



International mapping study on good practices of applied research in vocational education and training



PREFACE

The research paper “International mapping study on good practices of applied research in vocational education and training” has been funded by the European Union and produced by the European Training Foundation (ETF).

This report presents good practices of applied research activities in vocational education and training (VET). To this end, we have carried out an international mapping study of VET applied research in four countries: the Netherlands, Spain, Canada and Türkiye.

The study project was coordinated by Stefan Thomas (ETF). The research design was led by Meghan Rens (CINOP), Epke Vogel (CINOP), Jan Peter de Otero (ETF) and Stefan Thomas (ETF). The mixed-methods research was undertaken in the period from June 2022 to March 2023 by a team of researchers working at CINOP. The report was written by Meghan Rens, Epke Vogel, Daniëlla van Uden and Willem Kleinendorst (all CINOP).

We would like to extend our gratitude to all of the stakeholders who contributed to this research, either by helping with the data collection, providing feedback, or bringing us into contact with relevant experts. Our gratitude goes out to the Turkish Ministry of National Education, Colleges Ontario, Tknika, and Stichting ieder mbo een practoraat. Our thanks also go to the teachers, students, and companies from Vista College, Private Enka VTAH, Mohawk College, and Tknika for their time, openness and warm welcome.

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EXECUTIVE SUMMARY

INTRODUCTION AND RESEARCH DESIGN

The past years have witnessed a growing trend in applied research in Vocational Education and Training (VET). When we speak about applied research in VET, we refer to investigative activities and services conducted by VET organisations which have a strong practical focus on solving real-life problems. Insights from applied research can be used to develop or improve products and services, by commercialising ideas that can increase business productivity. Despite the many developments taking place on applied research in VET centres, carried out both within Europe and abroad, little empirical research has been carried out

to present these practices. This present study addresses this knowledge gap by exploring good practices of applied research in VET in four countries: Spain, the Netherlands, Canada and Türkiye.

To do so, it analyses the organisation of the respective VET systems, policy frameworks and financial mechanisms put in place to enhance these initiatives. Following this, the good practices of Tknika, Chemelot Innovation and Learning Labs (CHILL), Ideaworks, and Private Enka Vocational Technical and Anatolian Highschool (VTAH) are presented. The processes, activities, as well as levels of engagement of companies and students

are described. Finally, the learning benefits of students who participate in applied research activities are summarised. After providing a systematic description of each case study, the final chapter of this study presents a comparative analysis to identify similarities between the various practices.

POLICY FRAMEWORKS

Spain

In Spain there are both national and regional policies on applied research in vocational education. For example, both the Spanish and Basque Ministry of Education and Vocational training recognise the importance of VET in promoting innovation. They have therefore developed various policies and laws to strengthen the role of VET systems in applied research. The majority of funding for applied research takes place through ad hoc funding in the form of grants, prizes and pilot projects.

The Netherlands

In the Netherlands, education policy is organised in a decentralised manner, leaving room for initiatives to develop from the bottom-up. Such initiatives include practorates, which are multi-disciplinary research teams within VET centres which explore new professional practices, and public-private partnerships (PPPs) between VET centres, governmental and private actors to work on innovation projects. The Dutch government is involved in stimulating applied research mainly through the providing of funding. This often takes the form of ad hoc grants, but is apparently becoming increasingly structural in nature.

Canada

Canada's federal structure places the majority of policy responsibilities on provincial governments such as Ontario.

In Ontario, VET centres (known as 'colleges') are also given the freedom to develop their own policies and initiatives in applied research. In turn, colleges can make use of expansive sources of funding provided by both the federal and provincial governments to finance their projects.

Türkiye

Türkiye's centralised political system means that the Ministry of National Education is responsible for all activities and initiatives implemented in VET and applied research. In recent years, the Turkish government has implemented a new policy to strengthen VET systems. It equips both the weakest as well as high performing VET centres (known as Vocational Technical Anatolian High Schools (VTAH)) with new Research and Development (R&D) centres and laboratories. In addition to material funding, applied research in Türkiye can be financed through grants provided by the Scientific and Technological Research Institution of Türkiye (TÜBİTAK) as well as Centres of Vocational Excellence (CoVEs).

GOOD PRACTICES

Tknika

Tknika is an institute and expertise centre located in the Basque Country which is focused on strengthening vocational education through innovation, creativity and entrepreneurship. Applied research at Tknika is carried out through the Tkgune programme, where Tknika facilitates a network of companies and local VET centres. Tknika also offers local VET centres training on acquisition and project management skills, and monitors project progress. Applied research activities at Tknika are carried out exclusively by teachers from the participating VET centres. Tknika believes



that companies deserve the best possible quality for the services which they pay for, meaning that students are not involved in projects as their input cannot guarantee that. Projects are usually run for small and medium enterprises (SMEs) on a relatively low budget (usually between EUR 3 000 and EUR 5 000) and last approximately 6 months. Students learn from applied research projects in class when their teachers share insights from their projects.

CHILL

The Chemelot Innovation and Learning Labs (CHILL) was founded by Vista college, Zuyd University of Applied Sciences, Maastricht University and Royal DSM, a chemical company at the Brightlands Campus in the province of Limburg, the Netherlands. Within CHILL, students from intermediary and higher professional levels of vocational education work together on applied research projects in the chemical sector. They are coached and guided by teachers who are responsible for the successful completion of the private company-commissioned projects. Students participate in projects as part of their study programme and are evaluated on both the quality of their work as

well as their participation. As projects usually last longer than the 6 months which students spend on the project, a handover takes place to ensure the continuity of activities.

Ideaworks

Ideaworks is a faculty within Mohawk College, located in the Canadian province of Ontario, where applied research is carried out in the field of technology. Applied research at Mohawk college is carried out by teams of teachers and students who do this as an extracurricular activity. Students usually spend a maximum of 15 hours per week on the projects and are paid for their services. Ideaworks has developed an elaborate infrastructure to implement its activities, including policy, resources, tools and training for VET teachers interested in getting involved in research. Clients at Ideaworks can both be private companies as well as governmental agencies and community organisations who may not always be able to provide the full amount of funding necessary for the completion of projects. In these cases, Ideaworks plays an active role in helping to gather funds, either through national or provincial sources.

Private Enka VTAH

Private Enka VTAH is known as a high-performing VET centre in the province of Kocaeli in Türkiye. It is one of the several vocational high schools founded by a private corporation and is therefore equipped with the most advanced R&D facilities. Students at Private Enka VTAH are encouraged to participate in applied research projects which are initiated by governmental organisations such as TÜBİTAK or through the Erasmus+ programme. Within these projects, students work in teams on projects in the fields of robotics, physics, or chemistry. They are guided by a teacher and usually work on the projects throughout their entire period at the vocational high school. The projects include a competitive element, where

students' achievements are compared with schools across the country. The most successful projects are granted awards which give students additional points for their entrance exams to enter university.

Companies can be involved in applied research projects in different ways. They may either take the role of the client who commissions an assignment for a problem it faces. In this case, these companies are often solely responsible for the funding of the projects. Alternatively, companies can act as partners operating in a consortium. In these cases, companies and VET centres can search for funding together and collaborate closely in the execution of the project.

TABLE 0.1 OVERVIEW OF MAIN CHARACTERISTICS OF GOOD PRACTICES OF APPLIED RESEARCH IN VET

	SECTOR OF OPERATIONS	FUNDING SOURCE	STUDENT INVOLVEMENT	DURATION OF PROJECTS
TKNIKA	Broad range, mainly manufacturing	Private companies	No	6 months
CHILL	Chemistry	Private companies	Yes	6 months to several years
IDEAWORKS	Technology	Private companies	Yes	6 months to several years
PRIVATE ENKA VTAH	Robotics, physics, chemistry	Governmental funding	Yes	Usually around 3 years



COMPANY ENGAGEMENT

Companies can be involved in applied research projects in different ways. They may either take the role of the client who commissions an assignment for a problem it faces. In this case, these companies are often solely responsible for the funding of the projects. Alternatively, companies can act as partners operating in a consortium. In these cases, companies and VET centres can search for funding together and collaborate closely in the execution of the project.

STUDENT BENEFITS FROM PARTICIPATING IN APPLIED RESEARCH

When considering the learning benefits of students involved at VET EQF levels 4-5, we see that despite the differences in the design of the applied research projects, students across the good practices gain important learning benefits through participating in these activities. These can be categorised into three main kinds:

Soft skills:

By making collective decisions on the project's progress, communicating with clients, and working on a project basis, students practise and develop their teamwork, communication, presentation, problem-solving and leadership skills. Working in real-life settings has also taught them to deal with uncertainty and to demonstrate a certain level of flexibility and creativity. The students also gained project and time management skills, for example by learning to work with a project budget and dealing with the amount of administration and paperwork involved in managing a project.

Technical skills and substantive knowledge:

Research skills, such as carrying out a literature review or conducting experiments involving advanced chemical analyses and/or data-processing methods also constitute important learning benefits for students

who often have no previous experience with applied research. In this manner, participation in applied research can lead to better development of students' advanced cognitive competences. Students not only learn new substantive knowledge themselves, but are able to contribute to the development of new knowledge. This is very different to traditional learning processes in VET where students are usually the receptors of new knowledge.

Future outlook:

Participation in applied research also gives students the opportunity to get an insight into the labour market and potential employers they may work for upon graduation. This experience is also often added to students' CVs as proof of their experience and qualifications.

STAKEHOLDER BENEFITS FROM PARTICIPATING IN APPLIED RESEARCH

Although this research was primarily focused on exploring the benefits for students in participating in applied research, we also noticed many advantages for the other stakeholders involved. These include amongst others:

VET centres:

- Connection to social and regional challenges, and to technological and social developments in the labour market.
- Promotion of innovation, excellence and flexibility in education and training.
- Diversification of financial sources by engaging in commercial projects for companies.

Companies:

- Access to additional research and development capacities for an affordable price.
- Scouting of potential graduates through a first opportunity for collaboration.
- Ability to retain intellectual property rights on innovations.

Teachers:

- Co-create new expertise and know-how requested by partner companies and (further) development of their research skills.
- Support to professionalisation, to making their careers more dynamic and enhancing teachers' motivation and curiosity.

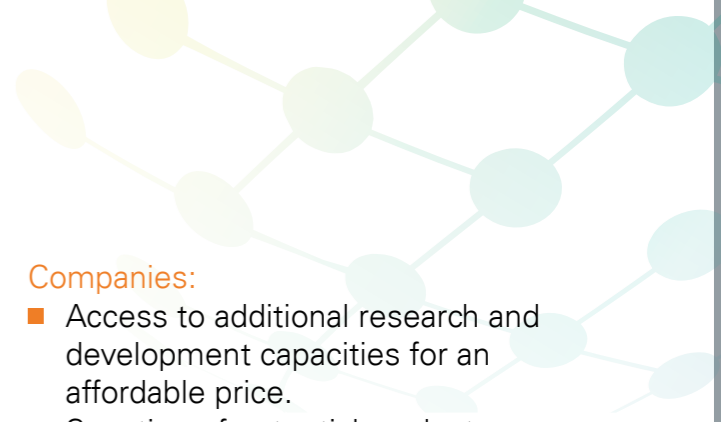


TABLE OF CONTENTS

Preface	4
Executive summary	5
List of tables and figures	12
1. INTRODUCTION	13
Research objectives and research questions	14
Outline	14
2. RESEARCH DESIGN	15
3. POLICY FRAMEWORKS FOR APPLIED RESEARCH IN VET	18
3.1 Spain	18
3.2 The Netherlands	22
3.3 Canada	26
3.4 Türkiye	30
4. GOOD PRACTICES	33
4.1 Spain (Basque Country)	33
4.2 The Netherlands	40
4.3 Canada	47
4.4. Türkiye	54
5. CONCLUSION	59
5.1 Policy framework analysis	59
5.2 Comparative analysis of good practices	61
Annex: Overview of Experts	67
List of abbreviations	68
References	69

LIST OF TABLES AND FIGURES

Table 0.1.	Overview of main characteristics of good practices of applied research in VET
Figure 2.1	Overview of research design
Table 3.1.	Overview of students enrolled in a Spanish VET programme
Table 3.2.	Overview of students enrolled in a Dutch VET programme
Table 3.3.	Overview of students enrolled in a Turkish VET programme
Table 4.1.	Overview of actors and responsibilities in Tknika's Tkgune projects
Figure 4.2.	Steps of a Tkgune project
Table 4.3.	Overview of parties and responsibilities CoP
Table 4.4.	Overview of CoP research team
Figure 4.5.	Processes and activities in CoP
Table 4.6.	Overview of parties involved in projects at Ideaworks
Figure 4.7.	Processes and activities in a project at Ideaworks
Figure 4.8.	Processes and activities in TÜBİTAK projects
Figure 4.9.	Processes and activities in Erasmus+ projects
Table 5.1.	Comparative overview of the types of VET programmes
Figure 5.2.	Comparative overview of policy frameworks facilitating applied research in VET
Figure 5.3.	Comparative analysis of organisational level of applied research
Figure 5.4	Comparative analysis of student engagement in applied research projects
Figure 5.5	Comparative analysis of company engagement in applied research projects



1. INTRODUCTION

The last decade has witnessed a transformation in the role of vocational education and training (VET). VET providers are no longer solely responsible for the delivery of trained professionals onto the labour market, but are increasingly expanding their responsibilities to have a broader impact on societies and their environments. One of the activities which VET centres have recently started to carry out is conducting applied research. When we speak about applied research in VET, we refer to investigative activities and services conducted by VET organisations which have a strong practical focus on solving real-life problems. Insights from applied research can be used to develop or improve products and services, by commercialising ideas that can increase business productivity. Insights from applied research can also help develop workforce solutions such as professionalising workers by teaching

them new knowledge and skills (Beddie & Simons, 2017). An important reason for the expanding role of VET providers towards the provision of applied research is the growing need of small and medium-sized enterprises (SMEs) to have proximal yet external agents assist them in their innovation activities (Navarro, 2018). Applied research can also have numerous benefits for VET centres, such as: (1) enhancing the capacity of VET organisations to keep their curriculum and teaching staff up-to-date with the latest trends in the labour markets; (2) giving students the opportunity to develop research-related skills, often in a real work environment, enhancing creative, problem-solving and design-thinking skills; (3) improving the attractiveness of VET for students, and (4) diversifying financial sources for the VET system.

