## ECER-Symposium “Construction 2.0: Concepts, Challenges and Chances for Research & Development Dialogue in the Learning Layers Project”

### Paper 2: Work Process Knowledge meets Mobile Learning - Insights into conceptual backgrounds and sectoral challenges within a participative design process"

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### Abstract

The Learning Layers project seeks to promote the use of digital media, web tools and mobile technologies to support learning at workplace. In this paper we focus on the pilot activities in the construction sector, including the initial development of a design idea, the iterative design processes and capacity building measures. We discuss a specific pilot context - the training centre Bau-ABC and development of the Learning Toolbox - as a cross-over case between two R&D traditions: the Work Process Knowledge research and research on Mobile Learning.

Our example is an application, which in the earlier phase of the design process was thought as digital content and facilitation manager for work-oriented learning projects. Later on, due to a reorientation in the design process it turned into a mobile ‘toolbox’ that can be adjusted both to the needs of training phase and to real work situations.

We reconstruct the participative development process from the perspective of the e*volution of a design idea* and from the perspective of *capacity building in the pilot organisation*. We also discuss the promotion of e-competences as a complex learning process that requires both individual and organisational learning efforts.

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## 1. Introduction: Insights into the contexts, concepts and processes

The Learning Layers project aims to develop sets of modular and flexible solutions for digital media, web tools and mobile technologies to support learning at workplace in SMEs. The project works with two target sectors, in which digital media until now has not been widely used: the construction sector (pilot region in North Germany and the healthcare sector (pilot region in England). The project consortium includes a wide range of technical partners with different responsibilities to support co-design processes, application partners in both sectors as well as research partners in both pilot regions (see on this parallel paper to this symposium Kämäräinen et alia 2014).

This paper takes firstly a closer look at two kinds of conceptual backgrounds as major sources for the pilot activities in construction sector:

a) earlier studies of the Work Process Knowledge network on the acquisition of work process knowledge in work organisations and its importance for successful innovations;

b) newer studies on introduction of digital media and mobile technologies in the context of work and workplace learning.

In **the second section** these background approaches are described briefly and some insights, lessons and working agendas are highlighted for current R&D activities.

Then the paper reconstructs the participative design and capacity building processes and gives insights into the learning gains of the users that have been involved:

**The third section** provides insights into the pilot context Bau-ABC (intermediate training centre) and into the mapping of possible uses of web, digital media and mobile devices in the construction sector.

**The fourth section** describes how the initial design idea (digitisation of workplace learning materials) was reworked a flexible framework “the Learning Toolbox” (that provides access apps, tools and web resources). In addition, this section gives insights to Multimedia Training and user engagement as capacity building measures.

**The fifth section** discusses, how the learning gains during the Multimedia Training and participative design process can be identified as growth of e-competences. Firstly an interpretative framework is outlined on the basis of the primary R&D phase of the project. Secondly, the development phases of the co-design and training processes are reviewed from the perspective of the framework.

## 2. Conceptual backgrounds and challenges: Work Process Knowledge vs. Digital media and Mobile Learning

Below, the two conceptual backgrounds for this paper - the European research on *‘Work process knowledge’* and the more recent research & development work on dig*ital media and mobile learning* - are discussed briefly.

### 2.1. The earlier conceptual background: Promoting Work Process Knowledge

The concept of ‘work process knowledge’ was introduced to European cooperation by an interdisciplinary network that worked from the early 1990s to 2004 and brought together different studies on industrial, organisational and occupational innovations. According to the key promoters of the network, Martin Fischer and Nick Boreham, the concept can be seen *“as a way of describing the kind of knowledge which employees need for working in organisations which have developed more flexible structures, and which have introduced new technology in search of greater competitiveness. The concept of work process knowledge is used in exploring the relationships between work, learning on the job, organisational development, individual knowledge, collective knowledge and occupational competence”*.

