

THE ROLE OF PROJECT-BASED LEARNING IN ENTREPRENEURSHIP EDUCATION: MAPPING HOW INDUSTRIAL INSTITUTIONS AND PROJECT BRIEFS CAN SHAPE UNIVERSITY-INDUSTRY STUDENT PROJECTS.

ABSTRACT

The Product Development Project Course (PDP) held at Aalto Design Factory at Aalto University is a successful project-based learning course carried out since 1997. Besides its multidisciplinary ground, it materialises the good practices of Entrepreneurship Education. The multidisciplinary teams of students in this course interact with enterprises with very diverse dimensions and typologies. A previous analysis of the projects briefs developed at the course led to a taxonomy of projects depending on the degrees of uncertainty and novelty, among other parameters. In this paper, we reflect on the adequacy of the different types of projects for Entrepreneurship Education. We verified that Research and Development (R&D) typology seems the most suitable since it fosters uncertainty and novelty. Nonetheless, the presence of R&D projects has been decreasing over the last seven years. This paper attempts to uncover the reasons for this phenomenon by analysing the type of enterprises that have been participating in the course.

Keywords: Project-based learning, Entrepreneurship Education, Product development, university-industry liaison, live projects

1 INTRODUCTION

Entrepreneurship education is often described as any pedagogical program or educational process that elevates entrepreneurial attitudes and skills [1]. The Product Development Project (PdP, www.pdp.fi) course has been running since 1997 and sparked the creation of the Aalto Design factory and the correspondent Global Network (www.dfgn.org). This course promotes a project-based learning framework that materialises some of the best practices in entrepreneurship education. In the existing body of knowledge, it is often mentioned that it is impossible to convey the challenges and complexities surrounding new venture creation using only conventional pedagogic techniques (such as lectures and seminars) [2]. Therefore the PdP course enables the direct experience of entrepreneurial activity by promoting self-practice and learning by doing in a safe environment. In the PdP course, each student team works on a unique design brief with a specific industry partner. The challenge presented by those is a real industry problem that requires the development of coherent and feasible product-service proposals and business models. Each industry partner contributes with a 10,000.00€ team budget to be used for product development and prototyping expenses by the student team. The industry challenges are often complex and messy, requiring multi-disciplined teams and the use of prior knowledge in varied knowledge domains. According to Raelin's (1997) terms, this product development course can be regarded as "an experiment for the students with the world to find out what it is like" [2]. For this reason, the PDP teams are multidisciplinary. The composition of student teams varies within each project, and those teams are also partnered up with students from international universities. It should

be noted that this multidisciplinary and international course structure favours the acquisition of entrepreneurial skills [2]. Furthermore, over the years, there has been collaboration with more than 135 companies, which exposed students to interact with diverse typologies of companies from different maturity levels and activity sectors.

In prior research led by Figueiredo, Eriksson, Björklund and Ekman [3], the typology of PDP projects was characterised and analysed over the years. The existing body of knowledge emphasises ambiguity and uncertainty as a valid function and prerequisite for action-orientated behaviour and experimental learning. This factor stimulates the real entrepreneur processes as it begins to expose students to some uncertainty and risk associated with the early stages of product development [2]. Based on the degree of uncertainty, certain typologies of project briefs explored in previous research [3] are more suitable for promoting entrepreneurship education than others. Over the last seven years, it was mapped the decline of one of the project typologies that featured the most significant uncertainty levels: Research and Development. This research aims to characterise the companies and the proposed project briefs to comprehend if the assumption that the PDP course contributes to the education of entrepreneurship skills as a leading reference is still valid and why is this type of project brief in decay. This studies the role of PDP as a capstone in the field of product development and materialisation of entrepreneurial values, which are reflected in its educational heterogeneity of varied composition of know-hows.

2 LITERATURE REVIEW

Since the first entrepreneurship course at Harvard Business School, created in 1947 [4], entrepreneurship education (EE) has been booming worldwide. Entrepreneurship is becoming increasingly popular in different educational institutions such as business schools, engineering schools, and design schools.

There is a deep intellectual devotion, emotional investment, and passion among educators, instructors, and people in the field of EE [5]. Furthermore, the last decade's advancements in product development represent vibrant field changes contributing to business and societal goals alike, with significant technological and paradigm shifts. From an educational perspective, this fast-paced evolution provides students with the opportunity to expand their field of expertise to create meaningful and cohesive product solutions. The use of university-industry collaborative projects as a pedagogic model is well established, and much has been written about the use of industrial briefs within design and engineering courses in higher education [6]. These collaborations reinforce experiential learning within educational programs and boost industry value creation [7], as they generate mutually beneficial knowledge and promote technology innovation exchange between parties. The format of these collaborations, or *live projects*, is often described as "out of the studio setting, repositioned in the 'real-world'" and existing "between the two tectonic plates of learning in academia and in practice" [8]. The format of this project-based learning seats under one of the cornerstones of EE, where a vast body of knowledge emphasizes the relevance of 'experiential', 'learning by doing' and 'real-world' pedagogies [5]. In this context, we refer to education for entrepreneurial attitudes and skills as entrepreneurship education [1]. As stated by Smilor in 1997, "effective entrepreneurs are exceptional learners. They learn from everything. They learn from customers, suppliers, and especially competitors. They learn from employees and associates. They learn from other entrepreneurs. They learn from experience. They learn by doing. They learn from what works and, more importantly, from what doesn't work" [2]. Other scholars support this idea by highlighting that critical entrepreneurial skills such as managing people are not learned through writing business plans [1]. Therefore learning-by-doing involves experimentation, increasing the entrepreneur's confidence and tacit knowledge.