Despite the growing interest in VET applied research, to this date few empirical studies have been carried out to describe these practices. This research therefore addresses this knowledge gap by exploring the ways in which applied research is carried out in different national and regional contexts in the Netherlands, Spain (including the Basque Country), Canada, and Türkiye.

RESEARCH OBJECTIVES AND RESEARCH QUESTIONS

The objective of this research is to explore good practices of applied research carried out in VET. More specifically, we focus on understanding how and to what extent various VET systems are involved in applied research projects. The main research question is therefore:

How and to what extent are the different VET systems involved in applied research projects?

In order to answer this question, the following sub-questions have been formulated:

1. How is VET organised in the four countries under study?
2. Which policy frameworks facilitate the involvement of VET in applied research in the four countries under study?
3. What are the common processes and activities deployed in applied research projects in the selected VET institutions?
 - a. How and to what extent do VET institutions engage private companies in applied research projects?
 - b. How do these VET institutions engage VET students in applied research activities?
4. What are the possible benefits for students participating in applied research activities?

OUTLINE

Chapter 2 describes the research methodology and data collection of the four research activities. Chapter 3 presents the policy frameworks which facilitate applied research in the four countries under study. Chapter 4 provides portraits of the case studies considered in this research. Chapter 5 concludes this report with a comparative analysis of the policy frameworks and good practices.



2. RESEARCH DESIGN

Our research design consists of four phases in which different research methods have been applied. Figure 2.1. provides an overview of the different phases, research methods, and questions answered.

Phase I: Research conceptualisation

In the first phase of this research, we conducted a broad survey of the countries to be included in the study. Israel, Türkiye, France, the Netherlands, Australia, Brazil, Spain, Canada and Finland were considered based on existing information on conducive environments and available good practices in the countries. We carried out desk research where various policy documents, reports and databases were consulted and analysed in order to gain a first understanding of the policy contexts operating in these countries. Findings from this review were presented in a short report delivered to the ETF. Based on this short report, the ETF made a selection of the four countries to be included in this study. This selection was based on the following criteria:

- 2 EU Member States: Spain and the Netherlands
- 1 member from the ETF Network of Excellence: Türkiye
- 1 non-EU country: Canada

Phase II: Policy framework analysis

In the second phase of this research, we conducted an analysis of the policy frameworks and financial mechanisms which facilitate applied research in VET in the four country case studies. Building on the desk research carried out in Phase I, we conducted expert interviews with policymakers, academics and stakeholders involved in VET applied research. Between two and six experts from each country were interviewed. An overview of these experts is provided in Annex I.

Phase III: Studying good practices

After analysing the policy in place, we explored applied research projects carried out by VET providers. One so-called 'good practice' of applied research in VET was selected in each country, based on the following criteria:

- The organisation is involved with the provision of VET at level 4 or 5 of the European Qualifications Framework (EQF)¹.
- The applied research project is commissioned and (at least partly) financed by a company.
- Students are involved in the projects, or at least derive learning benefits from the projects.

Selection of good practices

In Canada, Mohawk college was selected because it won the bronze medal in the Applied Research and Innovation Excellence Award delivered by Colleges and Institutes Canada (CiCan). CiCan is the national association representing the interests of colleges and institutes to government and industry (CiCan, n.d.).

In Spain, the Basque VET Applied Research Centre (Tknika) was selected as it is recognised as a pioneer in the

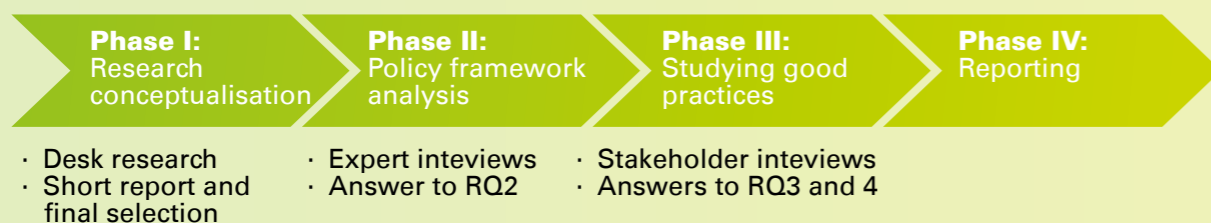
field of applied research and innovation in VET by the Spanish Deputy Directorate General for Vocational Training Planning and Management (P. Alegría, personal communication, 15 November 2022).

In the Netherlands, CHILL was nominated for the Dutch higher education award, which is granted to educational institutes that have achieved specific outcomes in the field of innovation and improvement of higher (vocational) education (Brightlands, 2020). It was therefore selected as an example of good practice for the Netherlands.

In Türkiye, Private Enka Vocational Technical and Anatolian Highschool (VTAH) was selected based on a recommendation from several experts to consider a private VTAH, as these were making important steps in applied research projects with students.

¹ For more information on the European Qualifications Framework, see: <https://europa.eu/europass/en/europass-tools/european-qualifications-framework>.

FIGURE 2.1 OVERVIEW OF RESEARCH DESIGN





3. POLICY FRAMEWORKS FOR APPLIED RESEARCH IN VET

This chapter presents findings from the analysis of the policy frameworks fostering applied research in VET. The information presented in this chapter was collected through desk research and expert interviews. It was also fact-checked by an expert for each country. This chapter is divided into four sections according to the respective countries under study: Spain, the Netherlands, Canada, and Türkiye. To ensure the consistency and systematic presentation of the findings, each section is organised according to the following themes: (1) VET system; (2) Policy context; (3) Financial mechanisms. The most recent available data are provided for each country.

SPAIN

In the academic year 2020/2021, a total of 852 000 students were enrolled in a Spanish VET programme covering levels 1-5 of the EQF. A small percentage (9%) of these students followed a basic VET programme (EQF 1-3), which targets the specific group of potential early school leavers who still want to obtain a diploma (Cedefop, n.d.). The rest either followed an intermediate or higher VET programme.

RESEARCH ACTIVITIES

For each good practice, interviews were conducted with various stakeholders involved in the project. The number of respondents interviewed varied depending on each project, but the following persons were usually surveyed:

- Project manager
- Teachers
- Students
- Company representative(s)

Depending on the number of respondents, interviews were conducted either on an individual basis or in the form of focus group discussions. Focus group discussions had the added benefit of providing insights from more stakeholders as well as an opportunity for exchange and discussion among the respondents, delivering valuable research information.

In the case of Spain and the Netherlands, the interviews were conducted face-to-face in the Basque Country and in Geerlen. Due to time and financial constraints, the interviews for Mohawk College were conducted remotely. As a result of the earthquakes in Türkiye in February 2023, the trip planned to Private Enka VTAH had to be cancelled and the interviews were also carried out remotely.

In total, 27 respondents were interviewed. An overview of these respondents can be found in Annex II.

Phase IV: Reporting

The final phase of this study consisted of drafting the report. To this end, the data collected was analysed and processed into findings. The chapters were fact-checked by experts for possible errors and/or misinterpretations.



Intermediate vocational education in Spain leads to a technical degree (in Spanish: 'título de técnico'). It is equivalent to EQF level 4 and is offered to students who have completed compulsory lower-secondary education. Intermediate VET teaches students core education subjects in combination with vocational subjects. It can last between 1 and 6 years depending on the study programme. Although students who complete intermediate vocational education usually enter the labour market directly, an increasing number of students continue their studies in higher vocational education. In the academic year 2019/2020, 47% of students in Spain continued their studies to pursue a degree in higher vocational education (Erudera, 2022).

Higher vocational education in Spain leads to a higher technical degree (in Spanish: 'título de técnico superior'). It is comparable to EQF level 5 and is offered to students as of the age of 18 who either have completed intermediate vocational education or upper-secondary general education (in Spanish: 'Título de Bachiller'). Students receive 2 000 hours of classes spread across two academic years. A significant part of the programme (up to 65%) consists of a

compulsory work placement module, at least 400 hours are completed in the workplace (Sancha Gonzalo, 2020). Since 2012, students can also choose to follow a dual VET programme. In the academic year 2019/2020, only a small percentage of students (4.5%) opted to do so (Spanish Ministry of Education and Vocational Training, in Sancha Gonzalo, 2020). A dual VET programme within formal initial VET can last up to 3 years instead of the original 2, with a maximum of 85% of the training spent at the company. Completion of a higher VET programme gives access to the labour market as well as to related university studies (Sancha Gonzalo & Gutiérrez, 2019).

SPANISH POLICY CONTEXT FACILITATING APPLIED RESEARCH IN VET

Although Spain is not a federation, certain policy responsibilities, including vocational education, are decentralised to regional governments. Autonomous regions of Spain, such as the Basque Country, carry a lot of policy responsibilities regarding vocational education. Both policy levels are therefore considered when exploring the Spanish policy context facilitating applied research in VET.

TABLE 3.1 OVERVIEW OF STUDENTS ENROLLED IN A SPANISH VET PROGRAMME

TYPE OF VET	NUMBER OF STUDENTS
Basic VET (EQF 1-3)	75 458
Intermediate VET (EQF 4)	367 409
Higher VET (EQF 5)	409 255

Source: Spanish Ministry of vocational education and training (2022)

National policy

The Ministry of Education and Vocational Training is in charge of national policies around initial VET and the quality of vocational education and training programmes and curricula. The Ministry of Labour and Social Economy is also involved in policymaking on topics regarding VET. Its role is to set policies for VET with the goal to (up)skill and retrain the unemployed and employed population, and to support employability by matching skills with the needs of the local economy (Cedefop, 2021).

For a long time, VET institutes were not seen as relevant actors within the Spanish innovation system. However, the important transformations taking place in the past years in the Spanish VET system are changing their position. Amongst these transformations is the expansion of the role of vocational education, which is no longer solely responsible for providing education and training, but also for contributing to innovation (Moso-Díez, 2020). As a result, the Spanish Ministry of Education and Vocational Training requires a core part of VET to consist of technological innovation and applied research activities. These are to be carried out with various actors, such as social partners, vocational training centres, companies and research centres. This has been outlined in the 2020 Plan for the modernisation of vocational training (Cedefop, 2022).

These policy efforts have culminated into the new organic law² on the organisation and integration of vocational education and training, passed by the Spanish

² An organic law is a law stating the formal constitution of a nation.

government in 2022. This law aims to strengthen the Spanish VET system in different ways. One of its key elements is to incorporate innovation, applied research, digitalisation, sustainability and entrepreneurship into all VET programmes (Spanish Government, n.d.). As a result, there are two main ways in which VET systems in Spain can contribute to applied research: first, by transferring knowledge gathered from applied innovation projects to local, mostly small and medium-sized companies. Second, VET institutions can facilitate test programmes, pilot schemes and deployment projects. Examples of these can include carrying out innovative applied research projects. Tknika can be seen as a pioneer in this field (Moso-Díez, 2020).

Regional policy

Although the national government plays an important role in Spanish education policy (including vocational education), Spain's federal structure also provides a lot of policy responsibilities to its provinces and regions³. This means that all students across Spain follow the same basic educational curriculum, but regions can adapt up to 35-45% of this curriculum in the ways they see fit (Cedefop, 2021). The Basque government plays an important role in shaping VET applied research and policy in the Basque Country. Over the years, it has taken several steps to facilitate the contribution of VET to applied research and innovation. This has mainly taken the form of two central policy measures: the first is the region's own VET law,

³ Regions are autonomous communities which enjoy a certain independence regarding the development and implementation of policy responsibilities.

which was installed in 2018. It expands the objectives of vocational education and changes the role of VET institutes from being merely VET providers to also include applied innovation and entrepreneurship as a central part of the Basque vocational education system. Internationalisation is also a cross-cutting theme (Basque Country Ministry of Education, 2019). This has serious implications for teachers, because apart from teaching they also need to have activities in these other fields (Araiztegui Arraiz & Alonso Suarez, personal communication, 22 September 2022).

The second policy measure is the 2019 V Basque Vocational Education and Training Plan, which was developed to respond to new challenges in society and includes insights into the current training model. An important part of this plan consists in defining Tknika as the Basque VET Applied research Centre and describing its role in implementing VET applied research and innovation projects (Basque Country Ministry of Education, 2019). It also encourages collaborations between VET centres and companies, technology

centres and various university and non-university research departments (Basque Country Ministry of Education, 2019).

FINANCIAL MECHANISMS FOR APPLIED RESEARCH IN VET

To encourage the quality of VET, research and innovation activities, local and national governmental institutions working in the field of education provide grants and awards to training providers with programmes stimulating the improvement of methodological, technological and training processes and promoting partnerships with enterprises (Sancha Gonzalo & Gutiérrez, 2019). For example, the Ministry of Education and Vocational Training provides financial support for pilot projects, the development of innovation projects, the identification of good practices and support for the creation of innovation hubs. Innovation hubs consist of vocational training centres and companies – especially SMEs – and promote the transfer of innovation. Vocational centres can apply for this funding (Spanish Ministry of Education and Vocational Training, n.d.).

TABLE 3.2 OVERVIEW OF STUDENTS ENROLLED IN A DUTCH VET PROGRAMME

TYPE OF VET	NUMBER OF STUDENTS
Basic VET (EQF 1-3)	363 400
Intermediate VET (EQF 4)	287 300
Higher VET (EQF 5)	20 000
Higher professional VET (EQF 6)	453 100

Source: Dutch Ministry of Education, Culture and Science (2022a,b)



Additionally, a selection of projects can receive funding from Erasmus+ Centres of Vocational Excellence (CoVE). The European partnerships for CoVEs are focused on innovative approaches in VET, in which several public and private partnerships cooperate internationally. In the current Erasmus+ programme, the CoVE initiative has been allocated a budget of EUR 400 million, with which the European Commission hopes to finance hundreds of projects in the next 7 years. In the first call for CoVE projects in 2021, 13 projects were selected. Spain has scored well in this first call, by being involved in nine of the thirteen awarded CoVE projects (European Commission, 2022). As a result of the new Basque VET law, an initiative has been developed by the Spanish Ministry of Education to create CoVEs within Spain, as is the case in France. Each autonomous community would then nominate VET centres to take part in CoVEs, which would receive funding from the national Ministry of Education. It is likely that these centres will need to have applied research included as one of their activities (Alonso Suarez, personal communication, 22 September 2022).