The first context in which the concept was used was a case study by Kruse on organisational development campaign in a Spanish hotel enterprise. When describing the results of the campaign Fischer and Boreham draw attention to the promotion of joint work process knowledge as a success factor: *“work process knowledge here refers to a way of knowing which employees developed as an unintended outcome of activities designed to develop a collaborative work culture. Initially, there was no involvement of formal training, nor was the knowledge of the labour process acquired extensively codified. The nature of (work) process knowledge was not so much the kind of technical knowledge which is taught in formal institutions of learning****, as a feeling which grew naturally out of the interdependence of the different departments*** *of the organisation in which the employees worked,* ***and a willingness to collaborate in ways that involved crossing the boundaries*** *of their formal job descriptions.”*

Also, the concept was used in bringing into concept the socio-technical consequences of the new production concept in manufacturing industries - the so-called island production. Fischer and Boreham refer to the points and questions raised by research projects of that time: “*The, new production concepts such as island production assumed decentralised planning and the delegation of decision making to the workshop. But how do skilled workers and apprentices react if they are confronted with such requirements when island production is introduced? What experiences can they incorporate into such tasks?”*

These two examples show, as Fischer and Boreham argue that ... “the concept signals more than practical knowhow or ‘procedural knowledge’, for this way of knowing also encompasses theoretical understanding. For this reason, the concept is a generative one which provides a framework for understanding how contradictions between theory and practice – and contradictions within practice – are resolved in the context of work. It also provides a framework for building effective partnerships between vocational education carried out in institutional settings and learning on the job.”

From the perspective of the Learning Layers project it is important that in its critique on parallel research the Work Process Knowledge network sought a conceptual balance between seemingly opposite positions. Here it is worthwhile to mention two issues:

**Issue 1: Specifying the relations between *informal learning* and *formal learning***

Concerning this topic the Work Process Knowledge network criticised reductionist or isolationist positions that ***either***

a) reduced vocational and work-related learning into proceduralised and popularised version of codified expert knowledge ***or***

b) overemphasised the situated and intra-organisational character of such knowledge and learning (without taking into account ‘external’ and long-term influences).

##### **Issue 2: Linking the role of ‘social’ and ‘technical’ in socio-technical innovations**

Concerning this topic the Work Process Knowledge network criticised reductionist or isolationist positions that ***either***

a) reduced technical innovations in working life into mere implementation (technology-push) of the allegedly innovative technologies ***or***

b) narrowed down the role participative co-shaping (by skilled workers) as activities of the (immediate) communities of practice in intra-organisational contexts.

In the light of the above,Fischer and Boreham summarised their conclusions in the following research agenda:

*“The* ***acquisition of work process knowledge*** *has to be c****onceptualised within a framework of****:*

*(a)* ***individual learning*** *(in the context of biographical strategies) versus* ***collective learning*** *(in the context of participation within a community of practice;*

*(b)* ***implicit learning*** *on the way to personal mastership versus* ***exchange of knowledge*** *within the lifeworld of a company;*

*(c)* ***given working conditions*** *and technical artefacts versus* ***their subjective*** *(individual and collective)* ***appropriation*** *and, furthermore, their* ***social shaping*** *to adjust technology and*

*(d)* ***experiencing and exploring*** *events at work versus* ***their theoretical explanation****;*

*(e) integrating* ***learning on the job*** *with* ***classroom-based education.****”*

### 2.2. Newer conceptual background: Introduction of Digital Media and Mobile Learning

So far, the use of digital media, web 2.0 and mobile learning have been discussed more prominently as means to enrich general and academic learning - and as means to find more cost-efficient ways to providers of higher education opportunities. In this context the emphasis has been given on e-learning designs and/or the usability of specific tools and packages.

