Tampere University

Qin Zhuoli

UNDERSTANDING INTERMEDIARY ORGANIZATIONS FACILITATED UNIVERSITY-INDUSTRY COLLABORATIVE PROJECT-BASED LEARNING IN HIGHER EDUCATION

A Case Study of Demola

Faculty of Management and Business
Master's Thesis
April 2023

ABSTRACT

Qin Zhuoli: Understanding Intermediary Organizations Facilitated University-Industry Collaborative Project-Based Learning In Higher Education

Master's Thesis

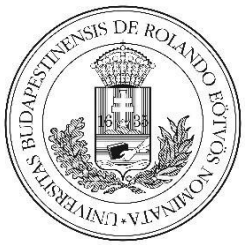
Tampere University

Research and Innovation in Higher Education

April 2023

The current study explores the outcomes, key elements involved and enabling environment of Intermediary Organizations (IOs) Facilitated University-Industry Collaborative Project-Based Learning (PBL) in higher education, with a specific focus on its implementation. Despite the practical benefits of University-Industry Collaborative PBL facilitated by IOs such as the Demola projects, there has been limited scholarly attention given to such PBL. To fill this research gap, this study examines the effectiveness and organizational matters of Demola-mediated PBL by adopting a case study design and using Demola as a case of IOs. The findings indicate that Demola projects have enormous advantages for students, industries, and universities, particularly regarding students' competence development. The success of Demola projects hinges on the co-creation of university student teams, company representatives, and Demola facilitators within the effective frameworks and tools provided by Demola. To establish and nourish a regional Demola program, the synergies of government, industry, and university as three key stakeholders are fundamental, with individual institutional entrepreneurs playing pivotal roles. This study proposes intermediary organizations facilitated university-industry collaborative PBL as a cost-effective approach for supporting students' competence development. It contributes to the discussion on this topic and offers practical implications for various stakeholders in higher education, including university managers and faculties, government education policymakers, and education entrepreneurs.

Keywords: Intermediary Organizations, project-based learning, university-industry collaboration, competence development, Demola



Eötvös Loránd Tudományegyetem
Pedagógiai és Pszichológiai Kar

Eötvös Loránd University
Faculty of Education and Psychology
Education Science MA

DIPLOMAMUNKA

Qin Zhuoli

2023

EÖTVÖS LORÁND UNIVERSITY
FACULTY OF EDUCATION AND PSYCHOLOGY
EDUCATIONAL SCIENCE MA

Understanding Intermediary Organizations Facilitated University-Industry Collaborative Project-Based Learning in Higher Education
A Case Study of Demola

Qin Zhuoli

Gábor Halász, PhD.
Professor Emeritus
Faculty of Education and Psychology
Eötvös Loránd University

2023

Abstract

The current study explores the outcomes, key elements involved and enabling environment of Intermediary Organizations (IOs) Facilitated University-Industry Collaborative Project-Based Learning (PBL) in higher education, with a specific focus on its implementation. Despite the practical benefits of University-Industry Collaborative PBL facilitated by IOs such as the Demola projects, there has been limited scholarly attention given to such PBL. To fill this research gap, this study examines the effectiveness and organizational matters of Demola-mediated PBL by adopting a case study design and using Demola as a case of IOs. The findings indicate that Demola projects have enormous advantages for students, industries, and universities, particularly regarding students' competence development. The success of Demola projects hinges on the co-creation of university student teams, company representatives, and Demola facilitators within the effective frameworks and tools provided by Demola. To establish and nourish a regional Demola program, the synergies of government, industry, and university as three key stakeholders are fundamental, with individual institutional entrepreneurs playing pivotal roles. This study proposes intermediary organizations facilitated university-industry collaborative PBL as a cost-effective approach for supporting students' competence development. It contributes to the discussion on this topic and offers practical implications for various stakeholders in higher education, including university managers and faculties, government education policymakers, and education entrepreneurs.

Keywords: Intermediary Organizations, project-based learning, university-industry collaboration, competence development, Demola

DECLARATION OF ORIGINALITY

I, the undersigned *Qin Zhuoli* , a student in the ELTE PPK *Educational Science MA* in awareness of my criminal liability declare and confirm with my signature that the thesis titled *Understanding Intermediary Organizations Facilitated University-Industry Collaborative Project-Based Learning in Higher Education: A Case Study of Demola* is **my own independent intellectual work** and the use of the referenced, printed and electronic, literature occurred according to the general rules of copyright laws.

I understand that the case of a thesis plagiarism is:

- using a literal quote without quotation marks and without reference;
- using citation of content without referencing to it;
- using another person's published thoughts as my own.

I, the undersigned state that I know the concept of plagiarism and I understand that in case of plagiarism my thesis will be rejected and in this case disciplinary action may be brought against me.

Budapest, April 2023

Acknowledgements

First and foremost, I would like to thank my thesis supervisor, Gábor Halász, for his exceptional guidance, expertise, and patience. His insightful feedback and constructive criticism have been instrumental in shaping the direction of this research. I am also deeply indebted to the participants who generously dedicated their time and energy to take part in this study. I would like to express my gratitude to my hosts Mark and Helen in Hungary, my friends, and family for their unwavering support, as well as to the Marihe programme for providing me with such a remarkable experience. Lastly, I appreciate the encouragement from my supervisor, Gábor Halász, in utilizing Chatgpt in a responsible and academic manner. I extend my acknowledgement to the Chatgpt language model for its outstanding assistance in elevating the linguistic quality of my thesis. Its remarkable capabilities and advanced algorithms have enabled me to refine my writing and communicate my ideas effectively.

Table of Contents

Tables and Figures

1. Introduction

The fast-paced, constantly changing world has brought significant challenges for higher education institutions (HEIs) to equip university students with the necessary competence to meet industry demands. The term “industry” here is used in a comprehensive sense, referring to “systematic labor especially for some useful purpose or the creation of something of value” (Merriam-Webster, 2023). In the present study, the term "industry" denotes any field or sector of the economy that is involved in the production of goods or services, such as technology industry, construction industry, film industry, healthcare industry. A plethora of studies has highlighted a significant gap between college graduates' skill sets and the evolving needs of the industry (e.g., Azevedo, Apfelthaler & Hurst, 2012; Kunttu, 2017). The volatile, uncertain, complex, and ambiguous nature of the world is further compelling HEIs to explore new ways to develop students' competence. Numerous initiatives have been undertaken to develop competence and skills in students that align with the changing demands of the industry and the rapidly transforming society. Such endeavors encompass an array of measures, including but not limited to industry-academia joint research projects (De Wit-de Vries et al., 2019), curricula revision in collaboration with industry (Dong-ha Lee et al., 2005), inviting industry speakers and mentors for students (Bliemel, 2013), work-based learning such as internships and apprenticeships (Lester & Costley, 2010), and industry-academia collaborative projects (Kunttu, 2017). Although these initiatives have yielded some progress, given the continually evolving societal and industrial landscapes, ongoing exploration is needed on how industry-academia partnerships can be optimized and leveraged for university students' learning and competence enhancement.

This study focuses on university-industry collaborative projects in higher education as a means of developing students' competence and bridging the gap between students' skill sets and industry needs. In recent years, some practitioners in universities have recognized the potential of university-industry cooperative project-based learning (PBL) as a way to enhance students' competence, such as problem-solving, critical thinking, communication, and teamwork skills (Shpeizer, 2019; Burch et al., 2019). Despite the positive outcomes of these cooperative PBL initiatives, organizing them can be tremendously challenging, and educators have to address various difficulties to ensure their success (Vasiliene et al.,2020). Therefore, while university-industry cooperative PBL has shown promise in enhancing students' competence development, to reap these benefits, it is important to identify strategies that can alleviate the challenges that university faculties encounter. The question arises as to how universities can maximize the advantages of university-industry cooperative PBL and enhance students' preparation for the workforce while minimizing the challenges faculties face when navigating the intricate and uncertain terrain of university-industry collaborative projects.

In the contemporary landscape, the integration of intermediary organizations as mediators between universities and industries in PBL initiatives may have presented itself as a promising solution to the challenges associated with university-industry collaboration. One such example is Demola projects, in which Demola as an

intermediary organization facilitates real-world projects between university students and industry partners, thus relieving university faculties from organizational matters related to university-industry collaborative PBL. This study investigates the outcomes and impacts of Demola projects, as well as the key elements and enabling factors involved, to deepen understanding of its effectiveness and organizational efficiency in promoting students' learning and competence development. Through an examination of the Demola case, this study aims to expand the current knowledge base in the domain of university-industry partnerships, intermediary organizations, and PBL by exploring how their synergies can be strategically utilized to advance students' competence development in a swiftly changing and unpredictable environment, as well as informing the practices and implementation of university-industry cooperative PBL.

2. Research Context

Demola is a global community comprising university students, co-creation experts, and various organizations with a shared drive to create an impact and shape the future. Demola, as a startup company, initiated a unique business in the sense that it acts as an intermediary organization between university students and industry partners. It offers a platform for students to engage in real-world projects and identify solutions to specific challenges or provide insights into complex issues faced by companies and organizations. Founded in Tampere, Finland in 2008, Demola has since expanded globally, operating in 18 countries, and has over 50 Demola Alliance Partner universities worldwide with over 750,000 students and multiple leading companies in its network (Demola, 2022). Many universities have integrated Demola projects as a part of their innovation or entrepreneurial curriculum. For instance, prestigious institutions like Tampere University (Finland), Budapest University of Economics and Technology (Hungary), Hokkaido University (Japan), and Fudan University (China) have embedded Demola courses in their curriculum, providing students with the opportunity to work collaboratively with industry partners and earn course credits upon completion.

Demola projects operate on a methodology in that real-world industry problems are curated in the form of challenges, and university students team up to address them by providing solutions or insights for industry partners. For example, companies in the healthcare industry seeking to utilize well-being data to provide personalized treatment but lacking viable ideas can launch a project with Demola and invite university students to explore this field. Demola projects revolve around five themes that are highly relevant to a technology-enabled and sustainable future: Healing the Planet, Future of Work, Human Beings in the Modern World, Byte-powered Future, and Value Creators of Tomorrow (Demola, 2022). Students from diverse backgrounds, irrespective of their disciplinary backgrounds, universities, study levels, or nationalities, select topics of interest to them and form teams. Facilitated by experts, student teams co-create with other stakeholders for eight weeks, with the ownership of the results belonging to the students. Industry partners interested in utilizing the results can purchase or license them. Demola's methodology is underpinned by the assumption that such an open innovation process connects

students that have ideas but lack authentic project experience with companies or organizations that need fresh insights and innovative solutions, thus enriching students' studies with real-life project experience, whereas providing companies with new perspectives (Halme et al., 2014).

While university-industry collaboration typically focuses on research and technology transfer (Nsanzumuhire & Groot, 2020), Demola was developed to overcome these limitations by supporting innovative learning and generating new ideas (Piippola et al., 2012). The inception of Demola was in 2008 in Tampere, Finland owing to the cooperative efforts from the Nokia Research Center, Tampere universities, and the city of Tampere (Demola, 2022). It is worth mentioning that the Tampere region has consistently nurtured strong and practical cooperation between academic institutions and the business sector with a region size that is conducive to initiatives such as Demola - sufficiently large to accommodate diverse interests, while remaining agile and eager to engage in trial and error (Business Tampere, 2016).

As per the official website of Demola (2022), the year 2009 witnessed the presentation of results of the first Demola projects as well as the involvement of new companies. Subsequently, from 2009 to 2011, Demola honed its operational framework, drawing on an iterative process of internal appraisal and responsiveness to input from diverse stakeholders. During this period, Demola also experienced a gradual, organic process of internationalization, as many foreign students became enthusiastic ambassadors for Demola, spurred on by their positive learning experiences. Demola Global Ltd was established in 2011 to support the global expansion of Demola. University representatives and city developers from various countries have visited Demola to learn about its innovation practices in catalyzing synergies between students and industry. Also, prominent local and global companies have come to recognize Demola's potential and joined the Demola network (Business Tampere, 2016). In 2020, as a response to the Covid-19 pandemic, Demola embraced the shift to fully online projects, thereby augmenting its scope of global outreach.

Along with its global expansion, the implementation practices of Demola projects have undergone some adjustments and adaptations, particularly in response to the Covid-19 pandemic. Before the pandemic, Demola projects were tailored to address the specific challenges of an individual industry partner in a particular region, with students and industry representatives meeting in person to co-create solutions. However, the pandemic has compelled a shift in approach towards a new style of co-creation, where Demola projects focus on broader industry trends and aim at providing insights for all relevant partners in the field. These projects are carried out online, allowing students from all over the world to participate. While industry representatives do not participate directly in the project process, Demola experts curate the results for industry partners who can then decide whether to utilize the outcomes. Currently, in post-pandemic time, Demola projects run parallelly in two styles – pre and post-Covid – with the same fundamental goal of connecting students with industry partners through real-world projects.

Notably, many regional Demola programs have been initiated to enhance

industry-academia collaboration and improve capacity for regional renewal and future-oriented ecosystems. For example, the Demola Portugal initiative was launched to enhance industry-academia collaboration, boost SMEs' innovation process, and improve regional business renewal capability (Demola, 2022). Demola regional programs operate nowadays in Europe, Asia, and Africa. In the meantime, leveraging its extensive experience and knowledge of facilitating university-industry collaborative projects, Demola has launched a teacher training service (staff development) in Portugal that provides training on co-creation, facilitation, building trust, networks, and a culture of cooperation between industry and academia.

While the project styles and services of Demola have diversified, with a particular interest in students' learning enhancement and competence development in the offline university settings, this study focuses on understanding the classic style of Demola-facilitated project-based learning where industry partners directly participate in the project process and co-create customized solutions or insights with student teams for their organizations.

3. Research Motivation & Goals

Despite the widespread interest in Demola projects among universities, students, and companies evidenced by Demola's internalization trajectory, there has been limited academic research on the subject. As Demola projects represent interesting examples of intermediary organizations (IOs) facilitated project-based learning (PBL) in HE, this study attempts to employ Demola as a case of IOs and seeks to understand the value of IOs facilitated PBL to various stakeholders and key elements involved as well as enabling factors for implementing such PBL. The ultimate goal is to provide an alternative and complementary methodology for students' competence development and learning enhancement in HE.

This study might be relevant to various audiences, including education scholars seeking to enrich the knowledge base of PBL, students' competence development, and partnerships in HE. It also hosts significance for faculties and university leaders striving to implement university-industry collaborative PBL but face resource constraints or lacks mature implementation tools. Furthermore, the study may prove useful for HE policymakers and government officials aiming to accelerate regional development and build innovation ecosystems through co-creation and partnerships between HE and industry. Additionally, companies, especially small and medium-sized enterprises (SMEs), that aspire to acquire novel ideas and tailor-made solutions for their enterprises without incurring substantial investments, may derive value from this study. Finally, educational entrepreneurs and venture capitalists keen on scaling up potentially profitable changes in HE may benefit from this study.

4. Literature Review

4.1 Partnership and university-industry collaboration

Despite the ubiquitous presence of partnership, no unambiguous and agreed-upon

definition of partnership exists. With this acknowledgment, Dowling et al.(2004) define partnership as a collaborative arrangement in which separate and independent organizations work together to achieve a shared objective. This may require developing new organizational structures or methods to plan and implement joint initiatives, as well as sharing pertinent information, risks, and benefits. Dowling et al.(2004) also note that this definition can encompass related terms, such as "cooperation" and "collaboration". In the domain of higher education, while higher education partnerships may include collaborative arrangements between different higher education institutions, such as student and faculty mobility programs, or between higher education institutions and other organizations, such as business or community groups, the focus of the resent study is on the latter, particularly university-industry partnerships, or university-industry collaboration (UIC). UIC refers to the interaction and cooperation between higher education institutions and industry, with the primary goal of combining academic knowledge and expertise with industry insights and resources as well as promoting knowledge and technology exchange (Ankrah & Omar, 215).

Research has shown that UIC can bring a plethora of economic-, institutional- and social-related benefits to both universities and industry partners (Prigge, 2005; Ankrah & Omar, 2015; Mascarenhas et al., 2018; Nsanzumuhire & Groot, 2020). UIC can contribute significantly to an increase in quality, productivity, and economic value of industry partners on the one hand (Marinho et al, 2020), and lead to enhanced research and innovation outcomes for universities, as well as improved student outcomes and employability on the other hand (Rahm, Kirkland & Bozeman, 2013), thus promoting social development. Meanwhile, the literature highlights drawbacks and risks that universities in UIC may face, such as conflicts of interest, compromises of academic integrity, impediments to the timely dissemination of research results and compromises of intellectual freedom, disagreements over the priorities of particular research projects, and the diverting of academic resources away from teaching (Matthews & Norgaard,1984; Prigge, 2005; Ankrah & Omar, 2015).

Concerning the implementation of UIC, in their systematic literature review of UIC, Ankrah & Omar (2015) note that universities may establish UIC by following a process of defining UIC, identifying partners, making contact, assessing partners, negotiating and agreement signing (See **Table 1**). Nevertheless, UIC in practice may involve continuous interaction instead of a linear process (Nsanzumuhire & Groot, 2020). UIC may manifest in operational activities such as meetings, communication, training, personnel mobility, employment, and others (Ankrah& Omar, 2015). UIC can take a wide range of forms. While Nsanzumuhire & Groot (2020) point out three major forms of UIC, i.e., educational collaboration, R&D-related collaboration, and academic entrepreneurship, Ankrah & Omar (2015) identify six main categories of UIC organizational forms, namely: personal informal relationships (e.g., individual consultancy), personal formal relationships (e.g., student internships and involvement in industrial projects), third party (e.g., university liaison offices and technological brokerage companies), formal targeted agreements (e.g., contract research, patenting, and licensing agreements), formal non-targeted agreements (e.g., broad agreements

for UIC and funding of university posts) and creation of focused structures (e.g., innovation/incubation centers, university-industry cooperative research centers). Despite the comprehensiveness of the six categories outlined for UIC, it is possible that other forms of UIC exist, and that there may be interrelationships or overlaps among them. Therefore, the creation of a typology for various forms of UIC that exist may further benefit future research on UIC.

