

***‘Begleitforschung’* as contributor to digitisation  
in vocational education and training (VET) for  
construction sector – Linking ‘work process  
knowledge’ to ‘Industry 4.0’**

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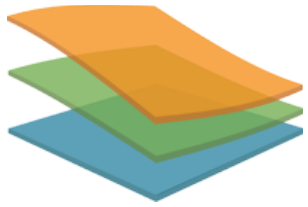
# Contents

- **The research questions**
- **Background and context of Learning Layers (LL) project**
- **Construction pilot and shaping the approach**
- **Conceptual support: The role of the Theory Camp**
- **Result and follow-up agendas: Learning Toolbox (LTB)**
- **Linking the LTB to old and new innovation agendas**
- **Reflecting 'Industry 4.0' by social/ educational research**
- **The research claims**

## The research questions

The paper discusses the Learning Layers' Construction pilot and newer research on similar innovation agendas with focus on the following questions:

- What role has '**accompanying research**' played vis-à-vis *innovations in practice* and *knowledge development on them*?
- In what ways has the theme '**work process knowledge**' been influential in the Construction pilot and its follow-up?
- How can the work of Learning Layers' Construction pilot be related to **older and newer innovation agendas**?
- How can the theme '**Industry 4.0**' be related to construction work, related training and to technology-enhanced learning?



## Background of the EU-funded RTD project “Learning Layers” (EU FP7)

Context: European programmes for ICT, Web 2.0 and learning (in work organisations)

- Early push of e-learning technologies vs. limited succes with SMEs
- Major projects with larger companies, „knowledge work“ and knowledge management technologies
- New efforts to promote web technologies to support learning in SME clusters

