on organisational learning. In organisations where employees had a lot of freedom in executing their work processes, reflection seemed to have a predominantly individual scope. In contrast, in organisations with highly standardised work (e.g., a clinic which must adhere to medical best practices, and legal/insurance constraints), employees may start noticing a discrepancy individually, but changes in the organisation can only happen if this is validated with others. Solutions have to be found via collaborative reflection, then giving them to the relevant manager to implement the change in work procedure. In one health care organisation for example, a nurse noticed problems with a medical instrument. She shared her experience with other nurses, and they found out that these problems were not due to faulty training or work practice, but were a construction weakness of the manufacturer of this instrument. Thus, what started as individual reflection became an organisational issue to reflect and decide upon when the responsible person for the process was involved.

A crucial finding in light of this paper was the lack of systematic and/or technical support of reflection. While the importance of reflection was widely acknowledged, and data for reflection either is or could be made available, no technological support was in place. For example, in a conversation regarding the duration of breaks, employees had to remember instances where break length was an issue – which was difficult and effortful to do. IT support that assists in capturing this data would have improved and facilitated the process, and it would have increased the validity of the data and the conclusions drawn. A solution was desired that would capture data automatically or at least with minimal effort. Other issues were that the data was not accessible – this is especially a problem for organisations where records are kept on paper, as paper is usually only available at one location. Also, it is problematic if not all processes are supported by IT. For example, in one health care organisation, the Quality Management Handbook was rarely consulted because specific or exceptional cases are not documented and it is hard to find information in it.

In all three organisations, management was very interested in getting more feedback from its staff. Likewise, employees often mentioned a desire to have more convincing data when dealing with management, e.g., an IT consultant regarding the amount of time spend on different work projects, which could be monitored to be more convincing in discussions with superiors.

## 4 Proposal of a solution for reflective learning at the workplace

The results and implications from the studies provide valuable input for the design of an appropriate solution to support reflective learning at the workplace. To base the design process on more solid ground, a theoretical foundation should be included. Accordingly, the next subsections show how the proposed solution, consisting of two applications, is designed based on the model of Boud, Keogh and Walker (see section 2.2). The first application - (1) in Table 1- allows a user to gather and record experiences, and relate these experiences to work tasks and business processes. Furthermore, this application provides some functionalities for an administrator in order to maintain this application. The second application (2) provides an organisational member with the appropriate information to support a reflective process. Table 1 gives an overview on the respective functionalities and data elements of these two applications, which will be further described in the next subsections.

Functionality	Description	Data Element	Mode	Data kind
<b>Application (1)</b>				
insert text	possibility to enter free text to describe current issue	Text	input	free text
assign tag	assignment of tags from tag cloud	Tag	input	predefined
assign type	possibility to classify input according to predefined values	Type	input	predefined
add tag	possibility to define new tags for the tag cloud	Tag	input	free text
assign process	assignment of business process to text inserted	Process	input	predefined
assign task	assignment of task in business process to text inserted	Task	input	predefined
show annotation	readout annotation chosen by user	Annotation	readout	predefined
edit annotation	possibility to change one's own annotations	Annotation	input	various
save data	storage of inserted information, timestamp and originator in database	mandatory: Text, UserID, Timestamp, Process, Task optional: Tag, Type	out-going	various
recommend tag	recommendation of tags according to text inserted	Tag	readout	predefined
recommend process	recommendation of business processes according to text inserted	Process	readout	predefined
recommend task	recommendation of tasks according to text inserted	Task	readout	predefined
<b>Application (1) - ADMIN</b>				
add type	possibility to create new types	Type	input	free text
import process	possibility to import process models (and corresponding tasks) into app	Process Model	input	predefined (e.g. epml)
add process	possibility to create new process or edit process	Process	input	free text
add task	possibility to create new task or edit a task (within process)	Task	input	free text
<b>Application (2)</b>				
display model	graphical representation of process models	Process Model	readout	predefined
aggregate annotations	aggregation of annotations according to user's choice	Aggregated Annotation	create	generated
show aggregated annotations	graphical representation of process models complemented by overview on aggregated annotations	Annotated Process Model	create	generated
show tag cloud	overview tag cloud, highlighting tags	Tag Cloud	create	generated