Table 1 *Process of Establishing UIC*

Stages Steps	Formation process
Stage 1: Partnership Identification	Establish the purpose Obtain general knowledge of the capabilities of potential partners Consider pre-existent relationships
Stage 2: Make Contact	Identify prospective partners
Stage 3: Partner Assessment and Selection	Objectively assess the strategic interests of the potential partners Analyze actual versus professed capabilities of potential partners Determine and organize the appropriate mix of partners Choose the partners
Stage 4: Partnership Negotiation	Define the partnership Define and agree on the partnership's documented purpose or mission/vision Determine the specific common goals/objectives for the particular effort Define the organizational structure of the partnership Define the management and administration of the partnership with clearly defined responsibilities Agree on the plan Specify the milestones Identify the measures/indicators for success Specify the interim and/or final deliverables
Stage 5: Agreement Signing	Preparation and signing of the collaboration agreement and/or intellectual property agreement

Source: Ankrah & Omar (2015)

A variety of factors can facilitate or inhibit UIC (Sjöö & Hellström, 2019; De Wit-de Vries et al., 2019; Nsanzumuhire & Groot, 2020; Marinho et al, 2020). From the perspectives of both university and industry, according to De Wit-de Vries et al. (2019), cognitive difference, institutional difference, and social capital are three key aspects that influence the success of UIC. Cognitive difference refers to the differences in knowledge and expertise between academic and industry partners. While bringing diverse perspectives to the UIC process may facilitate innovation, it

can cause huge challenges in communication and collaboration. Institutional difference refers to the differences in organizational structures and goals between universities and industry partners that can create barriers to effective collaboration. For instance, while university faculties may aim to publish their breakthroughs promptly, industry partners may prioritize safeguarding their intellectual property and commercial interests, thus prohibiting publication (Matthews & Norgaard,1984). Social capital refers to social networks, trust, shared values, and collaborative relationships that develop between academic and industry partners over time. Building social capital can enhance the effectiveness and longevity of partnerships by promoting communication, mutual understanding and trust, and a shared sense of purpose (Marinho et al, 2020). Focusing on the perspective of universities, Sjöö & Hellström (2019) identified seven key factors that stimulate UIC. These factors are as follows:

1) Resources: Availability of institutional resources to support collaboration.
2) University organization: Presence of a liaison office with expertise and networking abilities to facilitate collaboration.
3) Boundary-spanning functions: Regular and informal activities within the university, often linked to existing projects, that promote collaboration.
4) Prior UIC experience: Valuable experience gained from prior collaboration that, through institutionalization and routines, may result in partner familiarity, trust, formal ties, and informal contacts between academics and businesses, thereby stimulating further collaboration.
5) Culture: An entrepreneurial university culture that promotes activities that extend beyond the boundaries of academia and self-reinforces to promote collaboration.
6) Status centrality: Universities and researchers with higher status are more likely to be involved and preferred as partners in UIC.
7) Environmental context: Geographical and policy contexts that influence UIC. Government policy instruments such as cost-sharing and subsidies for R&D can incentivize UIC. Furthermore, the intensity of regional R&D and geographical proximity appears to positively relate to the formation of close relationships between firms and researchers.

The seven factors, to some extent, correspond or interrelate with the aforementioned three aspects, namely, cognitive difference, institutional difference, and social capital. While the provision of resources, university organization, boundary-spanning functions, and entrepreneurial university culture can reduce the cognitive and institutional difference between universities and industry, prior UIC experience, high status, and environment can help build social capital for better collaboration. In the meantime, the diverse factors echo Ankrah & Omar's (2015) assertion that the success of a UIC project is determined by a complex interplay of influences from various factors, in which organizational and managerial issues play a vital role.

While UIC research has extensively examined research partnerships and technology transfer activities between universities and industry, there has been

relative neglect in exploring educational collaboration in this domain (Kunttu, 2017; Nsanzumuhire & Groot, 2020), even though one of the primary missions of universities is to provide quality education, enhance students' competence and cultivate well-educated talents. Nevertheless, existing literature focusing on education activities in UIC has generally confirmed their fruitful results and the need for such initiatives (Neumann & Banghart, 2001; Burns & Chopra, 2016; Kunttu, 2017; Jussila et al., 2020).

Neumann and Banghart (2001) examined “consulternships” as a special form of UIC that involves an external organization's staff, student interns, and university faculties closely collaborating on intensive projects with the financial support of the external organization. On the one hand, the authors acknowledged the complexity involved in establishing and delivering consulternships that encompass formulating proposals, contracts, work plans, and communication and project management throughout the process. On the other hand, the results of consulternships were described as win-win for both universities and external clients, with the former benefiting from practical education opportunities, research linkages, knowledge dissemination, faculty development, organizational learning, and financial inflows, and the latter benefiting from cost-effectiveness, opportunities to connect with students and professors, and potential for future recruitment. The mutual benefits for both academia and industry through joint educational activities are conceptualized as "relational learning" for all stakeholders in Kunttu's study (2017). Relational learning includes knowledge-sharing, joint sense-making, and integrating new knowledge into the relational memory of active partners. Kunttu (2017) investigated relational learning in four types of UIC involving educational involvement, namely student projects, thesis projects, tailored degree courses, and jointly organized courses, and confirmed the practical benefits of involving students in industry projects.

While echoing abundant benefits in university-industry collaborative PBL, researchers have also approached the subject differently. Heikkinen (2017) examined the role of multidisciplinarity in university-industry collaborative PBL and concluded the multidisciplinary approach is a positive and meaningful learning experience for students, pushing them to work outside their comfort zone and increasing their occupational identities. Jussila et al. (2020) explored co-creation pedagogy and design thinking through a case study of rapid product development. Co-creation pedagogy involves collaboration among students, teachers, and business representatives as co-contributors and facilitates student competence development by emphasizing learning-by-doing and linking intended learning outcomes with authentic and meaningful industrial problems. Design thinking represents a person-centered and cross-disciplinary problem-solving approach that involves a structured process of empathizing, defining, ideating, prototyping, and testing. Both co-creation pedagogy and design thinking share a common emphasis on equal, multidisciplinary co-creation and person-centered approaches, making them supportive of each other (Jussila et al,2020).

In higher education, students play a crucial role as key stakeholders. Research has established that involving students as partners in higher education can lead to

improved student motivation, increased sense of belonging, and enhanced critical thinking and problem-solving skills (Mapstone et al, 2017; Felten et al., 2014). A meta-analysis examining the effect of industry engagement on student learning outcomes has demonstrated that it not only improves their academic achievements but also gives them a sense of direction for their future careers (Burns & Chopra, 2016). Given the relative overlook of research on educational collaboration in UIC, it is imperative that the educational involvement and competence development of students receive greater attention both in the practical implementation of UIC initiatives and in future scholarly investigations of UIC.

4.2 Project-Based Learning

Project-Based Learning (PBL) refers to a student-centered pedagogy that promotes self-directed learning based on authentic problems and engages learners to collaboratively develop real-world products (Kokotsaki et al., 2016). The key characteristics of PBL include a driving authentic question, the focus on learning goals, participation in educational activities, collaboration among students, the use of scaffolding technologies, and the creation of tangible artifacts (Guo et al., 2020). PBL has its roots in social constructivism, which states that learners construct knowledge based on their experience from a specific context and achieve their goals through social interactions (Jumaat et al., 2017).

PBL as a learning methodology for students. Numerous students have experienced PBL as a supplementary learning method in their studies. A plethora of empirical studies have investigated students' learning outcomes in PBL and concluded PBL is an effective means of learning (e.g., Martínez et al., 2010; Sandra et al., 2012). PBL has been positively associated with developing students' 21st-century Competences (Baird, 2019; Shpeizer, 2019; Burch et al., 2019). Vasiliene et al (2020) summarized the benefits of PBL for various stakeholders including students. Their research establishes PBL as an effective educational tool for developing learners' self-regulated deep learning and engagement, enhancing their employability and 21st-century competence including problem-solving, creative thinking, communication, cooperation, and managerial skills. The significance of PBL to students is echoed in Kokotsaki et al.'s (2016) literature review on PBL. Meanwhile, they critically pointed out that the majority of the reviewed studies lack a rigorous design of control and experimental groups. As a result, caution should be made when establishing a causal link between PBL and positive student outcomes. Similar concerns are expressed in Guo et al.'s (2020) systematic review of PBL in higher education. The authors differentiated learning outcomes into four categories, namely, 1) cognitive outcomes, i.e. content knowledge and cognitive learning strategies; 2) affective outcomes, i.e. students' self-evaluation and their perceptions of learning experiences; 3) behavioral outcomes, i.e. students' skills, participation, and engagement; 4) artifact performance, mainly including three types, i.e., documents, physical objects, and multimedia. They found that in studies on PBL's learning outcomes, affective outcomes measured by questionnaires, interviews, observation, and self-reflection journals were most applied, whilst reporting the items, reliability, and validity of the instruments adopted should be improved and more experimental research should be utilized in future research in this

field. Nevertheless, Guo et al. (2020) firmly believe in the importance of PBL in students' active knowledge construction, idea creation, and innovation competence as well as the necessity of integrating into PBL in higher education.

Despite the generally favorable learning outcomes, students have also voiced negative opinions about PBL, particularly about the learning process. PBL is associated with a significant workload for students (Martínez et al., 2010). Dedicating considerable time and effort to the project can lead to some students' high expectations for assessment results. However, they may end up being dissatisfied with their final grades, especially when they compare PBL to other forms of study and evaluation (Sandra et al., 2012). Some students also expressed concerns about teamwork and possible in-team conflicts (Frank et al, 2003). Furthermore, in projects involving collaboration with industry partners, students may feel pressured to engage with industry representatives and deal with complex, real-world problems (Marcketti & Karpova, 2014; Heikkinen, 2017). Nevertheless, these challenges can provide valuable learning experiences for students. It is therefore the responsibility of teachers to equip students with the necessary skills to enable successful university-industry collaborative PBL (Heikkinen, 2017).

PBL as a teaching and organizing process for practitioners. From university teachers' point of view, PBL can be deemed as a system of elements and their links: significant content, driving questions, students' voice and choice, developing 21st-century skills, inquiry innovation, feedback, and revision, publicly presented product (Lorin, 2013). Putting PBL into practice requires deliberate consideration of the leaders in HEIs and enormous institutional efforts in various stages. Butvilas et al. (2016) in their study identified six stages for implementing a university-industry collaborative PBL, namely, decision, preparation, the integration of PBL into study curricula, business sector involvement, the preparation of teaching staff, and constant process monitoring in the implementation. The preparation of teaching staff is vital for their significant role in various phases of PBL, as highlighted by Vasiliene et al. (2020) (See **Table 2**)

Table 2 *Teachers' Role in Project-Based Learning*

Phase	Teachers' Role
Pre-project	a knower, helping students select a topic, generate ideas through brainstorming/mind mapping, guiding students to formulate their project objectives, and developing a contract/proposal for the group
During-project	a consultant, a facilitator, or a co-learner, helping students gather ideas, defining objectives, drawing up the schedule and providing suggestions to solve problems, and responding to requests from students
Post-Project	a commentator and appraiser, paying attention to what students learned during the project, sharing the reflection, providing a balanced picture of strengths and weaknesses, offering suggestions for improvement

Source: Vasiliene et al. (2020)

Despite teachers' pivotal roles in all phases of projects, studies evidenced challenges faced by teachers as well as their confusion and concerns in applying PBL. For teachers, the major challenges in using PBL include: 1) Adopting new instructional strategies. Teachers have difficulty adjusting from a directive to a facilitative role in PBL. They may have a disorderly feeling about the classroom and are concerned about losing control both over the topic and the students' behavior (Tamim & Grant, 2013). 2) Designing and managing PBL. Barriers to PBL implementation also include the fact that project planning is time-consuming, creating a culture of collaboration and teamwork in the classroom is demanding, and scaffolding student learning requires further professional teacher training (Vasiliene et al.,2020). 3) Assessing students' learning in PBL. PBL practitioners in various studies have articulated perplexity and anxiety over assessing PBL learning, such as how to assess students' deeper content understanding, group processes, individual work ethic, alternative products, soft skills, and competence (Lee et al, 2014; Fitriati, 2016; Clark, 2017; Williams, 2017).

Kokotsaki et al. (2016) have outlined facilitating factors that can counter the various challenges associated with organizing PBL. These factors comprise modern digital technology, high-quality group processes with emphasis on group interdependence and individual accountability, the teacher's ability to effectively scaffold students' learning, motivate, support, and guide them along the way, learners' control over the learning process, support from senior management and colleagues, and the use of a two-phase project-based approach.

4.3 Intermediary Organizations

Dutt et al.(2016) define "intermediaries" as agents that can bring about specific activities and potentially provide value by linking two or more parties who may not directly connect. Intermediaries carry out boundary-spanning activities, i.e., take knowledge from one domain and move it to be applied in another, therefore facilitating the transfer of knowledge (Wright et al., 2008). Boundary-spanning activities are complex yet important considering the distance between the groups in terms of language, physical distance, and culture (Kostova & Roth, 2003). In the context of higher education, various types of intermediary organizations exist, such as research and technology transfer organizations, advocacy organizations that advocate for problems and solutions, foundations and funders that use the funding to drive policy, membership organizations that promote membership interests (Orphan et al., 2021; Virani & Pratt, 2016).

In parallel with a growing research interest in university-industry collaboration, studies have indicated intermediaries' significant role in enhancing higher education institutions' interaction with other sectors and contributing to economic growth (Kruss et al., 2015; Alexandre et al., 2022). Since the social networks of firms and universities often do not overlap, a wide range of intermediary actions affect the transfer of knowledge and convey influence between universities and other sectors.

Focusing on the connection between education and economic development, Kruss et al. (2015) stress the importance of the intersection between the global, national, sectoral, and spatial dimensions, as well as the interaction among various actors in networks (e.g., firms, higher education providers, intermediary organizations). They highlight intermediaries' role in connecting different sections and argue to shift from simply focusing on the responsibility of higher education to become more responsive to firms, to more attention on interactive capabilities and interaction dynamics of various actors. Scholars have considered developing intermediaries as one of the main mechanisms to enable HEIs to meet regional needs. Chatterton & Goddard (2000) assert that intermediaries lower the threshold between practices in HEIs and the world of business by facilitating the communication process, thus unleashing the potential of universities in a more regionalized economy. The study of Alexandre et al.(2022) echoes the idea that intermediaries such as Technology Transfer Offices (TTOs) link universities with small enterprises that have lower knowledge capabilities and physical proximity, thus contributing to wider dissemination of knowledge and promoting regional growth. Similarly, Virani & Pratt (2016) highlight the active and transformative role of intermediaries in collaboration between universities and small, medium, and micro-sized enterprises in the case of creative and cultural industries. They contend that intermediaries function as brokers, translators, and network builders to not only bridge a gap but also construct trust between small firms and universities, whose interaction otherwise is commonly obstacles by asymmetry and divergence in organizational form and scale. Virani & Pratt (2016) hypothesize strong intermediaries with successful mediation nourish and add resilience to a creative ecosystem. Such ecosystems are characterized by "a multiplicity of micro and project-based enterprises that suffer from a ‘missing middle’ organisationally and long-term sustainability" (p55).

In line with intermediaries' boundary-spinning roles between universities and industries, studies have investigated intermediaries internal to the university (e.g. TTOs, incubators, and science parks), as well as external intermediaries (e.g. Collective Research Centres, and surrogate entrepreneurs). Wright et al.(2008) point out that as universities are expected to generate a "third stream" of income alongside teaching and research, they are increasingly involved in commercializing research results. The process may include active react-out activities to launch educational initiatives, search for commercial opportunities in the pool of results, conduct market research, protect intellectual property, and provide guidance on establishing commercialization plans. Since academia and industry often speak different languages, a need for intermediaries who have particular expertise to speak both languages and bridge both sections has emerged. In many universities, such intermediaries manifest in the form of TTOs that are responsible for transferring codified or explicit knowledge such as in IP and licensing (Wright et al., 2008).

Collective Research Centres (CRCs) represent a type of external technology intermediaries in many European countries (Spithoven et al, 2010). CRCs are established to accelerate university-industry collaborated research & development (R&D) and stimulate the technological development of major industrial sectors. They are supported by federal and/or regional government and operate in traditional

industries (e.g., construction, textiles) characterized by low technology content measured by their R&D investments. CRCs perform applied technological research for a specific sector and actively engage in various technology transfer activities, ranging from organizing workshops to being directly involved in technology research activities. Under the premise that most firms operating in traditional industries "lack the absorptive capacity to turn available external knowledge into innovative products and services and strengthen their competitive position" (p17), Spithoven et al (2010) conclude CRCs, as technology intermediaries, can help to build absorptive capacity within their 'client firms' by performing diverse technology and knowledge service activities. Individuals and other organizations may also assume the role of external intermediaries. Surrogate entrepreneurs are individuals or organizations from outside the university who intermediate between technology originators in the university and the business world (Franklin et al., 2001). They possess both tacit and codified knowledge regarding a particular sector and enable spin-offs to access customers and suppliers. Universities that generate the most start-ups are found to have more favorable attitudes toward surrogate entrepreneurs (Franklin et al., 2001).

In the realm of higher education, there exist intermediaries primarily involved in HE policy formation and diffusion. Along with the rising importance of HE policy in societies and the apparent shift towards knowledge economies, agencies have emerged to intermediate or buffer in the process of developing and implementing policies, which Jungblut and Woelert (2018) term "agentification". Orphan et al. (2021) probed intermediaries' agenda-setting power in HE public policy. They assert that intermediaries successfully promote HE policy diffusion and influence HE policy formation by following a process of identifying policy issues, constructing problems, and solutions, and moving onto the HE policy agenda. The strategies utilized by intermediaries to manifest their agenda-setting power include coalition building, hosting convenings, storytelling, publishing policy agendas, and leveraging focusing events in their agenda-setting processes (Orphan et al., 2021).

Apart from research on intermediaries in research activities, technology transfer as well as HE policy formation and diffusion, literature on intermediaries in education activities in higher education is relatively scarce. The empirical study of Vanderlinde & Van (2010) on the gap between educational research and practice indicates that intermediaries such as teacher trainers can act as a go-between and bridge the communication between education researchers and education practitioners (i.e., teachers and school leaders). In relation to the education of university students, Elken & Tellmann (2019) portray professional associations and trade unions as intermediaries situated between higher education, the state, and the world of work. Their study asks to what extent such intermediaries engaged in determining learning outcomes in HE and how has this influenced the relevance of higher education to the labor market. The findings suggest that the degree of such intermediaries' involvement in developing learning outcomes varies distinctly, on the one hand. On the other hand, introducing learning outcomes through the activation of intermediary actors in the field does not necessarily create new links between higher education and the world of work. Kezar (2021) examines the role of the Association of American Universities (AAU) as an intermediary in scaling evidence-based teaching practices

at its member institutions, with a main focus on the organizational identity of AAU and its effects on scaled changes. He concludes the development of networks, forums for deliberation, and external support (e.g, national awards and other forms of recognition and support) as strategies that scale changes across higher education institutions. His study further reveals that AAU as an intermediary possesses identities comprising of prestige and influence identity, network identity, lobbying, and advocacy identity, which facilitate its use of scaling strategies to change teaching practices in HEIs.