THE NETHERLANDS

Overall, 1.1 million students were enrolled in a Dutch VET programme in the academic year 2022/2023. A third of these students followed a basic VET programme (EQF 1-3) offered as a form of secondary education. A quarter attended VET education at EQF levels 4-5. In contrast to other countries included in this study, VET in the Netherlands is also provided at EQF level 6. In this report, this type of education is referred to as higher professional education. Approximately one-third of all VET students in the Netherlands follow higher professional VET.

Intermediate vocational education in the Netherlands is called secondary vocational education level 4 (in Dutch: 'middelbaar beroepsonderwijs (MBO) niveau 4'). It is comparable to EQF 4 and is offered to students who have completed secondary education or a basic VET programme at level 2. Students can pursue vocational programmes in a wide range of fields which last 3 to 4 years⁴. Most intermediate VET programmes are

⁴ In the case of continuation from vocational level 3 (MBO 3), a level 4 degree lasts two years.



offered as a dual or theoretical school-based programme. In both programmes, students combine theoretical studies with practical periods: in the theoretical school-based track, students spend 20-40% of their curriculum on work-based learning, while the dual track comprises 80% of work-based learning (Cedefop, 2019).

Higher vocational education is offered by higher professional education institutes, otherwise known as Universities of Applied Sciences (UAS) (in Dutch: 'Hogeschool'). These institutes mainly offer higher professional education accredited at EQF level 6. However, they also offer associate degrees which are accredited at EQF level 5. Associate degrees are practically oriented tracks lasting two years, which are more strongly tailored to a specific profession than professional education at EQF 6. Associate degrees often involve in-

company assignments. Students who opt for an associate degree often do so to further specialise in a specific profession after completion of the MBO 4 track (EQF 4), but do not want to engage in a 4-year programme such as higher professional education (EQF 6) (studiekeuze123, n.d.). As the table above demonstrates, higher VET (EQF 5) is less developed in the Netherlands. Students either pursue intermediate vocational education (EQF 4) or higher professional vocational education (EQF 6).

DUTCH POLICY CONTEXT FACILITATING APPLIED RESEARCH IN VET

Education policy in the Netherlands is developed by the Ministry of Education, Culture and Science. In addition, the Ministry of Social Affairs and Employment shares responsibilities regarding life-long learning and continuing education programmes. Dutch education policy is organised

in a decentralised manner, meaning that aside from setting general quality standards⁵ and providing funding, schools are responsible for their own curricula and are free to decide how to spend available resources (Kloprogge, 2008). As a result, the way in which VET applied research is carried out is also largely dependent on the choices made by individual VET institutes. The government plays a supportive and stimulating role in this process by providing grants and other funding opportunities which can be used to start various initiatives, including VET applied research. Within this decentralised context, two types of initiatives for VET applied research have been developed: practorates (in Dutch: 'Practoraten') and public-private partnerships.

Practorates

Practorates are multi-disciplinary teacher teams installed in VET institutes which carry out applied research to explore new professional practices (practoraten.nl, n.d.). Eighty-five practorates are currently active across 44 VET institutes (Van der Meer et al., 2023)⁶. The goal of practorates is to stimulate a research mindset within the VET institutes they are working in, and eventually stimulate innovation in the vocational sector (practoraten.nl, n.d.). They carry out two different types of research: research specialised in an educational topic or a didactic theme⁷, and research in occupational domains⁸. In both cases,

⁵ These often have to do with the number of years of education needed, the subjects to be studied, teaching hours, or the content of examinations).

⁶ Not all MBOs have a practorate, as some count several practorates and others count none.

⁷ Such as citizenship, media literacy, work-based learning.

⁸ For example: logistics, mechatronics, care and welfare.


they focus on clarifying questions, looking at what is known about a specific topic, analysing data, making knowledge applicable and workable, bringing teachers and students into contact with professional practice and developing creative forms of education (Van der Meer et al., 2018).

Although practorates aim to stimulate innovation in the professional practice, in reality many practorates are to this date more focused on using research to improve the quality of education and further develop curricula and are to a lesser extent involved in stimulating innovation in the corresponding economic sectors.

Public-private partnerships

Another type of VET applied research is through public-private partnerships (PPPs) between VET institutes, businesses and (regional) government bodies to collectively work on various innovation projects. The types of projects which PPPs work on can vary. They can involve practorates, but VET institutes are sometimes directly involved in R&D projects. This is the case for the Fieldlab CAMPIONE⁹ PPP, where VET institutes and various industries work together on fields labs which help make the maintenance of chemical plants more predictable, contributing to safer, more efficient and more environmentally friendly production. In this case, the VET institute contributes to the project by designing and further developing the test installation (Worldclassmaintenance, n.d.).

⁹ For more information on the Fieldlab CAMPIONE project see: <https://www.worldclassmaintenance.com/project/fieldlab-campione/>.



There are currently 450 PPPs across the Netherlands (Katapult, 2021). In order to centralise and provide support to these various PPPs, the network organisation 'Katapult' was founded. Katapult brings project managers from different PPPs together, offers them support and creates a learning community between the different initiatives by facilitating the sharing of knowledge. As a network organisation, Katapult also helps foster and strengthen collaborations at all stages of development: from start-up to scale-up. It also helps PPPs find funding opportunities (Katapult, 2021).

FINANCIAL MECHANISMS FOR APPLIED RESEARCH IN VET

In its effort to stimulate VET applied research, the Dutch government has developed various funding opportunities which VET institutes and other partners can make use of to carry out applied research. In addition to various smaller grants and subsidies which usually appear on a more ad hoc and project-based basis, there are several sources of national funding which can be used to finance VET applied research activities.

The Regional Investment Fund (RIF) MBO (in Dutch: 'Regionaal Investeringsfonds MBO') aims to stimulate cooperation between the private sector and VET institutes in order to improve connections between education and the labour market. In the period 2014-2021, the fund granted EUR 173 million to a total of 184 projects in the field of teacher professionalisation, development of research capacities and stimulating lifelong learning. RIF MBO is targeted towards VET institutes which are expected to form collaborations with companies, not-for-profits, and labour organisations to form a PPP and carry out VET applied research projects together.

These organisations are expected to provide a certain amount of co-financing to the projects. In the period 2014-2021 the average contribution of a partner organisation amounted to EUR 100 000 (Government of the Netherlands, 2022a).

Another important source of funding for VET applied research is available at the National Growth Fund (in Dutch: 'Nationaal Groeifonds'). It was founded in 2020 by the Dutch government to stimulate projects promoting long-term economic growth through knowledge development, R&D, and innovation. It allocated EUR 24.8 billion to 35 projects ongoing from 2021 to 2025 in the field of High tech and materials, agriculture, healthcare, energy and sustainable development, mobility, education, and life-long learning (Government of the Netherlands, 2022b). Most of these projects have been founded by public-private partnerships, although public data does not disclose how much of this money is going to VET centres specifically.

The Dutch government has also developed funding specifically aimed at practories. In September 2022, the Ministry of Education announced that it would invest EUR 25 million per year in the creation of practories (MBO today, 2022). This lump sum amount is to be divided between all VET institutes according to the number of students per VET school.

In addition to national funding, financial mechanisms developed at the European level have been developed to stimulate VET applied research. Erasmus+, the European Union's programme to support education, training, youth and sport in Europe, has granted EUR 4 million for a selection of projects to support the

design of excellent vocational education (Erasmus+, n.d.). In the last round of funding, Dutch partners were involved in six of the thirteen CoVE projects, making the Netherlands the second highest ranking country in terms of number of partners involved in CoVEs (Bresser, 2022).

CANADA

A total of 765 555 students were enrolled in higher vocational education (equivalent to EQF 5) in Canada in the academic year 2021/2022 (Statistics Canada, 2022). This amounts to approximately one-third of all tertiary education students in the country (Statista, 2022). Although this report refers to 'vocational education', this is not a term generally used in the Canadian education context. Vocational education is mainly offered at the post-secondary level, however a certain amount of vocational training is also available at the secondary level¹⁰.

Intermediate vocational education (equivalent to EQF 4) in Canada is offered as part of upper-secondary education in high schools. Here, all students follow a general education programme, and those interested in pursuing a vocational career have the option to follow a number of vocational subjects within this education track (Nuffic, 2021). As such, students do not follow a separate vocational programme at the intermediary level, and graduate with a general education diploma.

Higher vocational education is mainly offered in colleges. Students have the option of following a programme lasting generally 1 to 2 years which leads to a certificate or diploma. Alternatively, they can pursue an associate degree which is more academically oriented and offers access to university.

¹⁰ Due to its integration in the general education system, it was not possible to provide an overview of students enrolled in a VET programme, as was done for the other countries in this study.





Vocational programmes can also be followed in private career and vocational colleges which offer short courses and programmes, usually at lower level than that of public colleges (Nuffic, 2021).

Post-secondary education (which includes higher vocational educational equivalent to EQF level 5) is the constitutional responsibility of provinces and territories and is therefore organised differently across provinces. In Ontario, higher vocational education is offered in Colleges of Applied Arts and Technology (CAAT), in the field of health sciences, technology, business, applied arts and community and social services. Colleges also deliver apprenticeship training, part-time education, distance education, continuing education courses and skills-programmes (CICIC, n.d.-a). The role of colleges in Ontarian education has changed over time. They were initially founded in 1965 as non-degree granting institutions offering vocational, adult and related education supporting the regional economy and the workforce (Ramdas, 2017). Legislative changes which were passed in the early 2000s transformed the Ontario college system to allow colleges to grant bachelor degrees in applied areas of study and conduct applied research (Holmes, 2017).

CANADIAN POLICY CONTEXT FACILITATING APPLIED RESEARCH IN VET

Applied research is widely developed in Canadian vocational education, as Canadian colleges count over 700 specialised research centres and laboratories (CICan, n.d.). In the academic year 2019/2020, 42.000 students were involved in more than 6 400 applied research projects in a large range of different fields, with the top five being in the manufacturing, professional and business, education and health, natural resources, and information industry (CICan, n.d.).

As Canada is a federal state, certain policy responsibilities are decentralised to the administrative divisions of Canadian provinces and territories. This includes the provision of all forms of education including vocational education, upon which provincial governments have the exclusive responsibility. As a result, there is no national ministry of education in Canada. Instead, each province and territory has its own provincial or territorial ministry which is responsible for education. The province of Ontario has a Ministry of Education and Ministry of Colleges and Universities. This is often the case in Canadian provinces. (CICIC, n.d.).

Provincial policy of Ontario

In Canada's most populated province of Ontario, applied research did not constitute one of the main activities carried out by colleges when they were first created in 1965. Initially, their role was to offer vocational education to train people for entering the labour market, and the task of conducting research was exclusively allocated to universities (Dennison & Gallagher, 1986; Ramdas, 2017). Research only became an activity carried out in colleges as of the early 2000s, when legislative amendments were made which expanded the role of colleges to become degree-granting institutions with the capacity to conduct applied research (Holmes, 2017). With this new role, the research activities carried out by colleges were to be distinguished from universities by focusing on applied research leading to innovation and wealth creation through the sales of new goods and services (Holmes, 2017).

As a result of the changes made in the roles and capacities given to colleges, policies and funding programmes for VET applied research have been created. Colleges have established research offices, with dedicated VET researchers and grant officers who help to search for funding opportunities (Ramdas, 2017). Each college in Ontario has established different policies and procedures that support their applied research activities. They have established research ethics boards which ensure that research involving humans meets scientific and ethical standards and they follow basically a policy that was released by the federal government to assess the use of humans in scientific study. Some of the colleges have established expertise in certain areas, such as energy research or advanced

manufacturing. Others have dedicated centres and innovation centres that focus on a particular area of study (Walji, personal communication, 15/09/2022).

The developments in the college system which have taken place over the last two decades have led to a significant expansion of applied research activities across Ontario, transforming it into a key component of college programmes (Holmes, 2017). As such, Colleges Ontario, the advocacy organisation for the province's 24 colleges, has set 'research and innovation to strengthen communities' as one of its priorities of the strategic plan 2021-2024 (Colleges Ontario, 2021).

FINANCIAL MECHANISMS FOR APPLIED RESEARCH IN VET

Although vocational education is a provincial responsibility, the federal government has nonetheless taken up a significant role in stimulating VET applied research. One of the most important ways it has done so is by providing the largest source of funding for applied research projects. Federal funds are provided through funds and councils set up by the government of Canada which provide grants, scholarships, fellowships, and other forms of investments. The three largest funding organisations are the Natural Sciences and Engineering Research Council of Canada (NSERC), the Canadian Foundation for Innovation (CFI), and the Social Sciences and Humanities Research Council (SSHRC). Each of these provide different forms of support to universities, colleges, businesses, not-for-profit organisations, and research hospitals in different fields, but all with the same goal, namely to promote research and innovation in all of its forms (Government of Canada, n.d.-a).



An example of a governmental grant is the applied research and technology partnership, which was a grant set up in light of the Covid-19 pandemic for a period of 2 years to enable colleges to carry out applied research in different sectors. Although this was not a requirement, these projects were often carried out in collaboration with the private sector. ‘Mobilize grants’ are another example of support which is provided over 5 years and is used as baseline funding for college research centres to set up their research infrastructure and try to generate interest from private sector companies to collaborate on a project (Government of Canada, n.d.-b).

