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Documentation of pilots

Digital Manufacturing, TalTech

Spring, 2020

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Introduction

This document contain the documentation of *Digital Manufacturing* Course, conducted in spring 2020 at TalTech. 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'.

Contents

- Description of pilot (summary)
- KPIs and how they are measured
- Implementation of the Educational Framework
- Results (KPIs) and evaluation

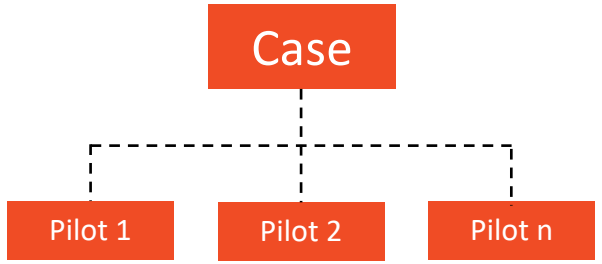

Fig. 1. The figure shows the relationship between the two terms: *case* and *pilot*.

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Description of the pilot (summary)

This pilot represents a course named: Digital Manufacturing that is taught at the educational programme of “Integrated Engineering” in TALTECH. Students from design, manufacturing, ICT and logistics (EQF level 5), and secondary school graduates can enrol into this educational programme. The education is at EQF level 6 (bachelor’s degree) with a total study load of 180 ECTS in the nominal study period of six semesters (3 years). This pilot is a 6 ECTS course, taught during the fourth semester under the module of Information Technology.

In this pilot, our aim is to develop the knowledge and skills for the applications of digital manufacturing principles that can be useful in the enterprises. The topics covered during the course are: Industry 4.0 trends and future technologies, Introduction to Virtual Reality (VR) and Augmented Reality (AR), cyber security in digitalization, understanding of automated production systems and layout creation in the virtual environment, digital Manufacturing tools to support robotic process simulation, and Machine Vision: recognition of technological objects. The pilot includes three hours class per week that combines 1.5 hour lecture and 1.5 exercises. Lecturers start with theory part and support with case studies and best practices on digital manufacturing.

The success criterion of the pilot is to enhance the interdisciplinary knowledge regarding digital and smart manufacturing, as this field is still relatively new and multidisciplinary itself. The competencies among the manufacturing students should still be expanded, with topics that they were not familiar with beforehand, while also bridging the knowledge gaps between the other fields.

The need to enrich the interdisciplinary knowledge was concluded from the industrial analysis, which pointed towards interdisciplinary knowledge as a necessity, where multidisciplinary is the enabler of implementing integrated systems rather than isolated stand-alone solutions. Furthermore, the digital mind-set of the manufacturing students can expand by the integration between manufacturing systems and ICT tools.

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Description of the pilot (summary)

The course, Digital Manufacturing, is based on the following learning goals from the curriculum:

Knowledge:

- Applied theory and methods for the applications of digital manufacturing principles and industry 4.0 trends, concerning the enterprise organization and systems, and the ability to reflect up on the business implications.
- Develop knowledge of the practical and theoretical contents during a group/project work.

Skills:

- Use tools and methods to identify and analyze the implications of technological issues regarding manufacturing and logistics, and to investigate the integration of product, process and information systems.

Competencies:

- Handle innovative, complex and practical-oriented problem solutions for production and applications of technology in an industrial setting.
- Identify own learning needs and develop knowledge skills and competences in their own discipline as well as interdisciplinary.

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KPIs and how they are measured

Based on the aim of pilot, three focus areas are identified and consider to be viable, through KPIs. The three focus areas are: 1) The student's ability to identify new learning needs related to digital manufacturing, 2) the student's ability to integrate the use of digital manufacturing tools into their project, and 3) Organization of the course/pilot study.

Identified KPIs and methods for measuring

1. The student's ability to identify new learning needs related to digital manufacturing

   At the start the course, the students are asked to identify their own learning needs and expectation 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 students' ability to integrate the use of digital manufacturing tools into their project

   During an evaluation after the course, the students' ability to integrate the digital manufacturing tools in the production process development is evaluated by the lecture and an examiner with experience from industry.

3. Organization of the course/pilot study

   Through a mandatory institutional evaluation after the semester, the students are asked to evaluate, how the course is organized and how it can be improved in future.

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Implementation of the Educational Framework

Educational activity sketch

The course is consist of 16 lectures, a lecture per week. Almost each lecture rely on a computer-based classroom, where the students will have to gain knowledge by using course relevant software applications, and the lecture will be targeting discussion, hands-on experience of digital tools and supervision.

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

In the remaining lectures, the students are expected to have prepared for lecture, and the task of the day will be presented. The task will show a detail of the specific digital manufacturing tool and technique, and part of the assignment is to describe how these sub-tasks 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 course project report. The course takes place over the 16 weeks, 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 by the students solve the task, concerning both personalities (tested by the Insights profile tool) and based on their backgrounds. The case topic is the use of studied digital manufacturing tools and techniques to solve the task and compile a report. Students will gain the opportunity to implement their domain-specific knowledge into the environment.

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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 computer-based class – the students will receive learning content online through a moodle environment so that they can have access to the study material during the class. This gives room for more insightful feedback.

Supervision and feedback – The reflection will be facilitated through feedback, both in class and online moodle platform.

Simulation with context – The students will meet the context either physically, or through moodle environment, or in the computer-based class.

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Results and Evaluation

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

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