The existing literature on intermediaries demonstrates a conspicuous emphasis on research and technology transfer activities. Despite some inclusions pertaining to intermediary organizations in HE policy creation and dissemination, and education involvement, such accounts remain scarce. Notably, there is a dearth of evidence of intermediaries directly engaging with student groups and elevating their voices, as posited by Orphan et al. (2021). Accordingly, a gap exists in understanding the role of intermediaries in the involvement of educational activities and the development of students' competence, and such a process in general remains elusive.

5. Research Questions

Synthesizing the current scholarly discussions on UIC, PBL, and IO in higher education, it is evident that the majority of research on UIC and IO involved has focused on university-industry collaborative research and technology transfer, with limited attention given to industry engagement in educational activities in HE (Kunttu, 2017; Orphan et al., 2021). Despite the proven effectiveness of PBL and university-industry collaborative PBL for student learning outcomes, implementing PBL entails tremendous challenges and great confusion for practitioners in HE (Vasiliene et al., 2020). However, Demola projects offer practical examples of university-industry collaborative PBL facilitated by intermediary organizations that can deepen our understanding of these aspects. Therefore, the present study asks the question:

What are the conditions for intermediary organizations to play an effective role in university-industry collaborative PBL in higher education?

which has been operationalized as three sub-research questions:

1) What are the outcomes and impacts of intermediary organizations facilitated university-industry collaborative PBL?
2) What are the key elements to the success of an individual university-industry collaborative project facilitated by intermediary organizations?
3) What enabling environment is required for the establishment and nourishment of a regional university-industry collaborative PBL program facilitated by intermediary organizations?

Given that Demola projects have been implemented in various locations globally, to some extent demonstrate the effectiveness of university-industry collaborative PBL facilitated by intermediary organizations such as Demola. The focus of this study is to explore the specific manifestations of the effectiveness of university-industry collaborative PBL facilitated by intermediary organizations and how such effectiveness can be achieved. The former is operationalized as investigating the outcomes and impacts of such PBL, while the latter is operationalized as exploring the core elements involved and its enabling environment. Analogies can be used to make sense of the underlying logic of these investigations (See **Figure 1**). If Demola PBL is deemed as an orange tree, the author first attempts to examine the results produced by Demola PBL, understanding the quality of oranges for identification and comparison. Subsequently, the author shifts the focus to key elements involved in Demola PBL, understanding the specific practices involved to cultivate high-quality oranges, which may include details such as the types of fertilizers and the sequences and quantities of their usage. Lastly, the author probes the enabling environment of Demola PBL, understanding the favorable environment for growing the orange tree. Mastering the detailed practice of growing orange trees does not necessarily mean that one can successfully grow orange trees anywhere, as suggested by a Chinese saying that "oranges grown south of the Huai River are true oranges; once transplanted to the north of the river, they become trifoliate oranges. Although they resemble in the shape of leaves, they differ widely in taste." Understanding the enabling environment is precisely about exploring advantageous contexts for Demola PBL to thrive. If understanding the key elements of Demola PBL concerns how to mass transplant the orange tree, then understanding enabling environment concerns identifying the right place to grow the orange tree. Put differently, the former relates to scaling up Demola PBL from 1 to 100, while the latter relates to localizing Demola PBL from 0 to 1.

Figure 1 *Analogy of Research Questions*

Source: own work

6. Research Method

6.1 Research design

As the research questions in this study are explorative in nature, a qualitative design was adopted, specifically a case study design. According to Creswell (2007), a case study is a suitable method when the inquirer has clearly defined cases with distinct boundaries and aims to gain a thorough comprehension of the cases or make a comparison of multiple cases. In the context of this study, while there might exist university-industry collaborative PBL facilitated by different intermediary organizations in higher education, Demola projects represent conspicuous examples of such PBL. Demola projects are clearly defined as they are operated by the global organization Demola implementing its methodology and frameworks in university-industry collaborative PBL. Therefore, Demola is adopted as a case of intermediary organizations, and Demola projects are regarded as a case of university-industry collaborative PBL facilitated intermediary organizations.

6.2 Data collection

To fully comprehend the efficacy and organization of Demola projects, examing their operation in different regions allows for more compelling conclusions based on the similarities and differences among the various sites. While Demola projects operate in multiple regions across the world, the present study selected Demola projects operating in four regions for data collection, namely, Finland, Hungary, China, and Japan, which are respectively referred as Demola Finland, Demola Hungary, Demola China, Demola Japan. The selection of these regions was largely based on a pragmatic and comprehensive consideration of various factors, such as the anticipated difficulties in conducting case studies on multiple sites, the feasibility of the study, the representativeness of the region, the accessibility of contacts, and the researcher's capacity. Demola Finland and Demola Hungary represent European contexts, with Finland being the birthplace of Demola, whilst Demola China and Demola Japan represent Asian contexts, with Demola Japan displaying better continuity than Demola China. By analyzing and synthesizing the shared characteristics, disparities, and patterns of Demola projects across these four sites, this study aims to provide valuable insights into the effectiveness of Demola-mediated PBL, critical components involved in and its enabling environment.

To comprehensively address the research questions and gain a holistic understanding of Demola projects, this study identified four key stakeholder groups involved in each Demola project: university students, university staff, Demola managers or facilitators, and industry partners. The study collected data on these groups' perceptions of Demola project outcomes and impact, project flow, and component elements, as well as enabling contextual information. A mixed-method approach was employed to collect data from various sources, including stakeholder interviews, documents provided by interviewees, and publicly available online information, such as website news, documents, individual blogs, and audiovisual materials on Demola projects, to enable data triangulation. Data triangulation is used

to enhance the credibility and validity of research findings by utilizing multiple sources to gain a comprehensive understanding of phenomena (Campbell et al., 2018).

For stakeholder interviews, Demola project stakeholders were sampled purposefully to obtain Demola relevant rich information with efficiency. Convenience and snowball sampling techniques were employed to recruit interviewees from each stakeholder group, namely, student participants, Demola managers or facilitators, university managers and faculties, and industry representatives. In each study site, the regional managers or facilitators of Demola were contacted through publicly available email addresses to participate in this study. Other interviewees were reached mainly via Linkedin and referrals. Semi-structured interviews with open-ended questions were adopted. Four interview guides were developed to tailor each stakeholder group with common themes surrounding research questions and slightly vary in each guide. The common themes in interview guides focused on assessing various stakeholders' perceived outcomes and impacts of Demola projects, organizational matters, and challenges involved in such initiatives. For university faculties and Demola managers, and facilitators, questions on the enabling environment required for nourishing regional Demola projects were also explored. Detailed interview questions are provided in the **Appendices.**

After obtaining research ethical approval, both in-person and online interviews were conducted. The interviews for Demola Hungary were conducted in person, whilst the interviews for Demola Finland, Demola China, and Demola Japan were conducted online due to the physical proximity. The interview language medium was English for Demola Finland, Demola Hungary, and Demola Japan whilst Chinese was used during interviews for Demola China. The online interviews were facilitated primarily through the use of virtual meeting software such as Google Meet and Zoom. Before recording the interviews, consent was obtained from the interviewees.

6.3 Data analysis

Thematic analysis was adopted for analyzing data in the current study. Thematic analysis is a qualitative research approach that encompasses the identification, analysis, and reporting of emerging patterns or themes within data (Braun & Clarke, 2006). Thematic analysis is highly adaptable and can be tailored to meet the requirements of various research projects, providing a comprehensive and nuanced, yet complex account of the data. It is advantageous for studies aimed at exploring and comprehending the subjective experiences, viewpoints, and interpretations of individuals or groups (Nowell et al., 2017). It is also valuable in summarizing key features of a large data set, as it necessitates the researcher to take a well-structured approach to data handling, resulting in a clear and organized final report (Nowell et al., 2017). The process of thematic analysis involves systematically organizing and categorizing data according to the themes and patterns that arise (Braun & Clarke, 2006). In this study, data were analyzed thematically first, and re-categorized in the last step into three overarching themes corresponding to three sub-research questions, namely, outcome and impacts, project elements, and enabling environment.

Based on Creswell's suggestions on qualitative data analysis procedures and coding techniques for the case study design (2007), data analysis procedures for this study were developed. The analysis procedure involved several steps. Firstly, the data files were organized and memos were created to describe Demola projects on each site. Secondly, the data were read through and initial codes were formed based on the different stakeholders' perspectives on the three themes. Thirdly, the theme analysis for the first Demola site was conducted by coding the relevant data and organizing the codes into three categories, followed by interpreting the findings. Fourthly, the third step was repeated for analyzing the remaining sites. Fifthly, cross-site theme analysis was performed by comparing and identifying regularities among the four sites and synthesizing the results. Lastly, assertions were formed, and findings were presented using visual displays such as tables and figures. Since this study collected data from various sources, the display of quotations from different sources is differentiated, with the quotations from interviews collected by the researcher being displayed in black color while the quotations from the website being displayed in blue color.

In this study, to maintain the confidentiality of the participants, all interview transcripts were anonymized, and pseudonyms were assigned to each participant throughout the analysis process. The pseudonyms and the stakeholder group distribution of all interviewees are displayed in **Table 3**. Interviewees were named following the format "the initial two letters of their participating Demola site + their sequenced number within the site". It should also be noted that the participating Demola site of interviewees does not represent their nationalities. For instance, four interviewees who were involved in Demola Finland were named respectively Fi1, Fi2, Fi3, and Fi4. However, the four interviewees are not all Finnish. Rather, they are from India, Nepal, Finland, and Finland respectively. Second, many interviewees were involved in more than one Demola project. Owing to their changing roles and duties within the Demola projects they were involved in, they may represent more than one stakeholder group. For instance, Fi3 was initially involved in Demola projects as a student participant. In the following other Demola projects he participated in, Fi3 became a trained Demola facilitator facilitating Demola projects and also a university staff member organizing Demola projects at his institute. Third, because of practical difficulties in reaching certain stakeholders and constraints of researcher capacity and time, limited interviews were conducted, especially for industry partners. This shortage was partially supplemented by views and quotations of participant stakeholders collected from website information and news. For instance, only one industry partner was interviewed whilst quotations from several Finnish and Japanese industry partners were collected from Demola's official websites.

Table 3 *Interviewees and Website Quotations*

Stakeholders	Demola Finland	Demola Hungary	Demola China	Demola Japan
Student participants	Fi1, Fi2, Fi3, Website quotations	Hu1, Hu2, Hu3	Ch1, Ch2, Ch3	Website quotations

Demola managers or facilitators	Fi2, Fi3, Fi4,	Hu4	Ch3	Ja1
University managers or faculties	Fi3, Website quotations	Hu5, Website quotations		Ja1
Industry partners	Website quotations		Ch4	Website quotations

7. Results & Discussion

7.1 Outcomes & impacts

This section discusses the findings on the outcomes and impacts of Demola projects sequentially on university students, industry partners, and universities. In the following discussions, the author wishes to draw the readers' attention towards the distinctive outcomes and impacts generated by Demola-facilitated PBL as opposed to the conventional PBL organized solely by academic faculties.

7.1.1 Students

The results from interviews with student participants show that participating in Demola projects has enhanced students' learning outcomes and generated significant impacts on their personal and professional competence development.

The completion of students' participation in Demola projects resulted in tangible outcomes that are intended to consolidate their knowledge and competence. These concrete outcomes mainly included project prototypes, presentations, reports, and certificates, providing evidence of the students' ability to apply theoretical knowledge to practical problems, work collaboratively in a team, and effectively deliver their findings. The project presentations and the reports in Demola projects resemble the typical outcomes of PBL (Guo et al.'s, 2020), with the former allowing students to demonstrate their understanding of the project, and the latter providing a detailed account of the project's development and findings. What Demola projects differentiate from typical PBL organized by faculties are the emphasis on developing project prototypes and the awarding of certificates to students upon their completion. Demola projects are "output-oriented" and creating a "prototype to demonstrate and showcase the solution" is key to the second half of Demola project work (European Commission, 2021, p34). To communicate their solution to industry partners clearly, student teams had to learn new skills to develop prototypes (Fi1). Through this learning-by-doing manner, students who completed Demola projects not only gained a deep understanding of the project topic but also used higher-level cognitive learning techniques such as applying, analyzing, evaluating, and creating.

"After comparing several different ideas, we decided to make it a bicycle storage space. We needed to develop a prototype to demonstrate our proposal, so we had to

learn 3D and animation… There were lots of new things learned along the way… We delivered our proposals through the demo and presentation. The company liked it and paid us for the patent." (Fi1)

The other concrete result, the Demola certificate, serves as a formal recognition of the student's achievements. Student interviewees highly valued Demola certificates and perceived them as having positive impacts on their educational pursuits (Ch3) or employment prospects (Hu2). Interviews with former participants revealed that when applying to universities, the inclusion of the Demola certificate and experience in their application letters lent additional credibility, and may have played a significant role in securing admissions into highly competitive programs. For instance, Ch3, who was part of one Demola China project, specifically attributed his and another teammate's successful enrollment into their ideal foreign universities partly to their participation in Demola. Also, interviewees regarded Demola certificates as a valuable externality to their degree study, which could enhance their appeal in the job market. Hu2, who shared his Demola certificate on LinkedIn, stated:

"Demola certificate gives you an international appeal which is valued by a lot of jobs for other organizations. And if you have run their (Demola) program, people see in your CV or on your LinkedIn that you have had the opportunity to work on a Demola project. It gives you a good appeal within the job market or something as compared to when your faculty handles it. [When you participate in the project handled by your faculty,] it is being looked at as part of your certificate or degree that you are going to earn. So for me, I would prefer a Demola lifestyle of an organization where it brings an external certificate or an external appearance, in addition to the one that I'm also going to get from the university. But if you look at [the projects organized by] the university, then it's like it's part of your degree study. So that is something that somebody will evaluate based on your study or look at only as a degree certificate, but not Demola's kind certificate and appeal". (Hu2)

In line with Demola certificates' impact on students' educational pursuits or job prospects, Demola projects in general have generated observable positive impacts on some students' prospects. Due to the nature of industry-university collaborative projects and Demola's stress on "co-creation", students not only interacted with but also co-created with industry partners and other stakeholders. This helped students build connections with professionals in their field of interest, benefiting their career development and advancement. Several former student participants attributed their internships, traineeships, or jobs to a direct or indirect result of their Demola project experience or the connections they made during the project (e.g. Fi1, Fi2, Hu2, Ch3). The valuable Demola project experience and the professional connections established through Demola projects especially have benefited international students seeking to work in foreign countries, who otherwise may encounter numerous difficulties. For instance, a Nepali student shared in her blog that her Demola and other co-creation experiences helped her "*build experience, network, skills, and understand the Finnish way of working*", and eventually led to her current job in a Finnish company (BG, 2020). Similarly, Fi 1, an Indian student who participated in Demola Finland projects at Tampere University and currently working for a Finnish company, reflected:

"Normally, it can be very difficult for us to find a job here [in Finland] since we don't speak Finnish. But Demola gave me the opportunity and experience to work with local companies, which led me to another opportunity and, in the end, landed me my current job... I was very lucky and got this job even before I graduated. So I didn't have to go through the anxious and difficult job hunting time which most international students have to." (Fi1)

Moreover, Demola projects have also inspired some participants to pursue entrepreneurship. The collaborative and innovative nature of the project has provided a fertile ground for the emergence of new ideas, which some participants have developed into viable business ventures. These startups represent tangible examples of the impact that Demola projects can have on fostering entrepreneurship and innovation, thus potentially driving economic growth and impacting society. For instance, Hu3 recalled two teams developing board games and automated beer taps respectively as startups thanks to the ideas they formed during Demola projects. Also, Hu4 shared a student team developing a phone application for families with disabled children to connect and join a community.

Alongside the concrete results and observable impacts, Demola projects have contributed to students' acquisition of intangible competence that are highly valued in the 21st century, which is consistent with findings of positive impacts of PBL (e.g., Shpeizer, 2019; Burch et al., 2019) and university-industry collaborative PBL (e.g., Kunttu, 2017; Jussila et al., 2020) on students' competence development. These competence include but are not limited to, effective communication, collaboration, critical thinking, and creativity.

Student participants in Demola projects experienced communication in a cross-cultural, cross-disciplinary, and cross-sector environment, which enhanced their communication skills. Demola values the diversity of team composition (Fi4, Ch3). As a co-creation platform that operates across universities, Demola has the capacity and capability to attract students with various backgrounds and diversify the cultural backgrounds of student team members. In interviews, all students reported having international peers in their teams and noted that working with them helped to develop their intercultural communication skills. Through engaging with peers from different cultural backgrounds, students were able to develop a greater understanding and appreciation for diverse perspectives and ways of thinking, thus cultivating global mindsets. For instance, Hu2 is a Ugandan who teamed with peers from Hungary, Germany, and Italy in the Demola project and revealed that talking with people from diverse countries made him "*see how people think*" and realize others' different ideas that he "*didn't even think about before*" (Hu2).

Multidisciplinary team composition represents another key feature of Demola projects (European Commission, 2021, p6). Through interacting with peers from other fields of study, students were exposed to a range of unique views, approaches, and ways of thinking that they may not have encountered otherwise, potentially breaking their stereotypes of certain disciplines. For example, Hu3 who majored in information technology noted that communication with his teammate whose major

was psychology was an enriching experience, as he realized his teammate's perspectives were "*so different and fascinating*". Had it not been for the Demola project, he may have "*never had the chance to engage with a psychology major*" (Hu3) and benefit from their insights and perspectives.

