

Intellectual Output 3

Development of constructively aligned courses
in the domain of Industry 4.0

Multiplier Event – E3



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Agenda

- O3 as for proposal
 - Output description
 - Division of work
- O3 implementation
- O3 in the context of the project
- Results:
 - Suggested Intellectual Learning Outcomes (ILO)
 - Suggested Teaching and Learning Activities (TLA)
 - Suggested Assessment Tasks (AT)
- Summary of the proposed educational units and plan for implementation





Output description

- O3 addresses the identified gap and mismatches by developing learning material for different courses which includes the technologies and applications identified in Intellectual Output 1 and organizes them according to the results of Intellectual Output 2.
- Courses will include:
 - Specifically designed, up to date, learning content-case studies featuring the existing implementation of **Industry 4.0 technology** in industry
 - Specific reference to the **sustainability** dimension.
- Each course will be designed and described according to **Constructive Alignment (CA)**.
 - Outstanding principle for devising effective and efficient pedagogical activities in higher education emerging from the work of J. Biggs.
 - Builds upon two main concepts: the **constructivist** understanding of the learning process and the practical need for **aligned** and **outcome-based** curricula designing.





Division of work

- KTH work package leader
- All the partners included in relation to their specific technical expertise.
- O3 is composed of 4 main tasks:
 - **Task 3.1: Design of learning material.**
 - > *Develop learning material both theoretical and methodological for each of the suggested technologies and based on the the learning outcomes identified in O2.*
 - **Task 3.2: Design of case studies.**
 - > *Develop course material in the form of case studies featuring current industrial implementation that enhance the sustainability of the related industrial operation. This for each of the proposed technologies.*





Division of work

- **Task 3.3: Workshop in constructive alignment (C1).**
 - > *Specifically designed workshop (in Stockholm) to acquire or refresh knowledge in CA. This will allow a homogeneous approach to the description and instantiation of courses across different institutions.*

- **Task 3.4: Course development.**
 - > *This task implements the results from Task 3.1 and Task 3.2.*

- All the learning material and case studies produced will be described as single, independent **educational unit** featuring a stated Intended Learning Outcome (**ILO**), and related Teaching and Learning Activities (**TLA**) as well as Assessment task (**AT**). This will include also a set of suggested **grading criteria** that could be customized to the audiences at different institution.