In addition to federal funding, provincial funding is also provided for applied research projects. For example, the Ontario Research Fund (ORF) provides funding for research in various disciplines (ORF, n.d.). Additionally, the Ontario Centre of Innovation (OCI) is supported by the Ministry of Economic Development, Job Creation and Trade. It connects Ontarian innovators with researchers, industry partners and funders to commercialise the next generation of made-in Ontario

intellectual property and solutions. One of the ways it does so is by providing a voucher for innovation and productivity for projects which use skills or resources of a post-secondary institution to respond to questions asked the industry partners (OCI, n.d.). This voucher covers up to half of the total eligible project costs, of which half has to be spent at the post-secondary institution. There is no deadline and the duration of the project should be between 1 and 2 years.

Finally, applied research projects in Canada can also be funded by the private sector. This usually takes place on a project basis. Although private sector investment in applied research was lagging in comparison to other OECD countries, it has increased significantly in the past years and is coming close to becoming equivalent to financial support from the federal government. According to representatives from CiCan, the increase of private sector investment can be seen as a sign of increased recognition from businesses of the value of applied research services carried out by Canadian VET institutes (CiCan, n.d.). Different types of companies collaborate with Canadian colleges and institutes on applied research and innovation, but

the majority (67%) are SMEs¹¹. The projects were carried out in a variety of sectors, including food and beverage, manufacturing, followed by, professional, scientific services & social innovation, agriculture, and information & cultural industries (CiCan, n.d.).

TÜRKIYE

Türkiye’s VET system comprised approximately 5 million students in the 2022/2023 academic year (General Directorate of Vocational and Technical Education, 2022). Of these students, half were enrolled in intermediate VET programmes (EQF 4) while the remainder follows higher VET programmes.

Intermediate vocational education in Türkiye leads to a vocational high school diploma (in Turkish: ‘Mesleki ve Teknik Anadolu Lisesi Diploması’). It is equivalent to EQF level 4 and is offered to students who have completed compulsory lower-secondary education. Intermediate vocational education is provided by two types of institutes in Türkiye. Almost half (48%)

of intermediate VET students attend a Vocational and Technical Anatolian High school (VTAH), which offers upper-secondary education programmes lasting 4 years to students aged 14-18. Within VTAH, students follow general education in combination with practical in-company training. The extent of practical in-company training depends on whether students are enrolled in the Anatolian Technical Programme (ATP), where students follow a 40-day internship in the last 2 years of the programme, or the Anatolian Vocational Programme (AVP), where they carry out an internship 3 days per week during their last year of studies (Özer & Suna, 2019). There are 3 262 VTAHs across Türkiye (General Directorate of Vocational and Technical Education, 2023).

Higher vocational education in Türkiye leads to an associate degree (in Turkish: ‘Ön Lisans Diploması’). It is equivalent to EQF level 5 and is offered to students who have completed upper-secondary education, often vocational education. Students follow a 2-year higher vocational education programme at a vocational education institute which is often linked to a university or higher technological institute (Renold, 2020). In 2012, eight institutions provided

¹¹ CiCan defines SMEs as companies counting anywhere from 1 to 500 employees (Soeras, P., personal communication, 06/03/2023).

TABLE 3.3 OVERVIEW OF STUDENTS ENROLLED IN A TURKISH VET PROGRAMME

TYPE OF VET	NUMBER OF STUDENTS
Intermediate VET (EQF 4)	2 623 020
Higher VET (EQF 5)	3 000 000

Source: Turkish General Directorate of Vocational and Technical Education (2023)

vocational courses leading to an associate degree in Türkiye (UNESCO-UNEVOC, 2013).

TURKISH POLICY CONTEXT FACILITATING APPLIED RESEARCH IN VET

Türkiye's political system is highly centralised, meaning that policy responsibilities, including those of education, are closely managed by the national government. Upper-secondary institutes fall under the responsibility of the Ministry of National Education (MoNE) (UNESCO-UNEVOC, 2013). Higher vocational institutes operate autonomously, but are represented in the MoNE through the Council of Higher Education (Renold, 2020). Both the Ministry of National Education and the Ministry of Labour and Social security are responsible and provide continuing vocational education programmes (European Committee of the Regions, n.d.).

In recent years, the Turkish government has made strengthening vocational education and training one of its top priorities. To this end, it has developed the 'Education Vision 2023', a policy presenting a comprehensive reform of the Turkish education system. One of these reforms involved strengthening applied research activities in intermediate vocational education, most notably VTAH. A distinction was made between types of VTAH: in schools which experienced higher rates of absenteeism, disciplinary problems, academic under achievement, grade repetition, and school drop-outs, the MoNE set out to modernise and improve the facilities by providing additional training to teachers, investing in the maintenance and development of the educational environment, and developing additional courses regarding basic skills

education. In a selected number of high performing VTAHs, the Ministry invested in R&D centres and laboratories working on intellectual property, registering patents, developing brands and product designs (Özer, 2021). These improvements led to a great increase in Intellectual Property Rights (IPR) products in a relatively short period of time (Özer, 2022). These VET institutes enjoy unique characteristics, as they are founded by private corporations and located in Organised Industrial Zones (OIZ), otherwise known as business parks, where industries come together to enjoy certain tax and practical advantages. The OIZs also host R&D labs and incubators. These schools are founded by companies with the aim of training qualified graduates which will subsequently be able to enter the workforce (Caglar, personal communication, 29/09/2022).

FINANCIAL MECHANISMS FOR APPLIED RESEARCH IN TURKISH VET

Funding for VET applied research can take place in different ways. The majority of VET applied research funding is managed by the Scientific and Technological Research Institution of Türkiye (TÜBİTAK), an agency within the Turkish government. TÜBİTAK aims to spark students' interest in scientific, technological and innovation activities by initiating, promoting, and financially supporting applied research activities in VET institutes (Uzunboylu & Demir, 2021). Aside from stimulating R&D activities in schools, TÜBİTAK also brings together business enterprises, the public sector and non-governmental organisations (NGOs) to strategically focus on joint collaboration on R&D and innovation. This initiative is achieved through the Turkish Research Area (TARAL) (TÜBİTAK, n.d.).

In addition to financing applied research initiatives, MoNE has also set up various Centres of Vocational Excellence (CoVE) across Türkiye. As such, the ministry has signed a protocol with the Istanbul Chamber of Industry (ISO) and the Istanbul Chamber of Commerce (ITO) to appoint 80 VTAH in Istanbul as CoVEs. It has also signed a protocol with the Turkish Union of Chambers and Commodity Exchanges (TOBB) to construct at least one CoVE in each of the provinces of Türkiye. Within these excellent vocational centres, students learn a foreign language (often German and/or English), and R&D labs have been set up (Özer & Suna, 2019).

Since 2021, VET applied research projects in Türkiye can also receive European funding, including the major funding programmes of Horizon

Europe and Erasmus+. By applying for such funding, Turkish initiatives can also cooperate with foreign VET institutes, private sector companies, and research institutes that are part of the Erasmus+ programme. Through these European programmes, research and innovation are stimulated and international cooperation between schools is promoted. An example of such programmes is the University Business Collaboration Platform¹² (UniBus) connecting research centres in universities and vocational colleges with companies through a cloud-based information sharing platform. In this manner, the UniBus project aims to support business-academia collaboration in Türkiye, as well as in Finland and Bulgaria (Erasmus+, n.d.).

¹² For more information about the UNIBUS project see: <https://www.poliunibus.org>.





4. GOOD PRACTICES

In this chapter, we present the good practices of VET applied research in the different countries under consideration: Spain (Basque Country), the Netherlands, Canada, and Türkiye. The information presented in this chapter was collected through individual interviews and focus group discussions with stakeholders involved in each good practice. The content of these descriptions has been reviewed by the interviewees to ensure that the information was correctly interpreted and accurately described in this report. Similarly to chapter 3, this chapter is divided into four sections according to the respective contexts under study. To ensure the consistency and systematic presentation of findings, each section begins with a general description of the good practice, followed by four main themes, namely: (1) Processes and activities; (2) Company engagement¹³(3) Student engagement; (4) Student learning benefits.

¹³ This paragraph is not present in the section on Private Enka VTAH as projects are not commissioned by a private company.

SPAIN (BASQUE COUNTRY) TKNIKA AND THE TKGUNE PROGRAMME

An exemplary programme of VET applied research in Spain takes place in the Tkgune programme of Tknika. Tknika is an institute and expertise centre focused on strengthening vocational education through innovation, creativity and entrepreneurship. It was established by the department of Education of the Basque Government, and is established as a UNEVOC-Centre and recognised as a Centre of Vocational Excellence (CoVE) by the European Commission (2019).

Applied research activities at Tknika are mainly carried out through the Tkgune programme. As part of this programme, Tknika manages a network of VET centres and companies to carry out applied research and innovation projects.

It also offers support to VET centres which carry out the applied research projects commissioned by companies. The projects are carried out in one of the following technological areas: (1) mobility, (2) energy and environment, (3) digitalisation and connectivity, (4) industry 4.0 and advanced manufacturing, (5) biotechnology and health and (6) e-commerce, hospitality and tourism. As of 2022, 300 teachers from 45 VET centres are involved in the Tkgune programme and working on applied research and innovation projects of over 3 000 companies. Approximately 200 projects are carried out every year.

VET centres must apply and go through a selection process in order to participate in the Tkgune programme. Naturally, they are free to carry out projects outside of the Tkgune programme, but they will not be eligible to receive support from Tknika nor have access to its resources.

TKGUNE RESEARCH TEAM Teachers-researchers

Research in the Tkgune programme is carried out by teachers from VET centres with an interest in conducting an applied research project in order to learn new knowledge and skills, contribute to innovation, and share insights with their students. These teachers often have an engineering background and industry experience. Usually, the applied research project is carried out by one teacher. In exceptional cases they may also receive assistance from a student, however most often they carry out this project alone.

TABLE 4.1 OVERVIEW OF ACTORS AND RESPONSIBILITIES IN TKNIKA'S TKGUNE PROJECTS

ACTOR	RESPONSIBILITY
Tknika	Provides support and training for teachers, as well as facilities for applied research
VET centre	Carries out research
Company	Commissions a project

Source: Dutch Ministry of Education, Culture and Science (2022a,b)

PROCESSES AND ACTIVITIES

Applied research and innovation projects in the Tkgune programme can be initiated in different ways. Companies may approach VET centres with a specific problem or project for which they seek support. For example, this can involve designing and manufacturing a new part for a machine of a manufacturing company. Companies often reach out to the VET centres in which their personnel has been trained. As the Basque Country is a well-connected economic region, the relationships between VET centres and companies are relatively strong. Another way which projects can start is through teachers from VET centres which may contact companies to offer their services. Tknika sometimes offers its services to bring companies and VET centres in contact through its extensive network. In order to ensure that companies are not approached by multiple VET centres offering their services, Tknika maintains a customer relationship management system which keeps an overview of this process. A smartphone application has been developed to this end, where VET centres can upload progress reports. On rare occasions, companies approach Tknika themselves for their services. In these cases, Tknika connects the company with a relevant VET centre.

In order to ensure the quality of applied research and innovation projects, Tknika has developed its own applied research methodology which VET centres participating in the Tkgune programme are expected to follow. It consists of four phases:

1. Phase one starts when a project opportunity arises. VET centres are to make an inventory of their expertise

and resources. They must also assemble a team of researchers to work on the project. This assembled team will then follow training at Tknika and learn about certain sales skills, such as how to approach a company and negotiate a project plan. It may also involve other project management skills.

2. The second phase involves developing a budget. Tknika requires that all applied research projects carried out as part of the Tkgune programme be fully financed by the company commissioning the project. This financing must also be of monetary value. To safeguard this, Tknika requires an invoice to be drawn up. Financial contribution is seen by Tknika as a proof of commitment from the companies. Companies requiring additional funding may apply for public funding. In such cases, the funding application is not done by the VET centre. Tknika can offer support in the application process by providing information and advice on which grant to apply for. Tkgune projects are not for profit, but do have to cover any costs incurred. A negotiation process takes place between the company and the VET centre. The project costs are generally between EUR 3 000 and EUR 5 000, with a maximum of EUR 50 000.

3. In the third phase, the project is carried out. This usually lasts between 3 to 6 months, and up to 1 year. The exact method and approach undertaken to execute the project depends on the individual project and current needs. Tknika does not outline a specific methodology on how to conduct the project.



Upon completion of the project comes the knowledge transfer phase. The teachers will have gained a lot of knowledge through the project and are expected to share their knowledge with students, fellow teachers, and company workers. They transfer knowledge to fellow teachers in order to develop new learning activities for students. Knowledge transfer also takes place with the staff of the company who commissioned the assignment. They are then taught to work with the technique/software/device which the VET teachers have developed. This can be done by organising an open-day event where the company is invited at the VET centre to learn about the innovation. It can also take form of an instruction manual, or through a YouTube video with explanations. Finally, knowledge must also be transferred to students, as will be further explained in the next section.

In some cases, knowledge cannot be transferred directly due to confidentiality requirements imposed by companies. Tknika allows companies to withhold the disclosure of confidential information for a maximum period of 3 years,

arguing that after this time, developed innovations cannot be considered as innovative anymore. Tkgune's project managers further add that confidentiality requirements do not always hamper knowledge transfer to students, stating that a lot can be learnt without divulging sensitive details.

Tknika considers knowledge transfer to be a very important part of the applied research and innovation project. It is what distinguishes the applied research and innovation project from a simple service to a company. Instead, the project is seen as part of a process of mutual exchange between VET centres and companies. Companies are therefore not only customers, but partners, where both parties are helping one another. To facilitate the knowledge transfer, teachers carrying out projects in Tkgune only spend part of their time working on applied research projects, focusing the rest of their time on giving classes in the VET centres for which they work. This accelerates the knowledge transfer process to students as well as fellow teachers.