# Learning Layers

17+3 partners

2+1 pilot regions and sectors

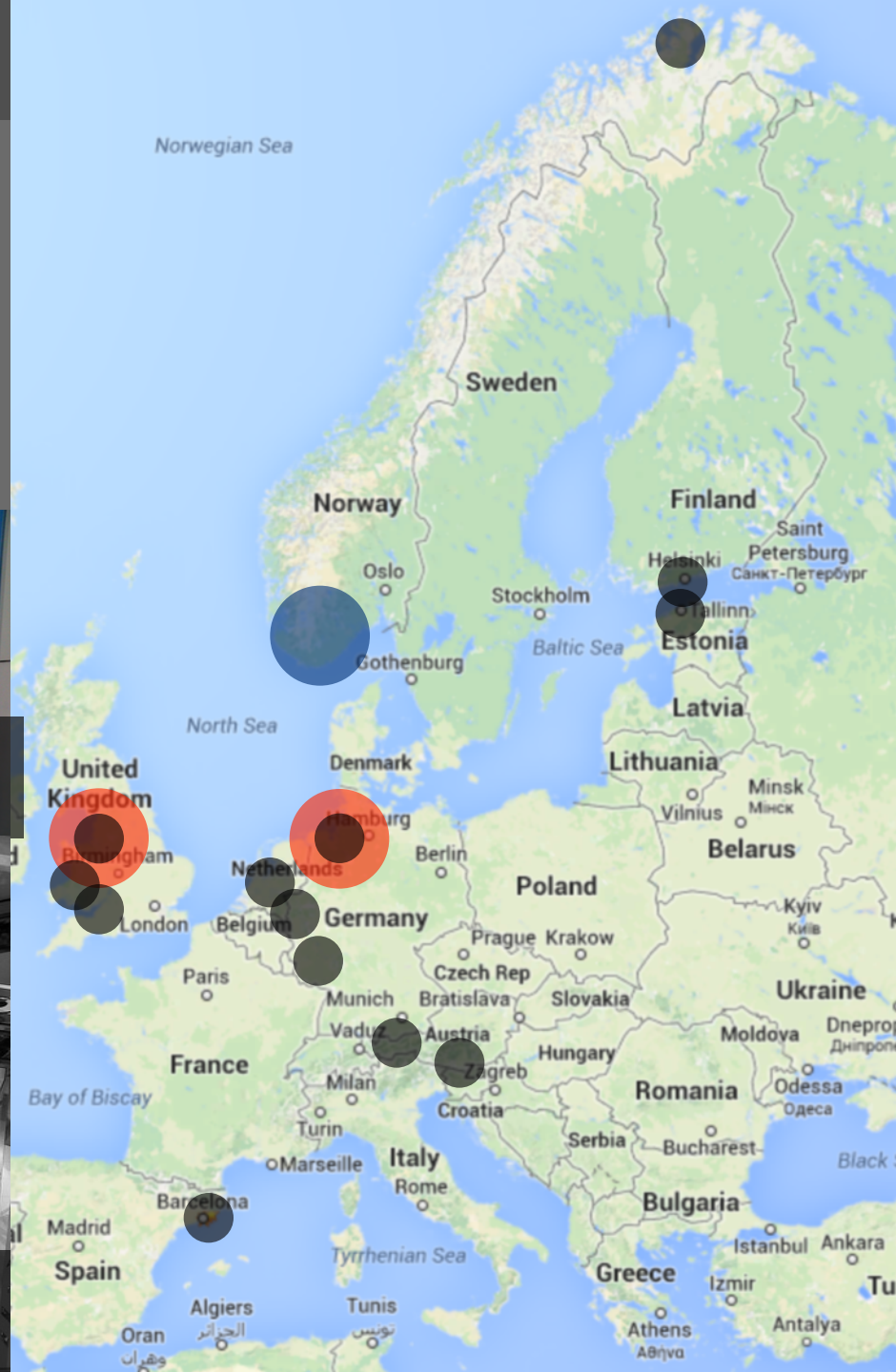
€13 MM, 30% for innovation

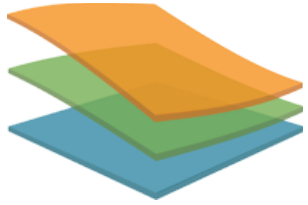
4 years (2012 – 2016)



Informal learning at workplace/  
Use of digital media & Web 2.0

Learning at multiple levels

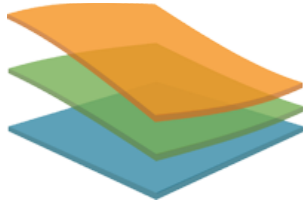




## Outline of the Learning Layers' Construction pilot ...

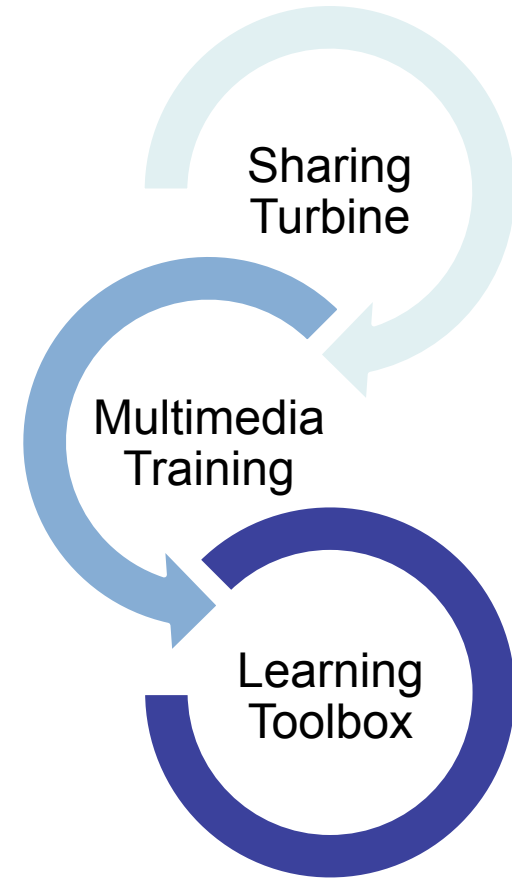
Context: Regional pilot activities with relatively open innovation agenda

- **Initial design idea** raised by *intermediate* training centre Bau-ABC (construction sector)
- **Participative design activities** involving developers, trainers, apprentices and researchers
- **Accompanying research** adjusting itself to iterative process and shifts of emphasis

