

Creation of a space for creativity and innovation within university, the experience of Creative Lab

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ABSTRACT

In order to stimulate innovation and sustainable development in a business environment that is always changing, it is important to support successful collaboration between academia, industry, and society. This project is focused on creating and implementing MDU's Creative Lab, an innovation lab based on the Quintuple Helix Model, in order to promote collaboration between students, academic institutions, and business partners and to meet the needs of all parties. The study was conducted utilizing a methodology that included a review of the literature, interviews, and data analysis. The primary issues that need to be resolved have been highlighted through the interviews as the absence of support systems, the requirement to create clear objectives at the outset of the project, and the significance of ensuring projects and authors maintain continuity.

The results of the research have shown that better communication between parties, a clear connection between projects and courses, and opportunities for students to obtain knowledge and experience in the real world are all necessary. In addition, major motivators such as the desire for a social impact, interdisciplinary teamwork, and satisfaction in one's job have been highlighted. As a result, a business model has been developed that takes into account the information gleaned from the presentations and aims to facilitate collaboration and communication between academic institutions, students, and business partners, guarantee the quality of collaborations, offer mentoring and guidance to students, and plan workshops and events that encourage creativity, innovation, and entrepreneurship.

This project provides a thorough analysis of how to create and implement a student-driven innovation lab that adheres to the Quintuple Helix Model and is geared toward sustainable growth in the direction of Industry 5.0. By encouraging student cooperation and contentment, it fosters an environment that fosters the development of creative ideas and the development of a team-oriented workforce that will progress society and business.

Keywords: Academy-industry collaboration - Innovation laboratory - Sustainable development - Quintuple Helix - Students

THESIS WORK ON CREATIVE LAB

This thesis is one out of three thesis's that are having Creative Lab as a partner. The other students involved, both from MDU, are Simon Lindblom and Cornelia Alenbring. Our ultimate goal is to create a synergy between academia, industry and society, fostering a collaborative, innovative workforce committed to creating sustainable solutions.

My project seeks to establish a strong collaboration between academia and industry, promoting sustainable development and innovation through a student-driven innovation lab. With an approach based on the Quintuple Helix model and the design of a solid business model to define Creative Lab as an organization, it seeks to ensure student satisfaction and the generation of projects with an impact on society.

The other thesis have been done by Cornelia ALenbring, on the investigation of the students' role in an innovation ecosystem with Creative Lab as boundary object; and by Simon Lindblom, on the factors that make a succesfull collaboration.

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1. INTRODUCTION

1.1. Background

We live in a time of rapid technological advancement, where computational intelligence permeates every facet of daily life and is managed by algorithms via apps; and where technology advances at a pace never seen before (Gajendar, 2019). Strong pressures like globalization, demographic changes, hyper-competition, and information technology advancements are altering the competitive landscape globally. So, to remain innovative, organizations must constantly change (Carayannis & Morawska-Jancelewicz, 2022). In this new framework, high education (education given in postsecondary institutions of learning) needs to adapt to the development of technology and society in order to offer, not only the best education but also one that is appealing, useful, and fulfilling for the students. Nowadays, students are demanding a more practical approach to education, as seen both in academic studies (Birkner, Máhr, & Berkes, 2017; and Schröder & Krüger, 2019) as in the interviews conducted for the development of this Thesis. How could a way to enhance the learning experience be designed? How could students be prepared to adapt to a dynamic and changing industry? And, most important, how can we make students enjoy learning and promote creativity? The task at hand is to humanize education by implementing more humanistic characteristics, like emotions and the opportunity to discuss and build relationships.

The inspiration for this master's thesis came to me during the Human Centered Design class me and my classmates took in the fall of 2022. My team and I worked on a project called “MDU Heritage”, where we focused on how to create a tool that connects MDU students with local businesses that worked with MITC, the Mälardalen Industrial Technology Center. This case concentrated on how to properly and efficiently handle the documentation of projects so that it does not impede the students' creative processes, as a multi-year endeavor where they engage in potentially life-changing learning experiences. The two components that made up my team's final solution were a Cloud Site, which acts as a link between academia and industry, and a Roadmap, which outlines the pedagogical framework, justifications, and potential implementation strategies for this project at the university with the aim of promoting collaboration both within and outside the institution.

This initial project has changed and developed during the last months towards a broader scope to become what is now Creative Lab, an innovation laboratory for an open innovation society. Innovation laboratories are settings created specifically to conduct the innovation process; they serve as an illustration of a novel organizational structure that has developed in response to managerial issues related to the growth of an organization's dynamic capabilities (Schröder & Krüger, 2019). Creative Lab has low barriers for collaborating with new talents, working interdisciplinary, internationally, and with new technology, connecting courses and student work to society's needs while combining Innovation and Design methods with Creative and Entrepreneurial practices. The ultimate goal is to make students enjoy university more and feel more fulfilled by increasing the number of project-based courses (Bouezzeddine, et al., 2022), as well as the quality and variety of these. The foundation of this project is the development of an open knowledge exchange system that fosters entrepreneurship and innovation, disseminates projects and knowledge, and connects the participants. The use of these open innovation systems in well-established businesses in the industrial sector might greatly help industry and represent a significant advancement in fields like sustainability, energy efficiency, automotive, and industrial design (Birkner, Máhr, & Berkes, 2017).

For the creation of this organization, I tackled the challenge as a personal goal - something I wished I had had as an engineering student and I have applied approaches from design and innovation research that will be discussed further in this paper. During the process, an extensive network of contacts has been generated, both within MDU and with students and external partners from government and industry in the region. With Creative Lab we aim to create a bridge between students, university, and industry, focusing on the satisfaction and enjoyment of the students, as well as the preparation for their future careers in the heart of the new social and technological paradigm shift the advent of Industry 5.0 will bring about (Breque, De Nul, Petridis, 2021). Throughout this thesis project, my purpose is to find the best way to give shape to the project that I and my colleagues at Creative Lab have initiated. The basis of Creative Lab is set up but we need to know what the needs and demands of students and teachers are in order to develop a functioning organisation. Thus, the goal of this thesis project is to develop a business model from the input of different stakeholders, which enables the implementation of Creative Lab and ensures its success.

During the last few years, as an engineer, I've become familiar with the concept of Sustainable Development (SD) and its goals, as it is at the forefront of any new project in the industry. SD refers to the concept of addressing present demands without sacrificing the capacity of future generations to address their own needs. It includes aspects of the economy, society, and environment and necessitates a comprehensive approach to decision-making, which makes it a key factor in today's universities (Price, et al., 2021). The most recent development in industrial

production, however, is known as Industry 5.0 and integrates the concepts of sustainable development, digitization, and human centricity. Industry 5.0 aspires to ensure social and environmental sustainability while also advancing economic progress (Müller, 2020). The relationship between Industry 5.0 and SD is, to my understanding, that the latter can make a substantial contribution to the former's objectives. Industry 5.0 can assist lessen environmental deterioration, advance social well-being, and still achieve economic growth by integrating sustainable practices into industrial output. To support SD, universities will need to give priority to research and instruction on sustainable practices, including the creation of novel technology and business models (United-Nations, 2022). Industry 5.0 will probably require a workforce with extremely specialized knowledge and abilities, which might result in an increase in the emphasis on practical skills and industrial relationships, as well as a shift towards more specialized and technologically oriented degrees at universities (Fan, Fan, Zhang, Mao, & Li, 2021).

In this new paradigm, the learning experience of university students becomes more important and it is vital that it provides them with the theoretical, but above all, practical and decisive knowledge to be able to function in the industry (Van Looy, Ranga, & Callaert, 2004). The "Learn by doing" theory, which asserts that learning occurs through practical experience and problem-solving in the actual world, is significant under the Industrial Revolution 5.0 paradigm. This emphasizes on applying theoretical knowledge to concrete situations and learning via mistakes and failures (Schirmer & Knudsen, 2019). This theory is applicable in the context of the fifth industrial revolution because the skills required to work in this field cannot be learned solely through theoretical education but instead require practical experience and the application of knowledge to real-world projects. On this basis, it is possible to effectively encourage innovation, creativity, and problem-solving. Overall, the convergence of Industry 5.0 and SD is expected to result in a more transdisciplinary and practical educational paradigm that is concentrated on answering the needs of an industry and society that are changing quickly. This goes hand in hand with the adoption of the Quintuple Helix Model which recognizes that effective innovation and development cannot be achieved exclusively through interaction between academia, industry and government, but also requires the active engagement of civil society and consideration of the environment.

1.2. Overview of the Design and Innovation field of research_____

The whole project has been done using a multi-phased process that is based on Value Driven Design (Hendry, Friedman, & Ballard, 2021), Human Centered Design (IDEO, 2015), and

Design Thinking (Lewrick, 2020). Design, according to Design Thinking, is more than merely making things that adhere to the highest aesthetic standards (Lewrick, 2020). Instead, it involves addressing users' problems and meeting their needs. To achieve this, Human Centered Design is employed as a method to ensure that products are genuinely advantageous and practical for their intended users in the long term (Hoover, 2018). Human Centered design is a methodology that prioritizes the user in the creation of products, services, and solutions, whether physical or digital. This approach involves the participation of users throughout the design process (IDEO, 2015). It can be considered in two main ways: as a set of procedures and techniques used during the design process, or as a design philosophy that establishes a new business model by involving users in the development of solutions. According to Hoover (2018), Human Centered design moves away from the traditional Technology Tentered design approach, which focuses solely on incorporating innovation by considering the product in isolation (Hoover, 2018). Instead, this methodology focuses on designing solutions that meet the needs of users. This involves researching their desires, problems, and behaviors, as well as soliciting their feedback throughout the development process (Nahavandi, 2019).

As this project touches many areas, the stakeholders that will be taken into account to gather input will also be numerous, so the Value Driven Design perspective was considered too, as it puts a strong emphasis on delivering value to all users and stakeholders involved by focusing on the needs, goals, and pain points of the users, and designing solutions that meet those needs (Hendry, Friedman, & Ballard, 2021). By focusing on delivering value and being an agile and iterative process, one can reduce the risk of investing time and money in a product that does not meet the needs of the customers. Value Driven Design aligns the objectives of all stakeholders with those of the design. By understanding the goals and priorities of all parties, it is possible to design solutions that not only meet the needs of customers, but also align with the overall goals of the organization responsible for it (Hendry, Friedman, & Ballard, 2021). Therefore, as far as the development of our project is concerned, I have tried to overlap Design Thinking, Value driven Design, and Human Centered Design models when planning and conceptualizing the project.

1.3. Significance of the study_____

Innovation is essential in today's market, as seen by the growth of organizational innovation spaces for fostering creative behavior and supporting new businesses, which is reflected in the increase of articles over the last few years in these search criteria (figure 1).

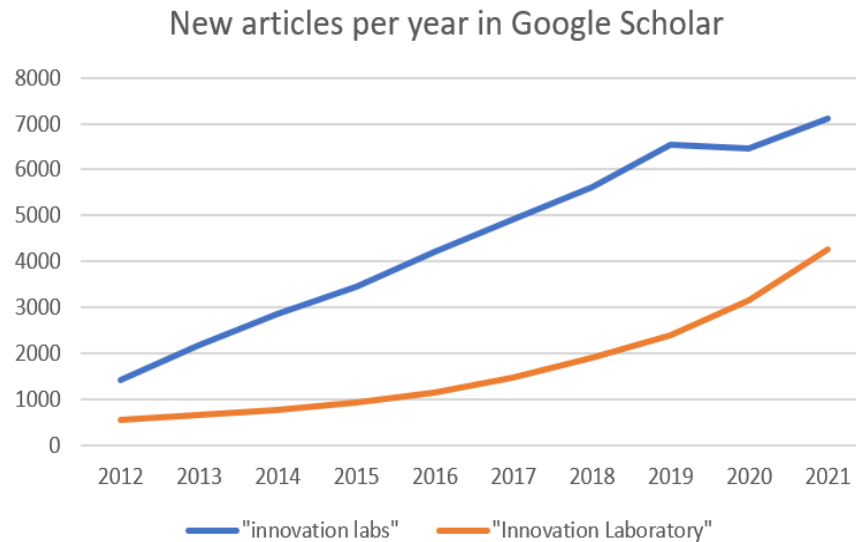


Figure 1. Evolution of the search for "innovation labs" and "innovation laboratory" in google scholar over the last 10 years.

Yet, little is known about how effective innovation laboratories are, and little has been done to understand the underlying concepts, general benefits, and drawbacks of these establishments, as well as the possible effects they may have on students' academic success and personal contentment. The need for additional research on the conceptualization of organizational innovation laboratories within universities, including design, collaborations, and administration, has already been raised by researchers (Birdi & Magadley, 2009). According to Lewis and Moultrie (2005), research on organizational innovation laboratories may also contribute to a better understanding of how these facilities affect the dynamic capabilities of organizations (Lewis & Moultrie, 2005).

To excel in their future occupations, students must develop abilities in creativity, critical thinking, cooperation, communication, and problem-solving. As I've discussed previously, The fifth industrial revolution is characterized by a greater convergence and interconnection of technologies, which leads to the development of integrated solutions and the emergence of new business models and markets (Müller, 2020). With Industry 5.0, where the emphasis is on creating highly personalized and adaptable solutions using new technologies, these abilities become even more crucial (Oktradiksa, Bhakti, Jepri Kurniawan, & Fahimur, 2021). In accordance, the Quintuple Helix Model (QHM) (Morawska-Jancelewicz, 2021) is a collaborative approach that involves five key actors: the government, business, academia, civil society, and users (Figure 2). Through cooperation and communication between these actors, this collaboration aims to promote innovation and sustainable development. The fifth industrial revolution makes the QHM particularly pertinent because key actors' cooperation can help identify areas of technological convergence and develop integrated solutions to address the challenges and opportunities that arise in this rapidly changing environment. Additionally, cooperation between these parties may

help to ensure that the fifth industrial revolution takes into account the needs and concerns of society as a whole, which is essential for achieving sustainable and equitable development. In this set-up, innovation labs can become crucial for the students' learning by combining all these new needs of society with the approach of transformative learning (Mezirow, 1978), where the individual's learning occurs when it changes how the individual behaves and acts or thinks.