Table 1. Functionalities and data elements of the solution

### 4.1 Gather and record data – an application to enlarge the experience base

In order to support the reflective process, experiences need to be available and valid in the first place. In general, human's capacity to remember accurately is limited. Memory is an active process that involves the *reconstruction* of past events. These events can easily be reconstructed wrong, especially if the knowledge of the person changes, or questions are asked in a certain way (see Wade and Tavris 1999, p. 228ff, for an introductory chapter on memory). Even the so-called "flashbulb memories"

(outstanding events that are ostensibly remembered vividly and in great detail) are often remembered wrong (see for example Wade and Tavriss, 1999). In workplace learning, it is important to gather the experiences related to the work context of organisational members. Employees are performing different tasks during their work day, and these tasks contribute to one or more business processes of the organisation. Therefore, every work activity of an employee can be related to a certain task, and this task again is part of a business process. Accordingly, every experience made while working can also be related to a certain activity, task, and business process respectively. In the context of reflective learning at the workplace, IT support could therefore be very helpful to record and store information about daily activities and working routines. In this way, a more comprehensive, accurate, and objective experience base can be provided to reflect upon.

In practice, the IT landscape of organisations is very heterogeneous. Even in organisations where Business Process Management/Workflow Management Systems are available, not all business processes are fully supported by IT. This lack of complete support is either because it is not reasonable from an economic point of view, or because it is simply not possible at all. Especially in the context of knowledge-intensive work processes, this impossibility to support is of importance. Accordingly, a solution to enlarge the experience base for a reflective process needs to provide the functionalities to first gather and record experiences and then to relate these experiences to the corresponding work tasks and business processes of the organisation. This support should be possible even if no other application system is available to support this special work task. If IT support is available for the respective work tasks, the experiences gathered and recorded (in the sense of context information) needs to be combined with the information provided by the application systems. It also needs to be related to the corresponding work tasks and business processes respectively. In this paper, we focus on the first situation where no other application system is available, in order to clarify our idea and approach. We also discuss it independent from a specific IT landscape, because the landscape can vary depending on the respective company or business field. As the solution can probably be integrated in many different IT landscapes, this specification would constrain our scope unnecessarily.

In order to support the reflective process, an application is needed from a user's perspective which provides the possibility to describe a current issue, i.e. an experience this user has made during a work process. The corresponding data element, which is created by the user inserting free text, is labelled *Text* in Table 1. In order to relate this experience to the work context, the user should assign a work task and the corresponding business process from a predefined list, thereby creating the data elements *Process* and *Task*. Afterwards, this *Annotation* must be saved to a database in order to record the experience. The data elements *Timestamp* and *UserID* are created by the system automatically and complement the *Annotation* with a chronological and individual-related classification of the experience. In order to enable a clearly-arranged classification of the gathered experiences, the user may also assign a predefined *Type* and/or *Tag* to the *Annotation* (for examples see section 5). To enhance the usability of such an application, it seems reasonable to provide a user with recommendations regarding a suitable choice of predefined values. The application should therefore be able to recommend suitable *Processes*, *Tasks*, and *Tags* according to the *Text* inserted, based on former entries in the system. Such features as well as the possibility to provide inputs in a fast and straightforward manner are prerequisites for the use of the proposed application in real work settings.

In order to provide the user with such an application, some preparation and maintenance has to be done. Therefore, the application also deals with an administrator's perspective, allowing the integration of new *Processes* and corresponding *Tasks*, as well as new *Tags*. Furthermore, the application provides the functionality to import whole *Process Models*, which are designed and documented by an external modelling tool suite like ARIS Business Architect & Designer<sup>1</sup> for example. In this case, the corresponding *Processes* and *Tasks* are derived from these *Process Models*, and provide the predefined entry options for a user as described above.