As a contrast, the Learning Layers project focuses on workplace learning - both in intermediate training centres and at the construction companies. ‘Learning’ is perceived as precondition, by-product and result of skilled work: *learning for*, *learning at* and *learning through* work. This provides the starting point for exploring the prior work on promoting digital media and mobile learning. Below some key points are summarised from recent studies (see in particular different contributions in Pachler et al. 2011):

Most of the studies in this area see the integration of mobile learning into work-based learning almost exclusively as a promising perspective. Mobile tools allow enriching concrete working situations with connections to additional knowledge sources (experts, wikis) or with the development of reflection (e.g. the making of short comments or video clips). The results of such reflection can be used not only by the single worker who reflected something, but they can also be shared with others.

Mobile learning in its modern sense implies therefore not only individual learning, but also communication and collaboration. But, as Cress and Kimmerle (2013) argue, it is not self-evident that knowledge or insights are shared: individuals must recognize that they gain an advantage by taking the effort to offer information. In the workplace, there are a number of variables which influence the motivation to collaborate:

* On the level of *work conditions*, time restrictions, tight hierarchies, the necessity to appear perfect, competition, company secrets etc. can be barriers for sharing information online; on the other hand, a tolerant, transparent and development-oriented company culture with space for experiments and collaboration supports sharing as well as learning and innovation in general.
* On the level of *individual characteristics*, openness and extraversion, general and work-related self-confidence, the feeling of integration into a working group and affection toward the issue about which information is shared influence the motivation to share knowledge.

This complex set of variables makes it difficult for researchers to estimate, whether the introduction of a certain tool into a certain company will be successful – but they can provide some hints and advice in the promising direction. What researchers can do is to design a tool which is basically useful for the world of work. Here, different criteria can be taken into account. Burden, Schuck and Aubusson (2011), to start with, have elaborated different possibilities of mobile technologies with reference to the world of work. For example, they think that collaboration as an important issue of the workplace could be enhanced by digital media. The focus on tasks and on authentic problems, the respect of the specific work context and reflectivity are from their perspective further important characteristics of work which can be supported by digital media. Here, not all references to work are necessarily related to formal learning processes but they may have implications for the learning culture.

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## 3. The pilot context: In search for solutions in an intermediate training centre

Below we give a brief description of the primary pilot context - the intermediate training centre Bau-ABC and the initial design idea. Then we give some insights into possible points of intervention that were identified during the first workshops.

### 3.1 Starting points and the initial design idea: Digitisation of the White folder

Within the German apprentice training in the construction sector the principles of the ‘dual system’ has been implemented in **three learning venues**:

a) vocational education schools provide theoretical backgrounds;

b) intermediate (industry-supported) training centers cater for delivering basic skills, widening the occupational competences and introducing apprentices to risky working contexts (e.g. using heavy machinery and equipment) in safer workshop-based environments;

c) companies train the apprentices at real construction sites.

In the German vocational education and training (VET) culture, there has been for some time a movement from insular workshop-based training to bringing learning back to holistic and authentic work contexts (*Handlungsorientiertes Lernen*). The apprentices are given basic guidance, but they have to work independently through the tasks, partly individually and partly in teams, whilst the trainers serve as mentors and resource persons which support the learners in finding their own solutions to the tasks. This pedagogic orientation has been implemented in the project-based learning concept of the training centre Bau-ABC. It has also guided the instruction, implementation and documentation of working and learning tasks with the help of the White Folder - a paper-based collector of instruction material, worksheets and evaluation sheets.

### 3.2 Interim observations: Points of intervention in work processes

Whilst the co-design work took the digitisation of the White Folder as its starting point, the workshops that were organised with apprentices sought to get insights into their work processes, in particular in real work contexts. On the basis of these workshops some work situations were highlighted as potential points of intervention to be tackled with digital media and mobile devices. Below two exemplary situations are presented:

* **Situation 1**: A plasterer drew attention to the problem situations in which he has not had the necessary tools for the particular worksites and he has had to return to the company the collect the missing ones. For such situations there is a routine to prepare checklists at the end of the day to make sure that the plasterers will have the right tools and materials with them on the next day. However, their tools and materials are not always packed by themselves. Other staff may be involved and they might not have the checklist on time.
* **Situation 2:** Two industrial maintenance men drew attention to the fact that they were working in food industry (dairy, meat processing). The disturbances in the production processes that they have to encounter may cause huge financial losses. Yet, these disturbances are mostly not routine cases for which there would be manuals with instructions. Often they have to do repair work based on their own guesswork diagnostics and with temporary solutions that keep the processes somehow running until more sustainable solutions could be implemented. The maintenance craftsmen work in shifts, so there is little time for joint meeting between the shifts to share experiences.