This project could be highly significant because it addresses a genuine and current problem in higher education and the labor market. The establishment of an idea laboratory that connects students, universities, and industry aims to solve current communication and collaboration problems, while also improving student training and preparing them for a more demanding and competitive work environment. In addition, the application of the fifth industrial revolution theory and the QHM in this project promotes innovation and sustainable development in the region by fostering cooperation and knowledge sharing among the various actors involved in the innovation process. In order to facilitate and collaborate with students on transdisciplinary projects both within the university and with the industry of Västmanland, this study will employ Creative LAB as a starting point. Creative LAB is started within the Masters of Innovation and Design, a program with international intake. The students involved come from various countries, regions, and parts of the world. The organization can play a role in Mälardalen University's role in attracting as well as integrating international competences. By using inclusion as a method and tool, both by nature of who makes the projects (diverse group, including international students) as well as the diversity of the projects made, it can help to create a campus and university which creates belonging (Mezirow, 1978). MDU has several well-functioning platforms for collaboration, but none focus on student collaboration.

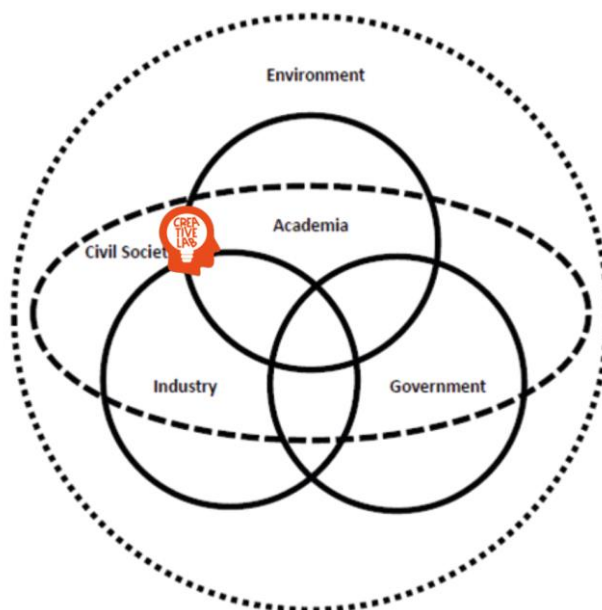


Figure 2. Situation of Creative Lab within the Quintuple Helix Model. Photo by creative lab.

1.4. Research question and objectives

As set out above, in recent years there has been an increasing focus on sustainable development and the need to adopt new technologies and practices to achieve it. Industry 5.0, the integration of advanced technologies and sustainable practices in manufacturing (Breque, De Nul, & Petridis, 2021), has emerged as a promising way to promote sustainability in the industrial sector. However, to achieve Industry 5.0, it is crucial to foster innovation and collaboration among students, who are the future of the workforce (Carayannis & Morawska-Jancelewicz, 2022).

This study aims to explore how a student-driven innovation laboratory can be refined to be adopted within universities, starting at MDU. By examining the challenges and opportunities of implementing such an organization, this research seeks to provide insights into what are the perspectives of students, professors, and how well the implementation may work with regional industry representatives. It also seeks to gain knowledge on how this laboratory could improve university-industry collaboration in the framework of the fifth industrial revolution. The final goal is to create and implement an optimal Business Model for the effective functioning of the organization that fosters collaboration between students, university, and industry. Taking all of this into account, my final research question is: *How can a student-driven innovation lab be designed and adopted in universities, following the Quintuple Helix Model and focused on sustainable development towards Industry 5.0, promoting a collaborative and innovative workforce and ensuring student satisfaction?*

The purpose of Creative Lab is to be a bridge between the university, industry, and students, building its entire structure around the students. It aims to promote the development of Industry 5.0 through the participation of students in projects that follow the QHM and to provide students with a setting where they may interact on an equal footing. Because of the potential for the study to significantly affect the University as a whole, we contacted many interested parties. Most of the program directors, several participating departments or research groups, students, office staff, and vice-chancellors have been in touch with us. At the same time, we have developed a wide network of collaborators outside the university to strengthen the structure of the project, both in the regional government and in the industry, whose impact will serve as a foundation for the success of the organization. All these contacts will add their input on how to maximize the benefits of our organization, as well as how to minimize the hindrances. By involving them I seek to answer different questions that will help me shape the business model of Creative Lab. In the case of the students, I aim to find out what are their needs and expectations for their education, what

are they lacking and how can Creative Lab help to fulfill their development. Other stakeholders from University will be involved to learn how the future of MDU is envisaged now that it is a university and how Creative Lab could be implemented. My thesis project will be done together with my colleagues Simon Lindblom and Cornelia Alenbring, who will work on other facets of the development and implementation of Creative Lab and how to make the project a success.

1.5. Following development of the thesis_____

The overview of the structure of the thesis and the main topics that will be covered in each section is as follows.

The first section of the thesis will provide a comprehensive review of the relevant literature related to Sustainable Development, Industry 5.0, collaboration platforms, and transdisciplinary teams. This section will explore the key concepts, theories, and practices that are related to each of these topics. It will also discuss the interconnections and relationships between these topics. The second section of the thesis will describe the overall methodology and methods that were used to collect and analyze data for the study. The research design, sample plan, data collection procedures, data analysis strategies, and ethical considerations will all be covered in this part. It will also discuss the strengths and limitations of the chosen methodology and methods.

The third section of the thesis will present the results and findings of the study. This section will use thematic analysis (Braun & Clarke, 2006) to analyze the data collected from interviews with participants. The themes and patterns that emerge from the data will be discussed and analyzed in relation to the research questions and objectives. The study's outcomes and conclusions are presented in the third portion of the thesis. The research questions and objectives will be discussed in connection to the themes and patterns that appear in the data. After that, a critical analysis and interpretation of the results and findings will be conducted, which will explore the implications of the study for theory, practice, and policy. It will also discuss the limitations of the study and suggest directions for future research. The final section of the thesis will provide a summary of the main findings and conclusions of the study. This section will discuss the contributions of the study to the field, as well as its practical and theoretical implications.

2. LITERATURE REVIEW

A literature review has been the first step in my research strategy. To get a thorough grasp of the state of research on the cooperation between universities and industry partners as well as to learn more in-depth about Industry 5.0., Sustainable Development, Transdisciplinarity, and the interconnection between these concepts, the literature review has been a key part of my work. The search and review of existing literature in the early stages of design has provided me with insight into the academic status of my topic as well as other professionals' perceptions. Thanks to the review, I was able to pinpoint research gaps as well as the main themes and elements that affect how well university-industry collaborations work. Definitely, it gave me a strong knowledge base on which to build and enabled us to better define the objectives.

2.1. Definition of key concepts

Hereafter, in this section I will provide an overview of the key concepts that are central to the topic of this Thesis. The major concepts that will be covered include creativity, innovativeness, collaboration, Industry 5.0., Sustainable Development, the QHM, and Transdisciplinarity. These ideas are crucial to the subject of this article because they offer a framework for comprehending the problems at hand and the potential solutions. This section attempts to enable a greater understanding of the subject.

According to Amabile (1996), creativity is defined as the "*production of novel and useful ideas or solutions to problems*" (Amabile, 1996). This definition emphasizes the importance of both originality and utility in creative thinking. Innovation is defined as "*the process by which individuals and organizations use creativity and knowledge to generate new products, services, processes, or ideas that are perceived to be new or improved by customers, stakeholders, or society*" (Gunday, Ulusoy, Kilic, & Alpkan, 2011). This definition stresses how crucial creativity and industry and societal effect are to the innovation process. Collaboration is defined as "*a process where two or more people or organizations work together to achieve shared goals by sharing knowledge, skills, and resources*" (Bowers & Luther, 2015). This definition emphasizes the importance of shared goals and resources in collaborative efforts and it also describes collaboration as a process that involves the coordination of activities, sharing of information, and mutual trust among participants.

The paradigm known as Industry 5.0 combines the developments of Industry 4.0 with a focus on production that is human-centric (Nahavandi, 2019). Industry 4.0 theory proposes a

vision of production based on the convergence of advanced digital technologies, which seeks to transform industrial processes, improve efficiency and productivity, and adapt to changes in society and the labor market (Şimşek, et al., 2018). With a focus on enhancing human well-being, lessening the influence on the environment, and boosting economic success, it seeks to foster the peaceful cohabitation of machines and humans in the production process (Bouezzeddine, et al., 2022). Using cutting-edge technology like artificial intelligence, robotics, and the internet of things to improve worker capacities and provide them the ability to carry out more value-added jobs is known as Industry 5.0. It also emphasizes the necessity of more resource-efficient and circular economy principles in production processes (Bouezzeddine, et al., 2022). Overall, Industry 5.0 denotes a new phase in manufacturing that aims to strike a balance between social and environmental responsibility and economic growth. In parallel to this, sustainable development is an approach that meets the needs of the present without compromising the ability of future generations to meet their own needs (UN, 2021). To give present and future generations equitable opportunities to develop their full potential on a healthy and prosperous planet, this approach seeks to strike a balance between economic growth, social progress, and environmental protection (Sachs, 2015). Sustainable development requires a long-term vision, integrated planning, and a holistic strategy that takes into account economic, social, and environmental factors at the same time to reduce inequalities, protect ecosystems and foster inclusive and peaceful communities (Goller & Bessant, 2017).

Moreover, and also related to the above, the QHM is a conceptual framework that stresses the importance of collaboration between five parties: government, industry, academia, civil society, and the environment, in the context of innovation and sustainable development (Carayannis, Grigoroudis, Stamati, & Valvi, 2021). In turn, transdisciplinary work is an approach that involves the integration of knowledge and methods from multiple disciplines to address complex real-world problems (Nicolescu, 2002).

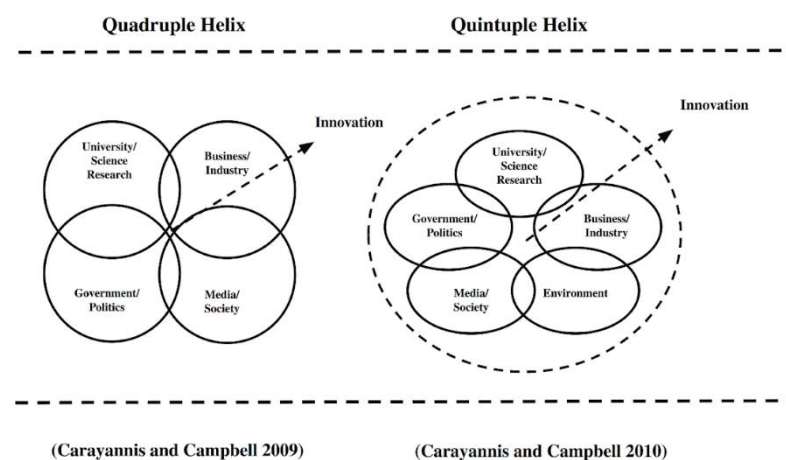


Figure 3. Quadruple and Quintuple Helix models, Carayannis & Campbell (2009,2010)

The QHM and transdisciplinary work share the common goal of promoting innovation and sustainable development through collaborative problem-solving involving diverse stakeholders. Transdisciplinary work can be seen as a practical application of the QHM, as it involves collaboration between stakeholders from different sectors to co-create knowledge and solutions of relevance to society. In a broader sense, transdisciplinary can mean integrating perspectives from different research disciplines (Rigolot, 2020). The QHM recognizes the importance of involving actors beyond traditional academia, such as industry and civil society, in the innovation process, while transdisciplinary work recognizes the need to involve stakeholders with different perspectives and expertise to address complex challenges. The model provides a framework for understanding the interaction between these stakeholders and their role in fostering innovation and sustainable development.

Last but not least, according to Lee and Chew, the "learn by doing" theory is an educational philosophy that maintains that hands-on practice and direct experience are the best ways to learn. This theory holds that students learn best when given the chance to experiment with and put into practice the theories and concepts they have learned in a real-world setting. The concept of "learn by doing" may be used to describe transdisciplinary work: by involving students in practical and applied projects that call for a combination of skills and knowledge from other disciplines, transdisciplinary collaboration is encouraged and an understanding of the complexity of real-world problems is promoted. In this way, "learn by doing" and transdisciplinary work can collaborate to prepare students for the complex challenges of the modern world (Lee & Chew, 2020).

The concepts of "learn by doing," "quintuple helix model," "industry 5.0," "sustainable development," and "transdisciplinary work" are intimately connected. The "learn by doing" philosophy implies a pedagogical methodology that fosters learning via practical experience, which is essential for the growth of an innovative and sustainable work force. The "quintuple helix model" highlights the significance of cooperation among the five key actors in innovation, namely universities, business, government, civic society, and students. For sustainable development and value creation in an extremely digitalized economic environment, "industry 5.0" views collaboration and innovation as essential. In conclusion, these ideas are interconnected and essential to the growth of an innovative and sustainable work force in the era of Industry 5.0. These connections are represented in figure 4.

