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Documentation of pilots

Thermal simulation integration, UCN

Spring and autumn, 2020

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Introduction

This document contain the documentation of Thermal Simulation Integration, spring and autumn 2020. The document contains a description of the settings and the motivation of the case, as well as an overview of the key performance indicators (KPIs) for the pilot. The execution and documentation of pilots are part of larger process, named Educational Framework, aimed at transforming educational programmes for future Industry 4.0 capabilities. The case/pilot is chosen based on two initial analysis, respectively focused at industry and the institution. For further information regarding the overall process, please see the document 'Educational Framework'.

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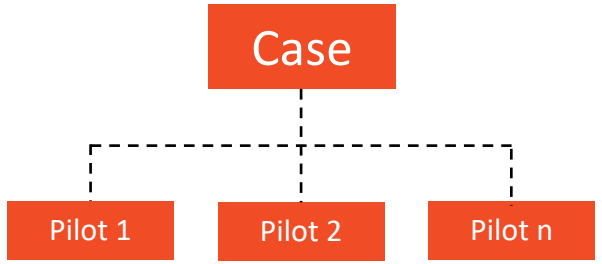

Fig. 1. The figure shows the relationship between the two terms: *case* and *pilot*.

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Description of the pilot (summary)

This pilot at UCN is a course at the educational programme “Production Technologist”. The education is at EQF level 5, with a total extent of 120 ECTS. This pilot is part of a 15 ECTS elective course in mechanical construction, during the third semester (the programme is four semesters in total).

In this pilot, our aim is to integrate the knowledge of, and ability to perform, thermal transfer simulations within a CAD environment. Each lecture consists of an introduction to the theory, followed by a hands-on exercise. The students give inputs and bring examples from their profession.

The success criterion of the pilot is to expand the digital mindset of the students, and at the same time, increase the thermodynamical skills. The competencies to use their already-acquired CAD-skills in collaboration with parametric simulations aims to act as a demonstration of the capabilities of integrated systems. This is a topics that they were not familiar with beforehand in a construction context.

To achieve these two success criteria, the awareness of digital possibilities within construction must be enhanced. By a higher consciousness, the students will be able to pinpoint possible areas of improvement in their own work routines, and thereby increase their ability to spot potential areas of improvement when entering the job marked.

This goal corresponds with the industrial analysis, which pointed towards digital mindset as a major driver, where the ability to conceptualise digital systems is an enabler of creating integrated systems rather than isolated stand-alone solutions.

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Description of the pilot (summary)

The course, Integrated thermodynamics, is based on the following learning goals from the curriculum:

Knowledge:
- Material properties

Skills:
- Use 3D modelling software
- Assess product dimensions
- Identify, analyze and solve problems related to products

Competencies:
- Handle and structure the development process in a business perspective and collaborate with other professional domains
- Within own professional domain obtain knowledge and skills related to technical problems, constructional principles and development or improvement of physical products

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KPIs and how they are measured

Based on the aim of pilot three focus areas are identified and operationalized, thorough KPIs. The three focus areas are: 1) The student's ability to identify new learning needs related to simulation of thermal systems, 2) the student's ability to integrate the use of parametric design into their project, and 3) the student's readiness for future jobs.

Identified KPIs and methods for measuring

1. The student's ability to identify digital improvements within own work routine

   After the course, the students are asked to identify their own improvement opportunities in writing. The students own identified learning needs are afterwards compared to the results of a multiple-choice test held at the end of the course.

2. The student’s ability to identify digital opportunities within their project

   During an evaluation/examination after the course, the student's ability to identify and implement parametric simulations in the product development process is evaluated by the lecture and an external examiner with experience from industry.

3. The student's readiness for future jobs

   At a mandatory institutional evaluation after the semester, the students are asked to evaluate their own readiness for future jobs.

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Implementation of the Educational Framework

Educational activity sketch

The course will consist of 4 lectures. Each lecture will rely on a flipped-classroom approach, where the students will have to gain knowledge themselves before the lecture, and the lecture will be targeting discussion, reflection and supervision.