## 4. The participative processes: Co-design, capacity building and user engagement

Below we give a picture of the participative processes, firstly from the the perspective of co-design (based on several iterations) and secondly from the perspect capacity building (based on multimedia training and user engagement).

### 4.1. Co-design process in Bau-ABC

#### 4.1.1 **“Sharing turbine” as the first iteration**

The design idea for “Sharing Turbine” emerged from the Learning Layers Design Conference held in Helsinki in March 2013. The idea was to digitise the White Folder - the collection of instructions and worksheets with which the apprentices at Bau-ABC work during their training periods in the centre. Currently the tasks are delivered and documented with papers collected in a physical folder. This was seen as inflexible and difficult to use in the context of construction sites. The development of a digital White Folder, accessed through a mobile application, was seen as linking informal and formal learning and learning taking place in different venues, in the training centre, in the vocational school and in companies. Initial development included design workshops with the Bau-ABC trainers and the development of wireframes as well as lengthy and in depth conversations with both apprentices and trainers regarding the pedagogic use of new technologies for informal learning.

#### 4.1.2. **“Rapid Turbine” as the second iteration**

The second phase codenamed “Rapid Turbine” was launched in summer 2013, with the aim to focus on selected pilot areas (road-building, pipeline-laying) that had indicated interest in serving as pilot areas and to use multimedia and video material in their training. The work in this phase was based on workshops involving both trainers and apprentices. The results were captured by producing wireframes and a clickable prototype, based on digitalisation of one task in the White Folder. At the end of this phase, an interim evaluation was carried out in the development team and discussed in meetings with Bau-ABC management and trainers. It was concluded that

1. The work of digitising existing materials was extremely time consuming.
2. There was a need for more flexibility in designing applications which can be used in different learning contexts - taking into account different working environments.
3. There was a need to develop tools and workflows that would allow trainers themselves to produce learning materials.
4. There was a need for closer integration between the Application frontend development and the social semantic server, acting as a back end.

#### **4.1.3. Learning Toolbox - the third iteration**

As a consequence, a third iteration of the original Sharing Turbine design was developed, Learning Toolbox, responding to feedback on previous iterations. Learning Toolbox is essentially a flexible framework connecting through the social semantic server to different offerings and applications from the Learning layers project. Learning Toolbox integrates the different tools and applications that are being developed in the Learning Layers project. It provides flexible access both to customised tiles (tiles are interfaces to tools providing different functionality, but accessed through a single mobile interface, the toolbox) and to tiles accessing other Learning Layers applications. Initially, the co-design and development work for the Learning Toolbox was launched with Bau-ABC and as a response to specific needs in the construction sector.

### 4.2. Capacity building and user engagement in Bau-ABC

Below we give a picture on the importance of capacity building measures, in particular of the Multimedia Training workshops as a support for co-design and wider user engagement.

#### 4.2.1 **Starting point – the results of the User survey with Bau-ABC apprentices**

A survey of apprentices’ use of digital media was undertaken with over 700 first, second and third year apprentices completing the survey. The survey confirmed the desire for more use of mobile learning resources and a frustration with the limitations of existing commercial applications. Whilst only a limited number of companies permitted the use of mobile devices in the workplace, 53% said they used them for learning or for obtaining work related information, explaining this was in their own times in breaks or after work.