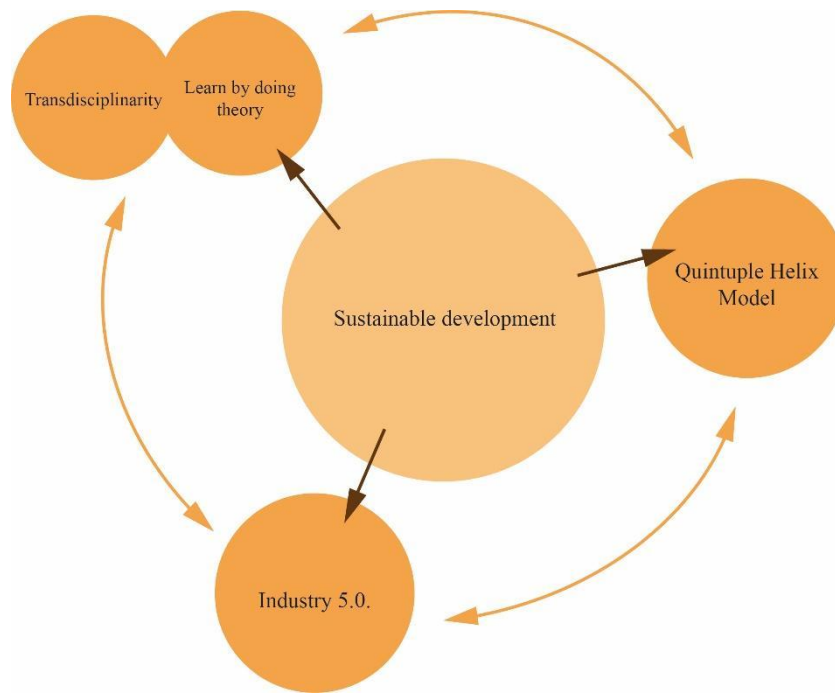


Figure 4. Representation of connections between the concepts of "learn by doing," "the quintuple helix model," "industry 5.0," "sustainable development," and "transdisciplinary work." Photo by Inés Acinas.

2.2. Sustainable Development, Quintuple Helix Model and Industry 5.0. _____

The importance of sustainable development and innovation in achieving it is discussed in multiple articles (Paula, De la Vega, & Gil-Lafuente, 2021), as well as the introduction of the QHM as an analytical framework to explain interactions among actors in society (Morawska-Jancelewicz, 2021). These studies identify gaps related to sustainable development and recommend investment in education, research and development, and quality employment (Morawska-Jancelewicz, 2021).

In "Introducing Research Loop to Achieve Open Innovation for Research Centers in Quintuple Helix (Arvaniti, 2022) is discussed that to implement Open Innovation concepts in research institutions and create partnerships with other organizations, a novel methodology is needed. For research and innovation centers, open innovation is important since it makes research possible that otherwise wouldn't be possible. The interactions and partnerships among stakeholders - which are essential for developing innovations in a way that balances the environment, society, and economy - are explained by the quadruple and QHM. Overspending on IT, an inability to pursue collaborations and financial constraints are the key problems facing research institutions (Carayannis & Morawska-Jancelewicz, 2022). The development of the Quadruple and Quintuple Helix innovation systems, following Carayannis and Campbell,

incorporates several stakeholders in the generation of knowledge and invention. The benefits of Industry 4.0 and its effects on society are also discussed by these authors, as is the idea of Society 5.0, which aspires to put people at the heart of innovation (Carayannis & Campbell, 2021).

Articles, like “Towards designing society 5.0 solutions: The new Quintuple Helix - Design Thinking approach to technology” discuss the integration of Industry 4.0 technologies into society through a human-centric approach; Society 5.0. (Bartoloni, Calò, Marinelli, & Pascucci, 2022). The authors present a conceptual model for building human-centric solutions that integrate Industry 4.0 technology using the Design Thinking approach, as well as an example of how this model was applied to a healthcare project. This study underscores the importance of integrating Industry 4.0 technologies into society to address concerns such as global pandemics, aging populations, and climate change. The report suggests a Society 5.0 strategy that emphasizes Industry 4.0 technologies' contribution to improving people's quality of life, sense of responsibility, and sustainability. According to this, we would create new 5.0 human-centric solutions by combining the Quadruple Helix Model and Design Thinking.

The goal of Society 5.0 and Industry 5.0, which seek to put people at the heart of innovation and enhance the quality of life, social responsibility, and sustainability, is discussed again by Carayannis in “The Futures of Europe: Society 5.0 and Industry 5.0 as Driving Forces of Future Universities”. The recent COVID-19 epidemic has increased the urgency of future planning and preparing for disruptive new developments. In order to improve how well the university performs within a contemporary regional innovation system, the article offers a model of a socially and digitally engaged university (Carayannis & Morawska-Jancelewicz, 2022). The QHM, the value of cross-sector cooperation for regional or local sustainability, digital social innovation, and the function and future of universities in Society 5.0 and Industry 5.0 is also covered in the paper.

Bellandi (2021) discusses the quadruple helix concept of collaboration for social innovation between the government, academia, civil society, and business, concentrating on the role of universities in these alliances (Bellandi, Donati, & Cataneo, 2021). The study outlines the major partnership phases for social innovation from the viewpoint of the institution, proposes a conceptual framework to capture the alignment path in quadruple helix partnerships, and describes the roles, competences, and legitimacy of academics engaged in community involvement. The report also analyzes three social innovation projects from Italy that have a quadruple helix shape.

Schröder and Krüger examine how social innovation and sustainable development can be used to modernize and improve the educational system, and they contend that these concepts have the power to influence educational change by advancing innovative methods for addressing

society problems and demands (Schröder & Krüger, 2019). They give an overview of various social innovation strategies and talk about how to use them in the classroom. In designing new educational approaches, the writers emphasize the value of co-creation, cooperation, and participatory processes. They also suggest that social innovation in education should focus on fixing existing practices, upgrading established structures, and altering the system to make it more inclusive and sustainable. The necessity for additional investigation and testing of social innovation in education is emphasized in the paper's conclusion.

2.3. Universities, collaboration platforms and transdisciplinary teams_____

According to Chen (2017), developing research field in science, technology, and innovation policy studies is focused on the notions of academic entrepreneurship, outreach, and university-industry partnership. The new emphasis is on the function of universities and their extended networks in translating research into products and services, as opposed to traditional innovation/industrial policy where the idea is that the private sector alone will drive innovation (Chen & Lin, 2017). Conditions for university-industry cooperation have been added to traditional studies on collaborative and networked innovation processes (Powell, Koput, & Smith-Doerr, 1996). According to Sjöö and Hellström (2019), there are six main points affecting the creation of collaboration platforms within universities; resources, intellectual property rights, boundary-spanning functions, collaborations, culture, and the environment (Sjöö & Hellström, 2019).

The provision of organizational resources for pursuing collaboration, or the existence of such resources, is observed to affect the likelihood of university-industry collaborative innovation (Franco & Haase, 2015). This refers to the requirement for additional funding to conduct academic research when such demand is not entirely fulfilled by available research funds (Erwee, 2019). University science parks, which encourage a two-way flow between universities and industry, and university-affiliated incubators, which assist knowledge transfer between universities and industry, are two other examples that are commonly discussed in the literature concerning the viability and reduced need for funding (Purcell, Henriksen, & Spengler, 2019).

Boundary-spanning functions are regular and ongoing informal activities at a university that are frequently linked to existing projects, the organizational structure component, which focuses on a formal university system, is slightly at odds with this (Franco & Haase, 2015). The literature highlights the significance of this boundary-spanning role for knowledge transfer as well as the centrality of project advocates and sponsors in both academia and industry who cross

university-industry barriers (Monteiro, Isusi-Fagoaga, Almeida, & García-Aracil, 2021). This entails starting projects, bridging the gap between academia and industry, and establishing effective lines of communication between the business world and pertinent academic research findings (Bouezzeddine, et al., 2022).

The literature on collaboration indicates that establishing connections with universities in an organization's service area is favorably regarded by both parties, as it has been observed that universities who have worked with industry for a considerable amount of time were more likely to do so again in the future (Carayannis & Morawska-Jancelewicz, 2022). The main issue that can arise is the appearance of conflict between a company representative's goals and the researchers' interests, which can make them decide not to work together. Another issue that can prevent researchers and the industry from working together is the potential for an industry partner to desire to keep the outcomes of a collaborative effort under wraps, which might prevent academic publishing (Fernandez-Orviz, 2013).

The importance of transdisciplinary research and human-technology collaboration in Industry 5.0 is also emphasized through the literature. According to "The Future of Transdisciplinary Design," transdisciplinary design will play a significant role in determining how universities, society, and the workplace will develop in the future (Blessing, et al., 2013). The capacity to tackle problems from a multitude of approaches without being constrained by ideology, custom, or academic norms is referred to as transdisciplinarity. According to experts, it is a way of thinking that rejects a single discourse and acknowledges that there may be different levels of reality, depending on the parts involved (Blessing, et al., 2013). The Book of Transdisciplinary Design by Blessing, Jawad, and Gericke (2013) asserts that design is no longer just about how well a product works and works well. It is becoming more and more important to have a more comprehensive understanding of value, one that considers many different points of view and puts the user first. Merely putting together transdisciplinary teams of experts could lead to disagreements, miscommunications, bad decisions, ineffectiveness, and inefficiency when it comes to coming up with answers (Fernandez-Orviz, 2013). Design issues frequently transcend the confines of a particular discipline. As a result, design practice necessitates the cooperation of designers from various fields. The main goal of this strategy is to pool and integrate team members' skills in order to provide more efficient and complete assessment and development of a project.

Transdisciplinarity entails understanding the links between disciplines and how they apply to everyday life, recognizing other people's perspectives as an enrichment of one's own, and learning to apply this information to formulate the best possible responses (Nicolescu, 2002). Conceptual frameworks from various disciplines are brought together through transdisciplinarity.

A transdisciplinary strategy requires team members to regularly cross discipline boundaries and share responsibilities, and it also emphasizes the value of transdisciplinary design in creating solutions that are efficient, sustainable, and socially responsible as well as preparing people for the challenges of the future. Additionally, Blessing also emphasizes how colleges should become more responsive and dynamic organizations that can successfully solve the complex issues facing society by implementing transdisciplinary design (Blessing, Jawad Qureshi, & Gericke, 2013). In order to encourage collaboration and innovation, prepare students for the challenges of the future, and improve society universities must adopt transdisciplinary approaches.

Regarding the literature on case studies attempting to create spaces for collaboration and innovation, “Design for social innovation between the university and the broader society: a mutual learning process” offers many interesting standpoints. Based on the design approach to social innovation, this study provides a model for the Social Innovation Support Unit of the Federal University of Rio de Janeiro. The Social Innovation Support Unit model was presented using the Business Model Canvas, and co-design processes were acknowledged as a crucial component of design for social innovation. The relationship between Brazilian universities and the general public as well as the function of design in enabling social innovation processes are also discussed in the study. After reviewing feedback from both inside and outside the university, the study draws attention to the crucial role that design plays in promoting communication between academic institutions and the larger community (Cipolla, Serpa, & Afonso, 2017).

The study by Christian Nielsen and Katja Cappelen intends to investigate the mechanisms of knowledge transmission in university-industry cooperation (Nielsen & Cappelen, 2014). Three Norwegian enterprises that worked with universities are included as case studies in the study. The paper highlights the importance of understanding the mechanisms of knowledge transfer in university-industry collaborations to enable the development of effective collaboration strategies (Nielsen & Cappelen, 2014). The most important mechanisms for information transfer, according to the authors, were co-creation, student involvement, and informal connections. The findings imply that developing connections between persons in the university and industry sectors is essential for effective knowledge transfer. The authors propose that in order to ease knowledge transfer, institutions should aggressively encourage student participation in these collaborations and that industry partners should offer possibilities for co-creation with academic academics.

The University of Porto's initiatives to encourage the development of innovation ecosystems are examined by Brito (Brito, 2018). According to the author, colleges are essential to promoting innovation and may achieve this by establishing innovation ecosystems that include academic researchers, entrepreneurs, and business partners. The author outlines the university's entrepreneurship support programs, including the establishment of innovation hubs, incubators,

and accelerators. The collaborations between the university and industry partners, as well as the University's initiatives to support technology transfer and research commercialization, are also covered in this report (Brito, 2018). The author makes the case that the University of Porto's initiatives to encourage the development of an innovation ecosystem in the Porto region have been successful. The research offers insightful information about how universities may support innovation and build innovation ecosystems. Other universities can learn from and use the case study of the University of Porto's experience's relevant examples and best practices to their own circumstances.

The study by Yasin, R. (2013) looks at several forms of cooperation, such as collaborative research initiatives, consulting services, internships, and technology transfer (Yasin, Omar, Tawil, Yusoff, & Rasul, 2013). The obstacles and advantages of these partnerships for universities and businesses are also evaluated in the article. The study concludes that effective communication, trust, and mutually beneficial outcomes are necessary for university-industry partnerships to be successful. Policymakers, academics, and business executives who are interested in fostering and advancing university-industry relationships will find the paper's observations to be helpful (Yasin, Omar, Tawil, Yusoff, & Rasul, 2013). The notion of dual education as a collaborative model between universities and industry to give students practical skills and academic knowledge is explored in the paper by Pogatsnik (Pogatsnik, 2018). The article emphasizes the advantages of dual education for both students and business partners, such as the creation of a skilled labor force, less hiring expenses, and higher production. The author also covers potential obstacles to adopting dual education programs, such as lack of funds and the requirement for strong collaborations between academic institutions and businesses. Overall, the study offers insightful information about how dual education may be used to serve industry demands and close the gap between theory and practice in education.

