Agility and Semantic Structures to Scaffold Modern Academic Education

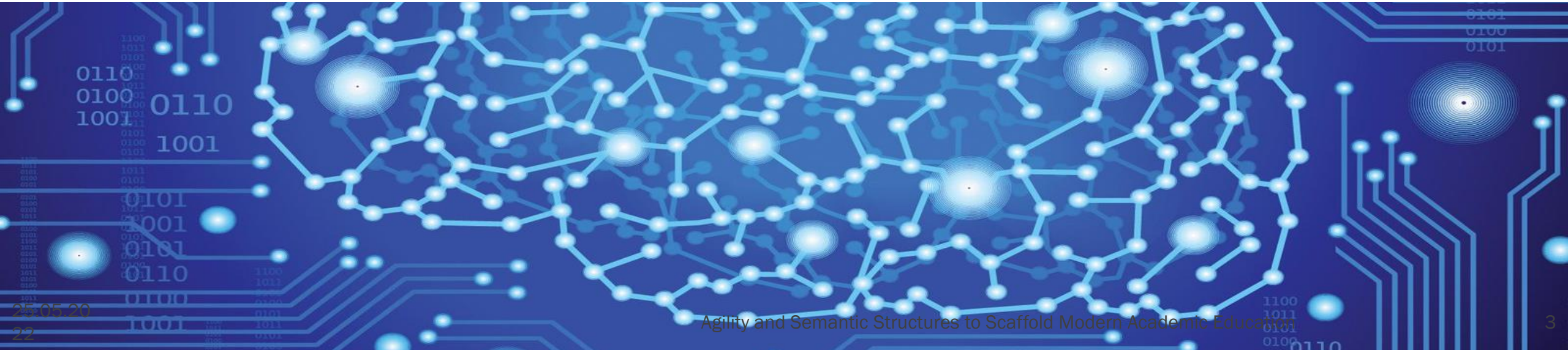
Supporting the Digital Transformation in Higher Education Institutions

Prof. (FH) Karsten Böhm, Keynote at ICAS 2022, 25th May 2022

Agenda

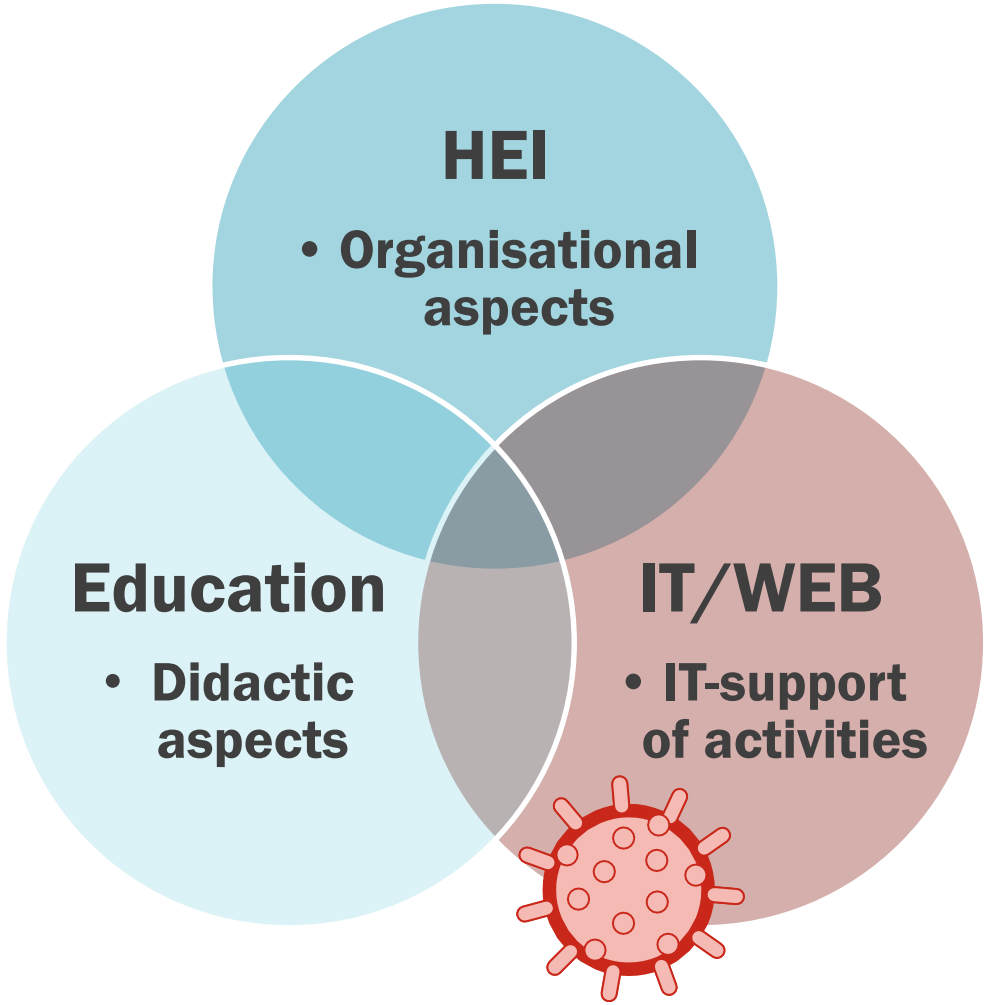
- The current situation of HEI in a VUCA world
- Agility in the execution of education programs in HEI
- Structural agility for increased ability to adapt
- Conclusion and Outlook

The current situation of HEI in a VUCA world



Introduction & Context of this Research

- Coming from the context of a lecturer, program designer and researcher in the field of IT-based KM
- During 2020 as a result of the COVID-19 pandemic the importance of IT-supported teaching became SUDENTLY prominent & mission critical
- Challenges and problems became MUCH MORE evident.
- Question arose how to support HEIs in a better way by IT-supported Knowledge Management (in the future).
- Traditional HEI practises were being challenged and they still are (“post-pandemic”)



Source of COVID-Icon: https://commons.wikimedia.org/wiki/File:Coronavirus_icon.svg

VUCA as a way to describe the world

Volatility – Uncertainty – Complexity – Ambiguity

- (V) – Volatility in HEI
  - changing topics that are concerned relevant and/or interesting by stakeholders (students, companies),
  - volatile group sizes with diverse backgrounds
  - programs are designed and funded in the long run – adaptations are difficult

- (U) – Uncertainty in HEI
  - external drivers like the digital transformation, the lasting effects of the COVID pandemic
  - changing expectations of future generation of students, working students, lifelong learning
  - topics and education profiles are changing and new job profiles are emerging
  - development and financing phases is not designed for such an uncertain environment

VUCA as a way to describe the world (continued)

Volatility – Uncertainty – Complexity – Ambiguity

- (C) – Complexity in HEI
  - In most engineering programs increasing complexity of the fields in terms of subjects becoming broader
  - subjects having a deeper level of knowledge that is needed to master it.
  - educating students becomes a challenge, as the time for education remains the same. Lecturers need to select and curate content and moderate the learning process more carefully.