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<sup>1</sup> [www.softwareag.com/de/products/aris\\_platform/aris\\_design/business\\_architect/overview/default.asp](http://www.softwareag.com/de/products/aris_platform/aris_design/business_architect/overview/default.asp)

## 4.2 How to use the enlarged experience base in a reflection process?

According to Boud, Keogh and Walker's model (see section 2.2), the reflective process consists in three major steps (Boud, Keogh and Walker, 1985a):

- *Returning to experience* means remembering outstanding events, repeating the initial experience in the learner's mind, and sharing characteristics of the experience with others.
- *Attending to feelings* is divided into the utilisation of positive feelings, which means to focus on successful learning situations as well as positive experiences, and removing obstructive feelings in order to enable a more rational examination of events.
- During the *re-evaluation of experiences*, the learner reconsiders the experience according to the specific intention, combines new and already processed knowledge, and finally integrates this knowledge into his conceptual frame of reference.

The solution proposed in this paper mainly supports the first step of *returning to experience*. However, it is planned to complement the solution with further applications in the near future in order to enable also the second step *attending to feelings*. Some interesting first ideas and approaches how this can be done are documented in Mora, Rivera-Pelayo and Müller (2011) for example. The third step, the *re-evaluation of experiences* depends heavily on cognitive processes of the individual. Therefore, it remains vague which of these processes can be supported by IT applications and to which extend. With the solution proposed in this paper, these cognitive processes are supported by an appropriate presentation of the relevant experience base.

Before this IT support can be provided however, all information gathered and recorded with the first application (1), described in section 4.1, needs to be stored in a database in order to provide an experience base to reflect upon. Afterwards, a second application (2) is needed, which prepares the stored information for the reflective process by enabling the return to experiences as indicated in Boud, Keogh and Walker's model. In order to support a user to return to the experiences relevant for the reflective session, three aspects need to be clarified however:

- *Who* is reflecting,
- on *which* experience base – own experiences, other's experiences, own and other's experiences?
- What is the *purpose* of the reflective session – should it lead to learning on an individual, on a team, or on an organisational level?

The first possibility is that an employee performing some work tasks reflects on own experiences in order to improve his individual work process. In this case, only the experiences gathered by this employee during instances of this specific work process are relevant for the reflective process. Apart from this scenario, it is also possible to base the reflective process not only on the experiences of the individual employee, but enlarge the experience base with information from other employees working on the same task or similar tasks. In order to support the reflective session, a graphical representation of the information available may be useful (for examples see section 5). This representation should provide the employee with all information available and necessary for the reflective session. Thus, an appropriate application should enable the employee to choose on which experience base the reflective process should be based on – only on the experiences of the individual, on experiences of the individual and other's experiences, or only on the experiences of others. Accordingly, the graphical representation of this information should also adapt to these specific requirements by providing an overview as chosen by the employee.

The second possibility is that a person would like to reflect on annotations of work processes on behalf of the organisation, which means to improve business processes not from an individual but also from an organisational perspective. In this case, a process owner, for example, needs aggregated information about all process instances of a (work) process and the corresponding annotations made by the executing employees. Due to the fact that we abstract from existing IT landscapes in this paper, there is no further information about executed process instances, which means that the annotations are connected to predefined process (type) models only. Even the provision of this information is not a

trivial task however. First of all, privacy aspects of the individual employee need to be taken into account when aggregating information about annotations to work processes and providing this information to another person or even supervisor. Another challenge while dealing with aggregated information, is that the person returning to the experiences stored in a database might not have personally performed the corresponding work tasks. Thus, a lot of knowledge about this specific work task is not available and the reflective process can only be based on the information provided by the data base. Nevertheless, recorded annotations from employees directly executing the corresponding work tasks can help to base the reflection process on more solid ground. These annotations may support a process owner, for example, to understand problems occurring during working routines, and to draw the right conclusions from this information by re-evaluating the experiences of many others.

Accordingly, the second application (2) is intended to provide an organisational member with appropriate support for reflective learning. The authors propose to use a graphical representation of the relevant information, giving a concise overview about the business processes and their corresponding tasks as well as the related *Annotations* (for examples see section 5). For this purpose, the application provides the functionality to readout and display a graphical representation of the different *Process Models* available (i.e. process type models predefined by an administrator). Furthermore, the system is able to create *Aggregated Annotations* according to a user's choice. In this way, for example all *Annotations*, classified with the *Type* "idea for improvement" or the *Tag* "Redundancy" by different users, can be aggregated and related to the relevant business process and its corresponding tasks. In order to provide a concise overview for a reflective session of an organisational member, the application allows to display this *Annotated Process Model*, containing the aggregated *Annotations* in relation to the respective business process of the organisation. In this context, it is important to provide only the information relevant for the specific reflection process with regard to the aspects discussed above: Who is reflecting on which experiences and with which purpose? Apart from this representation, it is also possible to create and display a list of topics in form of a *Tag Cloud*, indicating which *Tags* are used by organisational members and provide annotations to work tasks and processes. This support could indicate the frequently discussed topics within an organisation.