2.4. Synthesis of the literature

Several significant points were found after a review of the literature. First, it was stressed how crucial it is to build a relationship of trust and open communication between academia and business (Drimie, Hamann, Manderson, & Mlondobozi, 2018). These components are essential for promoting value creation and information transmission. Many articles examine the significance of innovation and sustainable development and how they relate to the QHM. According to the papers, research institutions need to use open innovation concepts in order to form alliances with other businesses and develop breakthroughs that strike a balance between the environment, society, and economy (Goller & Bessant, 2017). Also included are Industry 4.0 technology and Society 5.0's human-centered methodology. In order to solve problems like the

spread of infectious diseases around the world, aging populations, and climate change, the authors stress the significance of integrating these technologies into society. The role of universities in quadruple helix partnerships for social innovation is examined, along with the need for co-creation and participatory processes in designing new educational approaches that are inclusive and sustainable (Ierapetritis, 2019).

The literature also discusses the developing field of research in science, technology, and innovation policy studies, which focuses on academic entrepreneurship, outreach, and university-industry partnership (Dahlander, Gann, & Wallin, 2021). It was shown that students' active involvement in group projects is essential to enhancing their educational experience and boosting their employability. The necessity of transdisciplinary collaboration, in which experts from several fields come together to address complicated problems, was another significant discovery (Simonsen e. a., 2010). This enables a more comprehensive and imaginative method of issue-solving. The literature indicates that universities must adopt transdisciplinary approaches to encourage collaboration and innovation, prepare students for future challenges, and improve society. A user-centered approach was also emphasized, where the wants and preferences of students are taken into account to build projects and programs that are engaging and pertinent to them (Birkner, Máhr, & Berkes, 2017). Finally, the articles also encourage the development of innovation ecosystems, including entrepreneurship support programs and collaborations with industry partners, promote effective communication between the involved parties, and highlight the advantages of dual education as a collaborative model between universities and industry.

Moreover, the connections between the ideas discussed in the literature review are striking. Starting off, the Learn By Doing method of practical learning is one that universities can use to encourage innovation and creativity in their students. Universities can help students develop skills that are relevant to the job market and prepare them to face challenges in real life by offering practical experiences in solving real-world problems. The idea of Industry 5.0 is therefore essential for universities looking to give their students skills and knowledge for the future. To promote innovation and competitiveness, universities must work in partnership with industry. Regarding the QHM, universities might implement this approach to involve various parties interested in developing innovative and sustainable solutions to the world's challenges. The range of people and organizations that can participate in academic projects can be expanded by universities working with these interested parties to identify community problems and collaborate in the search for solutions. Last but not least, universities must promote transdisciplinary collaboration and teamwork in order to address the complex and global challenges of today. Combining students from different educational backgrounds will lead to the development of more creative and innovative solutions that might not otherwise be feasible using a traditional disciplinary approach.

In conclusion, the concepts of Learning by Doing, QHM, Industry 5.0, Sustainable Development, and Transdisciplinary Work may be crucial for the future of universities and the development of collaborative and innovative spaces. Universities that accept these ideas may be better positioned to give their students relevant skills and prepare them for the challenges of the future, while also working to develop novel and sustainable solutions to the world's challenges. The creation of spaces that seek to foster collaboration and innovation is therefore key to the development of universities and students.

3. METHODOLOGY

3.1. Epistemological approach and Research Design

Phenomenology, which focuses on examining the various ways in which people perceive and comprehend a certain occurrence, is a suitable epistemological approach for this study, as it is more focused on how people interpret and make sense of their experiences than it is in simply documenting those experiences (Alvesson & Skökdberg, 2018). This is in line with the human-centered design philosophy (Nahavandi, 2019), which aims to comprehend people's requirements, attitudes, and behaviors in order to create goods and services that are suited to their particular circumstances and viewpoints.

Considering I will be exploring complex social phenomena that are difficult to quantify or measure, such as people's experiences, beliefs, and attitudes (Hammarberg, Kirkman, & de Lacey, 2016), the use of qualitative methods, including interviews and observations, is well-suited to a methodological approach. The rich and in-depth data produced by qualitative research techniques, such as interview transcripts, field notes, and/or audio or video recordings, will aid in gaining a thorough knowledge of the topic and in its in-depth investigation. This information will later be used to build insights into the subject of the study. Exploring the social, cultural, and historical elements that affect people's experiences and behaviors can help to create a more comprehensive picture of the research issue, which is one of qualitative methods' main advantages (Alvesson & Skökdberg, 2018). Moreover, qualitative methods are more adaptable than quantitative ones (Hsieh & Shannon, 2005), enabling me to change my strategy as I learn more about the research issue. When conducting exploratory research or in circumstances when the research issue is not fully known, this flexibility can be especially helpful.

As I stated previously, by highlighting the value of cooperation with participants, Human Centered Design, Design Thinking, and Value Driven Design are integrated into the study to support its phenomenologist approach. Human Centered Design is a philosophy that ensures products are truly relevant and valuable to the people they are supposed to serve in the long run, and Design thinking is a human-centered approach to innovation that integrates people's needs, technological possibilities, and corporate success requirements (Hoover, 2018). Value Driven design is a design and engineering framework that ensures that the part of the problem solved by the designer adds value to all stakeholders involved (Hendry, Friedman, & Ballard, 2021). Value Driven design emphasizes the significance of understanding the social and cultural settings that impact people's experiences and behaviors, and design thinking methodologies are particularly beneficial in revealing the underlying wants and aspirations of individuals (Cross, 2007). These

connections are represented in Figure 5 where the individual is placed at the center of the entire design process.

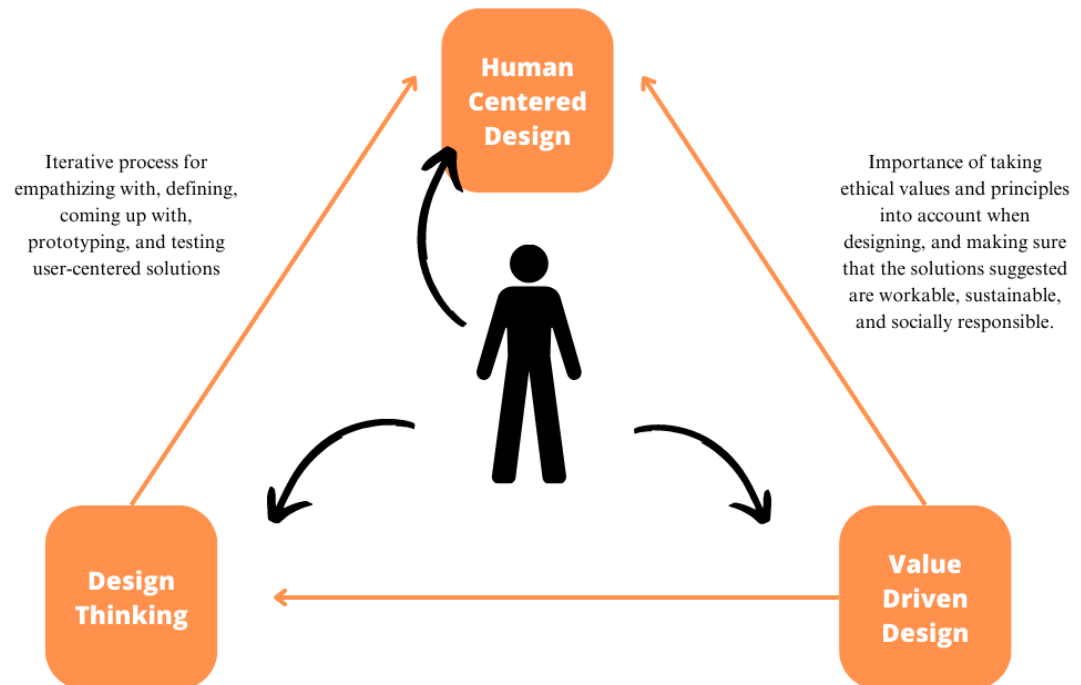


Figure 5. Underlaying connections between the methods considered during the project. Image by Inés Acinas.

Ultimately, phenomenology, along with qualitative approaches, human-centered design, design thinking, and value-driven design, offers a strong framework for examining the various perspectives that individuals may have on my research topic.

In the realization of this project, from its inception with the idea of Creative Lab until today, I've followed the next steps according to the graph done by Hoover (2018) (Figure 6). At the very beginning of this project, we began to generate ideas until we arrived at the objective of creating an innovation laboratory. After that, this thesis project was started for its definition and development. In order to understand the needs, difficulties, and expectations of university students and teachers; and able to translate those into future discussions of Creative Lab with industry colleagues, I began by conducting interviews with them. This enabled me to comprehend their viewpoints more fully and lay the groundwork for the design process. Following the data collection, I evaluated the information to find significant insights using qualitative theme analysis. I then started designing potential solutions once I was certain of the issue and the target audience.

Then, I used these concepts from the ideation stage and designed a prototype of the Creative lab business model. The business model was carried out in accordance with the business model canvas (figu, which was developed by Alex Osterwalder of Strategyzer and is made up of nine building blocks outlining a company's intended strategy for providing value and generating revenue (Osterwalder, 2018).

Finally, by the development of the first two projects following this design, the first prototype of Creative lab has been tested.

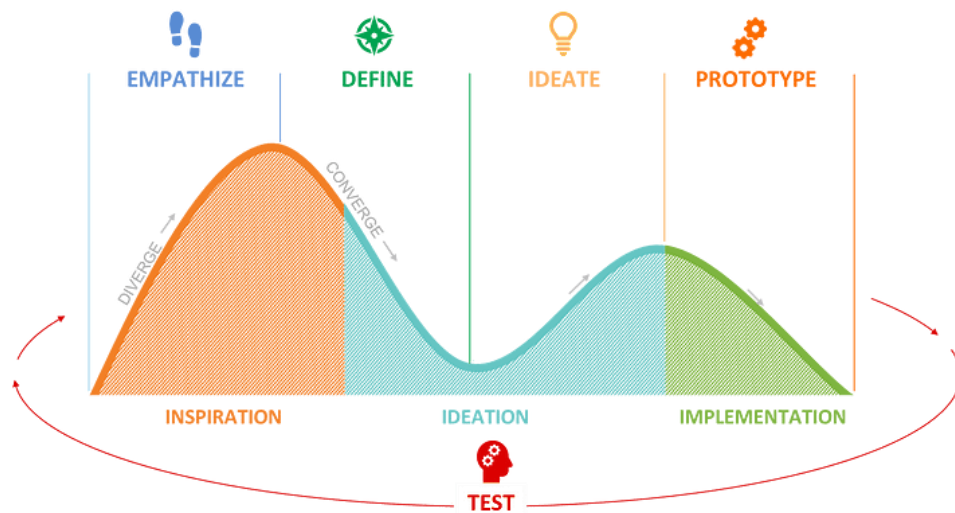


Figure 6. Combination of the Human Centered Design and Design Thinking approaches. Hoover 2018

3.2. Study context

The focus of the current study is on the necessity of fostering industry-university collaboration to enhance students' academic experiences and provide them with more opportunities for their future professional lives. Therefore, it is hoped to establish an organization that fosters communication between the two organizations by implementing programs and activities that enable students to develop practical skills and gain knowledge that is pertinent to the working world. It is hoped that this collaboration will be centered on the students' maximum satisfaction, making it essential to their academic and professional success. Furthermore, Creative Lab aims to be an intermediate agent that helps in the problematization, creation, and development of the projects with the partners, so that the collaboration is easier for all the participants.

The study was conducted using a methodology based on quantitative research through the conduct of interviews and questionnaires. This has been done considering both the target group of Creative Lab and the potential stakeholders. CreativeLab's target group is the students, as our organization is designed by and for them. In the case of stakeholders, the network is much wider. To get a precise idea of potential partners, I made a map of all potential stakeholders (figure 7). These had been contacted at the time of the mapping or have been contacted since the mapping, whether they are partners or potential funding agents. This list includes the closest and most direct stakeholders in terms of their links and possible involvement, such as MDU or Västerås municipality; organizations that may be interested in increasing their involvement with academia, such as ABF or ABB; and social, societal, and governmental and/or funding agents such as Svensk Form or Coompanion.

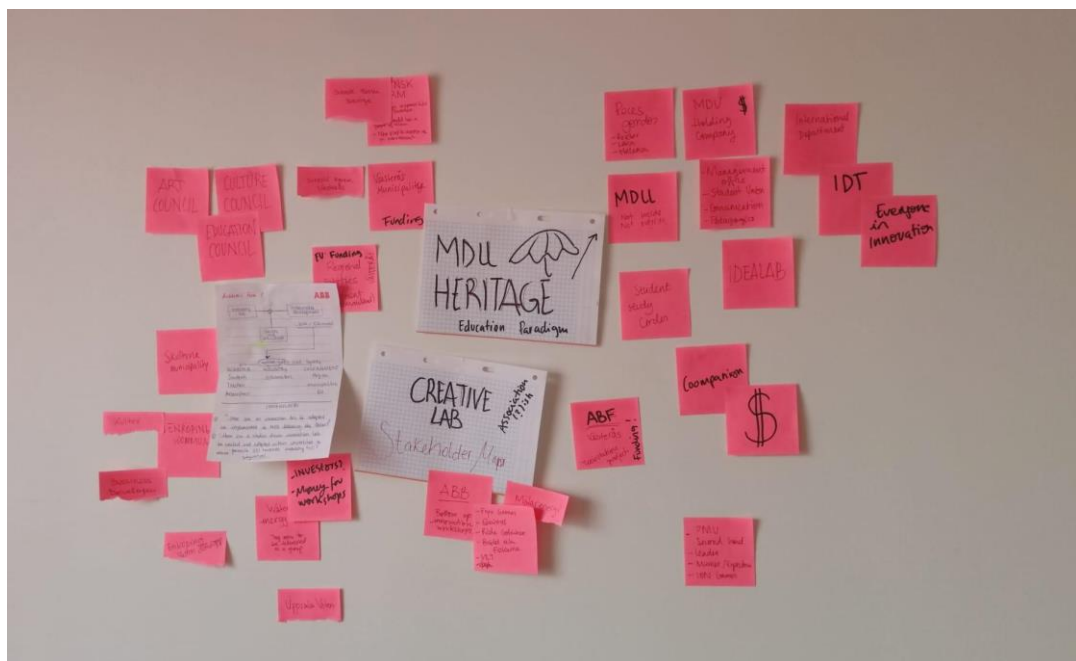


Figure 7. Map Of The Stakeholders. Photo By Inés Acinas.