In the most recent years, the contemporary world has been marked by vague boundaries between artefacts, structures, systems or services. Industry-provided challenges often require addressing an entire system and not just a single part or component. As such, the target scope of university-industry student projects can vary in width, clarity and uncertainty. Furthermore, this ambiguous context stimulates the creation of incertitude, encouraging students to step outside of the box and out of the taken-for-granted assumptions. Uncertainty in an educational context recites the circumstances in which an entrepreneur founds a business because starting a venture is an uncertain endeavor. Likewise, the addition of ambiguity also heightens emotional exposure, which is inherent in entrepreneurial learning since students work on foreign activities where the dynamics are critical but uncontrollable [2]. This research contributes to the existing knowledge regarding entrepreneurship educational practices and university-industry collaborations. It expands the work in [3] by reflecting how the level of project novelty and uncertainty can be impacted by the typology project brief and institutional partner in the university-industry collaboration setting.

3 METHODOLOGY

3.1 The course context.

This study expands on previous research that examines the changes in project brief typologies within the Product development Project course at Aalto University, spanning twelve academic years [3]. Furthermore, this study deepens the understanding of evolving typology of project brief in the course by analyzing the level of maturity and activity sector of each industrial partner that participated in this university-industrial collaboration. Between 1997 and 2021, approximately 2678 master's level students attended the course. In this multidisciplinary course, between 2018 to 2020, 46% of students were from Mechanical Engineering, 22% from Design, 10 % from Business and 7% from Electrical Engineering and Information Technology each [3].

3.2 Data collection and analysis

To analyze the trends underlined in the types of projects suggested by the industry design briefs and how these have evolved over the last 12 years in the context of the PdP course, the current study examines two data sets. One data set based on previous research [3] analysed (1) the 174 design briefs used in the course between 2009 to 2021 in the categorization of project briefs, and a second archival data set, namely: (2) the profiles of the industrial partners collaborating in the PdP course over the last decade.

3.2.1 Typology of Product Development Project Briefs

Previous research [3] utilized the course design briefs as the starting point of the study. Each design brief had an approximately one-page description of the project and was distributed to the students at the beginning of the course (and later expanded upon in meetings with the industry liaisons). These Design brief documents were classified into four degrees of novelty, building on the framework developed by Wheelwright and Clark [3]. The four degrees are Derivative Projects, Platform Projects, Breakthrough Projects and Research and Development. Based on this research [3], Figure 1 illustrates the different levels of methodological practices and degrees of the novelty of the four types of projects. Nonetheless, this study will examine the graphic representing methodological practices via the lenses of the degree of uncertainty in project-based learning and entrepreneurship education. This is perceived based on the existing knowledge in the Design Brief about methods needed to achieve the final solution and the goals of the final solution.

Managing volatility, uncertainty, complexity, and ambiguity is a key competency of entrepreneurs. Entrepreneurship Education boosts problem-solving skills and self-reliance. Traditionally courses often

do not recreate limiting factors or stimulate ambiguous context, thus acting as a learning platform encouraging students to step outside of granted assumptions. Therefore, uncertainty in an educational program replicates the circumstances in which an entrepreneur founds a business [2]. This positions students' learning on a pathway to ensure survival and success in an uncertain world, and to equip them to face the challenges of accelerated globalization. Many scholars also consider this imperative to improve economies by encouraging the start-up of new businesses as a source of innovation and new job creation [9]. For this reason, a consistent understanding of the typology of project briefs provided by Industry partners in this case study will contribute to mapping how the level of uncertainty and also novelty has been evolving over the years.