#### **4.2.2 Turning point – the transition to the development of the Learning Toolbox**

Whilst the year one workshops were already organised as contributions to a *participative* design process, there was a rather sharp division between workshops (as events to collect information and feedback) and the work of developers. The transition to the development of the Learning Toolbox gave rise to a new interaction between

1. the technical development of Learning Toolbox *and*
2. socio-technical shaping of the training and learning environments.

In this way, the participative design process redistributed the responsibility for introducing new technologies between the immediate development of the Learning Toolbox (as an integrative framework) and the ‘environmental’ initiatives to shape the processes of delivering training and learning (with further uses of digital media and web resources).

#### **4.2.3 Supporting initiative – the Multimedia Training**

In this context, the project partners (Bau-ABC, Pontydysgu and ITB) launched jointly a series of Multimedia Training workshops for Bau-ABC trainers using social software to develop learning materials. In some domains (in particular in carpentry) trainers were able to implement the original idea of Sharing Turbine by presenting the apprentices’ projects (information sheets and worksheets) via blogs (and covering all training periods). This was accompanied by the development of BauBildung.net - a social network platform for trainers and apprentices at Bau-ABC and the launch of trainers’ blogs focusing on learning in their work areas. At present, four trainers’ blogs (for carpenters, bricklayers, road-builders and well-builders) are being integrated through the platform (see [www.baubildung.net](http://www.baubildung.net)).

#### **4.2.4 Further initiatives – Stakeholder engagement events and outreach activities**

Parallel to the development of the Learning Toolbox, several Learning Layers partners have been involved in outreach activities to elicit feedback from sector actors and stakeholders, e.g. the trade fairs *Brunnenbauertage* and *NordBau*. Also, within Bau-ABC, a *Demo Camp* was organised to engage new groups of apprentices. The Demo Camp served as a pilot event for the joint dissemination of four parallel tools that are being developed by the Learning Layers project. As a follow-up to these events, the Learning Layers partners have involved building and construction companies and supplier companies in further talks.

### 5. Capacity building as promotion of e-competences

### 5.1 Interpretative framework for identifying growth of new competences

During the first two years of the project, partners have been involved in co-design processes with application partners in the construction sector. Altogether, this phase has provided rich information and the starting points for enhancing the use of technology for learning, knowledge sharing and improvement of work processes (e.g. in terms of quality assurance, coordination and promoting synergy). This primary research and development phase had the following purposes:

* **Firstly,** it provided an awareness of the initial conditions that were provided for the subsequent piloting with digital media, web tools and mobile technologies
* **Secondly**, it outlined an interpretative framework for analysing technology enhanced learning in organisations (from adoption to maturation) to clarify whether there was a pattern to this process.

From the information gathered, four factors emerged as contributing to the effective implementation of e-learning in a training organisation (or organisation that is involved in training and staff development):

* Leadership and management,
* Technology infrastructure,
* ‘Curriculum’ or training content and
* Opportunities for staff development.

The framework identifies four stages of development regarding the evolution of organisations as users of ICT, web tools and learning technologies.

* **The first stage** - **‘e-awareness**’ - refers to an organisation that has taken the first step into using technology for learning and implies a commitment by the management. The organisation may know what decisions need to be taken but may not yet have made them. Most importantly, there is the beginning of a culture change, for example, allowing staff to access learning resources online or lifting restrictions on the use of social media. This may also include having dedicated spaces, computers or time periods for learning.
* **In the second stage** organisations progress to **‘e-enabled’.** Plans and strategies are drawn up and one or more people take on the responsibility to drive these forward. Evaluation and monitoring systems are typically in place and there are written policies that staff are familiar with. There is likely to be a much more coherent and long term plan for expenditure on technology for learning. This will include additional investment in networking and improvements in connectivity and may include the acquisition of portable and mobile devices.
* **In the third stage** the use of technology for learning and teaching has become well established, companies may become ‘**e-confident’**. At this stage, the use of technology for learning is a key feature of the organisation and integrated within its future goals. In keeping with this, there is an increasing trend towards in-house staff development facilitated or supported by outside experts, rather than a reliance on external courses. There needs to be an upgrade of the technical infrastructure. IT support has dedicated area of service for learning technology or a specialised staff.
* **The fourth stage** of evolution is identified by the organisation becoming **‘e-mature’.** These organisations will base their decisions and forward plans on new trends in the pedagogy of technology enhanced learning and new developments in technology. Training professionals not only know where they can find ideas and resources that they can use and adapt but they consistently generate and share new ideas and learning resources within a community of practice and offer support to others using technology for learning. The organisations are actively exploring different models of continuing professional development (CPD) including online learning, and project based learning.