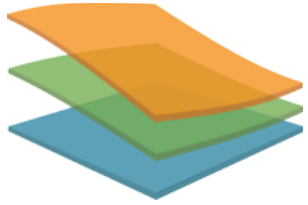


## ... adjusting the tasks of accompanying research during the iterative processes

- Initial stakeholder interviews
- Co-design workshops => Change of design idea
- Training schemes
- Support for piloting with LL tools => Learning Toolbox
- Outreach activities
- Continuing dialogue
- Documentation and reporting







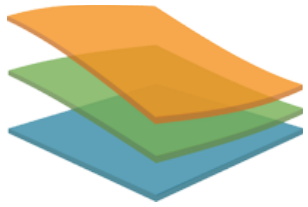
# Conceptual support for project activities in the Construction pilot

**Context:** Learning Layers “Theory Camp” in RWTH Aachen (March 2014) – preparation, workshops and follow-up

- Revisiting the legacy of earlier approaches to accompanying research (*AuT-Begleitforschung*; *Modellversuchsforschung*);
- Revisiting the legacy of *Work Process Knowledge network*, EU FP 4, Targeted socio-economic research (1998 - 2002);
- Revisiting conceptual approaches to *action-oriented learning* (*Handlungsorientiertes Lernen*) and *self-organised learning*;

=> Commentary notes, working papers, contributions to final deliverables (Methodology documents; Scenarios and models)

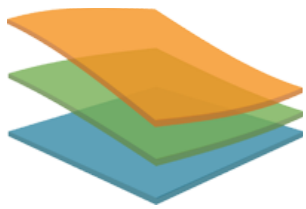




# Revisiting the legacy of the Work Process Knowledge network

Origins and achievements of the WPK network:

- **Case studies:** *'discovery' of learning potentials* of skilled workers, teams and cross-organisational cooperation in change processes (Boreham, Fischer & Samurçay 2002).
- *The key concept 'work process knowledge' - collective, boundary-crossing and cross-organisational knowledge processes and patterns of collaboration* that emerged in work processes (Fischer & Boreham 2004).
- **The findings** were *brought together* and interpreted in a period that favoured *basic research* on innovations in working life. It was followed by more utilitarian research agendas and finding periods.



# Making use of Learning Toolbox in vocational training and learning

**Construction Pilot: testing** Learning Layers

**Impact 1: Expectations/ Achievements**





What were the initial wishes/ expectations of the Bau-ABC Rostrup trainers on digitisation of training materials and reporting procedures?

- Complete digitisation (working documents, key resources, worksheets),
- Easy access for apprentices, clean and creative reports
- saving time on reporting and administration




What has changed during the project - what has been achieved and what not?

- From digitisation of documents to Learning Toolbox for using/sharing resources
- Blogs as the first step towards digitisation of learning contents
- Learning Toolbox easy to use - both for trainers and for apprentices.




What has changed during the project - what has been achieved and what not?

- Blogs as the major source of digital contents - choice of advanced bloggers.
- Learning Toolbox as toolset for learners - organisational measures are needed

**Construction Pilot: testing** Learning Layers

**Impact 2: New Integrative Initiatives**

The idea of a joint project of carpenters and bricklayers with an integrative construction task:



**Why? - Why not?** "We started the project sitting together. We discussed about where our work has similarities, where it has overlapping. Then we compared existing projects and discussed where we can connect the projects. This is when the "Holzrahmenbau" project came to live with the fine barrier requirement. And then we thought how we could implement this for our apprentices."

**How - content-wise?** In this stack we had two trade-specific stacks for brick-laying, containing detailed information like the required mortar, and one stack for wooden construction, also with the detailed information like drawings".

**How - with Learning Toolbox?** "Using LTB, we [the trainers who took part in the joint training project] recognized that we could much better connect ourselves with other trades or projects. That was a real advantage and without LTB these joint projects would not have taken place so fastly."

**Impact on the learning of apprentices?** "[...] for us trainers the most important thing was the increased understanding of the other trades: The carpenter apprentice suddenly understands the impact of his work for brick-laying. He can make the connection, he realizes "hm, my wooden construction needs to be fireproof, that is difficult, but hey, I could lay bricks in between!"