Moreover, in Demola projects, students had frequent communication with company representatives, providing them with opportunities to gain valuable insights into the expectations, culture, and practices of the professional world, and learn how to effectively communicate with industry professionals. Communication with industry further helped students to demystify the industrial world and gave them greater confidence in their ability to interact with companies. As Fi1 reflected,

"Demola helps me to speak the company's language and build up my resume... It's eye-opening to see how a company works in reality. It's like the holy veil of the company is removed. I mean, they are also common people working in the company. They also make mistakes. It's ok to make mistakes. Failures are normal." (Fi1)

Effective communication facilitated student participants' collaboration and led to the co-creation of the final results. In student teams, the allocation of tasks was generally based on an open discussion of individual interests and capabilities. The rapport among team members allowed for a dynamic and flexible task assignment process, which enabled the team to adapt to any emergent issues or changes in team composition while still ensuring the completion of tasks before deadlines. More than one interviewee (e.g., Hu2, Ch2) mentioned that during their teamwork, one team member couldn't manage and quit, but the team quickly adjusted and did not affect the work. More importantly, collaboration within the student team was democratic, with *"no team boss dictating task assignments" (Fi2)*. The same principle applies to students' collaboration with industry partners. Yet, as students and industry partners are naturally at asymmetric power relations, it is Demola's co-creation methodology and facilitators' efforts that strive for a balanced equal, and democratic collaboration between student teams and industry partners, which shall be further elaborated in answering the second sub-research questions.

In the course of co-creating solutions for Demola projects, students also developed critical thinking skills. Communication and collaboration with peers and industry partners from diverse backgrounds exposed students to various information and perspectives for analysis and evaluation. Interviews with student participants revealed they were challenged to question assumptions, consider alternative viewpoints and engage in meaningful discussion. For instance, Ch3 believes his Demola co-creation experience reshaped his perceptions about feminism and made him more *"sensitive towards unequal gender power and status"* in Chinese and Japanese societies. Meanwhile, the authenticity and complexity of industry problems presented in the Demola projects served as a catalyst for students to engage in analytical thinking and identify the most appropriate solutions. The process of identifying solutions to industry problems also involved continuous validation, and trial and error, all of which further enhanced students' ability to think critically.

Critical thinking further helped foster students' creativity in developing innovative solutions to industry problems. On the one hand, the collaborative, intercultural, multidisciplinary, intersectoral nature of Demola teams provided a fertile ground for students to explore new ideas and experiment with different approaches. As Fi2 noted, *"New ideas don't come easily. To have new ideas, you need a broader vision. You need an outsider's opinion. You need alternative mindsets to challenge the status quo."* On the other hand, the open-ended Demola projects, explorative approach, and facilitators' guidance all encouraged students to "be creative, *look for things that are not obvious" and " always think outside the box" (Hu2),* rather than relying on standard approaches, conventional wisdom or simply focus on the present.

Therefore, it can be inferred that Demola projects were advantageous for the development of students' competence, particularly in the domains of communication, collaboration, critical thinking, and creativity. These competence are interconnected and complementary, creating a set of proficiencies that are highly sought after in various contexts. Moreover, Demola projects contributed to enhancing the students' sense of belonging and building a community among the participants, as well as increasing their self-confidence.

Demola projects have fostered a sense of connection and community among its participants. Demola's student selection ensured students working in one team possessed similar interests and project topic-relevant skills or experiences, which built the foundation for developing meaningful connections and relationships among them. By working together towards a common goal, student interviewees reported a shared sense of *"bonding"*(Hu2), *"belonging"*(Ch1), and *"empowerment and accomplishment"*(Fi1) growing among team members. The bonds forged during the project often go beyond the project itself. Several interviewees (e.g., Ch3, Hu1) noted that they have remained friends with their teammates and stayed in touch even after the completion of the project. In the wake of the COVID-19 pandemic, many individuals had to adjust to online collaboration and remote or hybrid work modes. In this context, the community, connections, and relationships fostered by Demola projects have taken on even greater importance and served as a source of support and encouragement for some participants interviewed. Ch1, a Chinese student studying in Europe during the lock-down period and took part in Demola online project, conveyed his appreciation for all the *"small talks"* with his teammates and the community that made him feel *"being understood, connected and supported"* in a time of unprecedented disruption and uncertainty.

Demola projects not only helped participants develop various competence but also provided a supportive community with inspiration and encouragement. As a result, participants' self-confidence and self-esteem were greatly enhanced, which could fuel their future personal and professional growth. Students' self-confidence gained through Demola projects empowered them to take risks and pursue opportunities that they may have otherwise shied away from. Moreover, this sense of confidence could be contagious and inspire others to pursue their goals with greater determination and self-assurance. The impacts of self-confidence gained via Demola

can be well demonstrated by Ch3's experience. Ch3 was the only high school student and *"felt unsure and afraid"* among university students when he first participated in the Demola project. But this project participation later led him to become an intern at Demola China, working as a Demola project assistant and online community manager. He shared:

"These experiences with Demola have made me more confident. Even though I am a freshman and a foreigner [at Waseda University], I am not afraid of any task or academic challenge. I am fully confident in my ability to handle anything that comes my way. Currently, I am also working as an English tutor part-time, which has surprised my fellow students who seem still trying to figure out what to do." (Ch3)

To summarize, Demola PBL has brought students tangible and intangible learning outcomes and impacts. In Demola projects, tangible outcomes include project demos, presentations, reports, and certificates, which demonstrate students' knowledge and skills to contribute meaningfully to real-world projects through teamwork. These outcomes also differentiate Demola participants and enhance their professional prospects in securing internships, jobs, and educational or entrepreneurial pursuits as direct or indirect impacts of their Demola PBL experience. Demola PBL has also benefited student participants intangibly in terms of the development of effective communication, collaboration, critical thinking, and creativity skills, as well as being a part of a community of like-minded individuals and being more self-confident. Compared to the tangible outcomes, these competence and attributes perhaps are even more crucial for being in today's dynamic and ever-changing environment, where adaptability, innovation, and teamwork are highly valued. By nurturing these essential competence, Demola PBL has empowered its participants to be better equipped to navigate through challenges they may face and make meaningful contributions to their communities and society at large.

7.1.2 Industry partners

The engagement of industry partners in Demola projects has proven to be beneficial for both large international companies and small and medium-sized enterprises (SMEs), with SMEs particularly reaping the rewards.

One of the primary benefits that industry partners gained through their participation in Demola projects is access to innovative solutions and fresh ideas for their businesses cost-effectively. Traditionally, SMEs have limited financial resources for research and development, leaving them at a disadvantage compared to larger corporations who have the means to engage costly consultancy companies for professional solutions to specific problems. In contrast to huge consultancy fees from providers such as Boston Consulting Group, Inc., Demola charges firms and organizations relatively insignificant fees to establish a partnership. Meanwhile, Demola as an intermediary offers clear and well-defined frameworks and tools which are *"proven effective in Finland"* (Ja1) via its global success stories (Ch4). Therefore, the ease and affordability of partnering with Demola have *"lowered the bar"* for SMEs to access talented student pools and potentially secure favorable outcomes

(Ja1). For example, the participation fee of Demola Japan for companies is 10,000 Euros (Demola Hokkaido, 2022). Along with this small sum of expense, approximately 70% of participating companies licensing or purchasing the outcomes of the students' projects, signifying their high levels of satisfaction with the results (Ja1).

The interdisciplinary, intercultural, and future-oriented student teams assembled as consultancy groups in Demola projects have provided industry partners with fresh perspectives on their business, thereby facilitating the testing and development of new approaches and products. The value of Demola projects for industry partners was underscored by the feedback received from many company representatives. For instance, Ch4, who represented their company to partner with Demola China, confirmed that their company is currently implementing students' ideas. Similarly, five industry partners of Demola Finland highly appreciated student teams' work, expressing their resolutions to initiate changes in their future products and leaving comments such as " a wake-up call for us", "a surprise to us", "a force of change", "unbiased feedback for our thoughts" (European Commission, 2021, p63). Also, as shown on the Demola Japan website, representatives of Japanese companies such as Hori Holdings Co., Ltd., Hokusyo Co., Ltd., and IKEUCHI DATA PLACE CO., LT claimed that their companies are utilizing or would like to utilize the ideas generated by the student members (Demola Hokkaido, 2022). Perhaps the comments below on students' work in Demola China can further illustrate the value of Demola projects perceived by industry partners:

"The solution ideas were extremely varied... Each of these concepts tackles some needs in the possible challenges China's elderly people in the future will face... The team managed to gather good-quality background information from elderly people, one of the most challenging end-user groups to get in touch with...The key things for Kone are the real experiences, and interviews, that the team was able to produce. ...The results provided lots of reasons why elderly people should be more focused in the future. This helps Kone in both its strategy and design work related to future solutions in China. " (Demola Global, 2019)

It is noteworthy that Demola projects have allowed industry partners to benefit from the future-oriented and forward-thinking perspectives of the younger generation of student teams, thus contributing to companies' long-term development. The process of co-creation between industry partners and student teams has enabled collaboration and open-mindedness, allowing industry partners to gain insight into potential future trends and generate ideas that could lead to the development of new products, services, or even entire business models. The representative of AMINO UP Co., Ltd acknowledged the stimulation of company reflection by students' future-oriented thinking displayed via Demola projects:

"The DEMOLA program was a very valuable opportunity for companies to think about the future. In particular, we learned firsthand that the various "weak signals" that will lead to "big changes" in the future market can be caught by getting in touch with the students' daily thoughts. Our company participated in the event with the

theme of future work styles. Unintentionally, the world changed at COVID-19, and some of the first-hand sensations that the students talked about at DEMOLA have become common knowledge in the real world in just two years.“ (Demola Hokkaido, 2022)

The novel ideas and solutions proposed by student teams in Demola projects were intricately linked with the process of learning for industry partners. The co-creation process in Demola projects provided a valuable opportunity for industry partners to challenge their traditional ways of thinking and embrace new perspectives brought by the students. For instance, the representative of SCSK Hokkaido Co., Ltd has referred to the Demola project as"a great learning experience for the corporate side" (Demola Hokkaido, 2022). This was particularly significant as it served as a stimulus for industry employees who may have been afflicted by organizational blindness (Hu5) - a situation where individuals become entrenched in established practices and ways of thinking. When reflecting upon their co-creation experience with students in Demola projects, company representatives noted that engaging with talented student teams brought " a fresh sense and awareness" to employees who "usually spend time in the office" (Demola Hokkaido, 2022), making them get out of their "own expert bubble" and "see blind spots" (European Commission, 2021, p63). By co-creating with highly motivated student groups in Demola projects, industry employees were able to be inspired, learn from new perspectives and overcome their organizational blindness, thus potentially becoming change agents in their workplace by modeling for other employees. For example, the CEO of MOE Welfare Service Co, Japan shared:

"I was impressed with how quickly the members who had just met began to function as a team. I was impressed by the seriousness of the students' efforts and the lively ideas that came out one after another as the event went on, and the energy with which they kept running until the end in the limited time reminded me of something I had almost forgotten. In the end, we were able to purchase the business plans created by the students, which were created from a completely new perspective, not only the plans themselves but also the opportunity to review our own business from a new perspective." (Demola Hokkaido, 2022)

In addition to providing innovative solutions, future-oriented business ideas, and overcoming organizational blindness, Demola projects offered industry partners a distinctive recruitment opportunity to evaluate students' competence and identify potential employees or trainees. Companies are always looking for bright young minds and candidates for recruitment. Demola projects are *"a perfect tool to find the best talent or new thinkers or potential candidates to them"* (Fi4). Through participation in the project, companies were exposed to a diverse pool of students with heterogenous backgrounds, cultures, and disciplines. This exposure enabled companies to use the Demola project as a training program for new hires, cultivating employees who are aligned with the company's values and vision. The two-month project served both as a *"training and observation"* period (Ja1), allowing companies to observe the students' performance, problem-solving skills, teamwork abilities, innovation potential, and other relevant competence. This approach helped the

companies to make informed hiring decisions and identify candidates best suited for the position. It also reduced the uncertainty and risks associated with hiring based solely on short interviews. Simultaneously, the students who participated in the project gained valuable skills and competence necessary for the job and acquired a better understanding of the industry and the partner company. As a result, they could make better-informed decisions about whether the company is a good fit for them or not, reducing the likelihood of high turnover rates (Fi2). Additionally, this approach could save the company time and resources for in-house training if the student joins. In countries such as Japan, where permanent employment is the primary mode of employment, this recruitment approach is particularly important, as employment based on better-informed mutual decisions of both students and the company via Demola projects reduces the costs that may arise from normal recruitment procedures:

" Some companies also want to recruit students, especially talented students. So Demola projects are not only about ideas and results but also serve the purpose of recruiting employees for companies. ... In Japan, permanent employment is the major form. So companies want to select reliable employees carefully. Demola can serve this purpose. " (Ja1)

Partnering with Demola has also facilitated a range of partnership potentials for industry partners, including access to universities, research and development opportunities, cross-industry collaboration, and international partnerships. This corresponds to research findings on intermediary organizations' active and transformative role in connecting, engaging different stakeholders, and brokering partnerships (Virani & Pratt, 2016; Chatterton & Goddard, 2000). Ja1, who works in the field of university-industry collaboration, revealed that generally, few SMEs engage with high-profile universities. This especially stands true in Asian contexts, where a persistent lack of cooperation and long-standing distrust between two parties form a vicious circle (Fi2), resulting in a huge cognitive distance between SMEs. As identified in the literature, reducing cognitive distance and institutional differences as well as building social capital between SMEs and universities are vital to a successful university-industry collaboration (De Wit-de Vries et al., 2019). Demola projects displayed precisely such functions. The response of interviewees (e.g., Ch4, Fi4, Ja1) and relevant reports (European Commission, 2021, p54) have shown Demola's co-creation activity was perceived by industry partners as a low-threshold and well-facilitated method that fosters the establishment of a connection between SMEs and universities. This connection not only provided SMEs with access to universities' research and development opportunities but also created avenues for building new partnerships:

"In Japan, or Hokkaido University, the Demola program is one of the hooks for companies [to connect with universities] because most companies don't know how to establish partnerships with universities, especially middle and small companies. For small companies, Hokkaido University is at a very high level and [they would think] what to do and how to contact [the university]? They don't know. So Demola lowers the bar for these companies to reach universities and then [companies and

universities] develop long-term relationships for research, development, and other support services." (Ja1)

Moreover, Demola also represents a *"networking center"* for companies (Ja1), allowing them to join a business community and develop a close network. This community enables companies to explore potential partnerships with one another, creating opportunities for cross-industry collaboration and knowledge-sharing. The Demola networks include numerous international companies, particularly those from Nordic countries, providing domestic companies with opportunities to explore partnership potentials with international companies and expand overseas development (Demola Hokkaido, 2022).

Furthermore, Demola projects provided a unique opportunity for industry partners to effectively market themselves among students and a wider audience through the engagement of student teams. Many companies nowadays are particularly focusing on *"what kind of brand image they are building among students and how attractive they are"* (Fi3). Student teams who worked on the projects naturally grew recognition of the participating companies. Meanwhile, students became unconscious brand ambassadors of the participating companies when they interacted with various stakeholders throughout the process of collecting insights and validating their ideas. The exposure to a diverse audience through student engagement in Demola projects could assist industry partners in enhancing a robust and recognizable brand identity. This effect is even stronger in projects related to market and user research. For instance, a food company utilized Demola's challenges to find out the market popularity of various new sauces it had developed. Student teams set up stalls in the city center and invited passengers to try different new sauces and provide feedback. Through this process, the company was able to market its products as effectively as it could have done with its employees, but at a significantly lower cost. According to Hu1, this cost-effective yet equally effective process of marketing was "perhaps much more valuable for the company than the conclusions" reached by student teams and submitted reports. Therefore, in this case, students helped the company expand its reach and appeal to potential customers, further increasing its visibility and business opportunities in the marketplace but at an insignificant cost.

In summary, Demola projects provided a cost-effective means for industry partners to acquire innovative solutions and ideas, foster learning, and mitigate their organizational blindness. For companies, joining the Demola network also facilitated partnership potentials with universities, domestic, and international companies. Additionally, Demola projects assisted industry partners that look to expand their workforce in making better-informed decisions for hiring employees and trainees. Also, for industry partners that look for market and user-related signals, Demola projects could potentially serve as a marketing platform for them to be promoted to a broader audience with insignificant costs.

7.1.3 Universities

Demola projects have displayed equally important impacts on universities. The

integration of Demola projects into college curricula has yielded numerous benefits in terms of education, research, third mission, and institutional culture change.

Regarding education, Demola PBL has been proven to be an effective, sustainable, and low-investment approach for universities to enhance students' competence development. As previously discussed, Demola projects provided students with both tangible learning outcomes and intangible benefits, such as improved communication, collaboration, critical thinking, and creativity skills. They also offered students the opportunity to connect with a community of like-minded individuals and increase their self-confidence. In addition, Demola projects have been found to improve students' employment opportunities and promote the creation of startups. These outcomes and impacts can contribute to the reputation of universities, making them more attractive to prospective students. So integrating Demola projects into the university curriculum is advantageous for enhancing the provision of university education. As one professor involved in Demola projects reflected,

"I've been amazed at the discoveries and capacities of the team, working altogether and coming from completely different backgrounds, and I think that those occasions (Demola projects) are really great opportunities for young people because they realize that they have the power to think about the future and to have projections, to propose new things. It would be very important to have that kind of program in each curriculum." (*Demola,* 2022)

While one may argue that such educational effects can be equally obtained by typical university-industry collaborative PBL without the involvement of Demola-like intermediaries, the sustainability of Demola projects and low investment of institutional resources by universities must be highlighted. Universities only need to pay a modest alliance membership fee to officially signify their partnership with Demola and have a responsible contact person to support the operation of Demola projects (Fi4). In other words, PBL mediated by Demola allows universities to continuously reap its educational benefits for students without painstakingly navigating the challenges and resource requirements involved in university-industry collaborative PBL.

" They (university faculties) can do it (university-industry collaborative PBL) but it's not easy. I had one professor. He contacted us (13 students) with companies by using his connection. But he is exceptional. Not many teachers have that kind of connection. And it's lots of extra work for him too." (Fi1)

"What Demola offers is a whole package. It's simple and proven. And it's a global brand, which means it's easy to sell to companies. So universities just need a person responsible for running projects and managing credits. But with university faculties [organizing university-industry collaborative PBL], then it's like all-by-yourself work, they need to structure everything on their own." (Fi3)

The distinctive merits of Demola-mediated PBL in comparison to PBL administered solely by academic faculties can be underscored in multiple aspects.