3.3. Data collection

In this case, semi-structured interviews and questionnaires have been used to obtain data from different sources. The interviews and questionnaires focused on issues that influence the creation and design of our organization and concerning the topics discussed in the previous sections: Industry 5.0, Sustainable Development, and transdisciplinary work, all from the perspective of QHM.

9 interviews were conducted by me and my colleague Simon Lindblom, which allowed for an in-depth understanding of the participants' perspectives on the topic under study, while the

questionnaires completed by 14 students and 8 lecturers provided a broader picture of the situation at the university. The choice to keep the questionnaires anonymous ensured the privacy of the participants and may have increased the honesty of the responses.

3.4. Participants and recruitment_____

To carry out this work, a participant recruitment process was carried out and a selection criteria was established to recruit suitable participants for the study. They had to be MDU students and professors with experience in collaborative projects with companies and personalized invitations were sent and the purpose of the study was explained. Specific interview questions and questionnaires were designed to collect data relevant to the project. These questions were based on the initial literature review and focused on key aspects related to university-industry collaboration, sustainable development and student satisfaction.

Online survey tools from MDU and student networks were used to distribute the surveys. The interview subjects were made aware of their involvement in the thesis and the methodology used for the study. They were informed that the study's objectives were to learn about their experiences in such collaborations and to look at the process of industry-university collaboration. They were made aware that the study was completely voluntary and that they might discontinue at any time without suffering any repercussions. Participants were also told that the study would uphold their integrity and confidentiality and that no one outside the research team would have access to their personal information. In order to uncover patterns and themes, the obtained data was analyzed through many iterations of extraction utilizing tried-and-true techniques for data analysis and interpretation. Overall, participants were fully informed and aware of their position in the study, and the methodology was designed to ensure that the results were trustworthy and dependable based on the experiences of the participants.

In addition to the interviews with students, several interviews have been conducted with members of the MDU management board to discuss the possible feasibility of the project and its implementation at MDU. These people were contacted by creative lab exposing what we were developing and the idea of having several meetings with them appeared organically. Their input was very valuable in the further development of the organization's business model.

3.4.1. Questionnaires_____

The survey's questions were designed to elicit the participants' own experiences and perspectives. In order to acquire a variety of viewpoints on cooperation, the poll asked participants about both successful and unfortunate collaboration experiences. In addition, the inquiry on the advantages of teaming up with business partners during a class at a university sought to learn how these partnerships were viewed as valuable. The poll also sought to find possible areas for enhancement by asking about modifications to the existing procedure. The interviewer-independent nature of the questions was intended to allow participants to express their own opinions and experiences. As participants can respond on their terms and without feeling compelled to share the interviewer's opinions, this method enables the collection of a wider variety of viewpoints. The questionnaire was developed using a Google Form, which was designed to preserve anonymity by not requiring registration and not enquiring for any type of personal data. Because the respondent's identity was kept a secret, the participants could speak freely about their thoughts and experiences without worrying about the consequences.

A significant number of participants, including about 350 workers and 70 students, received the questionnaire. Two classes of students studying innovation and design were initially given the questionnaires. It was also given out to all IDT department staff a few days later. Some of the department employees who received the questionnaire initially questioned whether it was proper for them to respond. As a result, a separate survey tailored to employees was developed. The survey was distributed by various employees to PhD students and other programs.

3.4.2. Interviews_____

The interviews did have a general subject — what makes for beneficial collaboration? — which served as the first question in each one. It became clear during the interviews that some respondents gave inauthentic responses or what might be seen as textbook answers or answers that fit the norm. To solve this problem, impromptu questions that directed the interview back to the respondents' perceptions (Alvesson M., 2010) were posed and added to encourage respondents to share their personal views in greater detail. These questions revolved around making them describe more in-depth their experiences collaborating on projects at University and comparing them to other collaborating experiences they may have experienced before. In addition, based on the responses we received, we responded with counter-questions reflecting their answers and summarizing what they had said, in order to clarify the message and avoid confusion (Alvesson M., 2010). All around this less structured interviewing approach fit the study's exploratory nature well and allowed for a deeper exploration of the collaborative experiences. The use of open-ended

questions helped to reduce the risk of shallow or overly positive responses and allowed for the recovery of more genuine points of view.

The experiences Simon Lindblom, Cornelia Alenbring, and I had on our own as well as our involvement in the Creative LABs projects proved to be useful tools for conducting interviews and developing questions that explored the experiences of student, academic, and industry collaboration. The researchers were able to formulate questions that in-depth examined the various experiences, including the challenges or issues that emerged during collaborations, after learning about the projects firsthand. This made it possible to understand and contextualize the participant responses more thoroughly. This understanding was especially helpful when it came time to analyze the data gathered from the interviews and surveys. The interviews were conducted via the online video conferencing platform Zoom. The interview participants were given advance notice of the event and were given a link to Zoom so they could connect. The interviews were conducted conversationally and recorded using Zoom's built-in recording feature.

3.4.3. Meetings_____

Meetings with two vice-principals of the university's management team were held to explore the viability of the proposed project and its potential implementation at the institution. These meetings were personal and took place in Västerås MDU Campus. These discussions allowed us to gain a deeper understanding of the challenges and opportunities related to the implementation of this project. In these meetings, the need for greater industry-university collaboration has been extensively discussed especially in order to increase student satisfaction and enjoyment.

3.5. Data analysis_____

As I have a lot of data thanks to the numerous meetings and interviews conducted for the networking face, I'll be applying Qualitative Theme Analysis during the analysis of the data. According to Brune (2006), qualitative Theme Analysis will help me identify patterns and trends that might not be immediately obvious and gain insights into the underlying causes that influence people's experiences and behavior (Braun & Clarke, 2006). The Qualitative Theme Analysis approach entails a methodical and iterative process of recognizing themes and patterns in the data, classifying the data, and interpreting the data in light of the research question. The process includes familiarizing oneself with the evidence, creating starting points, recognizing themes,

examining and sharpening themes, and producing a final analysis. This approach was perfect for my study since it gave me the chance to carefully examine the data and pinpoint its major themes and patterns.

This method is in turn accompanied by an inductive approach to qualitative data analysis. The term "inductive method" refers to a kind of qualitative data analysis in which you study the acquired data in an open-ended manner rather than beginning with a predefined theory or specific premise. According to Thomas, this approach includes identifying patterns and emerging themes in the data, creating codes to label the data, and reporting the results (Thomas, 2006). To put it another way, you let the data "speak for themselves" and then make inferences and come up with theories based on them. The inductive technique is frequently employed in qualitative research, such as the interviews carried out for this project, where it aims to comprehend the perception and experiences of the interviewees concerning the study's focus without imposing biases or preconceived notions.

In order to start the data analysis process, I first wrote down all of the interview transcripts and questionnaire replies, which I then read several times to get familiarized with the information. After going through the interviews and questionnaires on the first iteration, I proceed with a second one which will aim to pinpoint the clear themes present in the data, following the Thematic analysis approach (Braun & Clarke, 2006). Once I had identified the words, phrases, and sentences that best encapsulated the main thoughts and ideas, I started to build guidelines based on the data. I then classified these guidelines into groups and started to find underlying themes among them. Throughout the analysis, I regularly examined and modified the themes to ensure that they appropriately captured the major ideas and concepts in the data. To do this, the themes from various data sources had to be compared and contrasted again and again and patterns and consistencies had to be questioned continuously. Overall, the qualitative theme analysis approach was suitable for my research because it enabled me to carefully examine the data and pinpoint its major themes and patterns. Using a methodical and iterative methodology, I was able to generate a robust and trustworthy analysis that provided insights into the study topic.

3.6. Creation of Canvas Business Model_____

The Canvas Business Model (figure 8) is a tool used to develop a business plan in a visually and methodically organized manner (Osterwalder, 2018). It consists of eight blocks that cover the essential elements of a business model: value proposition, customer segments, customer relationships, channels, key resources, key activities, key stakeholders, and cost structure. To use

the Canvas Business Model, detailed information about each of the blocks is required. This information can be obtained by analyzing the literature, interviews, meetings, and surveys we've already conducted. These data sources provide information about potential customers, market requirements, rivals, opportunities, and threats, as well as the resources and costs involved in developing and executing a business model.

Through the development and application of the Canvas Business Model, I was able to visualize the essential components of the project, identify the interrelationships between them, and develop effective strategies to drive university-industry collaboration, student satisfaction and the achievement of sustainable development goals clearly and concisely. Thus, the Canvas Business Model was developed in this context as it follows:

- Customer segment: The different customer segments that would be involved in the university-industry collaboration were identified and defined.
- Value proposition: The unique value proposition that the organization would offer to its customers was analyzed and defined.
- Distribution channels: Appropriate distribution channels were designed and established to reach different customer segments.
- Customer relations: Strategies and approaches were defined to establish and maintain strong customer relationships.
- Revenue sources: Different revenue sources were identified and developed to ensure the financial sustainability of the organization.
- Key resources: Key resources necessary for the efficient operation of the organization were identified.
- Key activities: Key activities that would be carried out to ensure the success of the university-industry collaboration were defined.
- Key alliances: Strategic alliances were established with key university and industry partners.

The Business Model Canvas

Designed for: _____ Designed by: _____ Date: _____ Version: _____

Key Partners Who are our key partners? Which key resources are we acquiring from partners? Which key activities do partners perform? Channels: (see resources) Channels: (see resources) Channels: (see resources) Channels: (see resources)	Key Activities What key activities do our value propositions require? Our Distribution Channels? Customer Relationships? Channels: (see resources) Channels: (see resources) Channels: (see resources) Channels: (see resources)	Value Propositions What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? Which one of our customer's needs are we offering to satisfy? Which one of our customer's needs are we satisfying? Channels: (see resources) Channels: (see resources) Channels: (see resources) Channels: (see resources)	Customer Relationships What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which one of our customer's needs are we satisfying? How are they integrated with the rest of our business model? How costly are they? Channels: (see resources) Channels: (see resources) Channels: (see resources) Channels: (see resources)	Customer Segments For whom are we creating value? Who are our most important customers? Which one of our customer's needs are we satisfying? Which one of our customer's needs are we satisfying? Which one of our customer's needs are we satisfying? Which one of our customer's needs are we satisfying?
Key Resources What key resources do our value propositions require? Our Distribution Channels? Customer Relationships? Channels: (see resources) Channels: (see resources) Channels: (see resources) Channels: (see resources)		Channels Through which channels do our Customer Segments want to be reached? How are we helping them reach? How are they currently paying? How much does each channel cost? How are we integrating them with customer relationships? Channels: (see resources) Channels: (see resources) Channels: (see resources) Channels: (see resources)		
Cost Structure What are the most important costs inherent in our business model? Which key resources are most expensive? Which key activities are most expensive? Channels: (see resources) Channels: (see resources) Channels: (see resources) Channels: (see resources)		Revenue Streams For what value are our customers really willing to pay? For what do they currently pay? How are they currently paying? How much does each Revenue Stream contribute to overall revenues? Channels: (see resources) Channels: (see resources) Channels: (see resources) Channels: (see resources)		



Figure 8. Canvas Business Model template and the distribution of the different blocks in the Canvas. Photo by Strategyzer.

3.7. Ethics, validity and readability considerations_____

Protecting the personal information of the people who take part in my qualitative research study is something I took very seriously as a researcher. I am aware that maintaining trust and adhering to ethical research techniques requires confidentiality and data protection. I implemented several measures to guarantee that the personal information of the persons I interviewed was safeguarded and kept confidential following the General Data Protection

Regulation (GDPR) of the European Union and the research ethics rules established by the Swedish Science Council.

Prior to conducting each interview, I first sought each participant's consent in writing. I went over the goals of the study, the procedures used to gather the data, and the steps taken to protect their personal information. Participants were made aware that taking part in the study was completely voluntary and that they can stop at any moment. If participants later decided against participating, they also had the option to have their information deleted from the study. The secure storage of all personal information gathered during the interviews needs to be ensured as well. Any audio recordings, transcripts, and field notes go under this category. Only those who have been given permission to participate in the study project had access to the data, as it's the case of my colleagues in Creative Lab Simon Lindblom and Cornelia Alenbring.

Finally, I removed the participants' names, addresses, and other personal information from the data. The information was displayed in a way that prevents personal identification. In conclusion, I pledged to respect the personal information of those who took part in my qualitative research study. I took all necessary steps to protect their personal information and make sure it's kept private in accordance with EU laws and the Swedish Science Council's standards on research ethics.

Furthermore, ensuring the reliability of data is of paramount importance. There have been numerous steps made to obtain credible data. The research questions and objectives were closely considered during the design of the study to make sure they were well-defined and precise. Furthermore, the sampling approach has been selected to guarantee that participants are selected from a variety of backgrounds, presenting a range of perspectives and experiences. The participants will offer first-hand perspectives to the study because they too have experiences that are connected to the subject at issue. Fourth, the qualitative theme analysis method will be used to examine the interview transcripts. This method is exacting and methodical, and it permits the discovery of important themes and patterns in the data.