In the first lecture, the lecturer introduces the program, including the task. Furthermore, the self-study for all lectures will be presented, consisting of reading materials, videos and audio material.

In the remaining lectures, the students are expected to have prepared for lecture, and the task of the day will be presented. This task will show a detail of the thermal simulation process, and part of the assignment is to describe how these sub-processes can be applied to their project.

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Implementation of the Educational Framework

Relation to Authentic Task Design

The educational framework is implemented through a case with an ill-defined output, which the students must integrate into the semester project of the students. The course takes place over one month, which lets the students investigate the problem field for several different perspectives and describe and implement relevant course material into their semester projects.

Groups formed in collaboration between the lecturer and the students solve the task, concerning both personalities (tested by the Insights profile tool) and qualifications.

The output will be a stand-alone model of a cooling device, which is a finished product on its own. It will be evaluated continuously within each lecture, and reflection upon integration within work-life routines are required. The students will assess each other during the project, allowing for competing products.

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Implementation of the Educational Framework

Elements

The learning process is iterative, as the students will get an overview in the first lecture, and the knowledge will be expanded in each lecture in the same topics.

Blended learning and flipped classroom – the students will receive learning content online for completion out of class. This gives room for more reflective feedback.

Supervision and feedback – The reflection will be facilitated through feedback, both in class, but also in an extended, online session with written or audio feedback available in extended timeslots.

Simulation with context – The students will meet the context either physically, or in the flipped classroom environment.

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Results and Evaluation - Spring

[A description of the results (KPIs) and an overall evaluation of the pilot. This is filled in after the pilot is executed]

The pilot was conducted according to the plan, though with minor modifications. The only change was, due to the COVID-19 lockdown of our institution, an online flipped classroom setting. The students reported positively towards the content but had major issues with the organisation of the course, which lead to modifications of the lecturing approach, going from a supervising setting towards more lecturing.

The students reported several learning-needs both within parametric drawing as well as thermodynamics.

No student reported to use the content within their projects, but also said that this was due to scheduling; the they had finished their drawing within their semester project.

The students have reported high confidence for job readiness. They feel an increased capability to connect the digital tools to the real problems (authentic tasks) which exist both within and outside of the education.

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Results and Evaluation - Spring

The student's ability to identify digital improvements within own work routine

The students point towards implementing automated drawing as a part of their work-routine if the products are customized on the same template. Furthermore, they describe an increased awareness of modular design.

The student’s ability to identify digital opportunities within their project

Few students used parametric design in the project work. They contribute this to the late date of learning in the semester.

The student's readiness for future jobs

At a mandatory institutional evaluation after the semester, the students are asked to evaluate their own readiness for future jobs. Not performed yet.

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Results and Evaluation - autumn

[A description of the results (KPIs) and an overall evaluation of the pilot. This is filled in after the pilot is executed]

The pilot was conducted according to the initial plan, but with an increased focus on the narrative of how the digital tools could aid the students in future jobs. It was still conducted as an online flipped classroom setting. The students reported positively towards the content, but suffered minor IT-issues as Autodesk had a server breakdown, prohibiting the students from acquiring Nastran. Hence, the parametric modelling got an increased focus.

The students reported several learning-needs both within parametric drawing as well as thermodynamics.

No student reported to use the content within their projects, but also said that this was due to scheduling; the they had finished their drawing within their semester project.

The students have reported high confidence for job readiness. They feel an increased capability to connect the digital tools to the real problems (authentic tasks) which exist both within and outside of the education.

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Results and Evaluation - Spring

The student's ability to identify digital improvements within own work routine

"I have obtained a lot of insights into inventor parameters, which I will continue to explore on my own", was the quote form one of the students. In general, the students got it working, and compared to the first test of this course, the students had more advanced ideas to solve the tasks of the course, and also to implement in their own projects.

The student's ability to identify digital opportunities within their project

Few students used parametric design in the project work. They contribute this to the late date of learning in the semester.

The student's readiness for future jobs

At a mandatory institutional evaluation after the semester, the students are asked to evaluate their own readiness for future jobs. Not performed yet.

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