- (A) – Ambiguity in HEI
  - fast-evolving knowledge domain in many [new] subjects.
  - [new] Concepts like Digital Transformation, Artificial Intelligence and the Cloud technologies with multiple meanings and require different levels of knowledge to become actionable.
  - Understanding those concepts and applying them in real-life scenarios if often the requirement

VUCA as a solution space

Vision – Understanding – Clarity – Agility

- (V) – vision to address volatility in HEI
  - guidance as USP is needed to navigate through changing topics
  - important to develop applicable knowledge, or to employ a guiding attitude to the education
  - vision needs to be employed in practice – need to become a cultural value in the HEI.

- (U) – understanding to address uncertainty in HEI
  - active and ongoing reflection process on the requirements of the application domain
  - Understanding expectations and requirements of the current and next generations of students
  - interplay and a communication of values between different generations: lecturers (“older generations”) and students (“newer generations”).
  - in a VUCA world this process is being accelerated and in the sense of a dialogue becoming more important

VUCA as a solution space (continued)

Vision – Understanding – Clarity – Agility

- (C) – clarity to address complexity in HEI
  - by building on existing knowledge and by employing scientific methods
  - objective view of the world help students to provide orientation in a complex and changing world
  - convey important tool-sets to navigate in that world at topics that they are faced later in their life

- (A) – agility to address ambiguity in HEI
  - important on the strategic level (for the development and adaptation of programs)
  - Important at operational level (the execution of programs).
  - tailored to the specified group of students and even towards the individual using learning analytics and digitization of learning environments to provide additional or alternative learning paths.

Agility in the execution of education programs in HEI

Agility and Learning?

- Learning is not a straight path and requires loops to reflect and learn from past experience, even failures.
- Learning‘s an individual journey.
- Learning and Teaching in Higher Education is often carried out in a one-size-fits-all manner and assumes to be a straight line from the first lecture to the final exam.

Image Source from PXHERE: https://pxhere.com/de/photo/1088522

Learning in the Technology Domain, mostly Information Technology

- Challenges and Drivers to Learning in the Technology Domain
  - Highly Dynamic – new technologies emerge all the time
  - Increasing Complexity – technologies become more powerful but also more complex (and thus hard to teach)

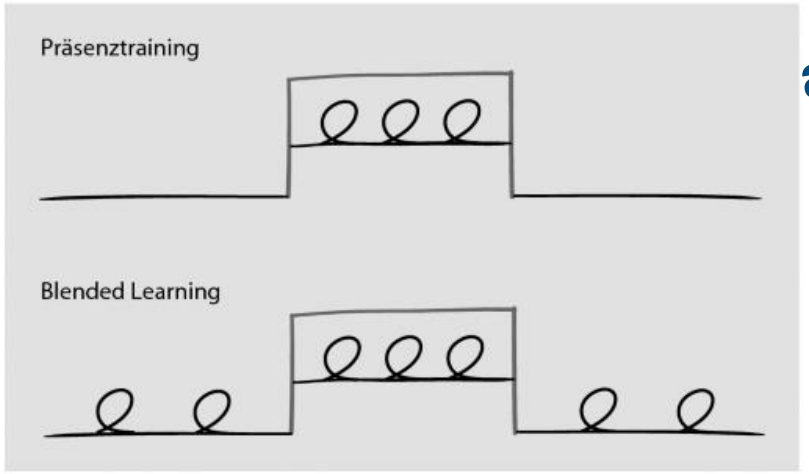
"Learning to learn" becomes as important as "knowing what is known today"

- One way of approaching those challenge is Problem Based Learning (PBL): self guided learning in which the solution of a problem is in the primary focus.

Image Source from PXHERE: https://pxhere.com/de/photo/140

Core Idea: Combining Iterative Learning & Agile Development Processes

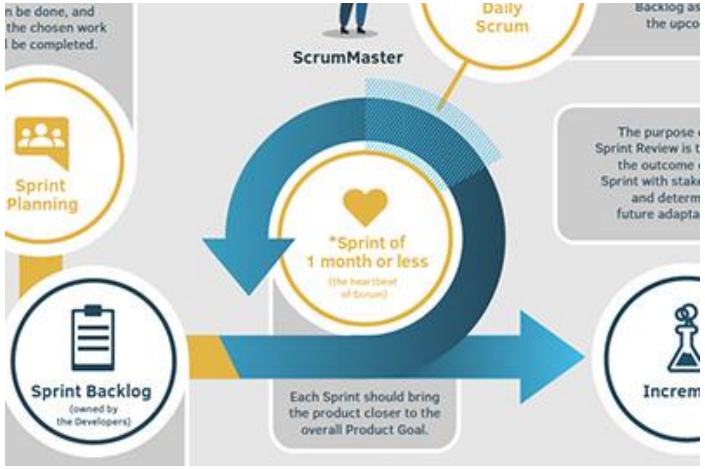
Learning Loops in the field of (adult) education (German „Lernschleifen“)



Source: Sammet, J; Wolf, J.: “Vom Trainer zum agilen Lernbegleiter”, Springer, 2019 (in German)

The Loop as essential Element

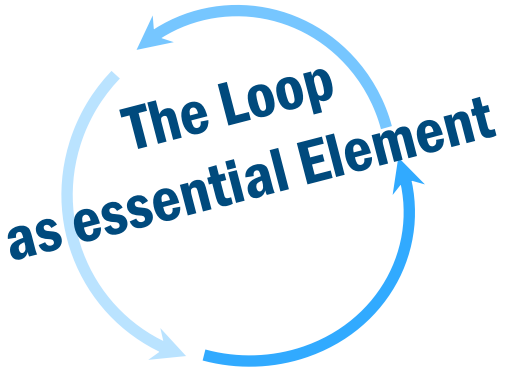
The SCRUM process in the field of agile software development

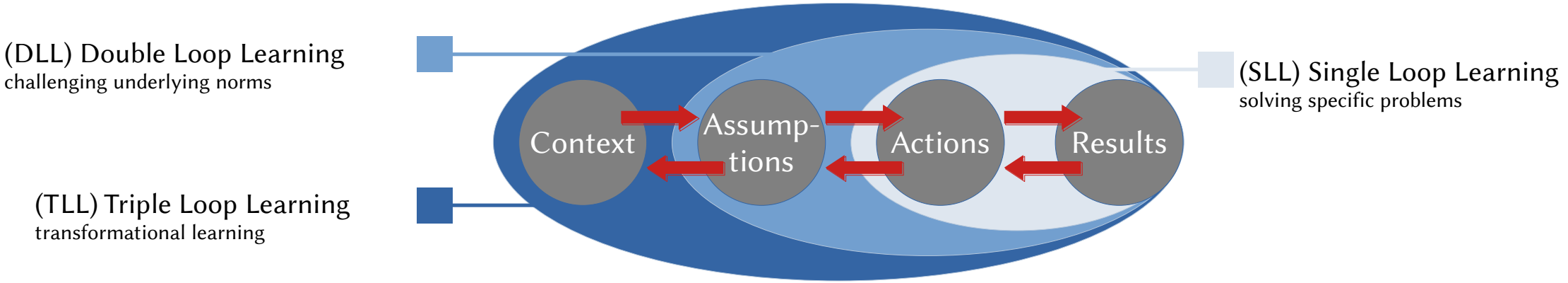


Source: The Scrum Alliance, 2021, https://www.scrumalliance.org/about-scrum/framework