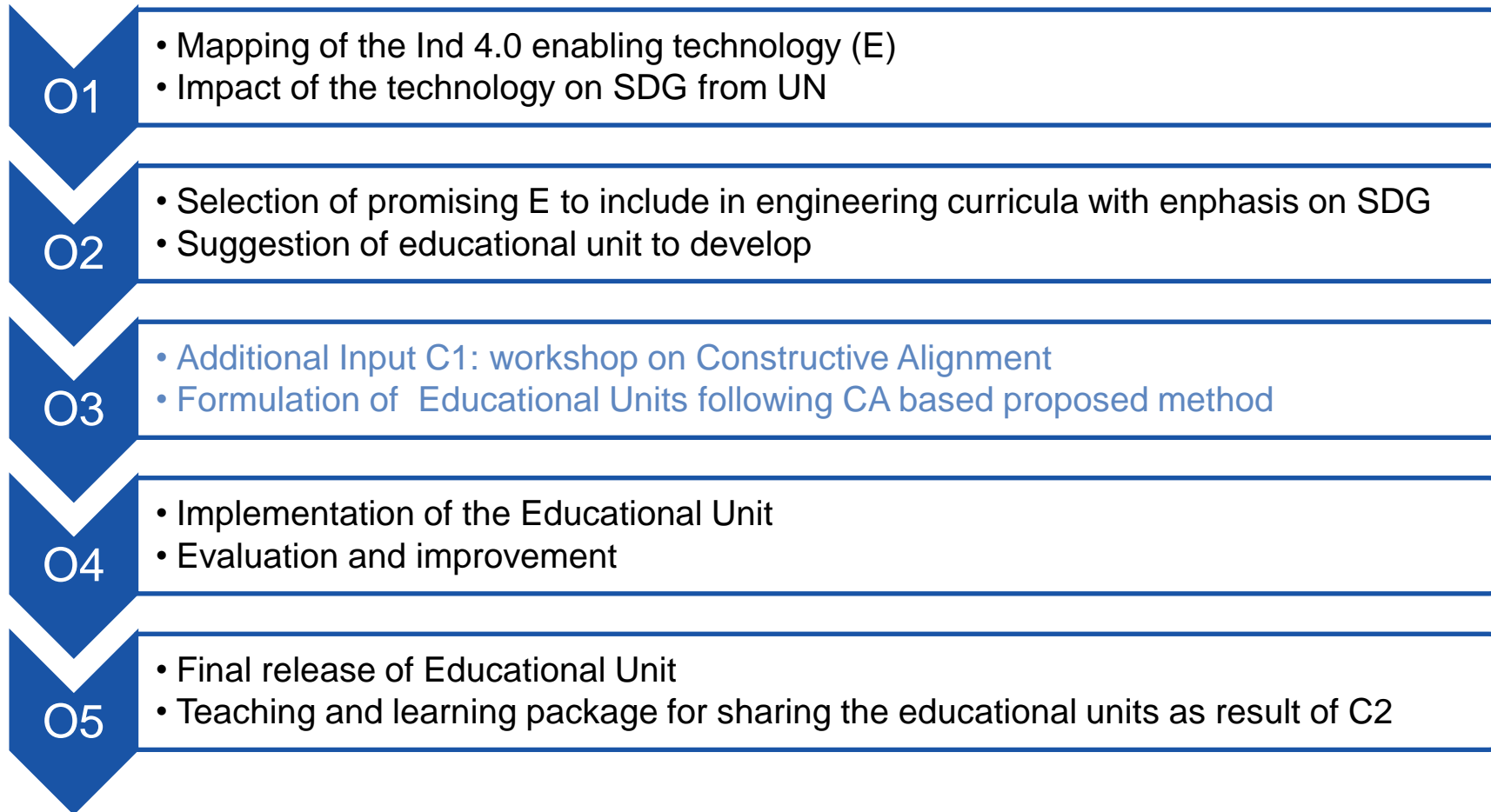


O3 implementation

- The activity in the O3 was on some extent affected by the Covid-19 pandemic.
- Alternative activities put in place by the consortium:
 - The planned **LTT**, Learning Teaching and Training, (C1) on **CA** was planned as a meeting in presence with intensive course. The workshop was converted in an **asynchronous on-line activity** based on lectures and homework.
 - The **Task 3.2** involved working with our industrial partners. However, this was hindered by various restrictions to external cooperation both from academic and industrial side. In view of this the consortium focused on strengthening the activities in the other tasks: special emphasis was given to developing the learning material for the educational units developed at the hosting university.
 - *This change of strategy resulted in a larger set of educational units that are implemented in O4. From a planned number of 3 MAESTRO implemented 7.*
- The adaptation of activities to answer the additional constraints posed by the pandemic has caused a prolongation of the planned time for O3 of 2 months.



