[Person responsible]

Documentation of pilots

[Product Development, Aalborg University]

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Introduction

This document contain the documentation of [pilot, period – one document for each pilot]. 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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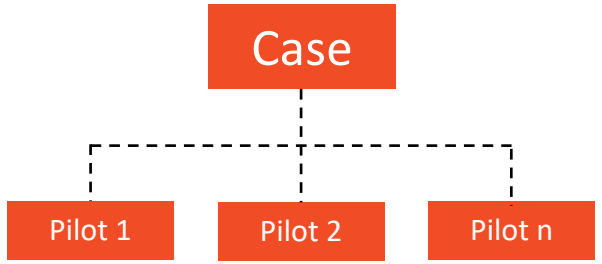

Fig. 1. The figure shows the relationship between the two terms: *case* and *pilot*.

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Description of the pilot (summary)

This case addresses the course Product Development and Production Preparation (PPDP) at Aalborg University, which is taught in the bachelor programme “Global Business Engineering” (GBE) on the third semester. The GBE program focuses on operations and supply chain management, but also includes several related fields such as marketing, accounting and strategy. The PPDP course has a total workload of 5 ECTS with equal distribution between product development and production preparation. The course teaches the students a structured method for designing and developing products and subsequently how to plan and prepare a production for the product.

The course already exemplifies to the students how production limitations should be considered during product development, and how product choices affect the choice of production technology. However, with the emergence of industry 4.0 and the increasing pace of innovation within manufacturing technologies, this pilot aims at explicitly addressing the opportunities (and challenges) imposed by industry 4.0 on product development.

The success criterions of this pilot are:

- Enhance the students’ awareness of Industry 4.0 technologies
- Students gain basic knowledge on how industry 4.0 technologies can support rapid product innovation.
- Students are more engaged through a hands-on mini-project and apply the learned knowledge.

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Description of the pilot (summary)

According to the curriculum, the students must obtain the following knowledge, skills and competences in the PDPP course. Please note, this does not include the added knowledge, skills and competences desgined into this pilot.

KNOWLEDGE

- Knowledge on the requirement specification process
- Knowledge on the core phases of the product development process
- Knowledge on the core elements of the production development process

SKILLS

- Able to analyse and evaluate customer needs.
- Able to conduct the initial elements of a product development process
- Able to analyse and evaluate derived requirements for establising a production system

COMPETENCES

- Able to demonstrate competences in relation to the above mentioned through exercises and industrial examples related to:
    - Relative simple mechanical and/or electronic products
    - Existing or newly established production facilities

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KPIs and how they are measured

Based on the aim of the pilot, three KPIs have been identified. The three KPI are:

KPI 1: The student's awareness of Industry 4.0 implications on product development

- Measured through multiple choice quiz during the lectures, and/or through question(s) in the written exam

KPI 2: The student's awareness of Industry 4.0 technology

- Measured through multiple choice quiz during the lectures

KPI 3: The students get more hands-on experience and consequently feel more engaged in the course

- Achieved by including a mini-project in the course with sufficient time for guided mini-project work
- Enabled by transitioning to a mix of class-room lectures and self-study video lectures.
- Supports the pilot's aim to include aspects of Industry 4.0
- Measured through qualitative interviews with the students

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Implementation of the Educational Framework

Educational design:

The course consists of 10 lectures, where five lectures are on product development (focus of the case). Out of these five lectures, we will in this pilot assign one of these lectures to the topic of I4.0 and its implications on product development. The pilot will also introduce a mini project serving as a continuous exercise for the students to apply the theory and practice taught at each lecture. This includes hands-on work with I4.0 perspectives and managing the implications in the mini project.

To allow one out of five lectures to focus on I4.0 and to offer enough guided interaction time for the mini-project, it is necessary to free up time in the ordinary lectures. To accomplish this, some supplementary topics will be moved from class-room lecturing to an online learning format (video lectures, flipped classroom, blended learning, etc.). Although not explicitly part of the pilot scope, this will be a prerequisite for implementing the pilot.

The pilot will apply the following elements:

- **Classroom lectures** – used to cover the core process of product development and the new topic of I4.0
- **Video-lectures** – used to cover supplementary topics, allowing students to spend more of the instructor time on mini-project work.
- **Flipped-classroom** – used to some degree in the teaching of the I4.0 topic.
- **Mini project** – used to give the students hand-on experience with product development including the implications from I4.0, and furthermore increase their engagement and motivation.

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Results and Evaluation

KPI 1: The student's awareness of Industry 4.0 implications on product development

- After the course exam, the students were asked to participate in an online multiple choice quiz. The quiz was designed with five questions addressing KPI 1 and five questions addressing KPI2.
- The students were asked to take the quiz without any prior preparation, and complete it within 5 minutes, prohibiting them from searching for the answer in the course material. Thus, the results should reflect the readily available knowledge that they gained from the course.
- Detailed results of the quiz can be found on the last slide.
- The average score across the five questions and across all participants were: 76,9% correct.

KPI 2: The student's awareness of Industry 4.0 technology

- The average score across the five questions and across all participants were: 75,2% correct.

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Results and Evaluation

KPI 3: The students get more hands-on experience and consequently feel more engaged in the course

- A mixed/blended learning approach was implemented, turning supplementary topics into online self-study topics supported by online video lectures. Consequently, the duration of the ordinary class-room lectures were cut down to below 1 hour, giving the student more of the allocated time for the lecture to focus on their mini-project.
- A mini project was introduced, giving the students hands-on experience with developing products. The “charter” used was for the students to develop an “intelligent product to aid in the fight against Covid19”. In other words, their “product” should 1) address some market need created by the Covid19 pandemic (being big or small), and 2) it must include some sort of connected/smart solution.
- Due to the impact of Covid19 restrictions, lecturers were not allowed to visit students in their group rooms. Consequently, the intended level of interaction with the students were not achieved.
- In three informal interviews after the course conclusion, the students found that:
  - The mini project increased their motivation to follow the course.
  - The mini project increased their effort in the course.
  - The mini project helped tie the Industry 4.0 lecture well into the general product development process.
  - Corona restrictions, partly virtual lectures, and limited direct interaction with the lecturer had reduced the anticipated impact of the mini-project.

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Results of Quiz used in KPI 1 and 2

KPI	Question highlight	Avarage across participants
1	Which of the following concepts affect the product development process?	93.4 %
1	Key aspects of "smart products" are …	80.2 %
1	For a "smart" product to succeed on the market, it must …	76.9 %
1	Servitization is the concept of ...	49.5 %
1	The increased pace in technology innovation is like to …	84.6 %
2	What entails a "Cyber Physical System"?	67.0 %
2	Which of the following is NOT a technology prospected to be a central part of Industry 4.0?	80.2 %
2	Which industries are best suited for Industry 4.0?	100 %
2	The concept of industry 4.0 focus on …	54.9 %
2	A smart factory must be ...	73.6 %

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