COMPANY ENGAGEMENT

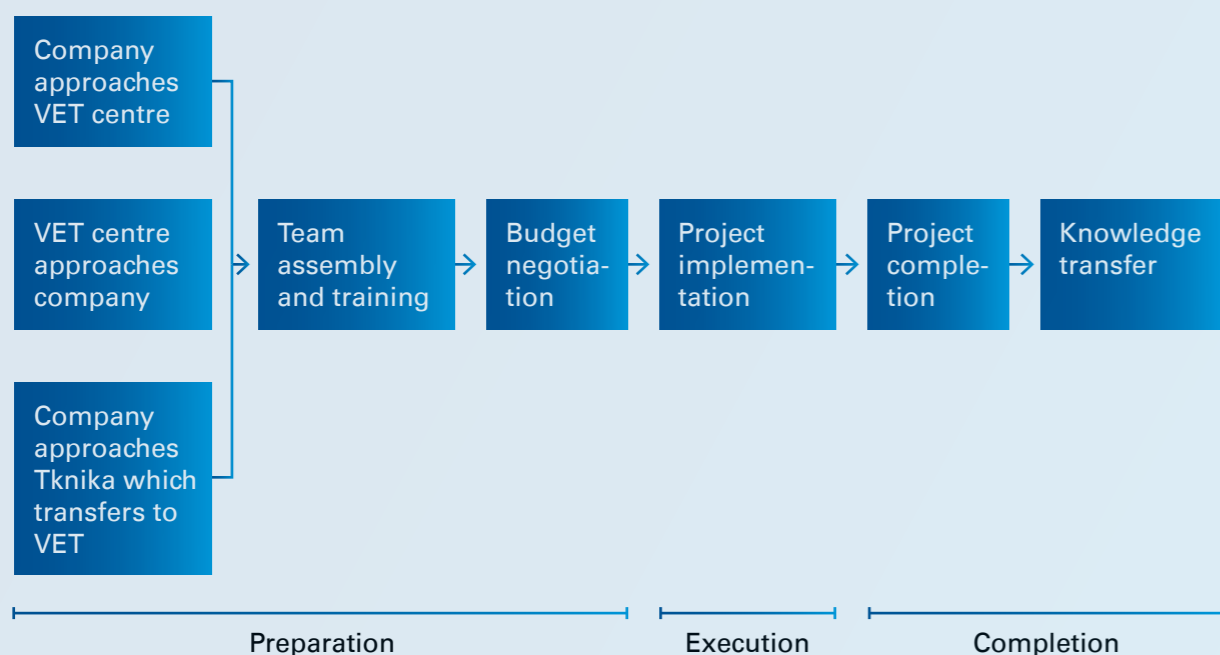
Most Tkgune projects are carried out with small and medium-sized enterprises (SMEs). This is because the majority of companies in the Basque Country are SMEs, but also because Tknika aims to specifically target these companies with its Tkgune programme. As a governmental organisation, Tknika values supporting small businesses in their competitiveness, and therefore facilitates VET applied research services for a cut-rate price. Furthermore, large companies are not usually in demand for Tknika's services, as they usually have their research & development (R&D) department which undertakes such projects.

An example of a company which has participated in the Tkgune programme is Hepyc, a company manufacturing machine taps. Hepyc was in need of a new part for a machine clamp and struggled to find a company which had

the engineering and manufacturing expertise to develop this part. The few companies which did have this expertise refused to take on the project, as it would not have been profitable for them to put in all the work to develop this complicated piece of engineering for just one clamp. Hepyc saw many benefits in collaborating with a VET centre, namely its expertise, the affordability of its services, as well as the rapidity and quality of communication.

Indeed, whereas a commercial applied research institute would have to take profit margins into consideration when calculating a price for such a project, VET centres only need to cover the costs they incur, in terms of materials as well as the hourly rate of the VET teachers' salaries. This amounts to a much lower sum than otherwise would be the case. As previously mentioned, VET centres and their teachers in the Basque Country are not motivated by economic

FIGURE 4.2 STEPS OF A TKGUNE PROJECT



considerations, and instead carry out innovative projects to promote their own learning process and to share insights with their students. VET centres would then also never take on an assignment to make 1 000 units of a machine clamp, as this would place too much emphasis on the production process, which does not fit with Tknika's innovation and learning goals.

STUDENT ENGAGEMENT

Students are not involved in the implementation of applied research projects with companies. This choice, embedded in the Tkgune programme policy, has been made because companies pay for the services of VET centres. As a result, even though the projects are focused on innovation and learning, Tknika finds that the quality of the projects should be a priority. The main goal of the Tkgune projects is to update teachers' knowledge and try to help competitiveness in SMEs, and knowledge transfer is to take place as part of the process. A second reason why Tknika does not involve students in projects is that VET centres are prohibited by law to charge money for students' work.

Students' lack of involvement in the project implementation does not mean that they do not learn from these projects. As previously mentioned, knowledge and insights gained during a Tkgune project is transferred to students by the teachers. As such, VET teachers who have been involved in Tkgune projects analyse how the findings of a project can be added to the curriculum. Insights from applied research projects can be shared through traditional learning forms, such as a lecture or tutorial.

Alternatively, VET centres can present the project as a mock challenge which students work on in the classroom. This way of teaching stems from Tknika's new teaching methodology, otherwise known as Ethazi, which means: 'high performance vocational training' in the Basque language. It was developed 10 years ago by Tknika and is now being used by a majority of VET centres in the Basque Country. It resembles the challenge-based learning (CBL) methodology, where students work on real-life challenges in the classroom.



In practice, the challenges carried out in Basque VET centres are not entirely authentic, as they have already been completed by teachers. However, students go through the thought process of solving problems in a fictional context, and discuss possible choices and considerations with teachers. Depending on the year of study, students may just follow the thought and development process drawn up by their teachers, or they may also reproduce the solution developed by the teachers.

VET centres explain their choice to work with the CBL methodology as being important to create connections between what students are learning in class and what is happening in the real world. They find this to be particularly important for vocational education, as it is closely knit to the labour market. By working on real-life challenges, teachers ensure that students are being kept updated about the latest trends and developments in the industries. One teacher explains that without CBL,

classes would be preparing students for a world which would probably no longer exist by the time they would graduate.

STUDENT LEARNING BENEFITS

Students explain that participating in challenges teaches them many different skills. Most importantly, they find that it helps them to gain a better understanding of the entirety of the development of a product, the value chain approach. Students from the production management study programme explained that, in class, they usually learnt about certain steps of the manufacturing process and only learn a limited number of techniques. Participating in the simulation of the applied research projects taught them about the many other activities involved in projects, such as the filing of paperwork and development of a project plan. One student explained that the manufacturing of a part which he had done several times in class can be much more complicated in a real-life project. This is because it not only involved

making geometric parts that they had not previously learnt to make in class, but also the time pressure involved in completing the challenges posed an important difficulty to the students. Students explained that being expected to solve problems which no one has a solution to, in a real-life setting with limited time, had taught them a lot. One student explained that time management was the most important skill he learnt by participating in challenge-based learning. The students who were interviewed found it motivating to work on challenges, as it gave them a taste of their future work.

THE NETHERLANDS CHILL AND COP

VISTA college is a VET institute located in the Dutch province of Limburg which offers initial and continuing VET programmes in a wide range of different fields. As many other VET centres in the Netherlands, VISTA college has several applied research programmes which operate separately from one another. In 2011, it founded the Chemelot Innovation and Learning Labs (CHILL), together

with Zuyd University of Applied Science (hereafter: 'Zuyd UAS'), Maastricht University and DSM (a multinational company operating in the field of fine chemicals and biotechnology). CHILL is both a physical lab of 800m² with various research and development facilities, as well as a learning, working, and research community where companies and students work together to develop new knowledge and products. CHILL is located on the Brightlands Campus, a science park hosting companies operating in the chemistry and materials sector.

Within CHILL labs, VISTA college carries out applied research projects which are known as the Communities of Practice (CoP). A CoP is a public-private partnership (PPP) between private companies, VET institutes, and governmental organisations where students across different levels of vocational education work together with companies on applied research questions and innovation projects.

TABLE 4.3 COMMUNITIES OF PRACTICE: ACTORS AND THEIR RESPONSIBILITIES

ACTOR	RESPONSIBILITY
CHILL	Provides support, training and facilities
VISTA and Zuyd UAS	Carries out research through CoP
Company	Commissions a project

COP RESEARCH TEAM

The CoP research team comprises students and teachers:

Students

Within the CoP projects, students from intermediate and professional levels¹⁴ of vocational education (VISTA and Zuyd UAS) in the chemical sector work together to address research questions and conduct innovation projects for companies. The first pilot of CoP was carried out in February 2022, and since February 2023, the CoP has open to all third-year laboratory technology students at VISTA college (80 students in total). VISTA college hopes to further expand CoP to students from other study programmes such as process engineering, industrial engineering, industrial design and development. Until that time, only students who study Applied Science at Zuyd UAS carried out applied research activities which took place outside the CoP.

Teachers

As most VET applied research projects in the Netherlands, CoP is linked to a team of teacher researchers. In chapter 3 these were referred to as 'practorates'. VET institutes may have several practorates operating in different fields. In the case of the CoP, the professional VET institute of Zuyd UAS is also involved. Therefore, their teacher team (known as lectorates) was merged with that of VISTA college to create the practorate-lectorate. Its role is to carry out research in the chemical sector and translate trends and developments into the curriculum of both VISTA and Zuyd UAS. It consists of one Lector-Practor, four researchers (some of which hold a doctoral degree), and one teacher. Furthermore, CoP is run by a project manager who collaborates with various of members of staff at CHILL, including lab technicians and business developers.

¹⁴ As explained in chapter 3, professional VET refers to vocational education provided at EQF level 6. In the Netherlands, professional VET is offered by universities of applied sciences such as Zuyd UAS.

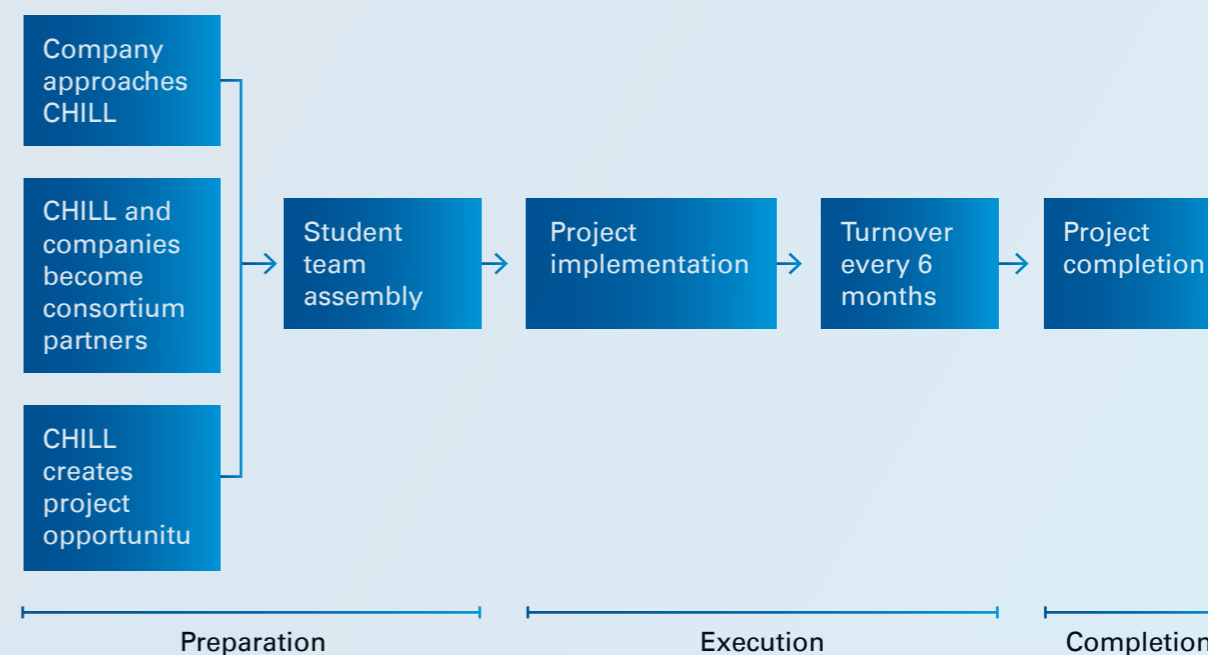
PROCESSES AND ACTIVITIES

Projects carried out in the CoP in part come from assignments directly commissioned by a company. In this case, a company may approach CHILL with an assignment or question which they need help with. Companies choose to collaborate with CHILL for a variety of reasons: because they do not have the R&D capacity or necessary lab equipment, or they may want to work with students as a way to scout for potential recruits. Furthermore, knowledge development through carrying out projects and working with CHILL facilities can also be a motive for participation. In some cases, companies also participate in CoPs for the public relations and networking opportunities involved in working with researchers and educational institutes. CoP projects are acquired by business developers employed by CHILL. They translate the company's request into

a research question to be answered. They also estimate the feasibility of the assignment and discuss the research design with the VET institutes. Budgets and quotes are drawn up based on the research design, which companies are required to pay for.

Another way in which CoP projects can be developed is in the context of long-standing research projects in which Zuyd UAS is involved. An example of this is the LUMEN project, in which a consortium of educational institutes work together with companies in order to develop a technology concept that will enable sunlight to be used as a 'fuel' for sustainable chemical processes. The larger research project is mainly carried out by researchers, but students can also be assigned smaller sub-projects which form the CoP projects.

FIGURE 4.4 PROCESSES AND ACTIVITIES IN A COP



In some cases, CHILL reaches out to companies to develop projects, but this is often not necessary, as companies know where to find them. This is particularly the case for companies established on Brightlands campus, due to the physical proximity. Companies outside of Brightlands Campus also know how to find CHILL, either through their contacts with education institutes, or through the awareness CHILL has gained in recent years.

Between three and five students can work together on a CoP project. The exact composition of the team (specialisation and education level) depends on the scope of the assignment. Some activities can be carried out by intermediate VET students, while others require a professional VET education level. Teachers from VISTA, Zuyd UAS and business developers from CHILL sit together to determine the composition of the CoP project teams.

Students are responsible for their CoP projects and conduct all the work themselves. They are nonetheless supported by a variety of different professionals in the process, such as lab technicians who provide practical support and supervise students working in the lab. In addition, each CoP project is also supervised by one coach who is a faculty member either from Zuyd UAS or VISTA college. Coaches are often academics who can use their expertise to help students with issues they may face in their research or provide theoretical input.