**Bottom line:** "With this joint project and LTB, apprentices understand the "why:"

**Construction Pilot: testing** Learning Layers

**Impact 3: Different pedagogic accents**

Shared pedagogic commitment to action-oriented learning and to self-organised learning - yet different pedagogic accents?



**Findings (quotes) from evaluation studies (interviews and focus groups)**

**a) LTB as a "well" - wide access to resources & explorative learning**

"LTB allows us to guide apprentices to find the webpages and links for certain topics for their needs [...] it makes it easier for the apprentices to learn whenever and wherever they want as the whole material is constantly available on LTB [...]"

"We have to trust in what the apprentices are doing and we have to remember that we cannot control everything. They will grow by what they are doing and not by what we tell them to do and not to do. The apprentices shall be allowed to try things out and also to make mistakes"

**b) LTB as a "watering can" - selective access and gradual opening**

"You have to arouse interest of the apprentices, it has to make sense and supportive for specific cases what you put in there! There should not be too much content in the LTB, [...] Putting everything in there is simply too much. Stacks should be build related to specific projects, not all content in one stack"

"As an example, when you provide photos to the apprentices illustrating an example how to lay bricks, they take it as a template and not inspiration. You have to instruct them well, you need to provide such instructions in LTB, a.g. with a text 'do not copy, it is an example'".

**Active piloting:** *Getting ready to use Learning Toolbox (LTB) in selected apprentices' projects; Shaping integrative projects; Setting different pedagogic accents with Learning Toolbox*

# Making use of Learning Toolbox (LTB) in workplace learning and new training initiatives

Three major strands of Learning Layers follow-up:

- **Company-specific pilot projects** with studies on different work processes (*Betriebsbezogene Analysetage*) and subsequent participative co-design workshops (Firma H.)
- **Joint curriculum design** by guest lecturers of CVT schemes and use of LTB as the learner-interface for accessing contents
- Joint development of **core curriculum** and core contents **for training in health and safety** (*Arbeitssicherheit und Gesundheitsschutz*) across different occupational fields

# Learning Toolbox (LTB) vs. older and newer innovation agendas

How to locate the work with LTB vis-à-vis older and newer innovation agendas (see Ahrens & Gessler 2017):

- a) *Humanisation of Work/ Arbeit & Technik* – remedial or counter-steering initiatives alongside the ‘mainstream’
- b) *Learning organisations/ Lernkultur Kompetenzentwicklung* – putting the main emphasis on organisational potentials
- c) *Industry 4.0* - Emerging innovation agendas based on networked production processes and tool configurations

# Reflections on 'Industry 4.0' from the point of view of social and educational research

Insights into R&D contributions to '**Industry 4.0**' from the *perspective of socio-technical design/ learning at work*:

- a) **Hirsch-Kreinsen**: Techno-centric vs. socio-technic scenarios  
=> polarisation vs. upgrading of competences (*scene-setting*);
- b) **Stich, Gudergan & Senderek**: Shaping of networked production systems as chance to create new spaces for technology-enhanced learning (*project ELIAS*);
- c) **Ahrens & Gessler**: Shaping work-related learning opportunities for learning-restrictive work contexts.

# ‘Construction 4.0’, ‘BIM’ and implications for construction work and education/training

Open questions, tensions and implications for construction work *and* learning potentials at work:

- a) **‘Construction 4.0’**: Building Information Modelling (BIM) vs. Production intelligence of skilled workers?
- b) **Training** for *‘lean construction competences’* or for *‘mastery of complex construction projects’*?
- c) **Technology-enhanced learning** as means to support *‘lean vocational learning’* or *‘enhancement of work process knowledge’*?

## The research claims

The paper has argued that the Learning Layers' Construction pilot is a special case vis-à-vis older and newer innovation agendas in the light of the following claims:

- **'Accompanying research'** has been strongly in search for *innovations in practice* to promote *knowledge development*.
- The theme **'work process knowledge'** has been central for the co-design, for the use cases and for the follow-up pilots.
- The Learning Layers' **Construction pilot as a project** has been a recent mixture of older and newer innovation agendas.
- The theme **'Construction 4.0'** is characterised by tensions re. design principles, training and technology-enhanced learning.



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