First, Demola as an intermediary has relieved faculties of the difficulties associated with organizing university-industry collaborative PBL initiatives. Literature has revealed that implementing university-industry collaborative PBL initiatives necessitates deliberation by university leaders and significant institutional endeavors at different phases (Butvilas et al., 2016). Faculty members also face multiple challenges when organizing university-industry collaborative PBL, such as transitioning from a directive to a facilitative role in PBL, assessing students' learning, and managing the process (Tamim & Grant, 2013, Vasiliene et al.,2020, Lee et al, 2014). It would require a tremendous investment of institutional resources including finances, human resources, and time to address these challenges. However, with its proven framework and know-how tools, Demola has tackled these barriers well as an intermediary.

Second, Demola PBL has proven to be sustainable in terms of the constant provision of authentic industry projects. Many university-industry collaborative PBL organized by faculties do not go beyond one semester, for having new industry partners and authentic projects remain a big headache for faculties who already have heavy education and research obligations (Hu5). Yet engaging industry partners is one of the key aspects of Demola's sustainable operation as an intermediary. Therefore, compared to PBL organized by facilities, Demola PBL has a more stable provision of authentic projects.

Third, Demola as an intermediary operates autonomously, allowing it to break boundaries flexibly and bridge various stakeholders effectively. It is extremely challenging for individual faculty members to create interdisciplinary, cross-level, cross-institutional, and international teams for collaborative projects. However, these are of paramount importance for the birth of innovative ideas and creativity, which have been achieved by Demola.

Fourth, while literature indicates that conventional university-industry collaborative PBL typically centers on the engineering and technology domains and tends to privilege the participation of STEM (i.e., science, technology, engineering, and mathematics) students (Kunttu, 2017), Demola, with its explorative nature and industry partners spanning various fields, offers greater opportunities for students from the humanities and social sciences to take part (Fi4). Given labor market mismatch can arise in any field of study, and students from the humanities and social sciences are more susceptible to such mismatch than their STEM counterparts (Montt, 2017), Demola-mediated PBL creates a more equitable platform for students across all fields of study to engage in authentic projects.

Last but not least, Demola offers an additional appeal highly valued by both students and companies and cannot be readily replaced by PBL organized exclusively by academic faculties. For industry, Demola's demonstrated track record of success makes it a trusted and preferred approach for collaborating with universities in educational activities (Fi3, Ja1). For students, Demola projects imply international real-world project experience that is external to their degree studies and goes beyond their normal coursework (Hu2). Also, due to this externality, Demola projects

empower students by creating an environment that allows them to jump out of their customary "student" roles with greater ease. As Fi1 shared, *"As a student, I'm invisible. But with this [Demola] project, I feel I can finally show what I can do." (Fi1)*

Regarding research, Demola's projects are beneficial for enhancing research in several aspects. As discussed earlier, Demola projects have fostered industry partners' further engagement and partnership with universities, leading to expanded university-industry collaborative research activities, more industry connections, and additional research income for universities. For instance, Ja1 claimed that Demola as a *"hook"* helped SMEs to connect with Hokkaido University, which eventually led to long-term university-industry collaboration. This collaboration allowed Hokkaido University to *"conduct more research or reach an advisory agreement with the company and get more income."* (Ja1) Similarly, Demola projects are viewed by university managers as a catalyst for discovering the university's entire range of research and development capabilities and bringing feasible ideas that align with the needs of the industry (University of Szeged, 2019):

"We strongly believe that Demola has strengthened our relationship with the industry. This relationship is very important to the university, as one of our strategic goals is to successfully channel research results into industrial innovations…Demola has proved to be very successful in bridging the gap between innovative approaches of students and market-oriented research." (University of Szeged, 2019)

Second, despite being secondary stakeholders in individual Demola projects (Fi4), university faculties can still take advantage of opportunities to connect with industry partners through these projects. Some student teams actively sought advice from faculty members during the course of Demola projects (Fi2, Hu4). By engaging with student teams or being involved in Demola projects, faculty members can gain a deeper understanding of industry needs and challenges, which potentially inspire their research endeavors. For instance, in Demola Hungary, one faculty member was intrigued by a project and got deeply involved in it, resulting in fruitful research outcomes (Hu4). Furthermore, Demola projects can inspire some students to pursue research as a career path. Through the intensive research involved in Demola projects, students are exposed to real-world challenges and acquire valuable experience in identifying and solving complex problems. As confirmed by student interviewees Hu3 and Fi2, this exposure has engendered some students' greater appreciation for the research process and an increased interest in pursuing advanced degrees or careers in research.

Regarding the third mission, Demola projects have made a substantial contribution to the third mission of universities. The third mission pertains to universities' societal and economic impact beyond their customary teaching and research roles (Compagnucci & Spigarelli, 2020). Demola projects integrate education, research, and industry needs, and encourage knowledge communication between students, faculties, and industry partners in the co-creation process. Thus, knowledge, expertise, and technology potentials in the academic world are

stimulated, released, and communicated to industry partners to support innovation and regional economic growth. Besides, startups that are stimulated and influenced by Demola projects can impact the regional societal landscape, and support economic growth and job creation, manifesting universities' third mission as well. For instance, owing to the ideas born in a Demola project, an APP was developed by the student team and helped connect local families with disabled children (Hu4). In addition to knowledge communication and entrepreneurship, Demola projects also engage university students in local communities and foster their social responsibility. As lots of Demola projects root in local communities, university students through the projects can interact and collaborate with local stakeholders to address social and environmental issues and improve quality of life. For instance, the current Demola project "Building a Sustainable Tampere" invites students to work on the most sustainable building approach and style for Tampere city development, to establish the Tampere region as a sustainability pioneer (Demola, 2022). As such, university managers can leverage Demola projects as a means of fulfilling their institutions' third mission by bridging the gap between academia and society and contributing to the broader public good. This is exemplified by the following remarks made by a vice victor:

”We believe that Demola’s innovation challenges will provide our students with the indispensable experience of working with experienced professionals from the private sector. We hope to become the powerhouse of innovation with a commitment to enhancing the lives of people not only in our region but also nationwide.” (University of Szeged, 2019)

Demola projects have also impacted institutional culture within universities. At institutions such as the University of Szeged(University of Szeged, 2019) and Hokkaido University (Ja1), the introduction of Demola projects has intertwined with an increased emphasis on innovation and entrepreneurship, which has consequently contributed to institutional culture changes regarding these domains. More importantly, influenced by Demola projects, more faculties become involved in PBL and some of them have received professional training from Demola on facilitating PBL, as evidenced by the Demola teacher training program in Portugal (Politécnico de Santarém, 2022) and the experience of Hokkaido University (Ja1). This can potentially lead to a gradual shift in the role of faculties from knowledge providers to knowledge facilitators for students, allowing students to take more ownership of their learning and promoting a collaborative approach toward problem-solving. Therefore, this shift in education culture can foster a more student-centered learning environment, empowering students to be active learners and collaborators.

"It is always inspiring for us trainers to also see teachers collaborating in person. Foresight work is speculative in nature, and in the boot camp, teachers explored this different approach with curiosity and an open mind." (Politécnico de Santarém, 2022)

"As entrepreneurial education was added to our (Hokkaido University's) mission, I started Demola with small steps. And then it grows bigger and bigger. In

the upcoming April, we will construct a new faculty in our university and more lecturers will be involved in Demola and other entrepreneurship education." (Ja1)

In summary, empirical evidence suggests that Demola projects can be utilized as a cost-effective tool for universities to enhance their educational and research endeavors, advance their third mission objectives, and foster an innovative and student-centered institutional culture shift. With Demola's proven efficacious partnership frameworks and know-how tools, university-industry collaborative projects executed by the intermediary Demola avoid problems commonly encountered in UIC including conflicts of interest between academia and industry, hindrances to the timely dissemination of outcomes, compromises of intellectual freedom, and the diverting of academic resources away from teaching (Ankrah & Omar, 2015).

Overall, Demola PBL has yielded favorable *"win-win-win"* results for students, industry partners, and universities (Ja1). Based on the detailed discussions above, the outcomes and impacts to various stakeholders are summarized in

Table 4.

Table 4 *Outcomes and Impacts of Demola PBL*

Student **“8C”**	**Industry** **"SIMPLE"**	**University** **"Missions & Management"**
Concrete results (project demos, presentations, reports, and certificates) **C**areer readiness (jobs, and educational or entrepreneurial pursuits) **C**ommunication: cross-cultural, cross-disciplinary, and cross-sector **C**ollaboration **C**ritical thinking **C**reativity **C**ommunity **C**onfidence	**S**olutions **I**nnovative ideas **M**arketing & branding **P**artnership with universities & other companies **L**earning for overcoming organizational blindness **E**mployee & trainee recruitment	**Education**: innovation & entrepreneurial education, students' competence development & employment **Research:** industry connections, research inspirations for faculties, new research forces (students) **Third mission:** knowledge transfer, startups, community engagement **Organizational culture** change**:** innovation, student-centered education

Source: Own work

7.2 Project elements

Given the favorable outcomes and impacts Demola PBL has yielded for students, industry partners, and universities, there arises a need to investigate the underlying methodology of Demola projects to identify key elements that influence

the success of Demola projects. Despite regional discrepancies in the execution of Demola projects, all implementation practices are underpinned by a globally standardized model (Fi4). Based on interviews with different stakeholders and public information available on Demola's official website, this section entails a comprehensive explanation of Demola's project operational framework as well as a thorough examination of the roles and obligations of critical stakeholders.

7.2.1 Co-creation as a principle

Demola projects hinge on the principle of co-creation, ensuring that all parties have a voice in the project's development and capturing innovative ideas through a culture of collaboration and partnership (Fi4). Resemble the co-creation pedagogy presented by Jussila et al. (2020), Demola's co-creation also involves multidisciplinary student teams and industry partners equally collaborating around an industry challenge, with the involvement of Demola facilitators as an extra stakeholder group. The co-creation principle emphasizes the equal status of all stakeholders, thereby discouraging any party or individual from dominating the project process. Specifically, within the dynamics of student teams and industry partners, the industry partners should not *"dictate"* the actions of student teams. Within the student teams, there should not be a designated *"team boss"* within student groups *(Fi2)*. Instead, all parties and individuals are to maintain equal status, stay open-minded, and engage in constant communication and co-creation.

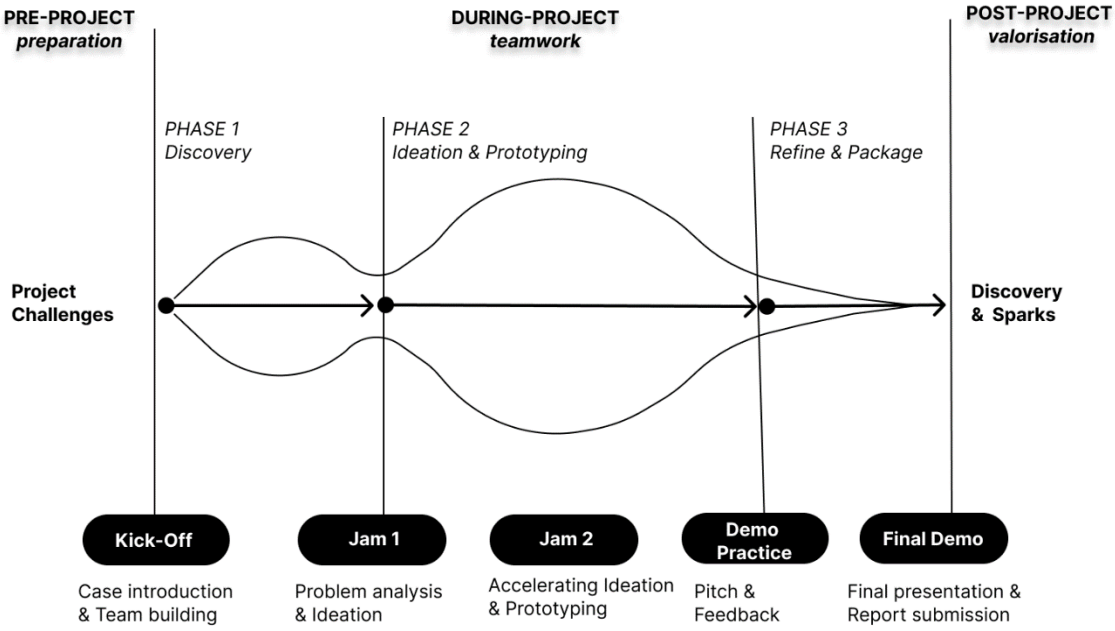
"Co-creation is at the core of Demola. Co-creation means a democratic process. It allows students to challenge [industry partners and each other], to have roundtable discussions…Students are equal among themselves, and also equal to firms. They should not be dictated." (Fi2)

The co-creation principle implies an explorative approach to industry problems, in which a co-creation team starts with broad concepts, explores new phenomena, and generates new ideas that may become the focal point for future research (European Commission, 2021, p15). The exploratory approach does not aim to provide definitive and decisive solutions to well-defined problems that only require the development of the right solution. Instead, it emphasizes open exploration and receptivity of new and unexpected ideas. The exploratory approach is equivalent to open-ended problems that lack defined objectives or established means to achieve them. Utilizing open-ended problems prioritizes finding solutions over the "correct answer" and positively impacts student motivation, problem-solving skills, negotiation, and creativity (Heikkinen, 2017). It also influences the power dynamics in UIC. While typical UIC involves a supplier–customer or a problem-solving arrangement, in which academic partners or students groups seek solutions to a predefined problem, such arrangements may indicate the company's dominant position in a UIC power dynamics and its passive role in the process of developing solutions (Kruss et al., 2015). Put differently, when addressing a clearly-defined industry problem, universities cater to industry needs, whilst industries act as clients and sponsors, passively awaiting well-developed solutions and receiving knowledge and technologies transferred from academia. Therefore, a pure supplier–customer

arrangement, or a well-defined problem-solving arrangement runs contrary to the co-creation principle, which requires the equal and active involvement of industry partners. In comparison, an exploratory approach is more in line with the co-creation principle.

The co-creation principle and exploratory approach necessitate Demola's neutral facilitation as an intermediary to ensure an equal and inclusive environment for teamwork. Nearly all interviewees acknowledged the significant role of good facilitation in Demola projects. Ideally, Demola facilitators should possess a blend of industry and academic knowledge (Ja1), coupled with facilitation skills such as *"lean, agile, design thinking, and co-creation"* (Fi3). Besides, having *"sufficient time and a committed attitude"* are equally important (Fi2). Demola's neutral facilitation strives to stimulate and sustain interaction among different parties by creating an appropriate environment. It tackles companies' frustration with bureaucratic processes they often experience when engaging in direct collaboration with universities. A flawed communication resulting from bureaucracy may impede effective and efficient joint efforts in UICs, as highlighted by Borys et al. (2012). Conversely, in Demola-mediated PBL, neutral facilitation has demonstrated efficacy in reducing formalities and improving communication. The role of facilitators encompasses providing a framework for interaction, managing diversity, promoting a culture of knowledge-sharing and open-mindedness, and fostering trust creation. These roles are further elaborated along with the project flow, which is presented below as three stages including pre-project, during-project, and post-project (See **Figure 2**).

Figure 2 *Project Flow of Demola Projects*



Source: Adapted from Demola website.

7.2.2 Pre-project

The pre-project stage aims to bring together all stakeholders and prepare for the project. It revolves around co-creating project topics by facilitators and industry partners and building student teams via the application and selection process.

Establishing a partnership between the company or organization and Demola is the premise of launching Demola projects. Demola managers or facilitators communicate with industry partners to ensure they understand and are committed to the co-creation principle and the explorative approach (Ja1). Also, Demola as an intermediary provides well-defined intellectual property rights (IPR) frameworks and agreements. This bears great importance as clear IPR and agreement frameworks avoid potential conflicts in utilizing project results, enable companies' engagement, and build *"trust based on rules"* (Fi4).

After a company or organization enters a partnership with Demola, under the guidance of an explorative approach, Demola facilitators co-create project descriptions with industry partners and prepare for the launch of projects. In Demola projects, industry partners are used to formulating the project topic and description independently. Yet it was found out they *"could not balance well"* to formulate a topic that not only suits their needs but also appeals to students (Fi3). Therefore, the methodology of preparing project topics was changed from formulation by industry partners to co-creation by facilitators and industry partners. In close collaboration with industry partners, Demola facilitators carefully customize and curate company-specific challenges that are business- and society-relevant (Fi3). Currently, Demola projects are categorized under five themes, namely, Healing the Planet, Future of Work, Human Beings in the Modern World, Byte-powered Future, and Value Creators of Tomorrow (Demola, 2022). The five themes respectively revolve around the environment, work, human behaviors, digitalization, and technologies. Also, project descriptions must be crafted in a way that remains understandable, appealing, and inspiring to students from a variety of academic backgrounds. If the descriptions are too technical or too plain, fewer students would be interested in participating in the project. For instance, Hu4 recalled that there were more applicants under an SDG-related and futuristic description of the projects in contrast with fewer applicants under a more technical description, although the two descriptions were for the same project. As such, Demola facilitators must strive to develop challenges that both meet the needs of industry partners and remain appealing to students. Two examples of

challenge descriptions from Demola website are displayed below (Demola, 2022).

Building a Sustainable Tampere

Tampere region, like many other rapidly growing cities, is facing major decision points when building new infrastructure as those decisions carry over for decades. As new research is emphasizing preservation and sustainability even further, it is increasingly interesting to play around with sustainability-cherishing scenarios: Could Tampere region be a sustainability pioneer?

What might be the most sustainable building approach and style in Tampere region? What is the role of locality and fitting characteristics of the construction materials? What kind of radical choices should be done if future city development of Tampere region was seen only through sustainability?

Sustainable Flight

To put it short: flying as it is today is not a sustainable way of travel. Encouragingly, to act on the problem, flight operators seem to be creating ways to offset the climate effects. However, new approaches have to be proposed, as the current ones, such as compensating CO2 emissions through an external service, are ambiguous and questionable at their worst. An additional layer of complexity is created by the passengers' lack of interest in paying extra for current "green" services when provided separately.