O3 in the context of the project





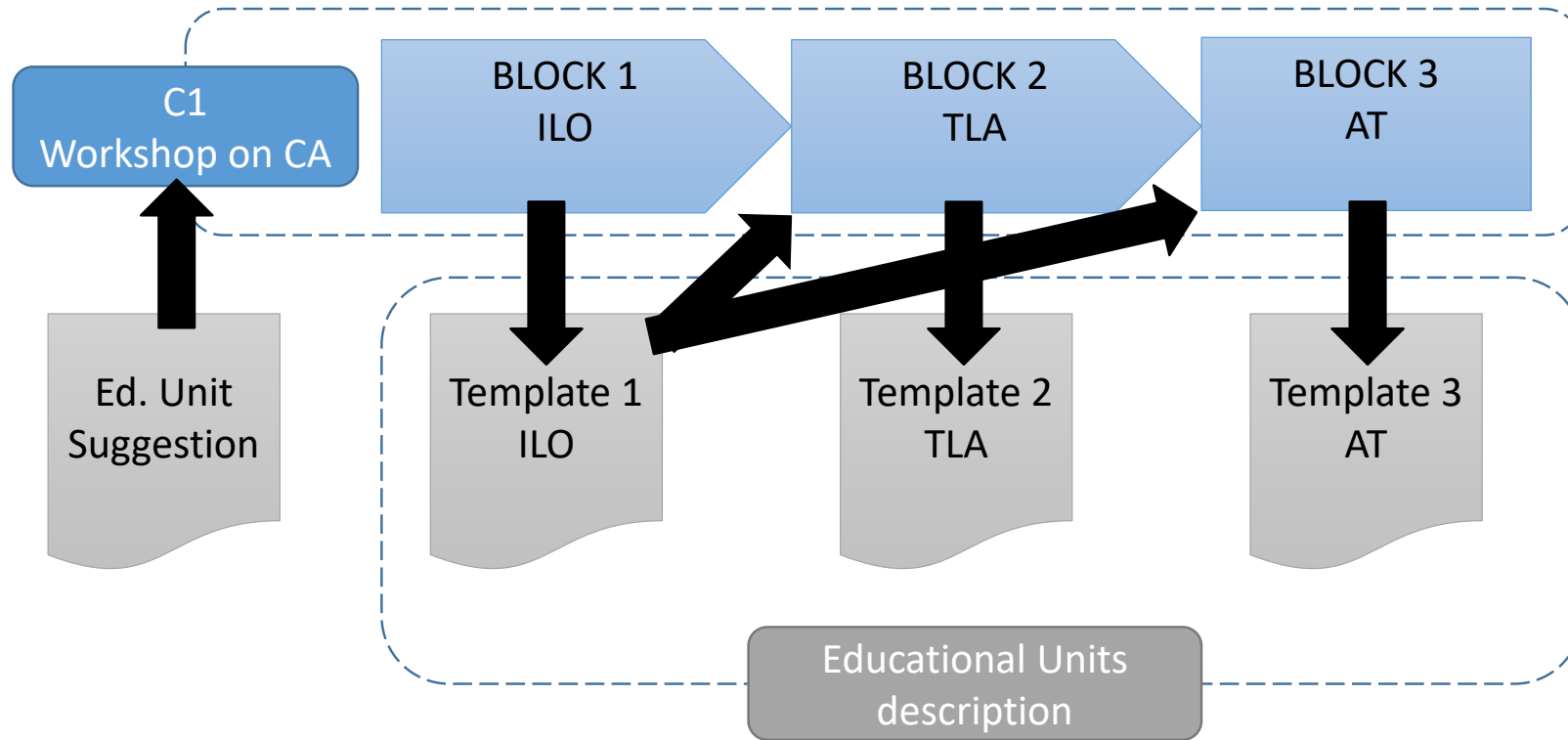
Results

- Output 3 **goal**:
 - to develop a series of Educational Units to introduce specific applications of the **technological enabler** of the fourth industrial revolution that address improvement on the **SDG** for UN.
- The candidate topics from each involved institution were selected during the Intellectual Output 2.

#	Technological Enabler
1	Internet of Things (IoT)
2	Big Data (BD) & analytics
3	Cloud Computing (CC)
4	Simulation
5	Augmented Reality
6	Additive Manufacturing
7	Horizontal & Vertical System Integration
8	Autonomous Robot
9	Cybersecurity



Results





ILO

- The template for the formulation of the ILO is emphasizing the **student** perspective.
- All the ILO are formulated to address directly **what** is expected from the **learner** after following the related educational unit.





ILO: template

Three are the **key elements**:

- **Verb**: detailing the action expected and referring to the expected level of understanding as expressed in the well-known Bloom taxonomy
- **Content** to which the action indicated by the verb refer to
- **Context** where the action for the related content must be applied



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Part of: Intellectual Output 3 - Workshop in Constructive Alignment

Document: Block 1 - Designing Intended Learning Outcomes

Partner: _____

	Short description	Verb (level of Understanding in the bloom Taxonomy)	Content	Context
ILO 1				
ILO 2				





ILO: example KTH

Proposal AR and VR for Assembly

	Short description	Verb (level of Understanding in the bloom Taxonomy)	Content	Context
ILO 1	Explain and use suitable AR and VR implementations for assembly on a lean shop floor.	Explain Use	AR and VR implementations	Assembly on a lean shop floor