Last but not least, this section is intended for addressing the potential ethical concerns associated with the use of AI in scientific articles. Disclosure of the AI tools used and the purpose of their use is recommended to assess the credibility and reliability of such an article. Hence, a list of the AI-based software used in the writing of this article is provided below:

- Grammarly - to correct spelling and punctuation and have a cohesive use of the English language, for better readability.
- DeepL Write - to correct the text and improve its readability.

- GPT Chat - to generate the structure and sections of the thesis, as an organizational tool; and to generate sample questions for the interviews and questionnaires.
- Cockatoo - for transcribing the audio recordings of the interviews. The transcripts were then manually reviewed and corrected for higher accuracy.

3.8. Limitations of the study

This section presents some limitations of the research work and general critique of the chosen methods.

First, on the use of interviews and questionnaires, since the case study was limited to the site of the innovation laboratory and the participants involved in the innovation project, the research situation was too vast to interview everyone or to observe everything associated to the topic. The fact that some the participants were part either of the innovation laboratory or MDU may have affected the general attitude towards expressing negative feelings about the laboratory.

Second, on the project being based on a case study, Flyvbjerg (2006) questions several misconceptions associated with the case study approach. One of these is the belief that theoretical knowledge has more value than practical knowledge (Flyvbjerg, 2006). This idea is developed and the author concludes that the case study research strategy offers the advantage of providing a more focused and realistic description of the empirical material. Another misunderstanding is the assumption that it is not possible to draw general conclusions from a single case study or that case studies do not contribute to scientific advances in the field. However, Stake (2000) argues that a case study is not isolated, but rather one among many, which allows the possibility of making general statements based on research conducted through a single case (Stake, 2000).

One may wonder if the participants in the interviews and observations were an accurate representation of the actors dealing with innovation labs generally, as well as whether the small number of participants was adequate for drawing conclusions about the innovation lab. The number of interviewees has been deemed sufficient to obtain a meaningful and diverse representation of the pertinent perspectives and experiences. In order to obtain a more comprehensive understanding of the challenges and opportunities related to collaboration key actors, such as representatives from academia and students, were sought for during the sampling.

The project's boundaries are thought to be ideal given the need to maximize the available resources and achieve a clear, focused goal. These boundaries allowed for the effective management of time, energy, and resources, resulting in a more coherent and significant outcome.

Additionally, by focusing on key issues and include a representative sample, it was possible to gain a more thorough understanding of the issue at hand and potential solutions in the context of academic collaboration.

4. RESULTS

Despite the vast number of participants, there were only 22 responses overall, which indicates a low response rate. This corresponds to a response rate of about 5.7%. The answer rate between the two groups, students and employees, differed significantly, with a higher response rate from students compared to employees. The average student response rate was 20% (14 out of roughly 70 students). Employee response rates were about 2% (8 out of about 350 employees). Fourteen of the total responses came from students, and eight came from workers.

4.1. Students' experiences from collaborating with companies in project courses_____

First of all, all of the interviewed students were asked about their experience at university during classes in collaboration with companies. In the following section they are referred to as S1, S2, S3... to differentiate between the respondents. They were asked about how important they think this kind of subject is for their academic training, to which all of them agreed on their importance, qualifying it as "important" or "highly important", but some students reflected on how the nature of the collaborators could be more diverse and on how they have encountered challenges:

S3: "It is great to get a connection and anchor in society. For me, it doesn't have to be just industry, specifically the "typical, ABB, Volvo, etc" It could be a kindergarten or anything."

S5: "It is important to better understand what we are studying and the purpose of it. Networking, help find our focus, open to new perspectives and ideas..."

S2: "We are studying to use the new information in the real world and when we are working. It's one of MDU's strongest points that has a strong collaboration with companies and industries. Though, sometimes language barrier would show up and exclude the international students from some events!"

All the interviewees have participated in classes where they have had a project in collaboration with a company or organization. In terms of their experiences, there are several clear commonalities. Firstly, when asked what makes a collaborative project successful, the interviewees put focus on the involvement and engagement of the partner, the group work, and the communication between those involved.

S5: “What made it successful was the partners' awareness that this was a course and not some consulting job that the students had to accomplish. We were allowed to make mistakes, learn and focus on the actual educational aspect of it all.”

S4: “The most successful collaboration was one where we had continuous communication with our partner. The outcome is harder to define, but the journey and collaboration were really good.”

S6: “Transparency, proper communication, and knowledgeable sharing are key factors for successful execution. Both parts have interest and time to collaborate”

However, a very important point is that all interviewees have had a bad experience during a collaborative project or know someone who has had one. Their comments all revolved around the relationship with the partner and how they felt “ignored” or “useless”:

S7: “The quality of these collaborations was however very different from one course to another and I would say that half of them went very well and half quite bad because it felt like the company was not involved or didn't know what we were doing. Actually, to answer this question, I had to look up the list of courses I took to remember which ones were in collaboration and I didn't remember that half of them were in collaboration, maybe because of the bad experiences I've had and the feeling that some of them were useless.”

The students interviewed also agree that they have mixed feelings about the collaboration projects. They claim to be both satisfied with the results achieved in the projects but point out that these projects have often been done with practically no collaboration and with extra effort and time on the part of the students. In addition, the interviewed students stress that they feel undervalued and that their work will not have continuity, which is demotivating.

S4: “Yes and no. With more communication, it would have been easier to make more progress or to create something that would give more value. The best projects are unfortunately the ones where you over-achieve and take effort and time from something else.”

S10: “Yes, I was happy with what I had created. But it feels like it wasn't taken seriously and not followed up after working on solutions for the companies. Which made it feel like it was just a credit to get and then it's done and no actual impact within the organization or society.”

When asked about unsuccessful or challenging collaborations, the answers all seem to revolve around the lack of interest and implication of the partner, the communication process, the lack of conveying value, the lack of understanding, and the topic and quality of the assignments. A reoccurring issue in the collaboration between businesses and students has been continuously observed throughout the interviews performed for the project: the lack of knowledge on the part

of businesses of the value that this partnership may offer them. This emphasizes how crucial it is to deal with these issues and make sure that everyone involved has a successful communication process.

S8: “...the company was not involved at all, I even wondered if the company was legit and actually working with other companies because what they were saying felt empty and the work they gave us was not even useful to them.”

S7: “Long time waiting for a reply through phone calls or emails was the most challenging experience so far. Not knowing who to turn to to get some help is another challenge. If there were one department regarding these collaborations between students and industries, it'd help a lot!”

S5: “Most of the collaborations have been on the brink of being unsuccessful, usually do to as mentioned before, ambiguous instructions and bad communication or expectations from academia and industry that does not go together.”

Last, but not least, the students were asked about what would they change in the current process being done at the university regarding collaborations. They all revolved around how the university should be able to review the partners and examine if they are contributing to the student's educational process or if they are hindering it. They also talk about transdisciplinarity within the teams, the possibility of working along other courses, and the number of tasks they receive.

S11: “...when the university is the one picking partner, they should be careful about the company's interest, type of tasks, and such. The idea of collaboration is to be constructive; I'd rather not collaborate and not say that I collaborated with X company if I don't get anything from it.”

S7: “I think there is a gap, and it is hard to fill. Since the university itself doesn't collaborate between faculties much, a lot of collaborations get lost. There can be projects which would have benefitted greatly from a more transdisciplinary team, or getting small parts done by another program. But the lack of communication between the departments. Adding a department in-between could add more bureaucracy, so maybe instead adding roles?”

4.2. University staff's experiences from collaborating with companies in education

In the following section the teachers are referred to as T1, T2, T3... to differentiate between the respondents. The responses from the teachers have been a bit more diverse than the ones from the students, but still, many clear themes have come out from their answers. They agreed with the students on the importance of working with companies for their education. They stressed how in this way students put their knowledge and training into practice: they learn about real industry problems and can put their knowledge and training to the test to solve them. In addition, these experiences can provide the appropriate expertise and portfolio through real cases and, preferably, implementation. Even so, some began to comment early on what organizational elements are favorable in these processes.

T2: "...Also, if a program has an Industry Council, it is more probable that the university ensures educating students suitable for the industry's future needs, including necessary knowledge the industry asks for, but also for ensuring industry trends are early adopted and planned for in the academic world."

Their opinions on what makes the collaboration process challenging focus on both the collaboration process and the difficulty of making the partners understand the value of these collaborations. They seem to agree also on the difficulty of making a long-lasting impact with the time they have and make the projects prioritized.

T6: "The biggest challenge is to convince the industry that collaborating with academics is a good idea. It is very easy for the industry to keep doing their own things without engaging academia. But it takes a common understanding on both sides that this collaboration has benefits, not only for the two sides but for the society as well."

T4: "Students serving as consultants where the research perspective is not understood by industry partner; ill-defined cases without any intention of implementation."

T5: "There must be a give and take and learning in the process for all parties. Students must have the right to experiment, test, and fail; not necessarily "deliver" a finished product/service. Lack of time for the company/contact person is common."

T3: "In a few cases, the industry contact person did not have enough time (or interest) to interact with the students working on their project (they just provided the initial project idea but were not sufficiently available during the project course)."

When asked about what is the key to having a successful collaboration between the students and the partners, the teachers point toward trust, mutual understanding, and engagement. They also talk about how it should be understood that there are always uncertainties and these can change the development of the project and final result; and how even failures in developing use cases, should be seen as useful and successful in some sense if they generate knowledge and debate.

T3: “A successful collaboration is a demonstration of an idea that sheds light on its pros and cons. Then you discuss the continuation of the collaboration so that it becomes a normal way to engage academia.”

Lastly, I wanted to know their opinion on how they see the collaboration process itself, what would they change, what do they think may be hindering the process and where would they point to improve the process of collaboration at MDU. Here, they agree with the students on the engagement and they add that industry seems more set on the outcome or final result of the collaboration than on the problematization and creation of knowledge this can create. Also, they were asked if they have noticed trends or patterns throughout the last years when dealing with the partnerships. Many of them said to not have noticed any, but some pointed towards the raising number of companies interested in collaborating with Academia.

T1: “Collaboration for the sake of collaboration, there should be a greater ambition than just collaborating because that is what we do, it should also lead to something in my view.”

T5: “More towards trilateral collaborations, industry-academia-public sector.”

T6: “Right now, academia has a lot of research about new technologies and the industry is aware of the benefits of them. The problem is that the industry doesn't know how to use these technologies and how to implement them and tries to rely heavily on academia to implement it for them.”

During this first iteration with the data, I noted themes that emerged as I read the transcripts, separately among students and teachers. These themes are shown in Figure 10 below.

THEME	STUDENTS?	TEACHERS?
Lack of clarity	✓	
Openness	✓	✓

Misunderstandings	✓	✓
Hierarchy	✓	✓
Loss of interest	✓	
Building strong projects		✓
Continuity	✓	✓
Different perspective		✓
Lack of support	✓	
Lack of time	✓	✓
Desire for impact	✓	

Table 1. Themes identified after the first iteration. Figure by me.

4.3. Similarities in themes identified from students' and staff's experience_____

After the first reading and analysis of the data, I proceeded to carry out a second iteration where I searched for more in-depth themes. Here are some potential themes or categories that emerged from the second iteration:

1. The communication process is the most challenging part:
 - a. Communication outside the workgroup.
 - b. Lack of clarity around goals and roles.
 - c. Trust and openness about issues.
 - d. Misunderstanding between the parties involved.
 - e. Power imbalances and hidden hierarchies lead to a lack of agency.
2. Different mindsets between the parties.
 - a. Many companies seem to have the “idea” of participating but end up being absent.
 - b. Importance of the journey vs. the end solution.
 - c. Focus on reaching goals set by the customer.
 - d. Collaboration leads to win-win situations.
 - e. Conveying value to and from partners, students, and academia.
3. Creating value.
 - a. Lack of supporting structures and framework for help.
 - b. Lack of clear red thread between projects and courses.
 - c. The desire for real-world experience and insights.
 - d. Building strong and good projects.
 - e. Willingness to continue working on projects and building on earlier work.
 - f. Lack of time to make something with impact.
4. Raising interest in collaboration, which lies along industry 5.0.
 - a. The desire for social impact and agency to act.
 - b. Interest in working with other disciplines and cultures.
 - c. Interest in having fun at work.

After all of the citations were sorted into categories, they were re-read, one category at a time. During this step, I tried to give more definitions to these categories and grasp how recurrent

they were. The categories are presented in a hierarchical order, with the most prevalent first. And so, my categories ended up as follows:

- **Communication.** In this context, communication refers to the capacity to comprehend and collaborate with individuals from various areas. When discussing their experiences, students tend to bring up this issue in interviews and questionnaires, and they typically do so negatively. The quadruple helix concept calls for open communication and an awareness of the viewpoints of each sector to facilitate effective collaboration. More meetings, information, and channels for communication are demanded for collaboration projects to succeed.
- **Value.** Creating value is a central element. Common points identified in the interviews point to the importance of establishing support structures, integrating projects with academic courses, providing practical and real-life experiences, ensuring the quality of projects, encouraging continuity in the work done, and allocating adequate time to generate impact. The data reflects the need for students to have the opportunity to gain practical experience and apply the knowledge acquired in a real environment is key, as is the importance of ensuring that the projects developed are of quality and have a significant impact. This involves establishing rigorous selection and evaluation criteria for projects, as well as providing resources and support to ensure their successful implementation.
- **Mindset.** The QHM's collaboration can be impacted by assumptions. Many businesses appear to have the intention of taking part but don't actually do so. Additionally, while businesses emphasize the final product, students and teachers place more value on the "journey" that participants take while working on projects. Respondents reiterated that lack of understanding and dissatisfaction may result from each sector's unique preconceptions about the other sectors. Building trust and fostering productive collaboration requires an understanding of these presumptions. Also, power dynamics and motivation can affect collaboration, so understanding these dynamics is important for achieving equitable collaboration.
- **Industry 5.0.** Several themes have been identified that are directly linked or pertain to Industry 5.0, even when the interviewees did not know about our work focus. Students are keen to collaborate with people from different disciplines and cultures. They recognize the value of diversity in generating innovative ideas and seek the opportunity to work in multidisciplinary teams. All parties recognize the need to adapt to the times,

both in the way they collaborate and, in the tools, and processes used. Importance is also given to providing students with an environment in which they can have a meaningful social impact and find satisfaction and enjoyment in their work. These aspects contribute to promoting an inspiring and motivating learning environment.