### 5.2 Using the framework for analysing progress in Bau-ABC

Below, examples of different *periods of wor*k are presented as documentation of the capacity building process. They provide insights into the aims of the ongoing activities carried out during the period. Then, interpretative comments are given on the progress during that period. These comments draw attention to movements between different evolutionary phases (indicated in the interpretative framework).

#### **Period 1: Co-design workshops of the Y1 “Sharing Turbine” design initiative**

**Activities:** During this period, the co-design workshops were firstly conversational workshops and then storyboard workshops. Apprentices and trainers (representing different trades) attended separate sessions in which they identified problem situations in their work processes. Then, on the basis of their mapping, different possibilities for introducing digital media and web tools (to be accessed via mobile devices) were discussed. This period was the early phase in the participative co-design process and gave some indications on the needs for Multimedia Training. (See the Logbooks on Co-Design workshops and on Multimedia Training workshops)

**Progress:** In the light of the criteria given in the scorecard on CPD, this period can be seen as a process of **achieving shared e-awareness** before entering a participative co-design work with focus on developing specific tools. In the same way it served as a preparatory phase before launching a systematic Multimedia Training programme and parallel capacity-building measures at the organisational level.

#### **Period 2: Co-design workshops of the next iteration (“Rapid Turbine”) and the beginning of Multimedia Training**

**Activities:** In the co-design work, it became necessary to select pilot areas for rapid prototyping *(*this was expressed with the name “*Rapid Turbine”* that was used for that phase of the design work). In this context, training projects for pipeline builders (*Rohrleitungsbau*) were explored more closely. In this phase, the workshops with Bau-ABC trainers were organised more directly as *Co-design meetings* that gave insights into selected pilot areas and project tasks. During this work the project team identified a need to promote the multimedia skills and overview of the trainers. Consequently, the first *Multimedia training workshop* gave insights into different prospects for co-creation and the co-development of web tools and apps. (See the Logbooks on Co-Design workshops and on Multimedia Training workshops.)

**Progress:** In the light of the criteria of the scorecard for CPD, this period can be seen as a further step in **consolidating the achieved e-awareness** with a focus on participative co-design, specific pilot areas and a range of tools. In the same way it served as an entry phase for planning of a Multimedia Training program to be implemented in Bau-ABC.

#### **Period 3: Co-design activities with the “Learning Toolbox” and the implementation of Multimedia Training program during year two**

**Activities:** In the co-design work, the emphasis was shifted from the digitisation of training materials and worksheets (in the Bau-ABC White Folder) to the development of the Learning Toolbox as an integrative framework tool (for mobile devices) to manage web resources and apps needed in working and learning. Therefore, a series of Multimedia Training workshops were implemented alongside the co-design activities. The emphasis shifted gradually from the most common web tools and services to such tools, applications and techniques that the trainers can use in their training. In particular, the development of trainers’ blogs and the editing of video material for the Learning Toolbox (and for other uses) were promoted. (See the Logbooks on Co-Design workshops and on Multimedia Training workshops.)

**Progress:** This period can be characterised as a **collaborative effort to become e-enabled**. This period was characterised by progress in individual mastery of digital media and web resources. But it was also characterised by progress in drafting follow-up plans at the organisational level.