The active role of students in projects is always clearly communicated towards the company at the start of every project. Even though faculty members are supervising the quality and progress

of the project, in practice it still means that the project will be carried out in a slower tempo than if it was carried out by experienced professionals. Inherent to doing business at CHILL is investing in the learning and development of the students. Companies which come to CHILL not only want to carry out an assignment, they also want to meet the students they may employ later on. As a result, they are prepared to invest in the education of students, so that they are better prepared to work for companies when they graduate.

An example of a company which has collaborated with CHILL in a CoP project is Innosyn, a customer-research organisation which carries out research for the chemical industry. Innosyn collaborated with CHILL to carry out plasmonic catalysis reactions. This took place as part of a larger collaboration within the LUMEN project which has been described above. The project has been ongoing for 4.5 years. Every 6 months a new team of students joins the project to carry out a smaller assignment/sub-project. CHILL ensures that an overlap takes place in student teams to make sure that knowledge is not lost and that the project can continue.

COMPANY ENGAGEMENT

The role and level of involvement of companies varies depending on the CoP project as well as the companies' preferences and availabilities. In most cases, companies take on the role of the client and do not actively contribute to the project, only providing feedback when necessary. In exceptional situations, they may send staff to participate in the project, however most companies do not have the capacity to free up personnel in this manner. Often,

they also do not have the appropriate expertise to make such a contribution, because this lack of expertise is usually the reason why companies turn to CHILL with an assignment.

In the case of the LUMEN project which has been described above, a clear division was made between activities which were carried out by Innosyn staff members themselves in their company's labs, and the work of students which was carried out in a mirror reactor at CHILL. Insurance reasons prevented students from working in the Innosyn lab. Instead, they were invited to observe experiments carried out in the company labs by staff members. Innosyn mostly worked on their part of the project, and monitored the students' progress at a distance through email correspondence.

STUDENT ENGAGEMENT

Students participate in a CoP as an intra-curricular activity, meaning that it constitutes an integral part of their curriculum. However, the scope and importance of CoP in the curriculum differs between the intermediate VET programme and the professional VET programme. For students at VISTA

college, the CoP is elective. Therefore, students from VISTA who choose to participate in the CoP spend 2.5 days per week working on the CoP for a period of 10 to 20 weeks, depending on the project. For students at Zuyd UAS, the CoP is a minor¹⁵. Zuyd UAS students also spend 20 weeks on the CoP with their peers at VISTA college, but work on the project on a full-time basis. Consequently, they also receive more study credits for their participation.

As previously mentioned, intermediate and professional VET students work together on a CoP project. This requires a certain level of coordination and division of tasks between the students, based on their knowledge, competences and experience. This is said to run very smoothly because such coordination and making agreements is a central part of the Community for Development (CFd) methodology used in CoP projects, where students determine together which steps should be taken. In general, professional VET students are asked to

¹⁵ A minor is a secondary subject within a study programme. It complements a major, which is the academic discipline which students follow during their studies.

TABLE 4.5 MAIN TASKS OF INTERMEDIATE AND PROFESSIONAL VET STUDENTS

INTERMEDIATE VET STUDENT	PROFESSIONAL VET STUDENT
Routine-based activities	Advanced research activities
Specific chemical analyses	Leadership and management role



take the lead within CoP projects and assign tasks to the intermediate VET students. Intermediate VET students' tasks are more often routine-based and require less research skills. The division of tasks is nonetheless always carried out in consultation with the entire team, and it should not be the case that the intermediate VET student does all the work that needs to be done. On the contrary, it may be the case that the intermediate VET student has gained more experience with a specific chemical analysis within their study which the professional VET student has not learnt. In that case it then makes more sense for the intermediate VET students to carry out these tasks as they are more competent to do so. The leadership role is given to professional VET students as undertaking such a role is more in line with their competence profile in their education programme. Table 1 summarises the main tasks of intermediate and professional VET students:

As a result of the more limited amount of time the intermediate VET students have to work on the CoP project, they cannot carry out as many tasks or experience the same level of engagement as professional VET students. This means

that certain tasks sometimes have to be carried out by a professional VET student, even though an intermediate VET student would be perfectly capable of doing these, but simply cannot due to limited availability. Ideally, all students would work on the CoP on full-time basis, but the educational requirements on intermediate VET programmes predetermined by national education regulations prevent VISTA from accrediting the CoP with more study points. On the other hand, Zuyd UAS was able to arrange this a few years ago. Students' work in the CoP project is assessed in two different ways. First, they are required to deliver a concrete product to the client. The exact form of the product will depend on the assignment of the CoP project, but could for example be a prosthesis or plastic granules. The product delivered is similar to the kind of work students will have to produce in their future jobs, and the quality is expected to be approximately equivalent to the work a VET graduate with 1-2 years of work experience would deliver. This high level of quality can be guaranteed due to the collaboration with the lab technician, whose support and experience helps students take their work a step further.

In addition, students are required to develop an individual portfolio, where they outline an individual research plan and a set of learning goals to be achieved throughout the project. Whereas the product is assessed based on quality and group work, this part of the assessment focuses purely on the individual progress and the soft skills which students develop throughout the project. The assessment is conducted by an external assessor who is not tied to the project and does not have expertise on the topic of the CoP project. Assessors carry out their assessments at three distinct moments: at the beginning to assess the starting point of the student, at the middle of the project to reflect with students on their learning and development process, and at the end they set a grade on the progress made. This grade is determined based on a set of pre-defined indicators and on feedback given by all project members. The development process that students experience in the CoP project weighs most heavily in determining the final mark students receive.

STUDENT LEARNING BENEFITS

Students reported that they have acquired a vast range of skills and

knowledge throughout their participation in the CoP project. First and foremost, they highlighted the soft skills and personal competences: teamwork, communication, presentation and negotiation skills. They were required to make collective decisions and consult one another in order to move forward in their work. One student reported having struggled with a team member not doing their work as had been agreed. Addressing this situation taught the student a lot on how to communicate and solve problems with a peer. By having direct contact with the client, students also gained better insights into how to communicate professionally with a client and work on a project-basis with a budget and a timeline. It also gave them some insight on how their future jobs could look like and what employers expect.

Another important learning experience for students was managing the uncertainty involved in the open-ended nature of the CoP projects. Due to its real-life and innovative character, no one knew which results would be reached and what the next step needed to be. This required a certain level of flexibility in students' attitudes, as well as creativity to come up with solutions

TABLE 4.6. OVERVIEW OF PARTIES INVOLVED IN PROJECTS AT IDEAWORKS

ACTOR	RESPONSIBILITY
Mohawk College	Provide vocational education
Ideaworks	Faculty within Mohawk for applied research
Company	Commissions a project



to the problems they faced. The teachers explained that some students were better at handling this uncertainty than others, and saw an important role for themselves to support students in navigating this uncertainty. The teachers did not see a difference in the extent to which intermediate VET students or professional VET students could manage uncertainty.

Finally, students also gained technical skills and substantive knowledge through their participation in the projects. They developed their research skills and learnt how to carry out new experiments. In relation to research skills, a difference could be noticed in the learning experiences between intermediate and professional VET students. Intermediate VET students explained that they had little knowledge and experience in literature reviews. This proved to be important to the project. As such, an intermediate VET student explained to have mastered this skill through the CoP and he claimed that he would not have learnt this skill to the same level if it had not been for this project. The substantive knowledge students acquired had more to do with the chemical analyses they performed, as well as knowledge about how a catalyst works. Thanks to this project, students considered that

they had acquired a significant level of expertise which they could present as an important strength on their CVs.

CANADA MOHAWK COLLEGE AND IDEAWORKS

Mohawk College is a college located in Hamilton, in the province of Ontario. It offers initial and continuing intermediate vocational education (EQF 5) in a wide range of fields. It also has an applied research and innovation department, called Ideaworks. Within Ideaworks, staff members and students partner with companies and community organisations to work on applied research projects for partners in the private, public, and not-for-profit sectors. Ideaworks consists of multiple research centres focusing on different sectors/areas of research, including: (1) Additive Manufacturing, (2) Biotechnology, (3) Energy & Power, (4) Healthcare and Medical Technologies, (5) Industrial Internet of Things, (6) Sustainability (7) Climate Change and (8) Unmanned and Remote Sensing. At the time of writing, Ideaworks counted 224 partnerships in industry, government and academia. These activities have led to projects in the order of CAD 10.8 million (EUR 7.42 million). In 2022, Mohawk College won the bronze medal for Applied Research and Innovation

Excellence, awarded by the national association of colleges and institutes in Canada, CiCan.

IDEAWORKS RESEARCH TEAM

Projects at Ideaworks are carried out by students and researchers.

Students

Students are involved in almost all of the research projects carried out at Ideaworks. Research centres usually hire several students each semester to work on projects. There is no age limit or experience level required, meaning that students from all grades can participate in applied research. Students will receive different guidance and tasks depending on their knowledge and expertise. However, students often follow a study in a field related to the subject matter they are conducting research on. The student interviewed for this study was enrolled in a civil engineering and technology programme at Mohawk College, which was in line with the field of remote sensing technology of the project he was working on.

Staff researchers

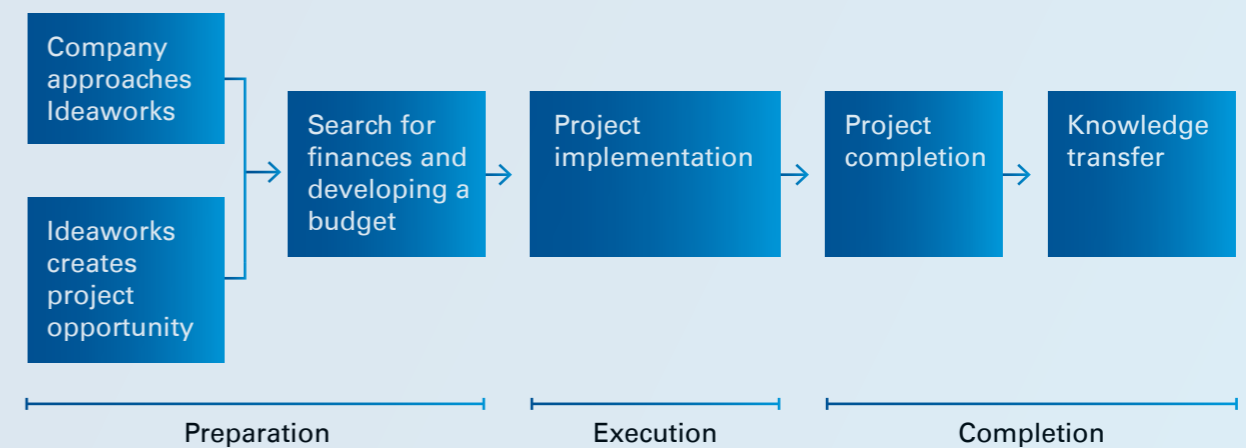
Staff researchers involved in research projects at Ideaworks may have different positions at Mohawk College. Many of them teach classes and have specific expertise, in the field of engineering, for example. However, teaching classes is not a requirement. Some staff members choose to focus purely on research.


At the time of writing, Ideaworks counted 153 staff researchers and 353 students engaged in applied research.

PROCESSES AND ACTIVITIES

Applied research and innovation projects at Ideaworks can be initiated in different ways. Organisations can approach Mohawk with a question/issue which is turned into a project. In these cases, organisations come to Ideaworks because they do not have the capacity to carry out the work themselves, either in terms of available staff, expertise, or access to equipment. They can then leverage faculty, staff and students who have the capacity and availability to work on projects. Ideaworks also actively works on scouting and acquiring

FIGURE 4.7. PROCESSES AND ACTIVITIES IN A PROJECT AT IDEAWORKS





projects itself. A lot of communication and marketing efforts are made to increase the visibility of the College and its applied research activities. As such, Ideaworks organises workshops, attends conferences, and networks in order to keep informed about the trends and developments in various industries, and show organisations what expertise and capacity Ideaworks has and why Mohawk College is an excellent partner of choice to work with on industry/ community problems.

The implementation of projects at Ideaworks is guided by research policies developed by Mohawk College. Policies have been developed regarding how research should be carried out, including guiding principles around financial integrity, placing an important focus on how to create a budget which is accurate as well as transparent for the funding agency. Mohawk has also developed templates for non-disclosure agreements, letters of understanding, collaboration agreements, and other

forms of contracts which may be used with industry partners. Mohawk College has also set up an ethics board which carries out ethical reviews of research projects done by Mohawk faculty, staff and students which are carried out on or including humans. The research policy also establishes Ideaworks as a self-standing research group within Mohawk College. The aim of Ideaworks is to provide the necessary support and expertise to those conducting research. Ideaworks not only helps manage the research processes necessary to develop solutions, but also provides the operational expertise for general processes across the different research centres. As such, it provides support in dividing research tasks and in the grant writing process.

Industry partners are not always able to finance the entirety of the project, requiring additional funding to be collected from governmental and/ or private donors. Some projects at Ideaworks are funded by the Ontario



Centre of Innovation and the National Science and Engineering Research Council. The former is a provincial and the latter a federal grant agency. Each grant agency establishes specific criteria to determine who qualifies as an industry partner. Some agencies refuse to fund projects commissioned by governmental organisations. In this case, funding can be applied for at private agencies, such as the Kenneth Molson Foundation. When this type of alternative funding stream is used, industry partners and researchers from Ideaworks work on a more equal footing, as they are not commissioning (financing) the project directly, but taking on a more collaborative role. However, Ideaworks has always been ranked high on so-called 'industry intensity', meaning that the proportion of funding they get from industry or community partners commissioning the project is comparatively higher than the funding they receive from funding agencies (Re\$earch Info Source, 2021). An example of an applied research project at Ideaworks is called the Waba Dam project carried out for the Ontario Power Generation (OPG) corporation. It was carried out by the Unmanned

and Remote Sensing Innovation Centre (URSIC), one of the research centres within Ideaworks. As its name suggests, URSIC works on projects related to remote sensing technology. Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). For OPG, URSIC explored whether drone-equipped Light Detection and Ranging (LiDAR) equipment could be used to complete a visual inspection of the vegetation covering Waba Dam facility. OPG was doing construction works on the dam and wanted to perform a scan of the dam before and after the construction. The company had no previous experience with LiDAR and was interested in understanding the benefits of this new technology. The project was initiated by OPG, who approached URSIC. OPG had worked with URSIC in the past so a track record had been established and they wanted to work with URSIC again on another research initiative. Data for this project was collected by the staff researcher at OPG, as Covid-19 regulations in place at the time restricted travel and contact





between people. A student was however involved in the processing of the data, which could be done at URSIC.