What might be models to enable air travel leap into sustainability, where real value is created for passengers in exchange of higher ticket prices? What kind of attitude changes are mandatory for the whole industry and its stakeholders when flight is seen necessary also in the future? How might flight-related technological innovations, such as electric planes, affect the way we fly more sustainably in the

Following the finalization of the project topic and description is student recruitment. Demola projects are not only released on the Demola official website but also promoted through university channels to attract more students. Most of the student interviewees reported that they first encountered Demola projects through institutional channels such as course registration portals and emails. To smoothly run Demola projects, a contact person at universities is indispensable. In the pre-project stage, the university's point of contact is responsible for disseminating information about the Demola project through institutional channels. In this way, Demola projects can steadily access a sizable pool of university students from a variety of backgrounds. As Demola projects are underpinned by a collaborative approach to innovation by involving students from diverse backgrounds in the co-creation process, there are few eligibility requirements for students to apply for a project. The application process is generally open to all students, and they are encouraged to apply based on their interests and skills. For online challenges, students have equal opportunities to participate in the project regardless of their backgrounds. For onsite challenges, students are eligible to

participate as long as they are from the same region.

The application stage is followed by student selection and team creation in charge of the Demola team. Demola aims to select the "most suitable students for the project", with its selection criteria typically including factors such as the students' motivation, their relevant experience, and skills, especially for more technical or challenging projects (Ch3). For creating teams, students' academic and cultural backgrounds are also considered to ensure diverse perspectives and optimized group work.

"When it comes to selecting students, Demola has a standardized process in place. The main focus is to find the best candidates who are most suitable for the project. So, to be considered, students must show genuine interest in the project and also have experience in the field that's relevant to the project. Meanwhile, Demola values diversity, and they take into account the nationality of the candidates when making their selections. This approach ensures that the project team has a wide range of perspectives and ideas, which can lead to more creative and innovative solutions." (Ch3)

Demola's student selection bears resemblance to the same principles adopted by companies to recruit students for internships and practices (Ch3), which is advocated by Boryz et al. for selecting team members collaborating on university-industry collaborative projects (2012). Demola's approach also supports the assertions that student selection for university-industry collaborative projects must be done with care, utilizing the best information available about the students (Heikkinen, 2017) and ensuring that they possess proven skills that allow them to work effectively as a team (Neumann & Banghart, 2001). In Demola projects, student team size is generally kept at 4-6 members to ensure a reasonable workload for each individual and also avoid free rider issues that may appear with a bigger team size (Fi2). Overall, the ideal student teams in Demola projects are heterogenous, motivated, and well-suited to the specific industry challenge.

7.2.3 During-project

The project stage aims to obtain desired results by facilitating meaningful interactions among different stakeholders. A typical Demola project duration spans over eight weeks, comprising three continuous phases: discovery, ideation & prototyping, and refining & package. Within these phases, four milestone meetings are held, namely Kick-off, jam 1, jam 2, and Demo practice.

1）Kick-off. The project kick-off marks the commencement of the Demola project, during which all stakeholders convene and student teams gather pertinent information regarding the case they will be addressing. Students meet their team members and begin the crucial process of team building. Students' interaction is essential in cultivating a positive team atmosphere, which serves as a fundamental basis for the subsequent co-creation process. Also, during these initial interactions, students start to establish relationships with their teammates, familiarize themselves

with their peers' skills and strengths, and establish communication protocols, which enable the team to make swift and efficient progress. Good team building eases the management of the team, which is pivotal to the success of the project. As Hu4 aptly stated, *"Managing the project is all about managing the people involved in the project. If you manage people well, then you get the project right".*

During the kick-off session, the project facilitator connects the industry partner with the student team for the first time. The industry partner provides all necessary inputs and resources for the student team to understand the context and expectations. Through communication with the industry partner and team members, the student team develops a shared understanding of the project objectives, and scope and gets equipped with the necessary information and resources to carry the project forward.

2）Discovery phase. In the discovery phase of Demola projects, student teams pursue to gain a deeper understanding of the project context and phenomenon, laying the groundwork for their upcoming solution ideas. During this phase, student teams are expected to allocate time to conduct fieldwork, benchmark industry practices, and gather insights from diverse stakeholder groups. They may apply various research methods such as interviews, observation, and desktop research. The importance of benchmarking industry practices and gathering information cannot be understated, as these activities augment students' knowledge of the industry landscape. Also, student teams are encouraged by Demola facilitators to investigate future trends rather than solely focusing on the present. With all the insights gathered from the field, student teams review and consolidate the information, prioritizing it accordingly. The discovery phase ends with Jam 1 session, whereby students thoroughly discuss with company representatives their initial results, including problem analysis and ideation, and then reach an agreement on the subsequent phase. The discovery phase provides a solid foundation for the rest of the project, and it is imperative that the student teams invest ample time to fully understand the problem and gather relevant insights before proceeding to the next phase.

3）Ideation and Prototyping Phase. The Ideation and Prototyping phase centers around brainstorming and generating a wide range of solution ideas and prototypes. The students are encouraged to prioritize the number of ideas and maintain an open-minded attitude towards others' ideas, while also keeping a framework and structure to organize the ideas generated. In parallel with idea generation, the team must quickly and crudely construct prototypes, which, owing to their tangibility, facilitate the comprehension of the proposed solutions and solicitation of feedback from relevant stakeholders. To develop the prototypes, the team may use university labs or request supplies from the industry partner. After the generation of a pool of concepts and multiple prototypes, the team must validate the proposed solutions and gain insights by interacting with end users, experts, or industry professionals.

During this phase, the Jam 2 session is organized for progress alignment and communication between student teams and the industry partner. This helps the team to accelerate the idea generation cycle and prototyping. The team needs to make some crucial design decisions and freeze their concept by the end of this phase. Ideation

and prototyping culminate in a “Demo practiced” meeting where the student team pitches their ideas to project partners and receives constructive feedback. This feedback serves as the basis for the final iteration, which the team may employ to make further adjustments and improvements to the solution.

4）Refine and Package Phase. In the Refine and Package phase, student teams polish their solution ideas and demos for them to be more comprehensive and presentable. Initially, the student team conceptualizes the solution from various perspectives, defines the value chain, and designs a business model for the solution by utilizing tools such as the Stakeholder Canvas or Concept Canvas. This helps the team to have a clear understanding of the functioning of the solution and its potential added value to users. Then the team must create a high-fidelity demo to better communicate their solutions. During this phase, the team also needs to package the results in a format that is easily comprehensible to the project partners. This may involve creating clear and concise documentation of the project as well as visuals, and demos to present their ideas and solutions. Before the final meeting, students are provided with some templates to aid in the organization and presentation of their deliverables, and facilitators also guide and support the fine-tuning of the content.

Throughout the project process, student teams are *"in the driver's seat"*(Fi2). While assembling a team of students with diverse backgrounds represents an important initial step in cultivating creativity, and harnessing the full range of perspectives, skillsets, and experiences that each team member brings, effective communication and idea-sharing are indispensable. Students must *"share their ideas and listen to others"*(Fi2), and demonstrate *"openness and respect"* for the perspectives of their peers. This sometimes can be challenging due to the heterogeneity of the group. Yet on the other hand, students are pushed outside their comfort zone and gain valuable learning experiences by igniting critical thinking and creativity among team members.

For optimal teamwork, students should be *"equally hungry, motivated for the project, and have the same level of commitment"*(Fi2). Each individual is expected to dedicate significant time and take ownership of their tasks. To co-create effectively, the delegation of individual responsibilities within the group should be democratically decided through group discussion, instead of a *"team boss dictating task assignments"* (Fi2). A collaborative and democratic atmosphere not only encourages mutual support among team members but also allows quick task adjustments in the event of unforeseen contingencies. However, if a team member consistently fails to complete their assigned tasks, they will be requested to leave the team (Fi3).

Apart from communication and collaboration within the team, proactive engagement with stakeholders and receptivity to their input is expected from student teams. Throughout the project, students should actively seek help and input from experts or professors and utilize all available resources to achieve their goals (Hu4). During milestone meetings, they engage in extensive discussions with the industry partner and adjust their approach accordingly. Therefore, a motivated, committed,

collaborative, and proactive student team is one of the key ingredients for Demola's fruitful project outcomes.

Industry partners represent another crucial stakeholder group in the Demola project. To effectively contribute to the co-creation process, industry partners must demonstrate a high level of commitment to the project and actively participate in meetings and discussions. As the project progresses, industry partners should provide student teams with all necessary resources and inputs, which may include industry information, access to relevant data, technologies, and subject matter experts (Fi3). They should also offer constructive feedback and suggestions to the student teams so that their expectations are well understood by students.

Beyond these activities, industry partners should always engage in a non-hierarchical and open-minded manner. Specifically, they are expected to treat students as equal co-creation colleagues, rather than subordinates, and avoid dictating the process or giving orders (Fi4). Secondly, industry partners should exhibit receptivity to new and unconventional ideas presented by the students, even if they may seem initially challenging or unfeasible. The adoption of the co-creation principle and open-minded mindset allows industry partners to dynamically exchange ideas with students and explore new possibilities, which can lead to unexpected breakthrough solutions.

Demola facilitators play a crucial role in mediating between the student team and the industry partner while guiding student teams to produce satisfactory results. Facilitators not only ensure both parties are working towards a common goal but also strive to keep them *"satisfied and happy"* (Ja1). To achieve this, facilitators undertake various actions that go beyond the organization of milestone meetings for both parties to align and adjust. Rather, facilitators continuously *"educate"* and mediate between both parties (Fi2).

With industry partners, Demola facilitators help them comprehend the progress and results achieved by student teams, while simultaneously encouraging them to be open-minded to students' various ideas. While the student team may generate lots of ideas and files, facilitators act as a "message broker and content interpreter" to help focus the industry partner's attention on the key aspects (European Commission, 2021, p64). Facilitators also undertake efforts to manage industry partners' expectations, cautioning against the disparity that may exist between their desires and necessities (Fi2). Meanwhile, regarding interactions with student teams, facilitators maintain ongoing communication with industry partners about the co-creation methodology, to mitigate the risk of student teams being treated as employees rather than as colleagues. As noted by Ja1, facilitators explicitly convey to industry partners that students are their equal co-creation colleagues:

"If the company is simply an evaluator of student work, or if company staff is at a higher level and students at a lower level, then the result is not good. So before the project, we talk to the company staff: please don't think of students as your slaves. During the project, we organize five events for students and companies to meet, sync

and co-create. The process is agile and student teams get constant feedback from companies to proceed."(Ja1)

With student teams, Demola facilitators help them to understand industry partners' expectations and provide scaffolding and support for their exploration and creativity. The use of scaffolding technologies is one of the key attributes of PBL and assists students to navigate through complex authentic problems (Guo et al., 2020). Throughout the eight-week project period, Demola facilitators scaffold students' teamwork by organizing the five milestone meetings, as well as creating weekly routines for student teams to maintain good team dynamics and steady deliverables. The weekly routines include facilitator-led team meetings, weekly task assignments, the team's own joint working time, and weekly assignment submissions (European Commission, 2021, p31). Also, Demola enables formative assessment of students by integrating self-assessment, peer assessment, and facilitator assessment in its digital platform (European Commission, 2021, p51). The integration of digital tools for assessment can potentially address the perplexity PBL practitioners typically experience in assessing students' learning (Williams, 2017). Meanwhile, facilitators encourage students to think outside the box and think beyond the current situation and provide relevant suggestions, tools, and templates such as PESTLE analysis and stakeholder analysis to guide and stimulate their creative thinking (Hu2). Additionally, Demola facilitators promptly respond to student teams' requests and regularly check on their progress to ensure the timely and productive advancement of the project. In the event of any potential conflicts, facilitators act *"like firefighters"* (Fi3) and address concerns to maintain a positive collaborative atmosphere. For instance, if an individual consistently shrinks their responsibilities, the facilitator assumes the role of a prompter, reminding them of their obligations. If the situation does not improve, facilitators are compelled to *"make quick and hard decisions"* and dismiss the individual from the team (Fi2).

During the project phase, universities do not have a strong presence in the operation of individual Demola projects. But the support and resources universities provide can be advantageous for the project's success. The university contact person may make some logistical arrangements for the meetings throughout the project (Fi3). Also, universities provide students with access to co-creation spaces on campus where they can work together and utilize resources such as 3D printing equipment, software, and other essential tools (Fi1). While faculty members may be proactively consulted by student teams for their expertise and guidance, their active involvement in the project is not always necessary (Ch2). This forms a contrast with the co-creation pedagogy presented by Jussila et al. (2020) where faculty members are involved as co-creation team members. It would be interesting to examine how the involvement of faculties as one of the primary stakeholders in the project phase may influence the project process and results.

7.2.4 Post-project

The post-project stage pertains to the valorization of project results and the completion of student evaluation-related tasks. While the project stage produces

immediate and direct benefits for both students and participating industry partners, the post-project seeks to further disseminate and exploit the project results, which are normally realized through the organization of a culminating event. In this final event, the widest possible audience from all stakeholder groups is brought together. On the one hand, student teams present their finalized solutions and ideas to the participating industry partner, and all stakeholders jointly interpret the project results and provide feedback. On the other hand, the event is utilized to explore further interaction opportunities at multiple levels. The opportunities may include but are not limited to the further development of ideas proposed by students with the company, new co-creation project topics for companies, potential internships, and hires for students, and potential new partnerships for academia (Fi4). Upon the completion of the project, students receive a digital certificate and individual feedback from Demola facilitators based on their engagement and contribution to teamwork, which can be subjective in nature (Fi2). In addition, in universities where Demola projects are embedded as a course, the university's designated point of contact utilizes the assessment information provided by Demola and undertakes administrative tasks related to academic credit.

Drawing from the investigation of Demola's project operational framework as well as the respective roles and responsibilities of key stakeholders, it can be inferred that the triumph of Demola projects is contingent upon an intricate system of interrelated elements. These elements comprise project challenges that are exploratory, authentic, and appealing; student teams that are heterogeneous, motivated, and competent; industry partners that are committed to co-create, engaged, and open-minded; facilitators that constantly intermediate and facilitate two parties for satisfactory results; university support that is indispensable albeit potentially limited; co-creation frameworks and tools that are effective. Therefore, the accomplishment of Demola projects is underpinned by the co-creation of all stakeholders within the efficacious frameworks provided by Demola.

7.3 Environment

To gain a comprehensive understanding of Demola projects, it is important to move beyond analyzing individual projects at the micro-level and consider the broader enabling environment. This section addresses the third sub-research question about the enabling environment for the establishment and nourishment of a regional Demola program. Four pivotal themes have surfaced from empirical analysis, namely, governmental support, university support, local industry dynamics, and the agency of institutional entrepreneurs.

7.3.1 Governmental support

To ensure the successful establishment and continuity of a regional Demola program, it is essential to obtain financial and policy governmental support. While Demola projects in each region have unique financial structures, a pattern has emerged in nearly all regions. That is, the initial stage of Demola projects in any region is typically financed by governments and public sources, with industry and

company services assuming a progressively more significant role moving forward (Fi4). This indicates the significance of government funding for the inception of a regional Demola program. In addition, in regions where universities have limited autonomy, securing government permission and backing is a prerequisite to involve universities as key stakeholders in a regional Demola program. According to an interviewee, the lack of government permission and support was a fatal factor in the lack of continuity of Demola China (Ch3). Without government permission, universities might hesitate to embrace *"foreign-born"* Demola and integrate Demola projects into their curriculum on the one hand (Ch3). On the other hand, in the context of Chinese universities where a top-down approach is deemed more effective, university personnel may lack the motivation to scrutinize Demola projects if they are not explicitly instructed to do so (Ch3). Conversely, once government permission and support are obtained, the implementation of Demola projects can be accelerated considerably.

Regions with favorable governmental policies promoting innovation and entrepreneurship can benefit from the establishment of the Demola program. Governmental support for strengthening innovation, startups, and economic competitiveness can catalyze the implementation of the Demola program. In EU countries, Demola projects have been financed through various existing public funding schemes aimed at strengthening innovation and startup ecosystems at the local, national, and EU levels (Fi4). The origin of Demola from Finland is not surprising, given the Finnish government's unwavering focus on innovation, supported by its multiple approaches to innovation policy implementation including the framework approach, entrepreneurial approach, mission-oriented approach, and facilitative, ecosystem approach (Laasonen et al., 2020). Despite the different approaches, the role of central and local governments as enablers remains the same. The implementation of Finland's "new innovation policy" gives prominence to the facilitative, ecosystem approach. Successful operationalization of this approach not only entails the support of the central government for public-private partnerships but also demands regional agencies to facilitate collaboration between ecosystem actors (Laasonen et al., 2020). Demola, as an intermediary organization facilitating university-industry collaboration, is an excellent fit for this innovation policy approach. Therefore, it comes as no surprise that Demola Finland receives funding and is actively endorsed by the Finnish government (Fi4). Additionally, the Tampere city government has been involved in Demola projects as an industry partner (Demola, 2022).

Governmental support aimed at enhancing entrepreneurship education, university-industry collaboration, and student-centered learning can equally play a crucial role in boosting the implementation of Demola projects. This is exemplified by the growth of Demola Japan, which was made possible through Japanese governmental funding for entrepreneurship education (Ja1). Hokkaido University, as one of the consortium universities of the EDGE-NEXT (Exploration and Development of Global Entrepreneurship for NEXT generation) initiatives, seeks to cultivate practical-minded human resources who can act as entrepreneurs to create new value in the region (Earth on Edge, 2020). Demola was seen as a good alignment

and a suitable tool for implementing EDGE-NEXT, leading to its adoption by Hokkaido University (Ja1). Notably, the EDGE-NEXT entrepreneurship education program was financed by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) from 2017 to 2022, which greatly fueled the development of Demola Japan. While Demola Japan currently operates through a sustainable market-driven funding approach whereby company services fees form the major part of its financial structure, this would not have been possible without initial support from the Japanese government for entrepreneurship education (Ja1). Similarly, Demola Portugal was initiated with governmental support from the Portuguese Ministry for Science, Technology and Higher Education (Demola Portugal, 2021), as a means to strengthen student-centered learning in higher education, facilitate cross-polytechnic interaction and promote effective industry-academia knowledge exchange. Demola Portugal was established together with the Portuguese government, Portuguese polytechnics, and Demola Global. The targeted support for Demola from the Portuguese government directly influenced the scale of Demola Portugal. According to its website, in the first phase of the program during 2021-2023, it is anticipated that Demola Portugal will bring together approximately 900 polytechnic teachers, 600 companies from Portugal and abroad, and around 5,000 students from Portuguese polytechnics and international institutions (Demola Portugal, 2021).