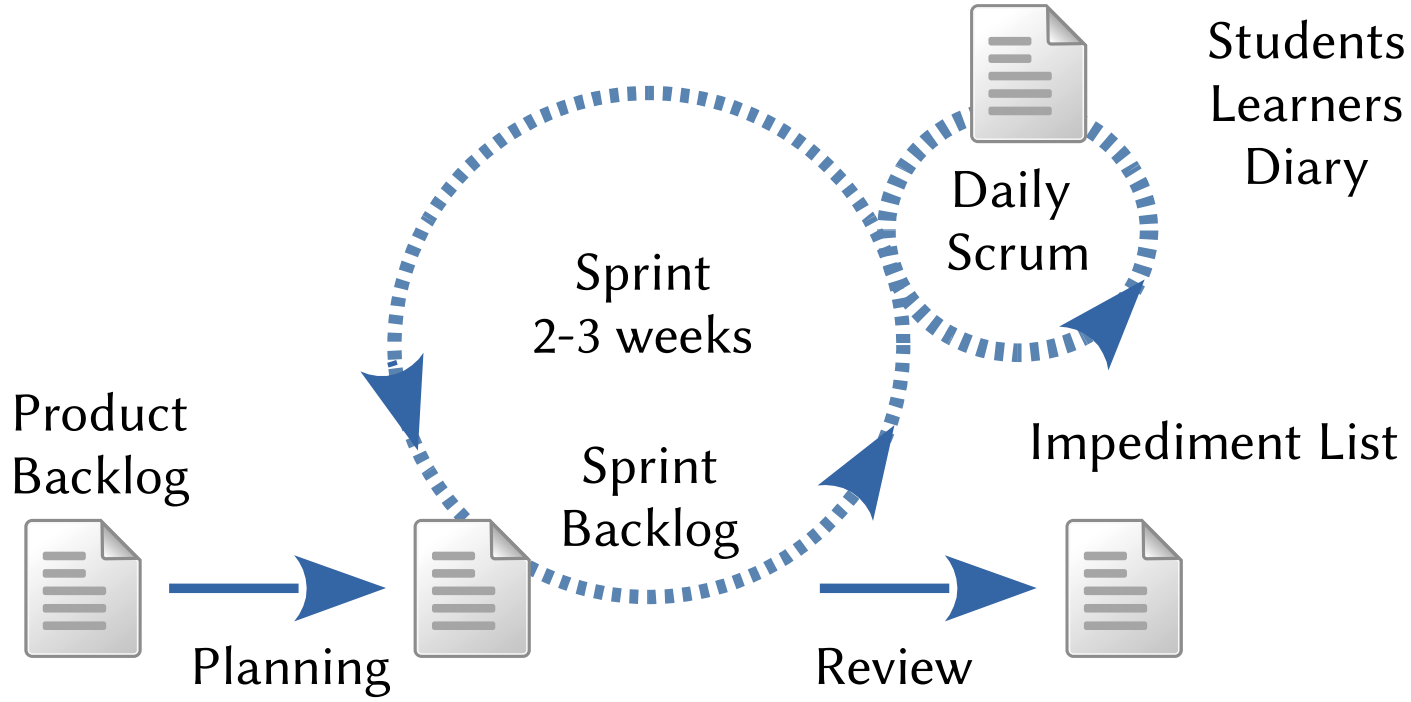
The Core Theory: Loop Style Learning Methods

- Defined by Chris Argyris to describe learning in organizations
- Later adopted in the education domain
- Especially suitable for PBL (SLL) and beyond (DLL,TLL)
- TLL as the ultimate goal for higher education





Idea for Agile Learning Loops – ALL: a combination of both worlds
The Sprint – iterative Learning from experiences



Two Current Application of ALL

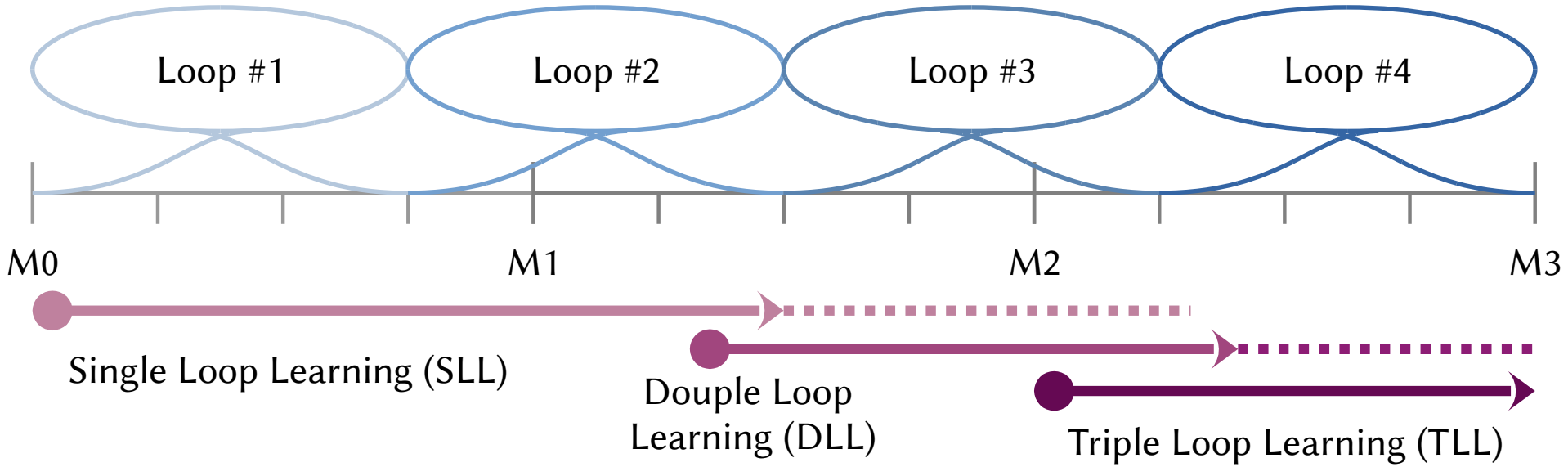
- Individual Practical Projects
  - Aiming to stimulate self-guided learning for students during their early studies
  - Leaving their learning comfort zone – brave on trying new projects
  - Providing ‘topical freedom’ in a structured curricula
  - Individualization of studies