#### **Period 4: Continuation of co-design with the Learning Toolbox and follow-up of the Multimedia Training implemented in year two**

**Activities:** After completion of the Multimedia Training programme, there have been plans to continue it as a regular internal staff training program in Bau-ABC. In this way, it can provide wider support for further development and implementation of the Learning Toolbox and enhance the capability of trainers as peer tutors and peer mentors. The videos prepared in Bau-ABC show how the trainers are developing and using their own web resources and contributing to the development of the Learning Toolbox.

Additionally, the [www.baubildung.net](http://www.baubildung.net) platform has been developed in order to promote knowledge sharing and exchange of good practice in using digital media and web tools in the construction sector. Here the purpose is to build upon such pioneering achievements like the trainers’ blogs created in Bau-ABC and engage further users in construction companies and their networks. (See the Logbooks on Co-Design workshops and on Multimedia Training workshops)

**Progress:** In the light of the criteria of the interpretative framework this period is already characterised by an **emerging and consolidating e-confidence.** When looking at the set of videos prepared by Bau-ABC, it becomes apparent that not only some individual trainers are becoming e-confident, but via their peer tutoring their example is being followed by others. Equally, the plans to continue the Multimedia Training and to take further measures to build the infrastructure for wider utilisation of web tools and mobile technologies, exemplify similar efforts to reach and consolidate e-confidence at organisational level.

## 6. Concluding remarks: Raising awareness of one’s competences and interests

### 6.1. The actual relevance of Work Process Knowledge

In the next phase it is essential to look, how the legacy of the Work Process Knowledge network can be taken into account in the further phase of the pilot activities of the project. The exemplary situations taken up in the apprentices’ workshops and have given impulses to further development of the Learning Toolbox. Here, it is worthwhile to note that the key issue has not been primarily the enhancement of formal learning processes - instead, the main interest has been on optimising work processes.

Yet, as has been observed during the Multimedia Training and in the further capacity building measures, the introduction of digital media and web tools has not been a separate ‘add-on’ process. Instead, the awareness of one’s new competences has influenced the whole working, learning and training culture. This can be demonstrated by the new initiatives of Bau-ABC trainers on the uses of Learning Toolbox in working and Learning contexts.

Altogether, these points bring back into picture the initial concept of promoting work process knowledge as

*“a way of knowing which employees (may develop) as an unintended outcome of activities designed to develop a collaborative work culture. Initially, there (may be) no involvement of formal training. (...) The nature of (work) process knowledge (is) not so much the kind of technical knowledge which is taught in formal institutions of learning****, as a feeling which (can grow) naturally out of the interdependence of the different (parts)*** *of the organisation in which the employees (work),* ***and a willingness to collaborate in ways that involved crossing the boundaries*** *of their formal job descriptions.* (Fischer & Boreham 1995)

### 6.2. Creating awareness of wider criteria for occupational competence

One of the issues arising from the experiences of the co-design workshops is the need to get the *use digital media, web tools and mobile technologies* anchored to the u*sers’ interpretation of their own occupational competences*. For this it is necessary to develop some pedagogical and occupational criteria. For such work the holistic model of occupational competences of Felix Rauner and his research team provides a conceptual starting point:



 Diagram 1: Criteria for holistic occupational competence (Rauner)

Originally the criteria of Rauner have been outlined to assess comprehensive mastery of working and learning tasks by skilled workers and by apprentices in vocational education and training. Yet, they can also be interpreted wider than just referring to particular occupational tasks. In a wider understanding they can be seen as more general aspects of occupational competence which also refer to the use digital media, web tools and mobile technologies in the context of occupational work. From this perspective it is possible to explore the exemplary situations presented by the apprentices to see, how the use of Learning Toolbox in such contexts may contribute to their professional development. In a similar way it is possible to explore how the learning gains with Multimedia Training and subsequent use of Learning Toolbox can contribute to the professional self-understanding of the trainers.