### **4.3 The desired outcome of the solution - supporting reflective learning**

In general, the institutionalisation and technical support of reflective activities within an organisation motivates employees to constantly scrutinize their daily working routines. Thus they are empowered to take an active part in the composition of their work, instead of just executing predefined tasks. Apart from an increased *job satisfaction*, this higher participation may also lead to an *improved performance* of the respective work tasks and processes, and the corporate performance accordingly. Apart from providing these benefits, the exchange of information and ideas can be addressed in a more systematic manner. For example, by communicating a problem, or the outcome of the own reflective process, to colleagues and team members, a discussion of the articulated case is enabled. In a kind of "collective reflection", this case can be further evaluated and may lead to *new insights* for or even a *change in behaviour* (see section 2.2) of the individual or the whole team, which could not be gained by a single employee.

The IT artefact proposed in this paper may support individual as well as team reflective learning. It provides a more accurate and objective experience base for the reflective process and establish functionalities to record and document results of individual or collaborative reflection processes, which can be used to improve the organisational performance. As already mentioned in section 4.2, also reflection processes of organisational members and decision makers, which are not directly involved in the corresponding work processes, are supported through the applications presented herein. In this way, organisational learning as defined in section 2.1 is fostered. The solution presented focuses primarily the first two parts of Boud, Keogh and Walker's model (*experiences* and *returning to these experiences*, see section 2.2), because the *outcome* of a reflection process depends on the content of reflection, which varies between and within organisations. However, a more detailed

discussion about possible outcomes of reflection processes with regard to the organisational learning perspective can be found in Balzert, Fettke and Loos (2011, 2012).

## **5 Prototypical implementation and evaluation**

As described in section 4, the prototypical implementation is divided into two applications. The first, (1), addressing the gathering and recording of experiences and their relation to work tasks and business processes, the second, (2) focusing on the visualisation of the gathered information for a reasonable support of the reflection process. The practical relevance and the usability of the developed prototypes is ensured by the theoretical and empirical work done in the in the European research project MIRROR<sup>2</sup>.

### **5.1 Implementation approach**

After the conceptual fixation of the basic ideas derived from the research work in sections 3 and 4, the technical backend for communication and data storage of the applications had to be set up. In a first approach, a relational SQL database was used, and web services for both applications were developed. Web programming standards were used in the development to support platform independence and portability into different network infrastructures.

The first application (1) developed was the gathering application, left side in Figure 2. It provides a free text field to articulate the issue as a starting point. The free text allows informal annotation of any issue occurring during work. To enable the positioning of the issue in the business environment, different tagging and classification opportunities were implemented. The issue can be classified into a predefined type that an administrator can set in advance. Furthermore a tagging system with free tags and the possibility to add tags is implemented. Tags that were used often are proposed to the user in a tag cloud. To enable the direct relation of issues to work tasks in the business processes, a drop-down based add-in was implemented. It allows the choice of a process the user is working in and then lists the tasks appearing in this process. This data is also predefined and can be added by an administrator through an XML standard supporting Event driven Process Chain (EPC) notation (epml).

The information gathered allows different visualisations (see Figure 2, right side) supporting, for example, the reflection process of a decider on behalf of the organisation. This visualisation is provided by the second application (2), conceptually described in section 4.2. Process views in EPC notation are enriched by notes on how many issues, classified according to the type assigned, were related to certain tasks. This can be supported by colour coding, allowing a quick overview on problematic work tasks or processes. By clicking on a highly annotated task, a list of issues named is derived from the information gathered before. This allows detailed insights in the issues the process participants have inserted, which can be used by an organisational decider. The tag cloud, created based on tags provided by the users in application (1), gives an overview of major topics in all issues. This overview can help to identify topics that are discussed and annotated over all work processes. An even easier visualisation can be defined by aggregation, providing a broad overview. Traffic lights can be used on each work task to help identifying tasks that need a detailed review. Measures like annotations per time, or total number of annotations, may determine the status of the traffic lights.