  - **Aiming to learn**, including failure with respect to the original goals

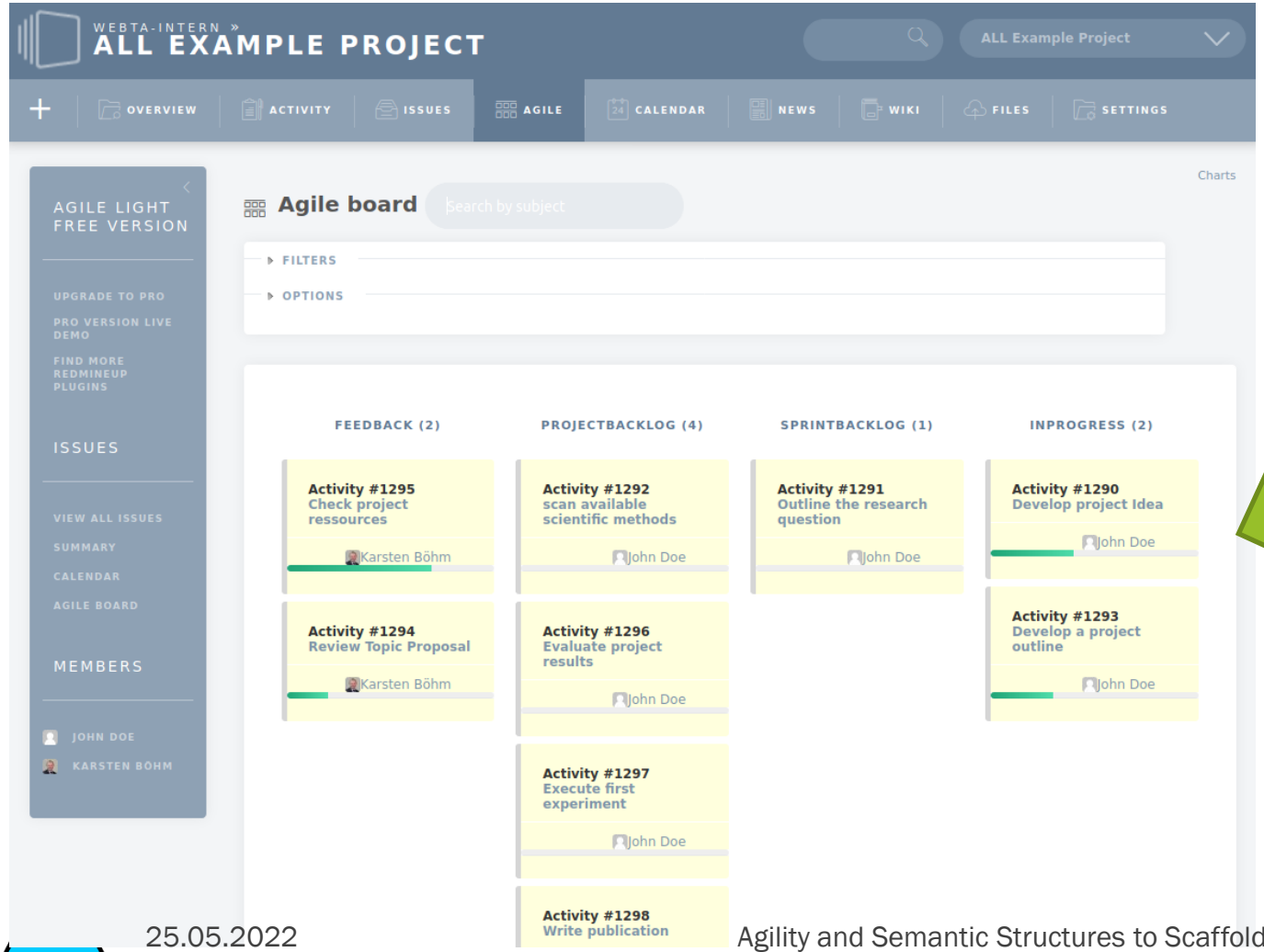
- Theses at Bachelors/Masters Level
  - Aiming to deliver the final and most complex research work of the student during her or his studies
  - Guided by supervisor
  - Student driven activity
  - Problem based learning activity

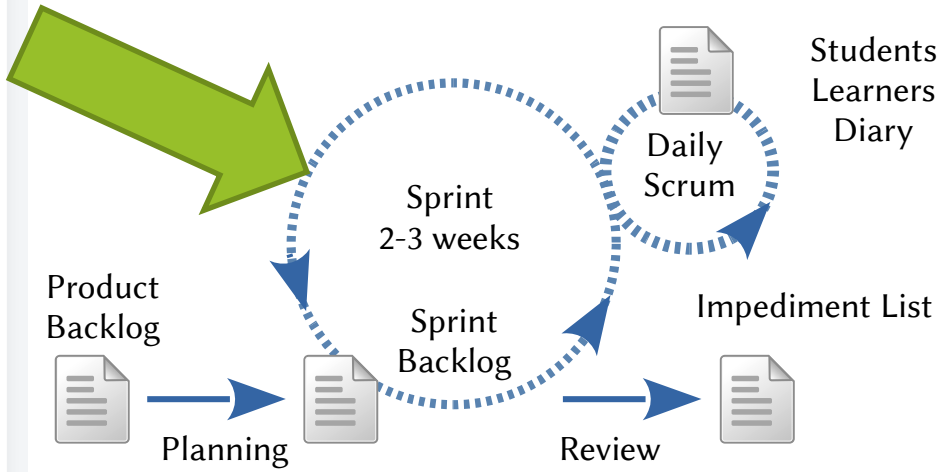
  - **Aiming to succeed** (in time and scope)