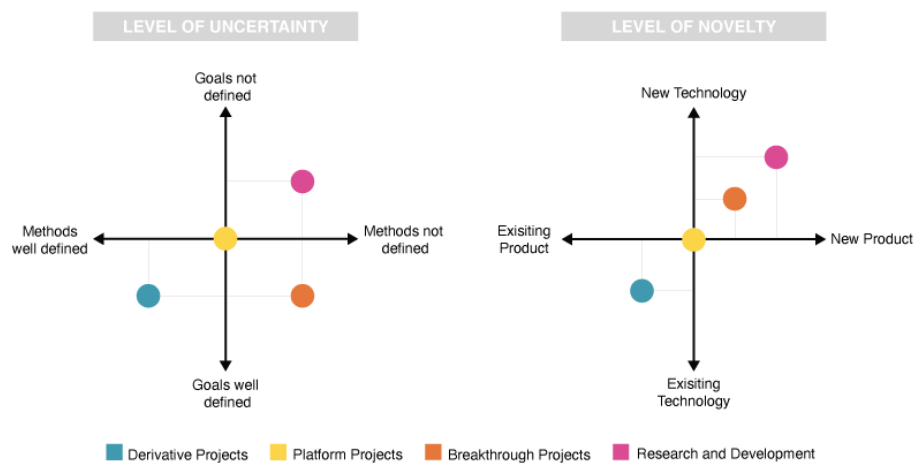


Figure 1 -Degree of uncertainty and novelty of project brief typologies

In the study in [3] each type of project was mapped across different years of the course to examine whether the distribution of projects or degree of novelty and uncertainty changed. This analysis was done by comparing descriptive statistics of the distribution. See Figure 2 to examine this distribution.

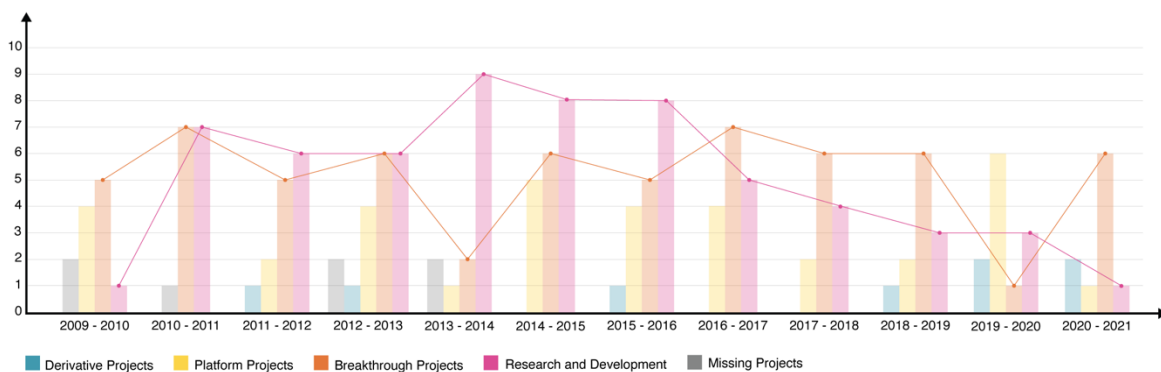


Figure 2 - Distribution of project design briefs between 2009 and 2021

After mapping the 174 design briefs, the distribution of projects over time was examined (Figure 2). The analysis revealed the prominence of two industry project-brief typologies: Breakthrough (illustrated in orange) and R&D - Research and Development (presented in pink). These types both represented 35%

each of all projects. However, a decrease in R&D Projects was noted from 2014 to 2021. The Breakthrough projects proved to be consistently prominent during the period observed.

This study and mapping of how the industry project brief categories have shifted over time shed light on the project types that the student might encounter in the future. This analysis showcases the nature of the collaboration between Industry and academia, contributing to a better understanding of both Industry's evolution and possibly the requirements of project teams for project-based learning in the context of Entrepreneurship education.

3.2.2 Mapping typologies of industrial partners of university-industry student projects.

This study bridges two strains of archival data by (1) looking at a map of 174 design briefs divided into four typologies of industry challenges, which study the distribution of projects over time [3] and (2) by examining the level of maturity and sector of activity of 135 companies which have collaborated with the PdP course since 1997. This research aims to investigate, from different perspectives, certain phenomena and identify the origin of pinpointed trends. Such as the decrease in R&D Projects over the last seven years in the PdP course. This research will shed light on the typology of companies and institutions collaborating with academia, the interlink between companies' profiles and the proposed design challenge, and the evolving nature of industrial needs when collaborating with the new generation of entrepreneurs and product developers. Furthermore, this research will provide insights into how the collaboration between different industry or institutional partners can influence novelty and uncertainty in student projects and entrepreneurship education.

To analyze this archival data, we will use the information on companies and financial institutions for academic purposes based on the Orbis platform for comparable data resources. As mentioned above, the company's data will be set based on the maturity level of the institution, size and activity sector.

4 EXPECTED FINDINGS AND CONTRIBUTIONS

Mapping the industry-provided project briefs used within the Product Development Project course (PdP) at Aalto Design Factory, highlights the variety of projects tackled in industry-university collaborations and how those might affect the level of uncertainty and novelty in student projects and entrepreneurship education. The findings reflect a noticeable shift in the typologies of students' project briefs during the period reviewed. Research and Development challenges have decreased in the last seven years, which has impacted the number of projects in which student teams both frame the problem space and conceptualize suitable solutions. This research aims to shed light on this phenomenon, understand the causes of this trend and, possibly, its impact on project-based learning. While additional research is needed on the prevalence of different types of design briefs in other contexts, this study sheds light on the reasons for the observed distributions based on the investigation of the nature of companies involved in this academia-university collaboration. Furthermore, the study will depend on the available knowledge on how to capture the varying degree of novelty and uncertainty within the initial design briefs, which can be of help to educators, students, and industry representatives, alike in scoping and planning university-industry project-based courses for active entrepreneurship education.

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