THEME	TIMES IS REFERRED	EXAMPLE
COMMUNICATION	43	S4: “The most succesful collaboration was one where we had continuous communication with our partner.”
VALUE	36	T2: “To conduct more workshops, lectures, company visits, know more about processes, practical challenges in company in collaboration with companies.”
MINDSET	27	S7: “What made it successful was the partners awareness of that this was a course and not som consulting job that the students had to accomplish. We were allowed to make mistakes, learn and focus on the actual educational aspect of it all.”
INDUSTRY 5.0.	16	S9: “Since the university itself doesnt collaborate between faculties/ departments much, a lot of collaborations get lost. There are projects which would have benefitted greatly from a more transdisciplinary team,”

Table 2. Theme groupss indentified after the second iteration. Figure by me.

4.4. Proposed Business Model for Creative Lab

As I stated above, in the fall of 2022, Simon Lindblom, Anna Khofman and I created the idea of a student-focused innovation lab known as Creative LAB. A multigenerational learning and project-based pedagogical framework was developed through human-centered research linked to student preferences and needs. Now, this idea has been refined through this thesis project and I will proceed to present the refined design of Creative Lab as an official organization. The organization is now more defined, with a structure, clear goals and a roadmap to follow through.

Creative Lab is a student-run, bottom-up innovation lab with students as the primary stakeholders along with universities, MDU in this case, and external industry collaborators. This generates a wider range of platforms for various projects and collaborations for the students as well as the university and also empowers students to take charge of their education and learn by doing. Along with allowing students to meaningfully develop their talents, it also promotes creativity and teamwork. This promotes an innovative environment and challenges students to think creatively. They can explore, experiment, and hone their abilities in a secure atmosphere

provided by the lab. No matter what their major, all students are welcome to use the lab to further their creative endeavors. The lab is made to give students a place to experiment with and practice addressing problems creatively. Students are encouraged to collaborate, think creatively, and experiment with various problem-solving techniques in the lab. Additionally, it offers them materials and direction to support the growth of their creative abilities. The purpose of Creative LAB is for students to collaborate with one another in order to share knowledge and gain a deeper grasp of creativity and innovation. Including projects that concentrate on helping students solve issues that are in their immediate study area and adding value for all parties involved. The students can obtain significant experience and apply their creative thinking to difficulties in the actual world through this. In order to assist the students in achieving their objectives, Creative LAB also provides mentoring and feedback.

The Creative LAB is intended to be a third space (Maniotes, 2005) for the students, where they can interact on an equal footing without respect for their individuality. Depending on how the student-focused projects turn out, there is also a chance that a physical third space, one distinct from homes and workplaces (Oldenburg, 1989), may emerge, which could improve communication and a sense of community as well as provide a location associated with the university that is social and has few communication barriers. The Masters of Innovation and Design program, which has a global intake and enrolls students from all over the world, is where Creative LAB was first established. Connecting the Region Västmanlands Affärsplan 2030's (.) goals, where attracting talent and fostering internationalization are key components, to the government's (Regeringen, 2020; Vinnova, 2022; Arbetsförmedlingen, 2016) goals for attracting, integrating, and maintaining highly skilled talent, the Creative LAB could assist Mälardalens University in fostering talent and fostering international competence. By using inclusion as a technique and instrument, both through the nature of who makes the projects (different groups, including international students), as well as the diversity of the projects made, can help to establish a campus and institution that fosters belonging (Nunn, 2021). Although MDU provides many effective tools for collaboration, none of them are specifically designed for student collaboration.

The business model is carried out in accordance with the business model canvas, which was developed by Alex Osterwalder of Strategyzer and is made up of nine building blocks outlining a company's intended strategy for providing value and generating revenue (Osterwalder, 2018). The three key components of a business—desirability, viability, and feasibility—are covered by the nine building blocks. This business model is focused on creating value for students, universities, and industry partners by providing opportunities for collaboration and promoting innovation, while also generating revenue through project-based work and funding opportunities. By focusing on maximizing student satisfaction and enjoyment, committing to Industry 5.0

projects, and promoting creativity, innovation, and entrepreneurial spirit, this organization aims to be a unique and valuable partner for all stakeholders involved.

The blocks for the Canvas Business Model for the organization of Creative Lab will go as it follows.

Key Partners:

- Universities and their faculties, with MDU as the starting point. Our idea can grow and be applied to other universities in the future, but our foundation lies in MDU.
- External partners have to come from a broad spectrum and focus on Industry 5.0. projects.
- Mentors and coaches, from Creative Lab, university, and Industry.

Key Activities:

- Co-creation of projects between universities and industry partners.
- Facilitating collaboration and communication between universities, students, and industry partners.
- Ensuring and enabling the quality of the collaborations.
- Providing mentorship and coaching to students
- Organizing workshops and events to promote creativity, innovation, and entrepreneurship.

Key Resources:

- Experienced and knowledgeable staff with a background related to innovation.
- A strong network of universities and industry partners that share the same goals.
- Well-established mentoring and coaching programs.
- Access to funding and resources to support projects.

Value Proposition:

- Maximizing student satisfaction and enjoyment of their education.
- Providing opportunities for students to make valuable contributions to industry partners.
- Creating projects that are oriented towards Industry 5.0., Sustainable Development and are based on practical and hands-on learning.
- Promoting creativity, innovation, and entrepreneurial spirit among students.

- Building strong and collaborative relationships with universities, students, and industry partners.
- Providing a strong link with the partners to assure engagement and successful results.

Customer Segments:

- Students.
- Universities and their faculties.
- External partners looking for innovative solutions and talent.
- Governmental entities that finance and support educational and entrepreneurial projects.

Customer Relationships:

- Providing personalized support and mentorship to students, as much as they demand it.
- Regular communication and feedback sessions with all stakeholders, monthly sessions.
- Be present in the courses and monitor the progress of the projects.

Channels:

- Social media and online platforms
- University internal promotion
- Workshops and events
- Referrals and networking

Revenue Streams:

- Project-based revenue from industry partners.
- Grants and funding for specific projects.
- Memberships are paid by the partners, not the students.
- Creative LAB owns the solutions made inside of Creative LAB, together with MDU Holding.

Cost Structure:

- Staff salaries and benefits.
- Operational costs for facilities and resources.
- Program development and marketing costs.
- Costs associated with funding and grants.

The Revenue Streams and The Cost Structure are in a preliminary state, as none of us in the Creative Lab group are experts in the financial field. In the future, we will require external help in this area but this represents our initial idea of what it can be. There is also the possibility of creating a physical space within the university depending on how the student-driven projects turn out and how this proposal is accepted. This could improve communication, and a sense of community, and also gain a place connected to the university (BHAKTI, OKTRADIKSA, & NOOR, 2020). Creative Lab aims to develop working methods that increase the exchange between research and education environments, testbeds, and innovation environments with different entrepreneurs and companies. It will seek to develop the ability to attract the best talent and organize the work for the implementation of strategic competencies in the business world, including diversity and transdisciplinary work. It also aims to strengthen the ability to lead innovation work and renewal processes with partners and collaborators such as abb.

4.5. The refined prototype of Creative Lab _____

At the moment, Creative Lab has been part of 2 projects, carried out by and for students. The first one carried out on 1 March, consisted of a day focused on repairing, renovating, and recycling textiles, ceramics, glass, etc. The graphics and the workshop have been developed by first-year students of the Master of Innovation and Design at the University of Mälardalen, in collaboration with PMU Second Hand and ABF. Creative Lab has acted as a connector between PMU Second Hand and the students, ensuring that the goals of both parties were aligned and effective collaboration was achieved. In addition, Creative Lab worked with the partners to ensure that the workshops were inclusive and accessible to all students and helped provide the space and resources needed to run the workshops. This workshop was a great success in terms of attendance and participation, and all those involved showed their interest in continuing the collaboration, involving new students and participants. This has led to a second session being held on 13 May.



Figure 9. Promotional posters made by the students working with creative lab for the event.



Figure 10. Picture from the workshop held the 1st of mars in PMU SecondHand. Photo by Creative Lab.

Secondly, Creative Lab is developing a project together with first-year students of the Master of Innovation and Design to carry out a hackathon focused on Industry 5.0. called WellBot. This is our most ambitious project so far, with multiple partners such as ABB and The European Institute of Innovation and Technology (EIT). Creative Lab has mediated the communication process between the students and partners and provided the necessary connections and support to make the event a success and to ensure that the collaboration is effective and that the event is realized to its full. The WellBot event was developed by students, for students. In order to bring together professionals, students, and experts to work together for a healthier, more sustainable future, MDU, Creative LAB, and EIT are sponsoring the hackathon. The theme of the competition revolves around service design, technical solutions, business models, social innovation, and/or coding and the topic is Innovating for Health and Sustainability using Technology and AI.

WELLBOT

Join the **WellBot** hackathon and use your **skills** to create innovative solutions for **health** and **sustainability**!

Competing in teams of **3-4 students**, you will work together to create **innovative ideas** related to **health, energy efficiency, well being** and **AI**.

DATE
May 26, 2023

TIME
10:00 AM – 18:00 PM

LOCATION
Mälardalen University
Hamngatan 15, 632 20
Eskilstuna

LIVE ON PLATFORM
Online

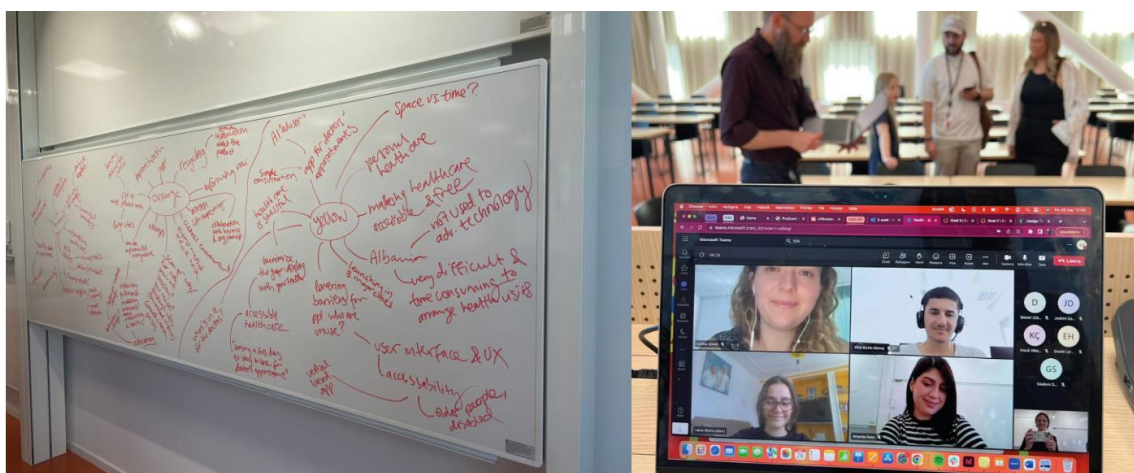
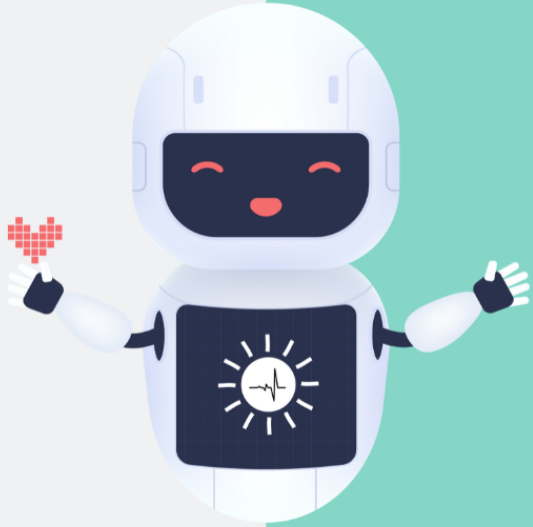


Figure 11, 12, 13. Promotional picture of the Hackaton and pictures took during the session.

The Hackathon was held both physically at the MDU Eskilstuna Campus with students from our university, and online to connect with students from other European countries. We worked in teams of 3 to elaborate innovative solutions focused on goals 3 (health and wellbeing), 7 (affordable and clean energy) and 9 (industry, innovation and infrastructure) of the Sustainability Development Goals. Participants were provided with design Thinking tools and intrigued on how to use them, as for some of them, it was a completely new field. The day was a success in terms of participant satisfaction and engagement: no one left the session; multiple discussions were generated around the topics and the students were receptive and interested in both the design process and the new tools they were acquiring.

5. DISCUSSION

5.1. Discussion of main findings

The purpose of this part is to compare the key results of the literature that has already been written on this subject with the information gathered through surveys and interviews. The questionnaires and interviews conducted provided a practical and contextualized perspective on the challenges and opportunities of university-industry collaboration. The diversity of data, both from students, teachers, and members of the organization, increases the validity and reliability of the results and helps to better understand the problem under study from multiple perspectives. Participants highlighted the need for greater flexibility and adaptability in collaborative programs to meet changing industry demands and student expectations. Additionally, the significance of increased collaboration between businesses and students through joint projects and new programs was highlighted. Additionally, the data gathered showed how important it is to establish effective and clear channels of communication between the parties involved because it appears that the current situation is not satisfactory. Participants emphasized the need for more coordination and planning to ensure the successful execution of the joint projects as well as the need of having clear objectives and expectations. Additionally, emphasis was placed on the significance of fairness and transparency in the distribution of the resources and benefits resulting from collaborations.