ALL in the Higher Education in the course of a Semester

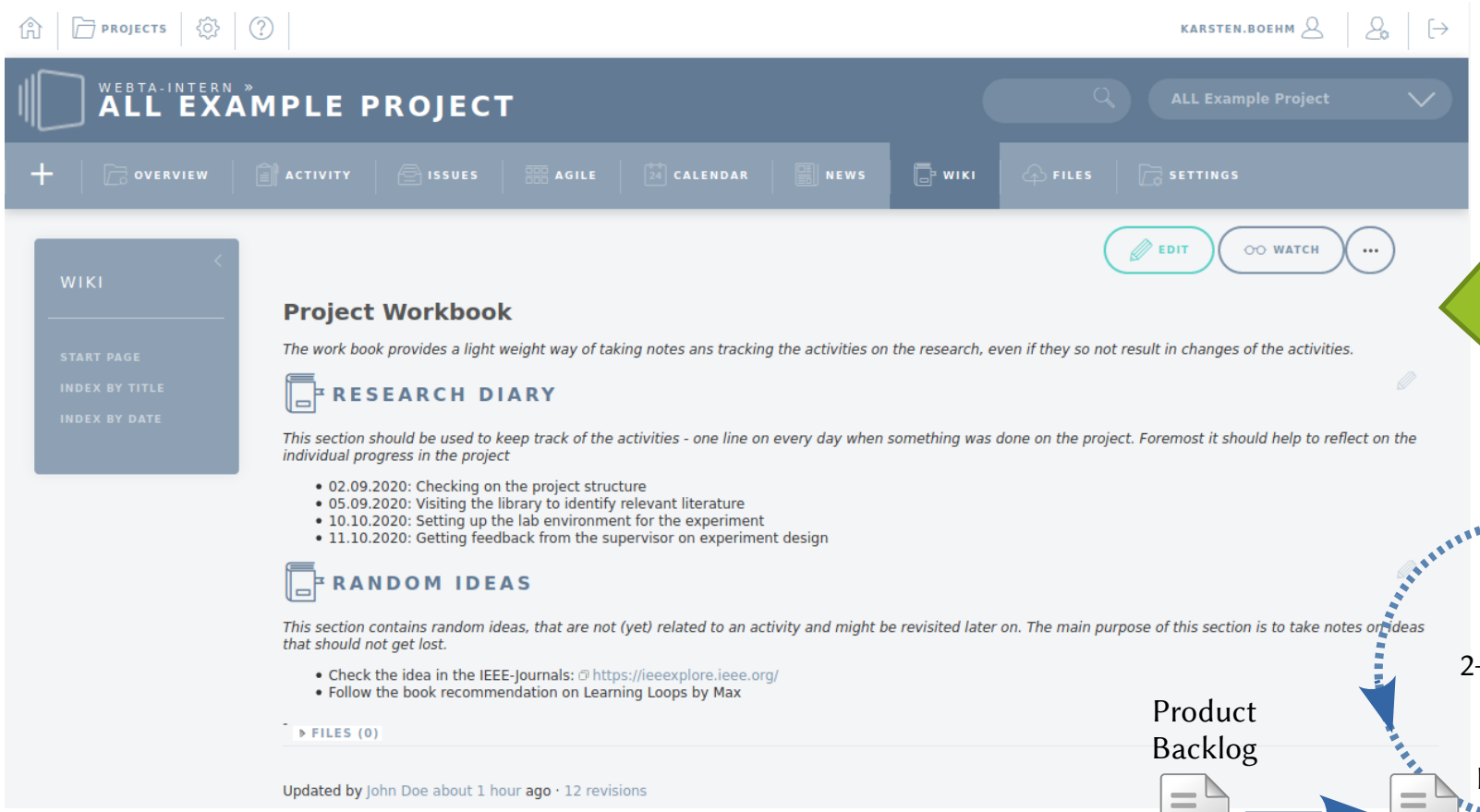


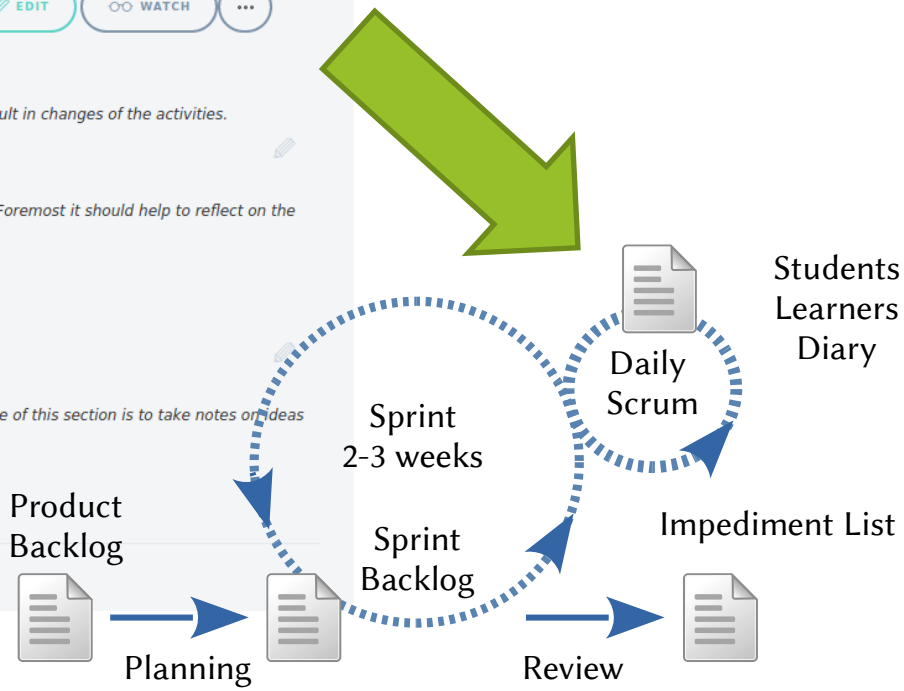
ALL – Technology Support Examples





ALL – Technology Support Examples (continued)





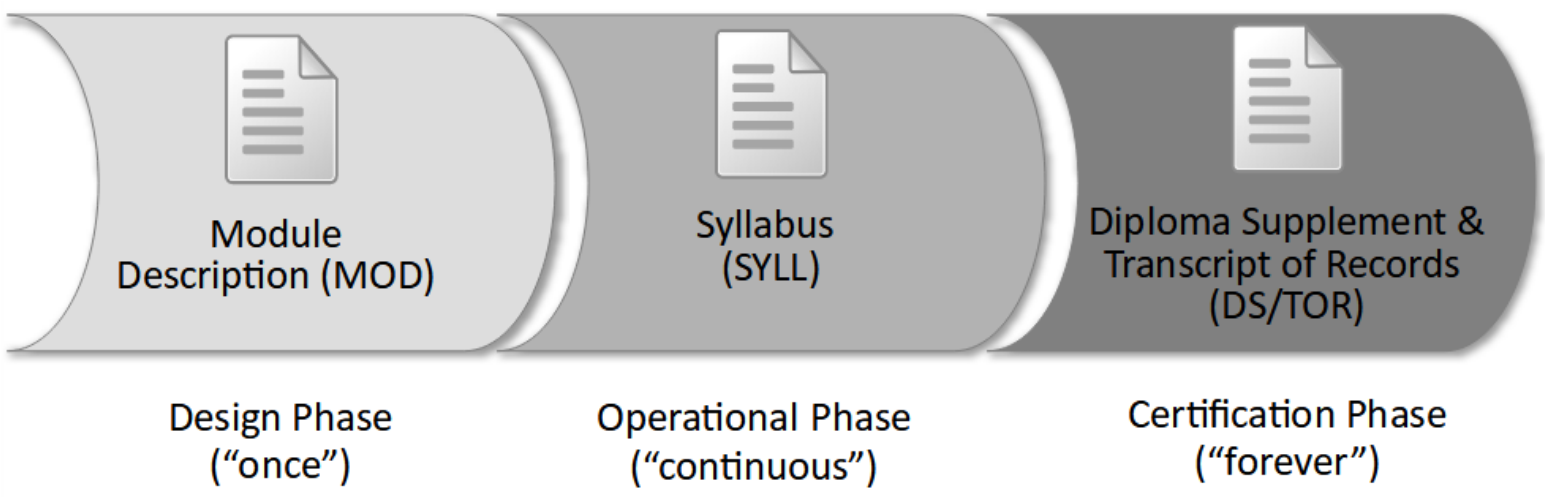
Structural agility for increased ability to adapt

Introduction to Structural Agility

- Study programmes in Higher Education Institutions (HEI) offer qualification programs in a number of different domains
  - From a KM perspective that's Knowledge Transfer and Knowledge Sharing from the HEI to the students and Knowledge Creation by students
  - Knowledge intensive by nature and orchestrated by the study programmes
  - Defined by a bunch of defining documents (curricula, program specifications etc.) that represent externalized knowledge
- Current challenges are the increasing dynamics of the sector and the digital transformation of education
  - Different levels of abstraction in the definition – trend towards competence oriented teaching
  - Different stakeholders at design time and execution time – with often little knowledge sharing between different lectures/lecturers leading to inconsistencies
  - New support structured needed, e.g. for e-Learning courses and integrated learning analytics