COMPANY ENGAGEMENT

The extent to which companies and community organisations are involved in projects at Ideaworks varies widely, and often depends on their own interest, willingness and ability to get involved in the project. It may also be determined by the way in which the project is set up. For example, researchers may sometimes need to test out different solutions to possible problems, and ask the industry partner for their feedback and opinion. In the OPG project, however, the industry partner was less involved because it knew very little about LiDAR technology, and therefore could not contribute to the research.

Upon completion of a project, the researchers of Ideaworks always transfer the knowledge gained in the project to the industry partner. It is a policy of the College to allow intellectual property (IP) to remain with the industry/community partner. The College does not seek to retain IP for its own benefit. This allows the industry partner to market the solution if it so desires without interference from the College. It also helps accelerate the implementation of the solution, as the company already

knows how to work with the developed solution. In the case of the OPG project, the LiDAR method was explained to the company, and the company is now able to replicate the research itself in other projects. Industry partners see this knowledge transfer as an important advantage of collaborating with Ideaworks, which they would not receive if they simply purchased the technology themselves, or outsourced the assignment to a commercial partner or university, which might also seek to retain the intellectual property rights.

Collaborating with VET applied research centres such as Ideaworks has another advantage for industry partners, namely that it makes innovations more accessible, and in this process also accelerates the implementation of innovations into industry. OPG indicated that, by collaborating with Ideaworks, they were able to reduce such uncertainties, as the research centre already has the technology and the Waba Dam project introduced new techniques. OPG was able to see how LiDAR works and determine its worth before purchasing the technology themselves. As such, these processes facilitate a smoother and quicker transition of innovation into industry.

'Working with [URSIC] helps us make better decisions. Of course there's always a certain degree of acceptable risk when working with innovations, but this relationship minimises our risk of getting things wrong' (OPG staff member)

A final benefit of working with Ideaworks is said to be the financial aspect of the project, as working with Mohawk College is considerably less expensive than with a commercial party.

STUDENT ENGAGEMENT

Students' participation in applied research projects is extracurricular, meaning that they do not obtain credits for their contribution to a project. However, students usually work on projects involving a research matter that is in some way related to their studies. This gives students the opportunity to acquire skills and knowledge that relates to their field of study. Students are hired as paid staff for 15 hours a week¹⁶. The hours are flexible, which means they can work around their schedule, with the exception of the staff meeting which they need to attend. When projects have different and varying durations, students can work on several projects at the same time.

The activities students are engaged in depends on their experience and level of expertise. Students who are in their first year of college may need more

¹⁶ Coop (part-time) students may work full-time hours/weeks for a number of months – 4 months to a year depending on the programme of study. The 15-month cap is for students who want to get paid to do research work while they are studying and therefore the cap is lower so as to allow the student to continue to concentrate on their courses.

supervision and therefore often work alongside a staff member. As they gain more skills, knowledge and experience, they are able to carry out more advanced tasks and work more independently. They may be involved in data collection and data analysis. In some cases, students may share project management tasks with the staff member. They have a seat at the table with the industry partner and contribute to determining the scope of the project.

At URSIC, students are often not allowed to fly the larger drones. They are covered by Ideaworks' occupational insurance, but staff members would rather not run any risks with such expensive equipment. Instead, the students provide all kinds of on-site support and log the data. Even though they do not fly the drones, they still gain a lot of hands-on experience and learn about safety regulations, by helping to switch batteries and set up generators. After the data collection, students process the data and almost always handle the communication with the partner directly, except when there is an issue or concern, in which case the staff member steps in. Staff members are always copied in emails so that they can keep track of the project's progress.

In some cases, students are given the task of becoming the office's expert on a new technology. As an example, one student became an expert on LiDAR data processing, and is now responsible for teaching other students, as well as staff members, on the nuances of this new technique.

Students also gain other managing experience, for example through the mentoring system set up between new and more experienced students. In this



case, the more experienced student may be responsible for training their peers on a certain technique.

Industry partners who have worked with college (EQF 5) and university (EQF 6-7) students do not notice a difference in their level of knowledge and expertise. Whereas university students receive academic training, when working on hands-on technology projects, partners find college students just as knowledgeable. In fact, industry partners sometimes find college students to be even more capable than university students, as students graduating from the college system have blended the theoretical knowledge with the hands-on procedural knowledge needed to start work in industry and be capable of running equipment, for example.

STUDENT LEARNING BENEFITS

Students who participate in projects at Ideaworks learn a variety of transferable skills for their future occupations. They learn many soft skills, such as project management and time management. Time management is seen by students as an important skill, keeping up with a large workload in a fast-paced environment. They also develop problem-solving skills, and learn how to develop relations with a client. As students often have direct contact with the industry

partner, they learn to interact within a professional setting. Students often come into contact with a larger group of professionals than the industry partner itself, and often gain experience on a multitude of different projects. This further develops their professional skills and gives them a deeper view of what the industry looks like. In addition, the knowledge transfer process towards the client is said to be particularly instructive, as it requires particular communication skills to make sure that the data is transferred in a clear and effective way.

The active contribution of students in the project also teaches them many technical skills. In the case of the remote sensing projects, students gain experience with data processing, which will be an important skill they will use in their future careers. Students are responsible for the entire data processing, with a staff member overseeing their work. They also gain on-site experience by carrying out ground surveying and flying the smaller drones which do not require a licence. Through these activities, students also gain more awareness about safety regulations.

As a result of this experience, students participating in Ideaworks are said to be in high demand in the labour market, and often receive job offers upon graduating.

TÜRKIYE PRIVATE ENKA VTAH

Private Enka VTAH is a VET institute located in the province of Kocaeli which offers upper-secondary education, accredited at EQF level 4. It was founded by a global engineering and construction firm known under the name 'Enka İnşaat ve Sanayi A.Ş.' (for short: 'Enka'). Enka has founded Private Enka VTAH to promote high quality education. This school should therefore not be confused with a training institute for future Enka employees, as most of its graduates continue to pursue university education. Enka is also not involved in the school's activities and does not contribute to the curriculum, which is exclusively determined by the MoNE. Türkiye counts approximately 200 schools which are privately funded in this way by a company.

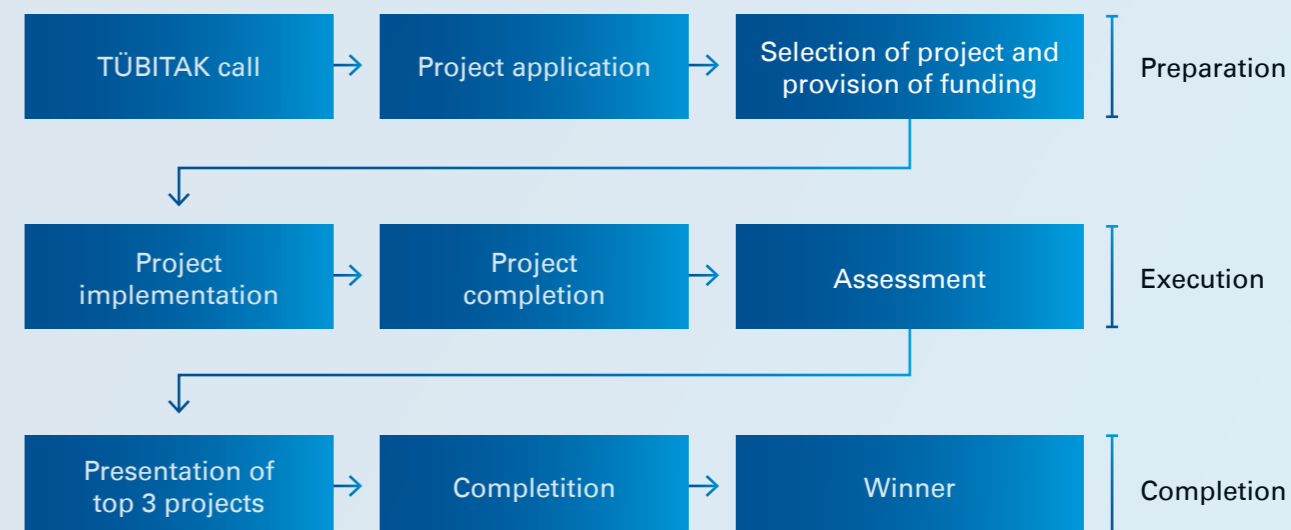
Through the Enka foundation, Private Enka VTAH has been equipped with high-quality facilities and advanced

technology. It has several R&D labs in the fields of biology, chemistry and physics. In addition, the foundation covers all education costs, including enrolment fees, school transport and lunches, as well as exchange and internship programmes abroad. Although the school also receives some funding from the Ministry of National Education, most of the funding comes from the Enka foundation. As a result, despite its name, Private Enka VTAH is still considered to be a public school as its curriculum is managed by the MoNE. Private Enka VTAH has become one of the most prestigious schools offering upper-secondary vocational education in Türkiye. It is said to attract the most competent students who achieve the highest scores on their lower-secondary state examinations.

PRIVATE ENKA VTAH RESEARCH TEAMS

Projects at Private Enka VTAH are carried out by students, who are coached and guided by their teachers.

FIGURE 4.8 PROCESSES AND ACTIVITIES IN TÜBİTAK PROJECTS



Students

Students of all grades may participate in the applied research projects. The project group size varies depending on the type of project to be carried out. In some cases, projects are carried out by two students, whereas other projects are carried out by 10 to 20 students. Students specialise in either chemistry, physics or mechanical engineering.

Teachers

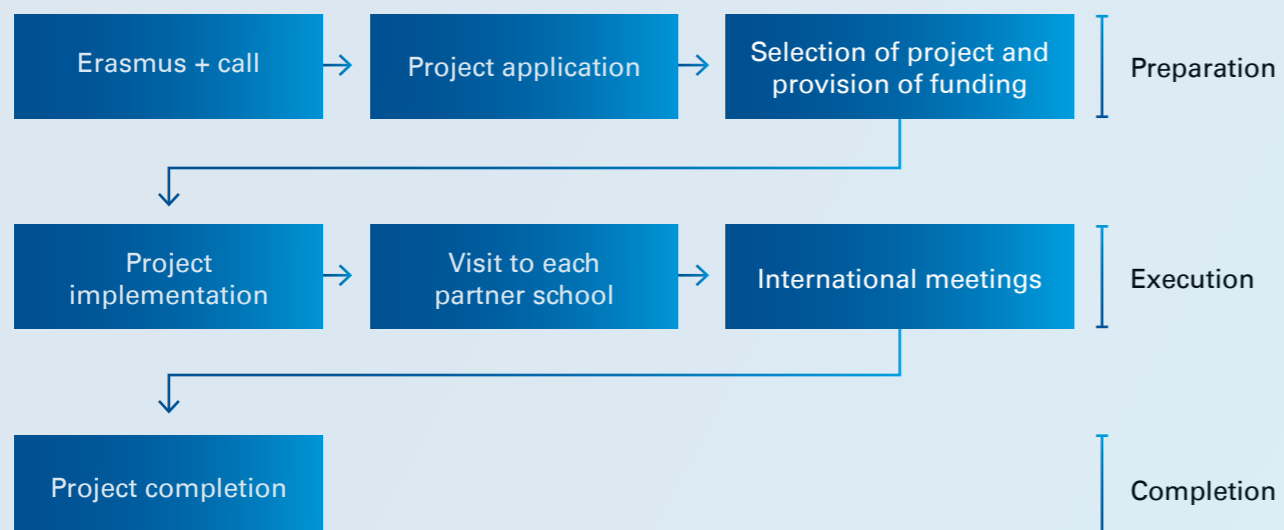
All applied research projects are carried out by students, with the support and guidance of a teacher. Generally speaking, teachers involved in these projects are experts in their fields, having a university education and sometimes also research or professional experience. Teachers are responsible for the selection of students who will participate in a research project. They also coach students throughout the project, either by sharing knowledge and expertise on a particular subject, helping students to collaborate, and at times coordinating

collaboration with external partners, such as for example the university to use their facilities.

PROCESSES AND ACTIVITIES

Different types of applied research projects take place at Private Enka VTAH and are usually related to the fields of chemistry, physics or mechanical engineering. Some projects are also implemented across departments, such as the interdisciplinary project, in which students from the automation and mechanical engineering department worked together to develop a dining chair for people with disabilities. There are two main types of applied research projects undertaken at Private Enka VTAH. The first types of projects are initiated by TÜBITAK, an agency within the Turkish government for establishing and financing projects to stimulate students' scientific, technological, and innovation activities (as described in chapter 3). Within these projects, students work in pairs, together

FIGURE 4.9 PROCESSES AND ACTIVITIES IN ERASMUS+ PROJECTS



with a teacher, on an applied research project in one of the pre-defined thematic areas outlined by TÜBITAK. Last year, students developed a natural biosorbent which removes chromium from industrial waste waters.

Students and their teachers develop a project application for TÜBITAK projects between the months of September and January. In May they are informed whether their project application has been selected to be carried out further. Students usually start working on the projects in their first or second year and the projects usually last around one year. Upon completion of the projects, the final product and findings are sent to TÜBITAK, which reviews and assesses their quality. The results are published in March. Completed projects are exhibited in a university located close to the school's district. The best three projects from each field then qualify for a national competition called 'one idea, one world' with schools across the country. This conference usually takes place at the end of May.