7.3.2 University support

Despite the weak presence of universities in any individual Demola project, they are fundamental in nurturing a regional Demola program for their impacts on both students and industry partners, who are key stakeholders of Demola projects. The endorsement and support of regional universities to Demola projects can positively impact student participants in several ways. First, promoting Demola projects through the institutional channels of universities can provide a steady student flow for Demola projects (Fi4). Universities have effective and trustworthy channels for disseminating information, which not only allows Demola projects to access sizable student pools but also enhances the credibility and attractiveness of the Demola program for students. Also, when Demola projects are integrated as formal components of curricula at universities, it provides ample time for students to engage in Demola projects as well as gain credits upon completion, thus further incentivizing students to participate. Moreover, when universities engage as key stakeholders in Demola projects, project, and student-related practical issues can be tackled with greater ease. Universities' engagement allows Demola to establish a partnership framework with universities, thus addressing issues such as processing student information more efficiently (Fi4).

The support of regional universities to Demola projects can have a considerable impact on industry partners as well. First, from the perspectives of companies, universities entering a partnership with Demola projects implies access to talented university student pools for fresh perspectives, recruitment, and potential further collaboration opportunities with universities. These are some major motivating factors for the industry to partner with Demola according to several interviewees

(Fi4, Hu, Ja1). Therefore, universities as key stakeholders increase the attractiveness of the Demola program for industry partners. Also, the reputation of the university can function as a quality assurance seal for Demola projects, enhancing its trustworthiness and credibility among industry partners. This corresponds to Sjöö & Hellström's assertion that UIC tends to involve and prioritize higher-status universities (2019).

Universities that prioritize innovation and entrepreneurship can nurture the adoption and implementation of Demola projects. Such universities typically integrate Demola projects as part of their innovation and entrepreneurship education curriculum. For example, Demola China was initially established as an innovation education course at Fudan University (Nordic Centre, 2022), while Demola Japan began as an entrepreneurial education initiative at Hokkaido University (Ja1). Similarly, the University of Szeged has joined the Demola Global Innovation Community within the framework of the USZ Virtus Enterprise Catalyst Program. The Program seeks to "*position the University of Szeged as a sustainable, entrepreneurial university, to catalyze the local start-up ecosystem and innovation milieu as well as to coordinate and integrate the activities into a single program.* "*(ASTP, 2020)*

Universities that encourage extracurricular activities and are mindful of students' course arrangements are better positioned to foster a successful regional Demola program (Fi2). Demola projects are intensive during the project period and can be challenging for students with heavy course loads (Hu2). On the one hand, project-based learning requires students' commitment and active engagement. On the other hand, co-creating with teammates, and facilitator industry partners towards satisfactory results involves time coordination among various stakeholders. Therefore, participating students are expected to have sufficient and flexible time. Universities that have intensive and rigid course arrangements can lead to students' insufficient time, thus discouraging them from participating in Demola projects.

Universities with strong industry affiliations can provide valuable assistance in developing local partnerships for Demola projects, particularly during the initial stage of a regional Demola program. Innovation diffusion theory suggests that early adoption is typically limited (Miller, 2018), which may explain the considerable difficulty in inviting industry partners to collaborate with Demola at the outset of a regional program (Fi4, Ja1, Hu4). However, if universities possess robust industry connections, they can serve as conduits for their industry partners to participate in the Demola program, thereby increasing the program's exposure to companies more easily. This is to some extent supported by the experience in establishing Demola Japan and Demola Hungary. The establishment of the former can be partially attributed to the endeavors of the head of the university-industry collaboration office at Hokkaido University, whilst the latter can be partially attributed to the endeavors of the head of the Technology Transfer Office at Budapest University of Technology and Economics. When they started Demola in their respective regions, the industry connections their institutes already established afforded them significant advantages in connecting companies with Demola projects (Ja1, Hu4).

7.3.3 Local industry dynamics

Industries are key components of Demola projects. Nourishing a regional Demola program is indispensable for a sufficient number of regional enterprises that are willing to co-create with university students.

Regions that exhibit frequent and dynamic collaboration between industry and academia are favorable for the implementation of the Demola program. In regions where there are significant disconnects between industry and academia, such as Japan, China, and Nepal, many companies fail to recognize the value and potential benefits of working with student teams (Ja1, Ch4, Fi2). For instance, Demola projects were perceived as more aligned with ESG (environmental, social, and governance) or CSR (corporate social responsibilities) concerns, and hence, more relevant for larger companies (Ch4), rather than a valuable means for fostering innovation and gaining competitive market edges, applicable to all companies, irrespective of their size. Companies often doubt the quality of project results provided by student teams (Ja1, Ch4), express concerns that students are concurrently studying and working on the project within a condensed timeline, and that the substantial amount of company and industry information required during the project is burdensome for participating companies (Ch4). Conversely, in regions where there is more robust and active collaboration between industry and academia, such as in Finland, it is relatively easier to engage companies in Demola projects (Fi3). Therefore, an environment that supports regional Demola programs should include a dynamic regional economy where some companies prioritize innovation and ideas, and possess experience and willingness to collaborate with universities and students. Such companies are more likely to become early adopters of Demola methodology and potentially model for others, therefore contributing to the development of a regional Demola program.

" In Nepal, there is a long lack of trust and transparency between firms and academia. Firms need to see that students can deliver high-quality results " (Fi2)

"I guess selling Demola to companies is very country dependent. Here (in Finland) it's normal for companies to work with students and relatively easy for them to see students as colleagues. But for example, I heard in Japan, in companies, the relationship is more hierarchical. Companies maybe are not comfortable with student teams giving suggestions, reports, and so on." (Fi3)

"I would say Chinese firms have nearly zero willingness to pay to a consultancy team that is composed of students. Because for Chinese SMEs, there are so such demands. Chinese SMEs have high production pressure and the resources they can allocate to things like ESG or CSR are scarce. Also, students do the project while they study. In a limited period, the project quality they can deliver is limited. And firms need to spend more time providing students with industry background information and contexts, which also causes lots of pressure on the company side." (Ch4)

7.3.4 Institutional entrepreneurs

While the university, local industry, and government have emerged as three key stakeholders to establish and maintain a regional Demola program, the key to the initial setup and smooth operation of a local Demola program lies in the role of institutional entrepreneurs. Institutional entrepreneurs are individuals or groups that possess the capacity to actively initiate and participate in changes within the institutional environment (Cai & Liu, 2020). While institutional entrepreneurs can be organizations or individuals, in the present study, individuals as institutional entrepreneurs are highlighted. They are pivotal in the localization of Demola projects as well as in bringing the projects to fruition in the local context. Their localization endeavors entail redefining Demola from a local perspective, recruiting local students, onboarding local companies, and customizing projects for them. Ja1 shared his experience of localizing Demola for Japanese companies in the initial stage of Demola Japan:

"Japanese company culture is very different from Finnish companies. In Finland, the relationship between the CEO and employees is flat, but in Japan, there is a hierarchy in company culture… We think about what kinds of things the company is interested in and we pick the specialties of Demola to sell. ... If Demola projects were not customized for Japan, it would be very difficult to get the Japanese company. Because the culture is different from Finland and other European countries. So we (as regional Demola managers）have to think about what is the most valuable thing (of Demola) for (local) companies. [We need to think] what is the main purpose of Demola from the (local) company side." (Ja1)

Recruiting local students for the Demola program is generally straightforward once universities lend their support. However, onboarding industry partners to the program remains a significant challenge, as it demands knowledge of both the academic and corporate realms, along with excellent brokerage skills and hard work. In regions where the Demola program is well localized, institutional entrepreneurs typically are university staff members working in the field of university-industry collaboration. For instance, Demola Hungary's manager is also the head of the Technology Transfer Office at Budapest University of Technology and Economics and Demola Japan's manager is from the university-industry collaboration Office at Hokkaido University. Such individuals typically spearhead local implementation efforts. They are ideal for setting up local Demola programs as they speak both languages of industry and universities, maintain contacts with numerous industry partners, and understand how to market academic services to industry partners. During the initial introduction to Demola, local companies may exhibit skepticism toward the program partially owing to the risk of *"upfront fees without any guaranteed results"* (Fi2). Therefore, on the one hand, institutional entrepreneurs play a significant role in proactively reaching out to a plethora of companies before identifying a willing partner, as exemplified by the experience of Hu4 and Ja1. On the other hand, these institutional entrepreneurs help potential industry partners to resolve their doubts and ensure successful onboarding.

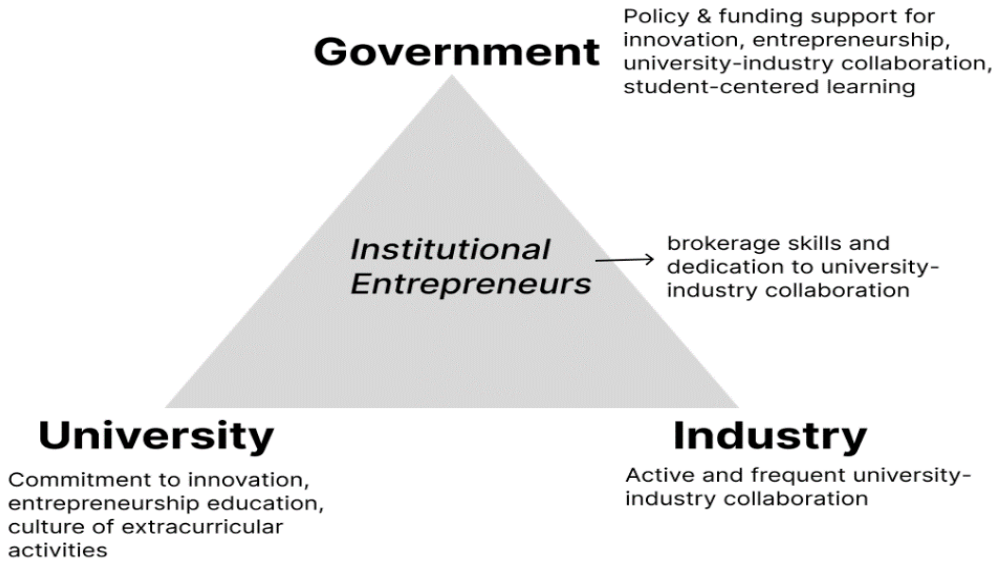
"Recruiting students is never difficult. There are always lots of students who want to participate in such projects. The difficult part lies in getting companies on board... There was one period when I went to those companies almost every day. I knocked on their leaders' door and explained to them what Demola is about and what they can get from it. " (Hu4)

Furthermore, the brokerage activities that institutional entrepreneurs engage in are beyond the initial onboarding of companies. They also undertake a supervisory role throughout the Demola project process, attending to nuanced details to ensure stakeholder satisfaction and thereby promoting the sustainability of Demola projects. This is aptly illustrated in Ja1's account of his role as Demola Japan manager:

"In the beginning, there was only me and another lady(responsible for implementing Demola in Hokkaido universities). But we both worked in companies and had selling experience before (working in a university-industry collaboration Office at Hokkaido University)... it's a very important thing to sell Demola's program and service. ...Six years ago, Japanese companies were the same [as Chinese companies]. The majority of the companies don't want to pay, but a small portion of companies notice the good results of Demola. So we two have contacted too many companies to sell Demola service. So until now, we two perhaps have contacted over 8000 companies… And one more important thing is, we customize the demo program for Japanese companies... We see Demola as our business... Our role is to return more value to paid companies and to ensure the final results are worth the money for companies...we want to keep them (companies) happy... For example, in Japan Demola final pitch, we ask students to prepare banners for companies and we send companies printed documents. During the final pitch, we also record the whole process and burn DVDs, and then send companies all these materials. " (Ja1)

To summarize, to establish and nourish a regional Demola PBL program, the synergies of government, industry, and university as three primary stakeholders are vital. This stakeholder composition bears resemblance to the "government-academia-industry" triple helix model, in which the government provides regulatory and policy framework, the industry commercializes research, and academia generates new knowledge and cultivates educated workforces, and their collaboration and interaction stimulates innovation and knowledge-based economic growth (Leydesdorff, 2020). In contrast to research commercialization and knowledge generation that represent the roles of industry and academia in the triple helix model, fostering a regional Demola PBL program requires both parties to conduct rather different activities. Industries need to engage in co-creation activities with students whilst universities should support Demola projects by providing support and a conducive institutional environment. Overall, the enabling environment for a regional Demola program may include governmental support in fields such as innovation, entrepreneurship, university-industry collaboration, student-centered learning, local industry dynamics that promote active and frequent university-industry collaboration, university commitment to innovation, entrepreneurship education as well as the culture of extracurricular activities, and the presence of institutional entrepreneurs with effective brokerage skills and a high-level dedication to university-industry collaboration (See **Figure 3**).

Figure 3 *Enabling Environment for a Regional Demola Program*



Source: Own work

8. Concluding Remarks

Against the constantly evolving societal landscapes and industry needs in an increasingly ambiguous world, enhancing students' competence that are in alignment with industry needs bears greater importance. Considering intermediary organizations facilitated university-industry collaborative PBL as a promising solution to students' competence development, the present study employs Demola projects as a case of such PBL and investigates the effectiveness and implementation matters of Demola projects. More specifically, the study examines the outcomes and impacts of Demola projects, as well as the key elements involved and enabling environment. The empirical evidence from qualitative research suggests that Demola projects can produce "win-win-win" results for students, industry partners, and universities. Through Demola projects, students develop essential competence such as communication, collaboration, critical thinking, creativity, and self-confidence, and benefit from the Demola community. Industry partners acquire innovative ideas and mitigate organizational blindness, and expand their workforce through Demola projects cost-effectively. Universities enhance education, research, and third mission activities, as well as foster an innovative and student-centered institutional culture shift with a light investment of institutional resources. The fruitful results of Demola projects are underpinned by the co-creation of all stakeholders, including competent student teams, committed industry partners, and facilitating intermediaries, within the effective tools and frameworks provided by Demola. To establish and nourish a regional Demola PBL program, a synergistic collaboration among government, industry, and academia is crucial. An enabling environment for a regional Demola program may entail governments that provide policy and financial support for innovation, entrepreneurship, university-industry collaboration, universities that emphasize innovation and entrepreneurship education, have a culture of extracurricular activities and good industry connections, a local economy dynamics

with active and frequent university-industry collaboration, as well as institutional entrepreneurs that possess effective brokerage skills and dedicate to university-industry collaboration.

The present study proposes intermediary organizations facilitated university-industry collaborative PBL as a cost-effective complementary approach for higher education institutions to support students' competence development. It adds to the knowledge of intermediary organizations facilitated PBL and contributes to scholarly discussions on students' competence development. The findings of this study may have practical implications for various audiences within the higher education domain. Higher education managers or PBL practitioners may consider adopting intermediary organizations facilitated PBL to improve education provision, research, and third mission activities at their institutions while avoiding the organizational complexities involved. Education policymakers in the government may leverage and support intermediary organizations such as Demola to enhance university-industry collaboration, stimulate innovation, and facilitate regional development. Education entrepreneurs may also find intermediary organizations that facilitate university-industry collaboration to be an interesting educational market worth exploring.

9. Limitations of Study

This qualitative case study seeks to deepen the understanding of intermediary organization facilitated university-industry collaborative PBL by adopting Demola projects as the case. The study sequentially explored Demola projects pertaining to their outcomes and impacts, process and key elements, and enabling environment. However, it is essential to acknowledge that the study has several limitations that need to be taken into account when interpreting its findings and can be further developed by future research in this domain.

First, this study's scope was limited to Demola as an intermediary organization of university-industry collaborative PBL. Therefore, it can not be generalized to other intermediary organizations involved in university-industry collaborative PBL. Future research can explore other intermediary organizations or persons involved in similar initiatives to develop a more comprehensive understanding of mediated university-industry collaborative education activities.

Second, regarding the findings on the outcomes and impacts of Demola projects, it should be noted that, first, the study included limited interviewees due to the availability of interviewees and the capacity of the researcher; second, the study did not employ any quantitative investigations, indicating that the results may not be statistically representative. However, a quantitative or mixed-method approach may generate more convincing results, which can be a potential venue for future research in this domain. Nevertheless, the findings of this study should be interpreted cautiously in the context of the specific Demola cases studied and may not apply to other cases.

Third, regarding the key elements and enabling environment of Demola projects,

although the present study collected data from different regions, its primary focus was to grasp standardized and idealized Demola project models from a methodological perspective, rather than exploring localized implementation practices from a case-by-case approach. Therefore, the findings presented in the project elements and enabling environment sections are akin to a generalized understanding of Demola projects' fundamental aspects. These findings may potentially serve as a foundation for systematically analyzing and comparing different Demola projects across regions, they do not necessarily reflect the actual implementation of Demola projects in individual contexts. This study acknowledges the presence of regional differences and their impacts on implementing the "ideal" Demola methodology locally, however, it does not examine in depth the implementation practices of Demola projects in specific contexts or offer a comparison of these projects across regions. To address this gap, it would be interesting to see future research investigating regional Demola cases in greater detail and compare them across various regions. This approach would enhance comprehension of the implementation matters in and across diverse regions and identify context-specific factors that could facilitate or impede the successful implementation of Demola projects in a certain context. The results of such research would inform the development of effective strategies and policies for promoting successful university-industry educational collaborations.

Last but not least, this study did not develop a framework to evaluate both the effectiveness and efficiency of university-industry educational collaborations. Such frameworks can be developed from multiple perspectives, including those of higher education managers, corporate leaders, and regional policymakers. Particularly from the standpoint of HE managers, developing such a framework would carry immense significance in comparing varying forms of university-industry educational collaborations as well as comparing such activities organized by internal institutes and external third parties. These understandings can potentially facilitate an informed decision-making process regarding the optimal leverage of university-industry educational collaborations to foster student competence development and prepare them for future career prospects. Thus, developing a comprehensive framework that encompasses quantitative indicators to assess the effectiveness and efficiency of university-industry educational collaborations represents an exciting area of investigation for future studies in this field.

10. References

Alexandre, F., Costa, H., Faria, A. P., & Portela, M. (2022). Enhancing University–Industry collaboration: the role of intermediary organizations. The Journal of Technology Transfer, 47(5), 1584-1611.

Ankrah, S., & Omar, A. T. (2015). Universities–industry collaboration: A systematic review. Scandinavian Journal of Management, 31(3), 387-408.