The interviews' goal was to gain a deeper understanding of the needs and challenges of our organization. These interview sessions have reflected on the challenges that arise in collaborative practices at University, as well as the power relationships and social connections that emerge from them. This approach enabled us to examine their experiences and viewpoints more deeply and to spot any possibilities or obstacles that the literature research might not have made clear. We were able to ask open-ended questions and elicit additional details while still retaining some structure to ensure consistency across the interviews by employing a semi-structured method. We were able to understand the opinions and experiences of the stakeholders more thoroughly thanks to this approach, which was needed. To get additional feedback from a bigger sample size of students and teachers, we also conducted written questionnaires. Using this technique, we were able to uncover any patterns or trends in the data and gather information on a wider variety of experiences and viewpoints. This approach was suitable because it made it possible for us to collect a lot of data quickly and compare and analyze the responses of various participants with ease.

It is important to note that even with a lower response rate from employees, their input is still valuable and can provide a different perspective on the collaboration process. The data from both groups will be used together with the interviews to provide a more comprehensive understanding of the phenomenon being studied. Despite the small number of comments, they could nonetheless offer insightful information about the experiences of employees and students while working with industrial partners. By combining the interviews and questionnaires, a more comprehensive understanding of the phenomenon can be achieved. The interviews allow for an in-depth exploration of experiences and perceptions, while the questionnaires provide a broader overview of opinions and experiences. This mixed-method approach can lead to a more nuanced and well-rounded understanding of the phenomenon of collaboration between industry and academia.

When the findings of the literature are compared to the data collected in the questionnaires and interviews, significant convergences emerge, emphasizing the importance of improving communication between the parties involved in University-Industry collaborations, establishing objectives and expectations from the start of the project, and giving continuity and weight/importance to the projects and authors (Fontanela, 2015). There is a need to strengthen communication between universities and industry, according to both the literature review (Heaton, Siegel, & Teece, 2019) and the data from interviews and questionnaires. Both sources stress the value of creating open and honest lines of communication in order to promote information sharing and goal alignment. To overcome obstacles and maximize the advantages of collaborations, effective communication is considered to be a crucial component. The necessity of outlining specific goals and expectations at the commencement of the project is another key area of convergence (Nielsen & Cappelen, 2014). The need to establish appropriate timeframes and identify explicit, quantifiable, and achievable goals is stressed by both the literature and interview participants. By preventing any misunderstandings or deviations, this alignment of goals and expectations encourages increased efficiency and effectiveness in collaborations.

Furthermore, the literature and data show how crucial it is to give projects from university-industry collaborations consistency, weight, and priority (Nielsen & Cappelen, 2014). To build a sense of ownership and incentive for additional collaboration, the literature emphasizes the need of recognizing and appreciating the successes and contributions of initiatives. The need for long-term continuity of initiatives, avoiding early discontinuance, and providing appropriate resources for their sustainable development was also stressed by interview participants (Fernandez-Orviz, 2013). Moreover, the difficulties that can arise while putting this kind of project into practice have also been discussed. Aspects like resistance to change and the need to establish a clear, defined structure for collaboration have been highlighted. These difficulties have

been recognized as crucial factors to take into account during the project's implementation. However, it was stressed how important it is to have a long-term perspective and understand how this project fits into MDU's future plans. The meetings with members of the university's administrative staff have, in essence, been a valuable source of knowledge and information for this project's data collection process. Key opportunities and constraints have been identified for implementing effective university-industry collaboration, allowing for a more accurate assessment of the project's viability and potential for success.

In addition to the convergences found in the contrast and analysis of the findings, it is crucial to highlight the advantages that the establishment of an innovation lab may provide in order to address challenges and enhance collaboration between academia and industry. These benefits have been demonstrated by the project carried out in collaboration with ABB, which exemplifies the concrete benefits of setting up an innovation lab such as Creative Lab. Through this initiative, more fluid and effective communication between University and Industry was achieved, resulting in a better understanding of the needs and expectations of both parties. This allowed for closer collaboration and increased knowledge transfer, resulting in innovative and high-quality solutions. Creative Lab has provided a dedicated and organized space for collaboration. The creation of an environment that is conducive to collaboration, knowledge exchange, and experimentation has encouraged the emergence of group solutions and ideas. This project has emphasized the significance of establishing clear and manageable objectives from the start of the project. By involving both parties from the beginning, deviations in the collaborative process have been avoided and there has been a greater alignment of objectives and efficiency in execution.

In relation to the upcoming insutrial revolution and the QHM, these dimensions interact and influence each other, creating an environment conducive to knowledge generation, collaboration and the search for sustainable solutions to societal challenges. The QHM serves as the foundation for my decision to emphasize industry-university collaboration in this project. Through this partnership, academic programs can better match the needs of the labor market; businesses can supply current data on necessary skills and competencies, enabling institutions to customize their curriculum and deliver more pertinent and useful training. Graduates have more work options when academic preparation is in line with market demands. Additionally, through encouraging entrepreneurship and the formation of new firms, this collaboration can also accelerate economic development in the area. Universities can also serve as hubs for cutting-edge research and development, and by forging strong linkages with business, a favorable atmosphere for open innovation and the development of answers to pressing problems is formed. Collaboration between academia, industry, and society is crucial for addressing the social and

environmental issues of today. A sustainable solution to issues like energy, the environment, health, and poverty, among others, can be found and developed with the help of academic knowledge, corporate competence, and public involvement. To address the complex issues facing our society, transdisciplinary collaboration with a sustainable development lens is imperative. We acknowledge the significance of including all pertinent stakeholders in the decision-making process and collaborating to achieve sustainable development and a more prosperous society by employing the Quintuple Helix strategy.

Overall, the combination of approaches carried out during this project has been beneficial since it has enabled me to collect a variety of data from various angles. A solid knowledge base was provided by the literature study, and I was able to elicit detailed insights from stakeholders and a wider range of opinions from a larger sample size using semi-structured interviews and written questionnaires. I have been able to triangulate the data by utilizing several different approaches, ensuring that our conclusions were solid and trustworthy. Moreover, the qualitative theme analysis approach was suitable for my research because it enabled me to carefully examine the data and pinpoint its major themes and patterns. Using a methodical and iterative methodology, I was able to generate a robust and trustworthy analysis that provided insights into the study topic.

5.2. Strengths and weaknesses of the study_____

This section presents some limitations of the research work and a general critique of the chosen methods.

Regarding the selection of semi-structured interviews and questionnaires as a method, as a result of the case study's connections to students and other MDU participants, it was difficult to cover every aspect of the topic because the research situation was so broad. Additionally, the participants' affiliation with the University may have had an impact on the general attitude of airing grievances about the lab. This approach was chosen because it allows for flexible inquiry while maintaining a level of organization and coherence in the information acquired. In addition, it allows difficult topics to be examined and gives participants the freedom to articulate their ideas and experiences on their own terms. Semi-structured interviews have the potential flaw that interviewer bias can cloud the information gathered. However, I took precautions to reduce the possibility of bias by allowing participants to describe their ideas and experiences in their own words through open-ended questions. Before conducting the interviews, I carefully weighed my own biases and ideas and strove to maintain objectivity.

Regarding the sampling, I chose students and teachers to conduct interviews about my topic because they are the ones who are directly involved and are impacted by the issue that my thesis addresses. I think it's vital to understand the viewpoints of all three groups in order to have a comprehensive and accurate understanding of the subject. A strength of using this sample is that there may be certain constraints or limitations on the perspectives that can be gained. For instance, students and teachers may have a more academic or theoretical perspective on the subject, whereas industry representatives may have a more practical and business-oriented perspective. Regarding the number of interviewees, I believe that having around 30 participants involved is the right amount because it allows for the collection of a wide range of perspectives and opinions, while at the same time remaining manageable enough to allow for a thorough analysis of each interview. However, one potential drawback is that there can be some variation in the respondents' responses and opinions, which could affect the validity and dependability of the results obtained.

Within the Quintuple Helix model, collaboration between academia and industry is especially relevant in this case. This collaboration is essential to leverage the potential of both parties, foster innovation and contribute to economic and social development. It is a strategic approach that promotes the co-creation of value and the satisfaction of the needs of both academia and industry. Collaboration between academia and industry fosters joint innovation. The combination of academic expertise and industrial expertise can lead to innovative and practical solutions. Academia can identify problems or areas for improvement, and industry can provide the resources and expertise needed to develop concrete solutions. This collaboration drives the creation of innovative products, services and processes that will benefit both parties and society at large.

5.3. Interpretation and implications of the results_____

The study's findings showed that students want to take part in courses that require working with companies, suggesting a motivation for using the knowledge they learned during their education in professional settings, which will be in line with Industry 5.0.'s focus on project-based learning (Pogatsnik, 2018). Additionally, it has been shown that students like and learn more from these assignments when their communication with the company is successful. However, there is persistent dissatisfaction with how this collaborative process is carried out at the university, as every student surveyed has had negative experiences working with a company. These statistics imply that there is room for improvement in the way collaboration is carried out.

Poor communication and a lack of engagement from the companies are listed as the underlying causes of these issues by the students. As a result, by encouraging effective and committed communication between students and partner companies, our innovation lab could address these issues. Additionally, this research points to a chance for Creative Lab to serve as an effective link between students, academia, and industry while addressing the weaknesses found in the collaborative process. Therefore, Creative Lab will be refined, as seen in the Business Model proposed in the previous chapter, to enhance the quality of collaborative experiences by providing the right working environment and tools and resources for the students, as well as a facilitator for the correct communication between the parts. It's vital to keep in mind, nevertheless, that the population sample used in the study may have limitations in terms of representativeness and result generalization.

5.4. Suggestions for future research

Several points have emerged during the development of my project that could act as a starting point for future research. The future of CreativeLab presents itself as an opportunity to address communication challenges and ensure the satisfaction of all parties involved. Throughout the interviews conducted during the project, a recurring difficulty has been consistently identified in the collaboration between companies and students: the lack of understanding on the part of companies of the value that this collaboration can bring them. Moreover, a "fuzzy zone" has been described where, although companies initially show interest, they end up disconnecting or facing problems in communicating with the university. The study of this phenomenon is of interest to future research. Despite the fact that an Innovation Laboratory for ideas to promote collaboration between these parties has been established, it is crucial to thoroughly explore the potential communication challenges. Finding the problematic points and practical solutions to improve collaboration may benefit from a more thorough approach.

In addition, I've noticed that student disengagement can have a significant impact on the success of an idea-generating lab. It is crucial to research methods for boosting students' motivation to participate in university-industry collaboration projects. This may include incentive strategies, changes to the program's structure, or creative approaches of include students in the process.

Finally, I think that it's important to look into how student participation in an idea lab affects them. What impact does participation in an idea lab have on students' motivation, skill development, and professional careers? Are there differences between students who take part in these projects and those who don't? These inquiries may provide important information about the

effectiveness of university and industry collaboration programs and their effects on students' professional development. These three research areas are crucial for enhancing industry-university collaboration and fostering students' professional development. More research is required in order to recognize and address any communication-related issues, boost student motivation, and assess the effects of participation in an idea-sharing lab.

6. Conclusion

Significant findings that have indicated essential requirements and obstacles in the partnership between academia and industry have been attained through the surveys and interviews that were done. Participants emphasized the absence of support systems, the necessity of creating a distinct link between projects and courses, the desire to obtain knowledge and experience in the real world, and the significance of creating strong and long-lasting projects. After the completion of this project, I believe it is evident that University-Industry collaboration has become a topic of great importance in academia and business. The creation and adoption of a student-driven innovation lab in universities, following the QHM and focused on sustainable development towards Industry 5.0, offers a unique opportunity to promote a collaborative and innovative workforce, while ensuring student satisfaction. This project has demonstrated the importance of actively engaging students in collaboration with industry, fostering a "learn by doing" approach, and harnessing the potential of transdisciplinary work. By implementing approaches such as Design Thinking and Human-Centered Design, priority has been given to maximizing student satisfaction and enjoyment, enabling them to acquire practical and relevant skills for their future careers. The project with ABB demonstrates how the implementation of an innovation lab can generate positive results and contribute to the achievement of a successful and enriching collaboration for both parties involved.

A strong and flexible business model that encourages the co-creation of projects between academic institutions and commercial partners has been designed using the Canvas Business Model, guaranteeing the caliber of collaborations, and offering students mentoring and supervision. Implementing a student-driven innovation lab that follows the QHM and is focused on sustainable industrial 5.0 development represents an effective strategy for encouraging collaborative and innovative work practices in higher education. By giving students practical and meaningful experiences, this approach ensures student satisfaction while also advancing society's advancement and sustainable development. Paying attention to the challenges identified, such as improving communication and understanding the value of corporate collaboration, will be

essential to the ongoing success of the innovation lab and its influence on the university and business systems. A new refined version of Creative Lab has been developed, following the business model, and has been applied successfully. Together, these results show the viability and potential of creating and implementing a student-driven innovation lab in universities, based on the Quintuple Helix model and geared toward Industry 5.0 sustainability. This strategy encourages a cooperative and creative workforce, guarantees student satisfaction, and encourages the development of solutions with significant social and economic benefits.

On the basis of these findings, it is advised that universities take into account setting up similar innovation laboratories that are suited to their unique circumstances and requirements. These labs have the potential to develop into places where innovation and teamwork thrive, bridging the gap between academia, business, and society. This will encourage the growth of talent, the production of knowledge, and the development of original ideas that progress society as a whole.

7. References

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