### 6.3. Creating awareness of potentially matching (or mismatching) interests

One of the main achievements of the Work Process Knowledge was to analyse cases of technical and organisational innovations from the perspective of contrasting (if not conflicting) interests. Furthermore, these interests were not taken as granted but traced on the grounds and in the context of changes. Concerning the introduction of digital media, web tools and mobile technologies such mapping and monitoring of matching (or mismatching) interests becomes complicated. Very often the developers do not have a clear picture of the implications of their designs for users. The management and the staff has not a clear picture of the design options and eventual conflicts that may arise from certain choices in the design process. Therefore, in particular in the transfer-promoting phase, it is necessary to enrich the design tools (such as conceptual maps) with further analyses on the underlying interests (and eventual conflicts of interests) between different parties involved.

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### News articles and working documents of the Learning Layers project

**Article series: Milestones in co-design and user engagement activities of the LL project**

<http://learning-layers.eu/recent-progress-with-learning-layers-activities-in-the-construction-sector>

Article 1: [From Application Partner Days to creation of Design Ideas](http://learning-layers.eu/from-application-partner-days-to-creation-of-design-ideas/)

Article 2: [Co-design process from “Sharing Turbine” to “Learning Toolbox”](http://learning-layers.eu/co-design-process-from-sharing-turbine-to-learning-toolbox/)

Article 3: [LL project goes to Brunnenbauertage with the “Learning Toolbox”](http://learning-layers.eu/ll-project-goes-to-brunnenbauertage-with-the-learning-toolbox/)

Article 4: [The Demo Camp presents the LL tools to apprentices and trainers](http://learning-layers.eu/the-demo-camp-presents-the-ll-tools-to-apprentices-and-trainers/)

Article 5: [The LL project goes to outreach activities and pilot workshops with construction companies](http://learning-layers.eu/the-ll-project-goes-to-outreach-activities-and-pilot-workshops-with-construction-companies/)

**Logbooks on Co-design workshops and Multimedia Training Workshops**

**Logbook on Co-Design Workshop reports Y1-Y2 (Bau ABC)**

<https://docs.google.com/document/d/1xnFD6gVM1dg6X7yVKMO1eQ7jJMdmN8ZR2yhBLiJm4_k>

**Logbook on Multimedia Training Workshop reports Y1-Y2 (Bau ABC)**

<https://docs.google.com/document/d/1X5DeXXD7LBzK7OVdPbH2V_sbsfo1D7pgz9MtkFL5rHs>

**Videos of the Bau-ABC team on the impact of Multimedia Training and on possible uses of the Learning Toolbox**

* [**Video 1: The Multimedia Training of Learning Layers has had impact**](http://learning-layers.eu/video-1-the-multimedia-training-of-learning-layers-has-had-impact/)
* [**Video 2: Bau-ABC trainers’ views on the use of Learning Toolbox in training**](http://learning-layers.eu/video-2-bau-abc-trainers-views-on-the-use-of-learning-toolbox-in-training/)
* [**Video 3: Use of Learning Toolbox in an apprentice’s project in Bau-ABC**](http://learning-layers.eu/video-3-use-of-learning-toolbox-in-an-apprentices-project-in-bau-abc/)
* [**Video 4: Learning Toolbox in different contexts of construction work**](http://learning-layers.eu/video-4-learning-toolbox-in-different-contexts-of-construction-work/)
* [**Video 5: Learning Toolbox as means to highlight Health and Safety issues**](http://learning-layers.eu/video-5-learning-toolbox-as-means-to-highlight-health-and-safety-issues/)
* [**Video 6: Learning Toolbox as means to capture instructions at the workplace**](http://learning-layers.eu/video-6-learning-toolbox-as-means-to-capture-instructions-at-the-workplace/)
* [**Video 7: Learning Toolbox as means to support storage of special tools**](http://learning-layers.eu/video-7-learning-toolbox-as-means-to-support-storage-of-special-tools/)