Defining documents & Phases of Study Programs in HEI

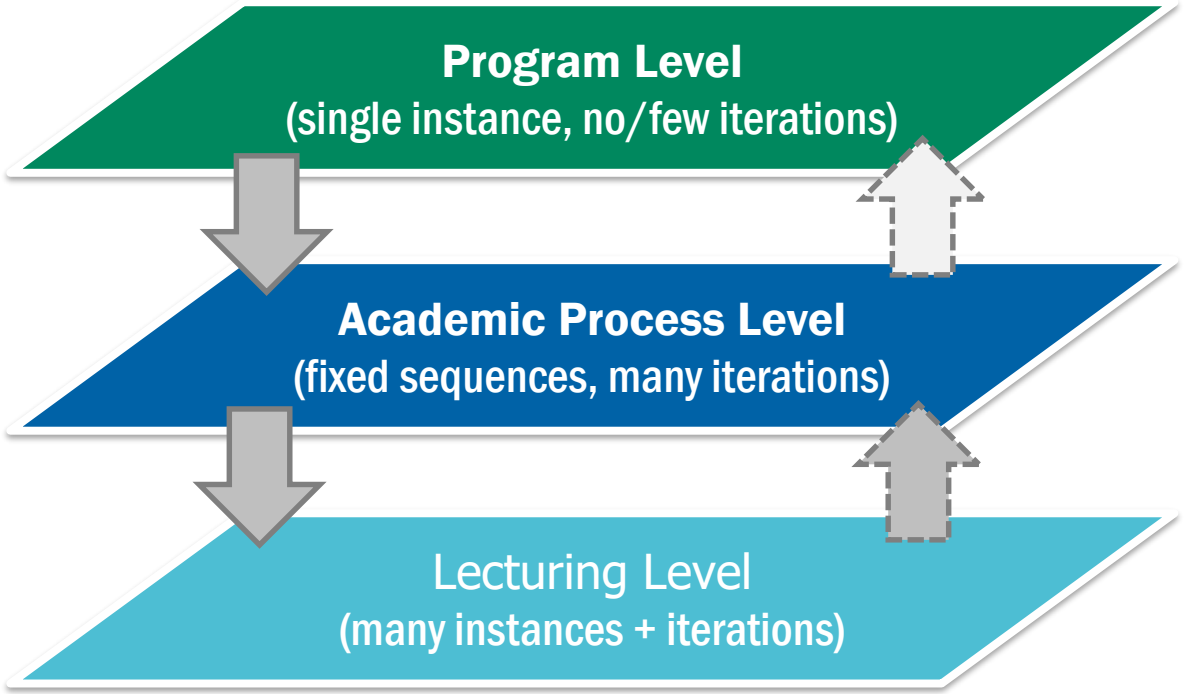
- Analysis of (Austrian) study programs shows
  - A number of important specification documents and
  - Three phases that occur during the lifetime of a program



- Noteworthy to mention that all activities are document based often without any systematic structure or IT-system support
  - leading to unconnected concepts, duplicates and inconsistencies

Overview on the Potential of Semantic Web Technologies in HEI

- Important: Most documents in HEI are semi-structured and suitable for the support with Semantic Web representations, but this potential is NOT used widely
- HEI world from a more abstract view:



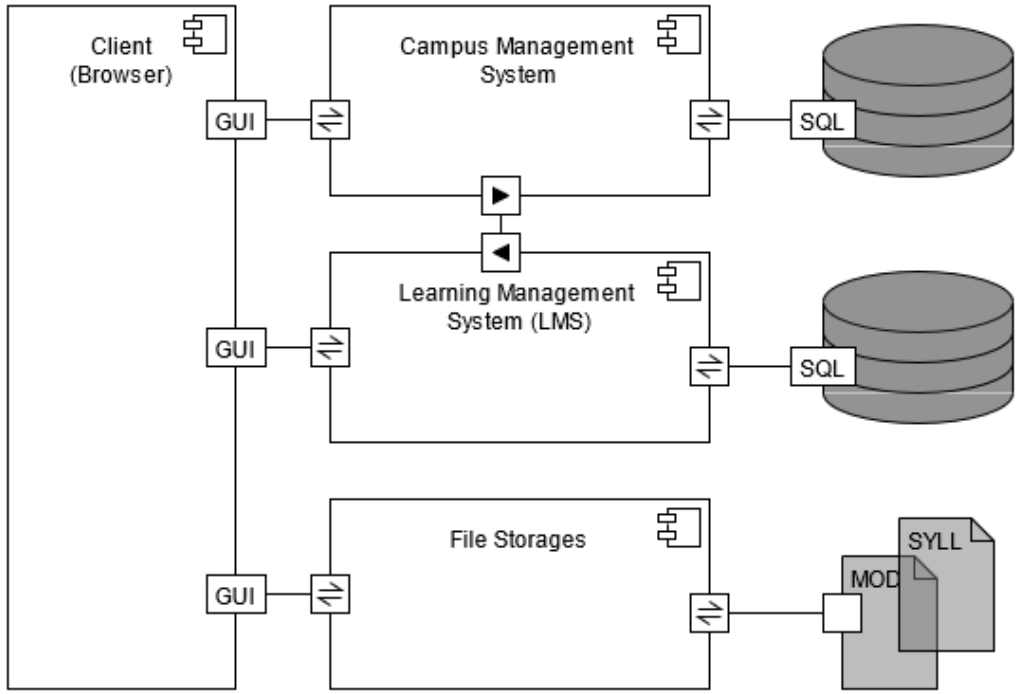
<u>Design-Time</u> (Scope: Academic program): focussing on competences, learning objectives, market requirements – the "Big Picture"
Output: [unstructured] Documents/Web-Pages

<u>Planning-Time</u>/Scope: Semester: focussing on timing & resources (persons, rooms, tools)
Output: artefacts in different systems (appointments, mails campus systems, …)

<u>Execution-Time</u>/Scope: Individual lecture: focussing on content, assessment, didactic methods
Output: wide range of digital and often unconnected digital artefacts (e.g. learning materials, grades, video-resources)

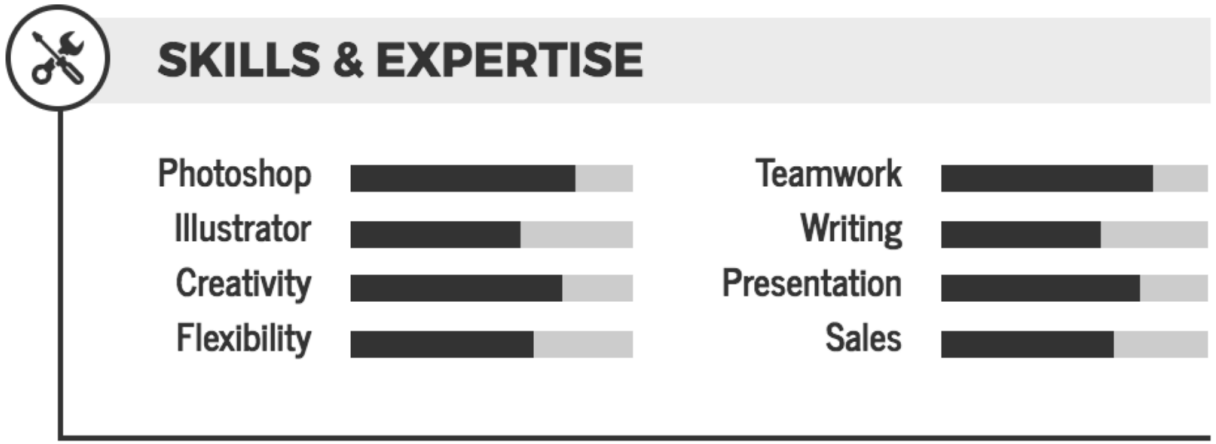
Current Approaches & Solutions from a generic perspective

- Typical setup of a IT landscape in a HEI
- Different systems for various purposes and stakeholders
- Integrated in Browser-based clients
- Usually a structured slow-paced development (external or internal)