### **5.2 Evaluative character**

The prototypical implementation proposed in the section above can be seen as an exemplary use of the concept introduced in section 4. It covers most functionalities and supports the handling of all data

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<sup>2</sup> [www.mirror-project.eu/](http://www.mirror-project.eu/)

types presented in Table 1. The gathering application (1) allows an enlargement of the experience base for reflective processes completely independent from the IT infrastructure given in a usage scenario. Administrative functionalities, like the import of process models for the selection menu and the opportunity to name preset types for issue classification, ensure the usability in different scenarios. At the moment the tool is limited to two preset categories (problem and idea for improvement), but this number may be increased in future versions.

Application (2) addresses mainly the first step in the reflective process *returning to experience* (cp. section 4.2). The articulation of an issue is connected with individual reflective elements. Additionally, the visualised data, for example for an organisational decider, is derived from experiences in the past. In future versions of the applications, a social element is planned. The users will have the opportunity to share and discuss their issues with self-chosen groups of users, which will be implemented via a MS Sharepoint interface in a first version. Apart from allowing the user to discuss the issues, it will also give the organisation the opportunity to discuss the measures taken.

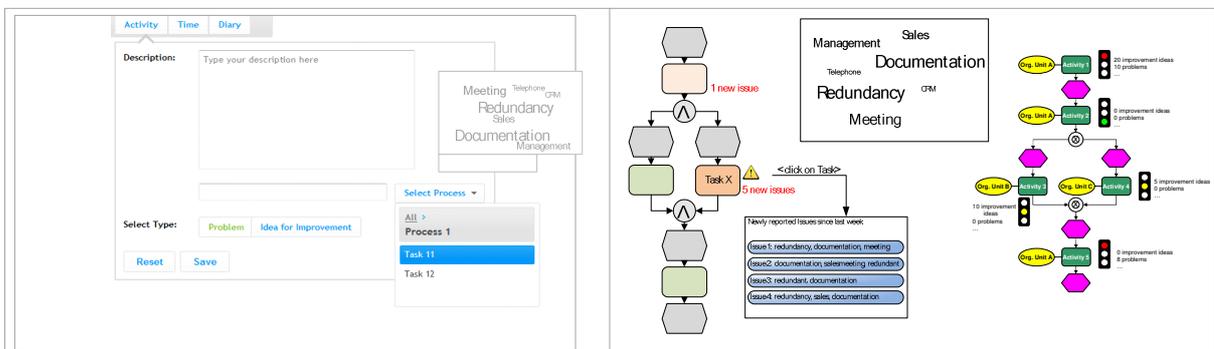


Figure 2. GUI of the first application (1) and visualisation approaches for the second application (2)

## 6 Conclusion and outlook

In this paper, an IT artefact to support reflective learning at the workplace was designed, consisting in two prototypically implemented applications. We based our development on a well-accepted model in reflective learning theory and key findings from a study within three different organisations. The conducted studies have shown clearly that an appropriate technical support for reflective learning is currently missing, despite the wide acknowledgement of the importance of reflection within organisations. This paper contributes to closing this gap by providing a technical solution to support reflection at the workplace. This solution can be used even if no other IT support is available within the corporate environment.

The authors are aware of the fact that some limitations need to be taken into account while dealing with the results of this paper. First of all, the study was conducted in three organisations from two different business sectors only. Therefore, the degree to which the results can be generalised is limited. Furthermore, the proposed solution currently does not address privacy issues or the related user management. In order to use the proposed IT artefact within a business environment, these issues need to be clarified. However, this topic is important enough to warrant its own paper, in which solutions to the privacy issue can be developed. Possible solutions are anonymising and aggregating the gathered experiences in a way that it is impossible to identify the originator, or to enable users to decide whether their annotations should be traceable or not.

While the developed applications are well-founded in theory, our next step is to test them in three different scenarios and organisations. This will help us to empirically evaluate and refine our support for reflective learning at the workplace.

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