ASTP. (2020). ASTP 2020 Survey Report on Knowledge Transfer Activities. Retrieved April 9, 2023, from https://www.astp4kt.eu/about-us/kt-news/astp-survey-report-on-knowledge-transfer-activities-2020.html

Azevedo, A., Apfelthaler, G., & Hurst, D. (2012). Competency development in business

graduates: An industry-driven approach for examining the alignment of undergraduate business education with industry requirements. The International Journal of Management Education, 10(1), 12-28. https://doi.org/10.1016/j.ijme.2012.02.002.

Baird, M. (2019). Project-based learning to develop 21(st)-century competence. Technology and the Curriculum: Summer 2019.

BG, L. (2020, July 5). Innovation and co-creation in Tampere. LinkedIn. Retrieved March 29, 2023, from https://www.linkedin.com/pulse/innovation-co-creation-tampere-lakshmi-bg/

Bliemel, M. J. (2013). Getting entrepreneurship education out of the classroom and into students' heads. Entrepreneurship Research Journal, 4(2). https://doi.org/10.1515/erj-2013-0053

Bootcamp Demola no Politécnico de Santarém 21 e 22 de Novembro de 2022. Politécnico de Santarém. (2022, November 23). Retrieved April 4, 2023, from https://www.ipsantarem.pt/bootcamp-demola-no-politecnico-de-santarem-21-e-22-novembro-de-2022/

Borys, M., Milosz, M., & Plechawska-Wojcik, M. (2012, September). Using Deming cycle for strengthening cooperation between industry and university in IT engineering education program. In 2012 15th International Conference on Interactive Collaborative Learning (ICL) (pp. 1-4). IEEE. doi: 10.1109/ICL.2012.6402164.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Burch, G. F., Giambatista, R., Batchelor, J. H., Burch, J. J., Hoover, J. D., & Heller, N. A. (2019). A meta-analysis of the relationship between experiential learning and learning outcomes. Decision Sciences Journal of Innovative Education, 17(3), 239-273.

Burns, C., & Chopra, S. (2016). A meta-analysis of the effect of industry engagement on student learning in undergraduate programs. The Journal of Technology, Management, and Applied Engineering, 33(1).

Butvilas, T., Butvilienė, J., & Vasilienė, V. (2016). Education and business through project-based learning: A college case description. CROSSING BORDERS AND CREATING FUTURE COMPETENCES, 68.

Cai, Y., & Liu, C. (2020). The role of University as Institutional Entrepreneur in regional innovation system. Examining the Role of Entrepreneurial Universities in Regional Development, 133–155. https://doi.org/10.4018/978-1-7998-0174-0.ch007

Campbell, R., Goodman-Williams, R., Feeney, H., & Fehler-Cabral, G. (2018). Assessing triangulation across methodologies, methods, and stakeholder groups: The joys, woes, and politics of interpreting convergent and divergent data. American Journal of Evaluation, 41(1), 125–144. https://doi.org/10.1177/1098214018804195

Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. Oncology nursing forum, 41(5), 545–547. https://doi.org/10.1188/14.ONF.545-547

Chatterton, P., & Goddard, J. (2000). The response of higher education institutions to

regional needs. European Journal of Education, 35(4), 475-496.
Clark, B. A. (2017). Project based learning: assessing and measuring student participation. Research and Evaluation in Literacy and Technology. 39. http://digitalcommons.unl.edu/cehsgpirw/39
Compagnucci, L., & Spigarelli, F. (2020). The third mission of the university: A systematic literature review on potentials and constraints. Technological Forecasting and Social Change, 161, 120284. https://doi.org/10.1016/j.techfore.2020.120284
Creswell, J. W. (2007). Qualitative inquiry and research design: Choosing among five approaches (2nd ed.). Sage Publications, Inc.
De Wit-de Vries, E., Dolfsma, W. A., van der Windt, H. J., & Gerkema, M. P. (2019). Knowledge transfer in university–industry research partnerships: a review. The Journal of Technology Transfer, 44, 1236-1255.
Demola – how did it come about? - business Tampere Magazine (2016) Business Tampere. Retrieved March 31, 2023, from https://businesstampere.com/demola-how-did-it-actually-come-about
Demola Hokkaido｜北海道大学. (2022, August 27). Retrieved March 31, 2023, from https://demola-hokudai.jp/
Demola Innovation Course. Nordic Centre. (2022). Retrieved April 9, 2023, from http://www.nordiccentre.net/demola-innovation-course-1
Dong-ha Lee, Kyeong-Hoon Jung, Kang Yi, Yun-Seok Cho, Youn-Sik Han, & Deuk-Cheol Kang. (2005). Development of partnership between industry and university via customized field-oriented curriculum. 2005 IEEE International Conference on Microelectronic Systems Education (MSE'05). https://doi.org/10.1109/mse.2005.26
Dowling, B., Powell, M., & Glendinning, C. (2004). Conceptualising successful partnerships. Health & social care in the community, 12(4), 309-317.
Dutt, N., Hawn, O., Vidal, E., Chatterji, A., McGahan, A., & Mitchell, W. (2016). How open system intermediaries address institutional failures: The case of business incubators in emerging-market countries. Academy of Management Journal, 59(3), 818-840.
Earth on edge. EARTH on EDGE アントレプレナー育成コンソーシアム. (2020). Retrieved April 7, 2023, from https://edge-next.eng.tohoku.ac.jp/english/summary/
Elken, M., & Tellmann, S. M. (2019). Linking higher education and the world of work: learning outcomes and intermediary organisations. Journal of Education and Work, 32(8), 678-692.
Eugloh program brought together talents from five European universities. Demola. (2022, December 12). Retrieved April 4, 2023, from https://www.demola.net/stories/eugloh-program
European Commission, Directorate-General for Research and Innovation, (2021). Testing the feasibility of a new industry-academia knowledge exchange concept focusing on companies' needs : final report, Publications Office of the European Union. https://data.europa.eu/doi/10.2777/530089
Felten, P., Cook-Sather, A., & Bovill, C. (2014). Engaging students as partners in learning and teaching: A guide for faculty. John Wiley & Sons.
Fitriati, F. (2016). Assessing Students' Learning in Project-based Learning Approach. Visipena Journal, 7(1).

Frank, M., Lavy, I., & Elata, D. (2003). Implementing the project-based learning approach in an academic engineering course. International Journal of Technology and Design Education, 13(3), 273-288.

Franklin, S. J., Wright, M., & Lockett, A. (2001). Academic and surrogate entrepreneurs in university spin-out companies. The Journal of Technology Transfer, 26(1-2), 127-141.

Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of Project-based learning in Higher Education: Student outcomes and measures. International Journal of Educational Research, 102, 101586. https://doi.org/10.1016/j.ijer.2020.101586

Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. International Journal of Educational Research, 102, 101586.

Halme, K., Lindy, I., Piirainen, K., Salminen, V. & White, J. (eds.). (2014). Finland as a Knowledge Economy 2.0: Lessons on Policies and 530 Governance. The World Bank: Washington, DC. https://doi.org/10.1596/978-1-4648-0194-5

Healing the planet. Demola, Building a Sustainable Tampere. (n.d.). Retrieved April 4, 2023, from https://portal.demola.net/themes/10?page=1&theme=10&sort=recent

Heikkinen, J. (2017). Conceptualizing the role of multidisciplinarity and student perceptions of university-industry collaboration in project-based learning. Jyväskylä studies in computing, (264). http://urn.fi/URN:ISBN:978-951-39-7164-9

Jumaat, N. F., Tasir, Z., Halim, N. D. A., & Ashari, Z. M. (2017). Project-based learning from constructivism point of view. Advanced Science Letters, 23(8), 7904-7906.

Jungblut, J., & Woelert, P. (2018). The changing fortunes of intermediary agencies: Reconfiguring higher education policy in Norway and Australia. Reconfiguring knowledge in higher education, 25-48.

Jussila, J., Raitanen, J., Partanen, A., Tuomela, V., Siipola, V., & Kunnari, I. 2020. Rapid Product Development in university-industry collaboration: Case Study of a Smart Design Project. Technology Innovation Management Review, 10(3): 49-59. http://doi.org/10.22215/timreview/1336

Kezar, A. (2021). Understanding the relationship between organizational identity and capacities for scaled change within higher education intermediary organizations. The Review of Higher Education, 45(1), 31-59.

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. Improving schools, 19(3), 267-277.

Kone: Tackling the challenge of Ageing Society in China (2019) Demola. Available at: https://www.demola.net/stories/kone-tackling-the-challenge-of-ageing-society-in-china (Accessed: March 31, 2023).

Kostova, T., & Roth, K. (2003). Social capital in multinational corporations and a micro-macro model of its formation. Academy of management review, 28(2), 297-317.

Kruss, G., McGrath, S., Petersen, I. H., & Gastrow, M. (2015). Higher education and economic development: The importance of building technological capabilities. International Journal of Educational Development, 43, 22-31.

Kunttu, L. (2017). Educational involvement in innovative university–industry collaboration. Technology innovation management review 7(12), 14-22. https://dx.doi.org/10.22215/timreview/1124

Laasonen, V., Kolehmainen, J., & Sotarauta, M. (2020). The complexity of Contemporary Innovation Policy and its governance in Finland. Innovation: The European Journal of Social Science Research, 35(4), 547–568. https://doi.org/10.1080/13511610.2020.1842176

Lee, J. S. , Blackwell, S., Drake, J., & Moran, K. A. (2014). Taking a Leap of Faith: Redefining Teaching and Learning in Higher Education Through Project-Based Learning. Interdisciplinary Journal of Problem-Based Learning, 8(2). Available at: https://doi.org/10.7771/1541-5015.1426

Lester, S., & Costley, C. (2010). Work-Based learning at higher education level: Value, practice and critique. Studies in Higher Education, 35(5), 561–575. https://doi.org/10.1080/03075070903216635

Leydesdorff, L. (2020). Triple Helix of University-industry-government relations. Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship, 2356–2364. https://doi.org/10.1007/978-3-319-15347-6_452

Lorin, M. (2013). The Essential Elements of Project Based Learning. [online] Available at: http://www.shsu.edu/centers/project-based-learning/k-12.html

Marcketti, S. B., & Karpova, E. (2014). Getting ready for the real world: Student perspectives on bringing industry collaboration into the classroom. Journal of Family & Consumer Sciences, 106(1), 27-31.

Marinho, A., Silva, R. G., & Santos, G. (2020). Why most university-industry partnerships fail to endure and how to create value and gain competitive advantage through collaboration–a systematic review. Quality Innovation Prosperity, 24(2), 34-50.

Martínez, F., Herrero, L. C., & De Pablo, S. (2010). Project-based learning and rubrics in the teaching of power supplies and photovoltaic electricity. IEEE Transactions on Education, 54(1), 87-96.

Mascarenhas, C., Ferreira, J. J., & Marques, C. (2018). University–industry cooperation: A systematic literature review and research agenda. Science and Public Policy, 45(5), 708-718.

Matthews, J. B., & Norgaard, R. (1984). Managing the Partnership between Higher Education and Industry.

Merriam-Webster. (n.d.). Industry definition & meaning. Merriam-Webster. Retrieved April 23, 2023, from https://www.merriam-webster.com/dictionary/industry

Mercer-Mapstone, L., Dvorakova, S. L., Matthews, K. E., Abbot, S., Cheng, B., Felten, P., ... & Swaim, K. (2017). A systematic literature review of students as partners in higher education. International Journal for Students as Partners.

Miller, R. L. (2018). Rogers' innovation diffusion theory (1962, 1995). Technology Adoption and Social Issues, 1558–1571. https://doi.org/10.4018/978-1-5225-5201-7.ch073

Montt, G. (2017). Field-of-study mismatch and overqualification: Labour market correlates and their wage penalty. IZA Journal of Labor Economics, 6(1). https://doi.org/10.1186/s40172-016-0052-x

Neumann, B.R. and Banghart, S. (2001), "Industry-university “consulternships”: an implementation guide", International Journal of Educational Management, Vol. 15 No. 1, pp. 7-11. https://doi.org/10.1108/09513540110380596

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis.

International Journal of Qualitative Methods, 16(1), 160940691773384. https://doi.org/10.1177/1609406917733847

Nsanzumuhire, S. U., & Groot, W. (2020). Context perspective on university-industry Collaboration processes: A systematic review of literature. Journal of cleaner production, 258, 120861.

Orphan, C. M., Laderman, S., & Gildersleeve, R. E. (2021). Advocates or honest information brokers? Examining the higher education public policy agenda-setting processes of intermediary organizations. The Review of Higher Education, 44(3), 325-355.

Piippola, T., Poranen, T., Vuori, M., Kairamo, V., & Tuominiemi, J. (2012). Teaching Innovation Projects in Universities at Tampere. In J. Björkqvist, M-J. Laakso, J. Roslöf, R. Tuohi, & S. Virtanen (Eds.), International Conference on Engineering Education 2012, Proceedings, ICEE 2012, Turku, Finland, July 30 - August 3, 2012. Research Reports from Turku University of Applied Sciences (pp. 785-792). (International Conference on Engineering Education; Vol. 38). Turku University of Applied Sciences.

Portugal implements modern co-creation methodology in cooperation with Demola Global. Demola. (2021, September 22). Retrieved April 7, 2023, from https://www.demola.net/stories/portugal-implements-modern-co-creation-methodology-in-cooperation-with-demola-global

Prigge, G. W. (2005). University—Industry partnerships: What do they mean to universities? A review of the literature. Industry and Higher Education, 19(3), 221-229.

Rahm, D., Kirkland, J., & Bozeman, B. (2013). university-industry R&D collaboration in the United States, the United Kingdom, and Japan (Vol. 1). Springer Science & Business Media.

Sandra Fernandes, Maria Assunção Flores & Rui Manuel Lima (2012) Students' views of assessment in project-led engineering education: findings from a case study in Portugal, Assessment & Evaluation in Higher Education, 37:2, 163-178, DOI: 10.1080/02602938.2010.515015

Shpeizer, R. (2019). Towards a successful integration of project-based learning in higher education: Challenges, technologies and methods of implementation. Universal Journal of Educational Research, 7(8), 1765-1771.

Sjöö, K., & Hellström, T. (2019). University–industry collaboration: A literature review and synthesis. Industry and higher education, 33(4), 275-285.

Spithoven, A., Clarysse, B., & Knockaert, M. (2010). Building absorptive capacity to organise inbound open innovation in traditional industries. Technovation, 30(2), 130-141.

Tamim, S. R., & Grant, M. M. (2013). Definitions and uses: Case study of teachers implementing project-based learning. Interdisciplinary Journal of problem-based learning, 7(2), 3.

University of Szeged (2019, May 8). "The powerhouse of innovation" – Demola expanding in Hungary. Magyar verzió. Retrieved April 4, 2023, from https://sci.u-szeged.hu/news-and-events/2019/the-powerhouse-of?objectParentFolderId=35465

Vanderlinde, R., & van Braak, J. (2010). The gap between educational research and practice: Views of teachers, school leaders, intermediaries, and researchers. British educational research journal, 36(2), 299-316.

Vasiliene-Vasiliauskiene, V., Vasiliauskas, A. V., Meidute-Kavaliauskiene, I., & Sabaityte, J. (2020). Peculiarities of educational challenges implementing project-based learning. World Journal on Educational Technology: Current Issues, 12(2), 136-149.

Virani, T., & Pratt, A. C. (2016). Intermediaries and the knowledge exchange process. Higher Education and the Creative Economy: Beyond the Campus, 41-58.

We build positive futures. Demola. (n.d.). Retrieved April 10, 2023, from https://www.demola.net/

Williams, S. (2017). Investigating the allocation and corroboration of individual grades for project-based learning. Studies in Educational Evaluation, 53, 1-9.

Wright, M., Clarysse, B., Lockett, A., & Knockaert, M. (2008). Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries. Research policy, 37(8), 1205-1223.

11. Appendices

Interview Guides For Different Stakeholder Groups

Interview Guide For Students

1) Can you describe the Demola project you participated in and your overall experience?
   a) Problem to be solved
   b) Team formation
   c) Tasks & Communication (with teammates, industry partners, faculties, facilitator) .....
   d) Outputs
   e) Assessment
2) What did you gain from this project experience?
3) How did you get to know Demola? What motivated you to apply for the Demola project?
4) What do you think are the strengths of Demola? Or, if you are a Demola worker, what will you continue?
5) What do you think should be improved in Demola projects? Or, if you are a Demola worker, what will you stop doing or start doing?
6) Is there anything else important in your experience that you would like to add?

Interview Guide For University Managers/Faculty

1) Can you describe the Demola project you were involved in? How was it organized and who are the stakeholders? What are their roles and responsibilities?
2) How do you see the outcomes of Demola projects?
3) How did you get to be involved in Demola?
4) What do you think are the strengths of Demola?
5) What are the difficulties or challenges faced in interacting with different stakeholders?
6) What do you think should be improved in Demola projects? Or do you have any concerns regarding Demola projects? (e.g., student assessment, credit, learning schedule...)
7) What suggestion would you give for new HEIs to implement Demola or a similar approach?
8) Is there anything else important in your experience that you would like to add?

Interview Guide For Industry Partners

1) Can you describe the Demola project you were involved in?
2) Who are the stakeholders? What are their roles and responsibilities?
3) How do you see the outcomes of Demola projects for each stakeholder?
4) How and why did your company get involved with Demola in the first place?
5) What do you think are the strengths of Demola?

6) What are the difficulties or challenges faced in interacting with different stakeholders?
7) What do you think should be improved in Demola projects? Or do you have any concerns regarding Demola projects? (e.g., student outputs, partnership arrangement, project pace, confidentiality...)
8) What do you imagine are the best ways for your company to partner with universities?
9) Is there anything else important in your experience that you would like to add?

Interview Guide For Demola Employees/Facilitators

1) Can you use one recent Demola project you were involved in to illustrate the whole Demola procedure? (topic, student selection, team formation, project facilitation, etc..)
2) In a typical Demola project, who are the stakeholders? What are their roles and responsibilities?
3) How do different stakeholders get involved and engaged in the first place?
4) What value do various stakeholders see in Demola projects?
5) What are the difficulties or challenges faced with partnering with each stakeholder?
6) What are the key elements for a "good/successful" Demola project?
7) What do you think are key to the success of a **regional** Demola program?
8) What do you see for the future of Demola? What support or resources do you think are needed to sustain Demola?
9) Is there anything else important in your experience that you would like to add?