Competence Matrices as a Common Structure

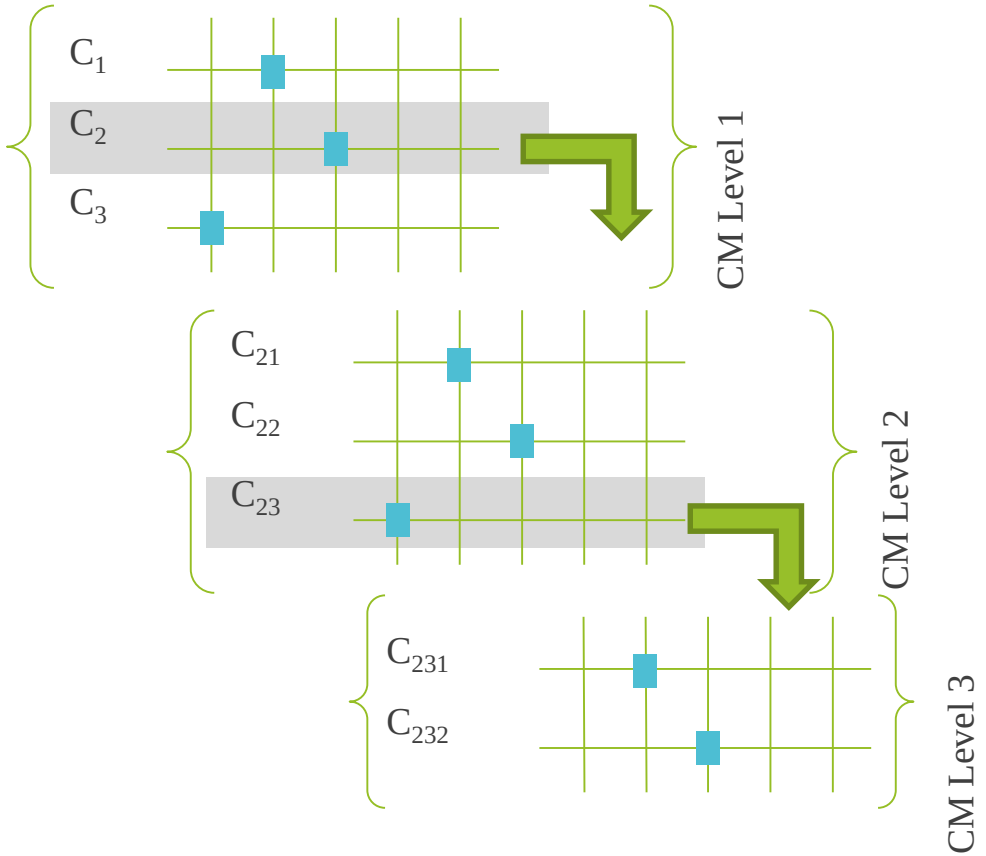
- Structural description of programs are built around learning outcomes
- Usually encoded in text and less formalized
- CVs often use competence matrices (CM) to visualize type and level of skills in an easy to comprehend structure



- Structurally similar approach with Blooms taxonomy with different levels (remember – understand – apply – analyse – evaluate – create)
- → could be used for programs combining Bloom and CM

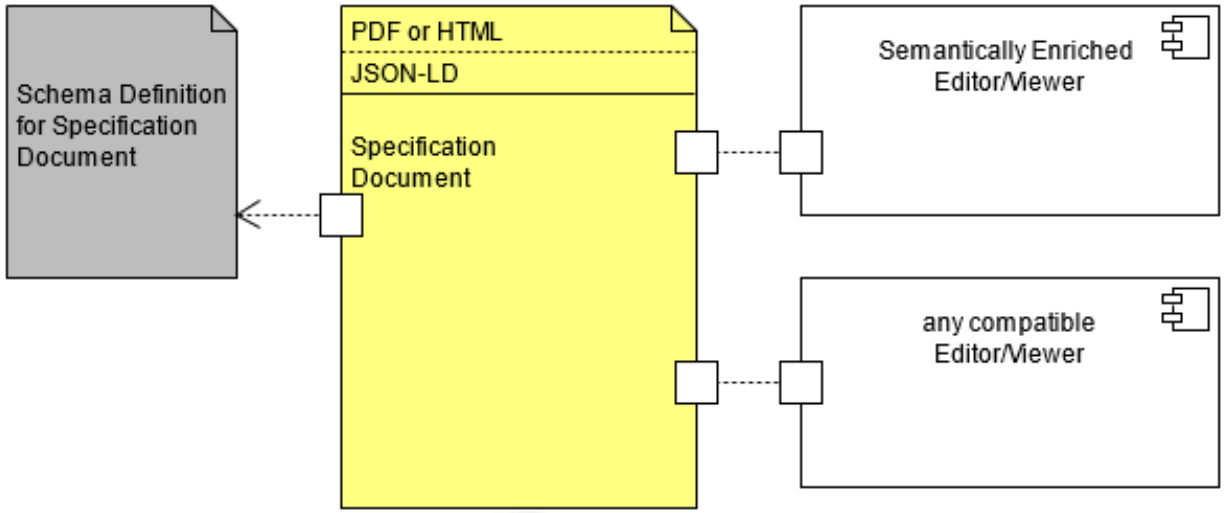
Hierarchical Concept Matrices (HCM)

- Building on the CM approach we realize that learning outcome are usually organized in a hierarchical way
- Top-Down: Module – Lecture – Unit (generic to specific and vice versa)
- Could be used to build an hierarchy of connected CMs → HCM
- Leads to a consistent backbone structure over all levels that supports modelling and execution



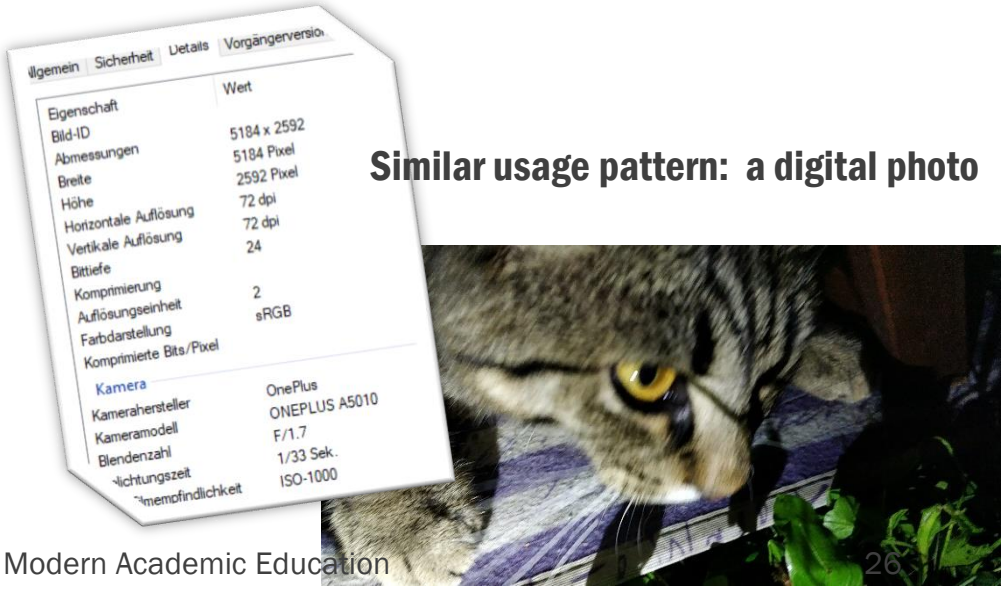
PreBuilt Information Spaces for education – Step I: Robust Web-based semantic documents