TLA

- The template for the formulation of the TLA is emphasizing the following dimensions:
 - **What** is the **teacher** supposed to do to enact the underlying ILO
 - **What** is the **learner** supposed to do to enact the underlying ILO
 - How does the suggested activity relate to good teaching practices as expressed in the **7 principles of good learning**¹
 - *Encourages contact between students and faculty,*
 - *Develops reciprocity and cooperation among students,*
 - *Encourages active learning,*
 - *Gives prompt feedback,*
 - *Emphasizes time on task,*
 - *Communicates high expectations*
 - *Respects diverse talents and ways of learning*





TLA: template



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Part of: Intellectual Output 3 - Workshop in Constructive Alignment

Document: Block 2: Designing Teaching and Learning Activities

Partner: _____

ILO reference (Highlight the Verb)	Teaching Activity (What the teachers do)	Learning Activity (What the students do)	How does this use the 7 Principles of good learning ³
ILO 1	TA 1.1 TA 1.2	LA 1.1 LA 1.2	
ILO 2	TA 2.1	LA 2.1	





TLA: example KTH

Proposal 1 AR and VR for Assembly

ILO reference (Highlight the Verb)	Teaching Activity (What the teachers do)	Learning Activity (What the students do)	How does this use the 7 Principles of good learning
ILO 1 Explain and use suitable AR and VR implementations for assembly on a lean shop floor.	TA 1.1: Present AR and VR technology in a lean assembly context. TA 1.2: Explain how AR and VR technology can be applied for assembly instructions. TA 1.3: Create and show a real application of AR and VR for assembly instructions in the assembly line used for the lab session. TA 1.4: Encourage discussion on the application provided.	LA 1.1: Listen to the presentation, take <u>notes</u> and ask questions. LA 1.2: Listen to the presentation, take <u>notes</u> and ask questions. LA 1.3: Review the notes to recall the key points of AR and VR applications. Observe the AR and VR demonstration and apply it on the application provided. LA 1.4: Discuss about the experience on the application provided.	Encourages contact between students and faculty: LA 1.1 LA1.2 Develops reciprocity and cooperation among students Not applicable Encourages active learning: TA 1.3 TA 1.4 LA 1.3 LA 1.4 Gives prompt feedback: TA 1.4 LA 1.3 LA 1.4 Emphasizes time on task Not applicable Communicates high expectations Not applicable Respects diverse talents and ways of learning: TA 1.3 LA 1.3





AT: template

- The template for the formulation of the AT is emphasizing different **assessment strategies** for different verbs and different learning style.



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Part of: Intellectual Output 3 - Workshop in Constructive Alignment

Document: Block 3: Designing the Assessment Tasks

Partner: _____

ILO reference (Highlight the Verb)	Assessment task 1	Assessment task 2 AT X
ILO 1			
ILO 2			





AT: example KTH

Proposal 1 AR and VR for Assembly

ILO reference (Highlight the Verb)	Assessment task 1	Assessment task 2
ILO 1 Explain and use suitable VR and AR implementations for assembly on a lean shop floor.	Verb: Explain Activity type: Exam essay question Answer questions regarding the presented AR and VR applications discussing on the experience had during the lab session. Grading: assessment by grades (A, B, C, D, E, F)	Verb: Use Activity type: Laboratory session. Use the AR and VR application developed for assembly instructions Grading: assessment by P/F





Proposed edu. unit. and implementation plan

Institution	Proposal	Implementation	When	N students
KTH	AR and VR for Assembly	Yes	Autumn 2021	90
	FEM and lab analysis in CAD	No		
PRZ	Decision Support Systems	Yes	Spring 2022	30
	Lean Manufacturing	Yes	Autumn 2021	30
	Risk Management	No		
POLITO	Life-Cycle Assessment	Yes	Spring 2021	150
UNILJ	Cloud Robotic	No		
	UN SDG	No		
LBORO	Autonomous Robot	Planned	Autumn 2021	-
	Future Automation Strategy	Yes	Autumn 2021	52
UNIFI	AM in medical implants	Yes	Spring 2022	15
	Digital lean	No		
	Cobots	Yes	Autumn 2021	15





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Thank you for listening

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