- Concept of a Semantic Specification Document (SSD)
  - Self-contained (content + semantic information)
  - Agnostic to semantic tooling
  - Robust local edits (only client needed)
  - Ease of use & low entry barrier (Browser-only, no Semantic Web knowledge needed)
  - Instances only, Schemas predefined



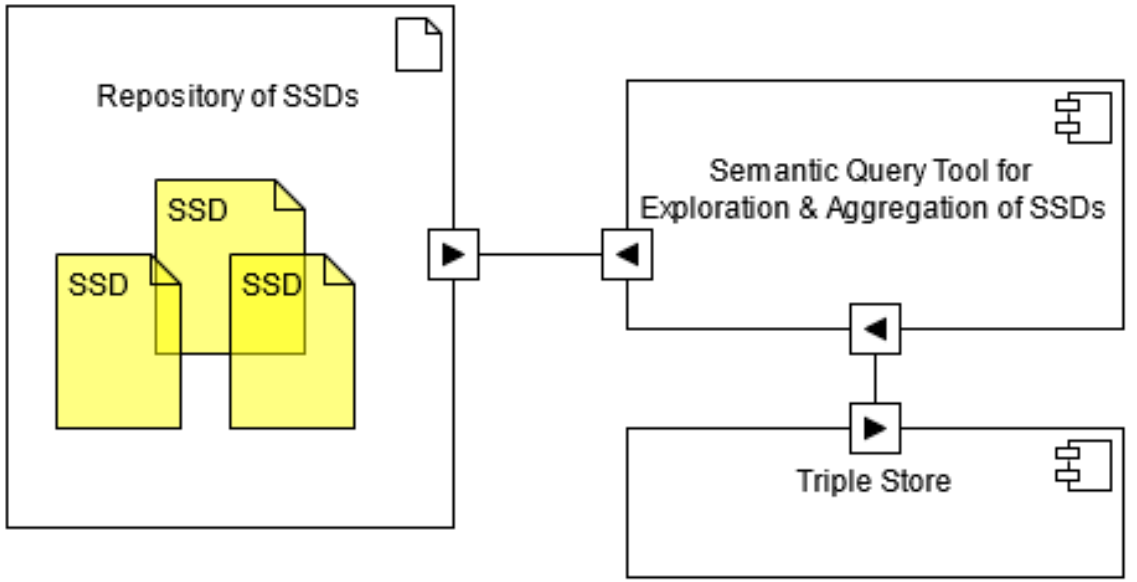
- A SSD contain a single description of a MOD or SYL
  - Local information on the instance level
  - Can easily be shared (as any other document)

Similar usage pattern: a digital photo

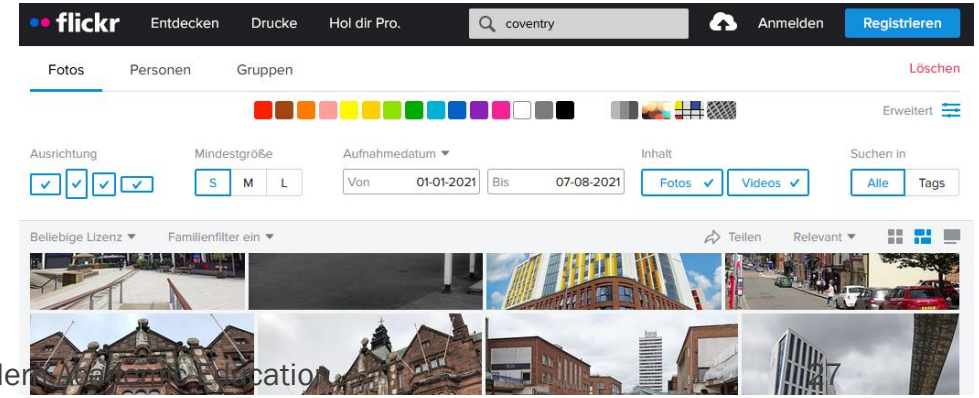


PreBuilt Information Spaces for education – Step II: Aggregation of documents

- In order to go beyond instance view, an aggregation of the SSDs is needed (the notion of Linked Data)
  - Connects the semantic information of the individual SSDs in a common place
  - Enables aggregated queries and view as well as consistency checks
  - Web-based Client/Server-system but still agnostic to a specific system → open to integration in existing systems via data transformation & filtering

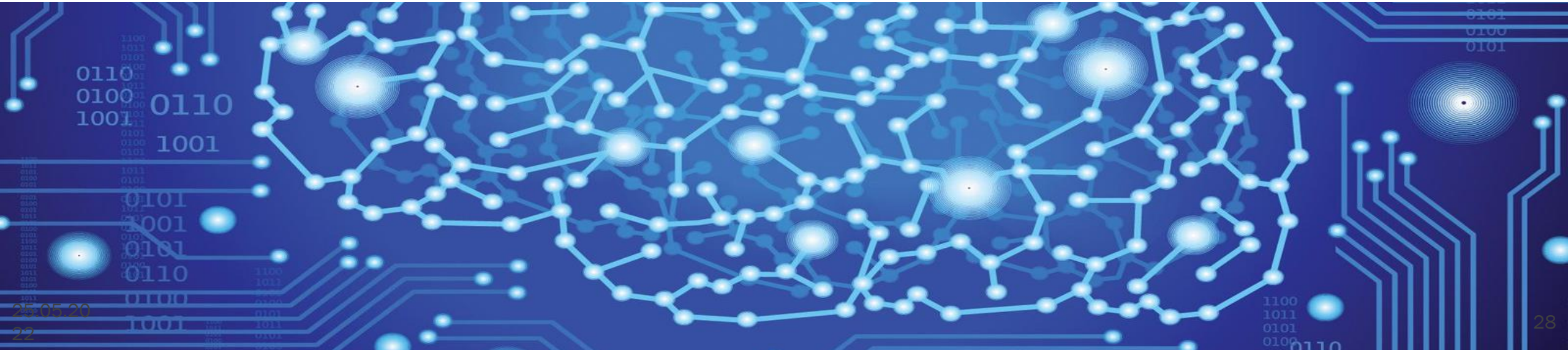


Similar usage pattern: Flickr as platform



- Aggregation results in a in prebuilt information space that is supporting knowledge structuring in a HEI

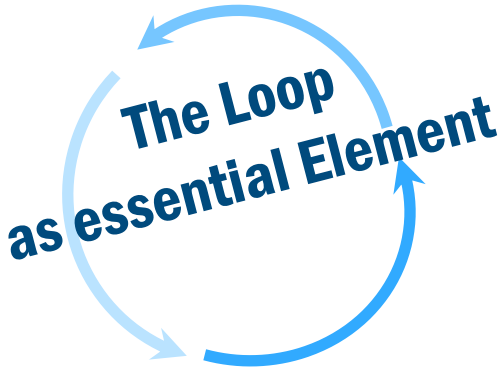
Conclusion and Outlook



Summary // Outlook // Q&A

- **Summary:** Outlined a concept for scaffolding modern education in HEI to address the VUCA properties of the environment, focusing on agility on the execution level and the structural level.

- **Outlook:** Research is continued into three dimensions:
  1. Empirical research on the impact on ALL on student performance
  2. Realisation of the Pre-Built Learning Environments using HCM
  3. Application in the own HEI and lecturing activities



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