The second type of applied research projects carried out at Private Enka VTAH are Erasmus+ projects. Within

these projects, students work on an applied research assignment which is also running in other vocational schools. When students have completed the project, visits are then organised in each of the partner schools for students to present their findings to one another and also have an intercultural exchange. Last year, students developed a gripper robot which grabs a ball and moves along a line. They visited Italy, Germany, Hungary, Poland and Belgium. Private Enka VTAH will be hosting a meeting in September. In order to apply for the Erasmus+ project, teachers and their students jointly write a proposal for a project which will be carried out by students. Typically the students then work in pairs to complete their objective and present their work in the following 'meeting'. On average, the Erasmus+ projects last between 2 and 3 years. The currently ongoing project covers the years 2021-2024.

Although some projects receive a patent award, these cannot to be commercialised. This is because the school is recognised as a public institute which is not allowed to commercialise its products.



STUDENT ENGAGEMENT

Participation in the projects is voluntary and mostly carried out as an extracurricular activity. Many students choose to get involved in applied research projects in order to improve their university applications. Students who win the TÜBİTAK competition receive additional credits on their university entrance exams. Furthermore, it can help students with their education grant in case they applied for it.

STUDENT LEARNING BENEFITS

The development of soft skills was often reported by both teachers and students as being an important learning outcome and benefit from participating in the applied research projects. By working in teams, students developed their collaboration and leadership skills. They described getting to know one another, as well as getting to know the teacher they were working with, as an important

step in their own learning process as well as an important contributor to the project's progress. As the development of the biosorbent encountered many challenges, the students explained that they also learnt about perseverance and learning from their own mistakes.

Communication and presentation skills were also developed by participating in the projects, as students were often asked to present their findings. This was for example the case in the context of national competitions, such as in the TÜBİTAK event 'one idea, one world' where students had to pitch their projects. Presentations to peers was also an essential part of the Erasmus+ applied research project, where visits to each vocational school were organised in order to share findings. In these cases, students also practiced and improved their English language skills, and learnt about intercultural communication. One

student said that developing intercultural skills had been of particular importance for her:

"I think that I have improved my communication skills with people who are not from my country. Talking with foreigners used to be a source of anxiety for me. Through getting to know the students from the other countries, this fear started to disappear." (student from Private Enka VTAH)

In addition to soft skills, both teachers and students reported that the applied research projects also teach students extensive technical knowledge and skills. This can have to do with specific chemical reactions and analyses which students may learn to carry out during their projects. It can also refer to the experience gained with operating specific equipment and advanced machines. For one student, an important learning outcome from participating in the applied research project was learning how to consult literature and carry out a literature review. This student explained that literature reviews are an important part of research, especially in the chemical sector, in order to understand which chemical reactions have been tested in the past and which prove to be most effective. How to carry out a literature review is not taught in class, so this student sees this as an important additional learning outcome which she benefited from by participating in the project.

The knowledge, skills and experience which students gathered was also said to be valuable to students in preparing for their future careers. One student explained that learning to use advanced equipment as well as working in a team would be very important for when she would become a surgeon, as collaboration is an important part of surgery, as well as operating the machines which she had familiarised herself with during the biosorbent project. Teachers at Private Enka VTAH also add that the insights which students have gained in how research is carried out, and how professional laboratories as well as university facilities operate, would be important assets for students in their future careers. For half of the students which were interviewed, participating in the applied research project had also influenced their orientation on university and future career choices.

"I was already enthusiastic about chemistry and biology when I first started school. Through doing this project, my excitement has only grown. So I think that it's pretty clear that I should pursue a degree in chemical engineering." (student from Private Enka VTAH)

CONCLUSION

This study has been guided by the central research question:

How and to what extent are the different VET systems involved in applied research projects?

In order to answer this question, we began by analysing how VET systems are organised in the different local and national contexts under study: Spain, the Netherlands, Canada and Türkiye. We also explored which policy frameworks and financial mechanisms enhance the involvement of VET in applied research. Following this, we examined an example of applied research in VET taking place in each context. To this end, we studied the processes and activities in place, the engagement of companies and students, and the learning benefits for students participating in these projects.

Chapters 3 and 4 have presented a country-specific answer to each of these research questions. A summary of these answers can be found in the executive summary. In this chapter, we bring the insights from the four cases together and consider them in comparison to one another. We do this at two levels: firstly at the policy level, and secondly at the level of good practice.

POLICY FRAMEWORK ANALYSIS

In Chapter 3, we discussed three main themes within policy frameworks facilitating applied research: the

organisation of VET systems, the policy context and the financial mechanisms. These themes are discussed below. For the continuity and readability of the text, we have combined the comparison of the policy context with that of the financing mechanisms.

ORGANISATION OF VET SYSTEMS

Looking at the ways in which vocational education is organised in the four countries under consideration, we see many similarities, but also many differences. Starting with the similarities, Spain, the Netherlands, Canada and Türkiye all offer intermediate and higher levels of vocational education. Higher vocational education is usually only accessible upon completion of intermediate VET, or by obtaining a general secondary education diploma.

However, in contrast to Canada and Türkiye, Spain and the Netherlands also offer basic VET programmes. In Spain, basic VET is a type of alternative education for early school leavers who otherwise would not obtain a diploma. This is different for the Netherlands, where basic VET (MBO levels 2 and 3) are seen as more practically oriented programmes open to a broader group of learners.

In Spain, Türkiye and the Netherlands, higher VET is offered in the form of an associate degree programme lasting 2 years and focused on rapid integration into the labour market. Although the term 'vocational education' is not used in Canada, its equivalent is found in

TABLE 5.1. COMPARATIVE OVERVIEW OF THE TYPES OF VET PROGRAMMES

	SPAIN	THE NETHERLANDS	CANADA	TÜRKIYE
Basic VET	Alternative education	Practical education	N/a	N/a
Intermediate VET	Upper-secondary education	Upper-secondary education	Upper-secondary education	Upper-secondary education
Higher VET	Associate degree programme	Associate degree programme	College programme	Associate degree programme
Professional VET	N/a	Professional education	N/a	N/a

programmes offered at colleges, which last 4 years. The Netherlands is the only country providing so-called professional VET (or higher professional education), accredited at EQF level 6. This level of vocational education is non-existent in the other countries, and rather takes the form of a technical degree at a university.

POLICY FRAMEWORKS FACILITATING APPLIED RESEARCH IN VET

When it comes to the policy frameworks for applied research in VET, we see that whereas Spain, the Netherlands and Canada have a largely decentralised governance structure, Türkiye has a more centralised approach to developing policy. In Canada, the decentralised policy structure is related to the fact that Canada is a federal country. Spain, although not officially considered a federation, does present federal elements, such as the existence of the autonomous communities such

as Catalonia and the Basque Country. The decentralised governance structure in the Netherlands is the result of a decentralisation trend of policy processes ongoing in the Netherlands since the turn of the century.

The policy and governance structure in place does not seem to be decisive for the types of applied research policy initiatives put in place. Within the decentralised structure of education policy in Spain, the Basque government has in fact taken important steps to codify the role of VET providers in applied research. In the Netherlands, the decentralised policy structure has led to the grass-roots development of various applied research initiatives such as practorates and public-private partnerships. The Dutch government facilitates these initiatives by supporting Katapult and by developing structural funding opportunities for practorates.

In Canada, colleges are left to develop their own applied research policy, in stark contrast with Türkiye, which has developed a 2-track policy investing in the R&D facilities of both the weakest as well as strongest schools in the country. Looking at how these positions translate into funding structure, it is also difficult to identify a specific trend. The decentralised policy structures in Spain and the Netherlands come paired with ad hoc funding through grants, pilots and awards. However, in Canada funding is expansive and structurally implemented at federal and provincial level. Funding in Türkiye is also structural, however this comes as less of a surprise given the largely centralised structure of the Turkish policy system.

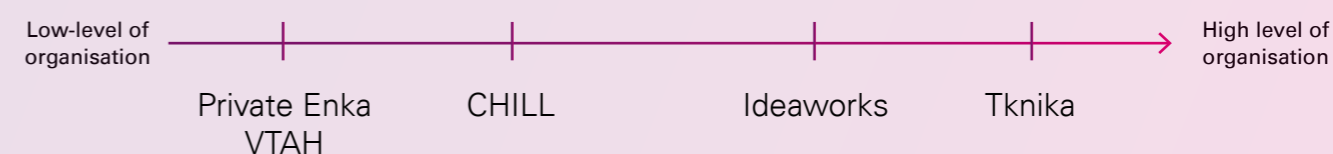
COMPARATIVE ANALYSIS OF GOOD PRACTICES

Tknika, CHILL, Ideaworks and Private Enka VTAH differ greatly from one another. They also show several similarities. These differences and similarities are discussed below.

ORGANISATION OF APPLIED RESEARCH

A first striking feature when considering the good practices is the way in which the applied research projects are organised. Tknika operates as an institute/expertise centre providing support (through training, networking and monitoring of projects) to VET providers who wish to carry out applied research (see section 4.2 for more information). Tknika does not carry out the applied research projects themselves.

FIGURE 5.3. COMPARATIVE ANALYSIS OF ORGANISATION LEVEL OF APPLIED RESEARCH ACROSS GOOD PRACTICES



In Canada, Ideaworks operates in a similar way, by developing policy regarding how applied research should be carried out and through its installation of an ethics board (see section 4.4 for more information). Whereas Tknika collaborates with VET centres, Ideaworks operates from within Mohawk College, thereby constituting an important difference in the way in which applied research is organised.

On the other side of the spectrum are Vista College and Private Enka VTAH. Through its involvement in CHILL, Vista College is pioneering in the field of VET applied research within the Dutch context and therefore still setting up the infrastructure for applied research projects to take place on a structural basis. As described in section 4.3., Vista

implemented its first applied research project as a pilot in February 2022, and plans to further expand its activities into other educational programmes throughout the coming academic year.

Private Enka VTAH has developed a wide range of applied research initiatives. Similarly to Mohawk College's Ideaworks, these mainly take place within the VET institute. However, the applied research projects are initiated through governmental calls and are not commissioned by a company. The level of organisation and structures that can be found in Mohawk College is therefore not yet in place. Furthermore, interviewed Enka VTAH stakeholders are not interested in further expanding and commercialising their activities, as they are satisfied with the current process.

TABLE 5.2. COMPARATIVE OVERVIEW OF POLICY FRAMEWORKS FACILITATING APPLIED RESEARCH IN VET

	SPAIN	THE NETHERLANDS	CANADA	TÜRKIYE
Governance structure	Decentralised	Decentralised	Decentralised	Decentralised
Main policy initiatives on applied research in VET	Codification of applied research as a primary responsibility of VET centres in Basque Law	Supporting existing initiatives of vocational institutes to carry out applied research	Colleges determine own policy	Active financing
Funding mechanism	Ad hoc funding	Ad hoc funding	Structural multi-level funding	Structural funding





STUDENT ENGAGEMENT

As was discussed in the introduction of this report (see section 1.1), the development of applied research in VET can serve several purposes, amongst which the two most important ones are (1) to address the growing need of SMEs for support in innovation efforts, and (2) to promote the innovation and learning processes of VET students and teachers through research activities. Naturally, these two goals are not mutually exclusive. Nonetheless, our analysis of good practices suggests that these can also be placed on a similar spectrum, where on the one side companies' innovation efforts are promoted, and on the other students' learning processes are prioritised:

At Tknika, students are not directly involved in the applied research projects. As described in section 4.2, this choice was made by Tknika and embedded in the Tkgune programme policy.

Companies pay for the VET centre's services, therefore Tknika is of the opinion that the quality of the project deliverables should have priority over students' learning experiences. The main goal of the Tkgune projects is to update teachers' knowledge and promote competitiveness within SMEs. This does not mean that Tkgune projects neglect student learning experience. Learning takes place in the classroom, where teachers share their insights from the projects with their students.

Students are involved in projects implemented at Ideaworks. Depending on the research centre, they may even be the lead researcher on the project, undertaking the majority of the research activities independently, including maintaining contact with the client (for more information see section 4.4). Students thereby gain considerable learning benefits in the process. However, promoting students'

learning experiences is not the primary goal of Ideaworks, which is to promote innovation and competitiveness in SMEs. Applied research projects at Ideaworks are carried out as an extracurricular activity and students are paid for their work. In this process, they are recognised as an equal member of the research team, but their work within the applied research project is not necessarily directly related to their studies.

At CHILL, the CoP represent an elective course for Vista College students. As such, the applied research project is the subject matter of their study programme. Students are paired with a coach who offers regular guidance and support, and they are graded on both their participation as well as the quality of their work. In this way, the learning experience of students at CHILL occupies a more central role than is the case at Tknika and Ideaworks. At the same time, attention is also paid to the company's needs. CHILL guarantees this by making the professional researcher ultimately accountable for the project. In other words, if the quality of the student's work does not meet

expectations, the teacher will step in and complete the work.

At Private Enka VTAH, applied research projects are not commissioned by companies. Therefore, company needs are not taken into consideration. Applied research projects are carried out to promote students' learning experiences and teach them new skills.

COMPANY ENGAGEMENT

The role performed by companies in the applied research project also varies across the four good practices.

As mentioned above, companies are not involved in the projects carried out at Private Enka VTAH. Applied research at Private Enka VTAH is funded by governmental programmes and mainly takes the form of a national or international competition.

A striking commonality between Ideaworks and Tknika is the attention placed on the transfer of knowledge to clients, which both organisations highlight as a central step in their applied research processes. The transfer of knowledge appears to play

FIGURE 5.4. COMPARATIVE ANALYSIS OF STUDENT ENGAGEMENT



a less important role in the projects implemented at CHILL. One possible explanation for this could be found in the closer and more equal collaboration taking place between CHILL and the companies commissioning the projects. For example, in the case of the LUMEN project, researchers from Innosyn were simultaneously carrying out experiments in their own labs.

Another interesting theme in the engagement of companies in applied research projects is the attention placed on gathering funding as part of the process. This was namely the case for Ideaworks and CHILL, who participate as co-applicants for (governmental) funding with companies. In contrast, Tknika maintains a more commercial relationship, requiring companies to carry the financial responsibility entirely on their own. As explained in section 4.1, Tknika can only inform and advise companies about funding opportunities. As such, one could describe the relationships with companies at CHILL and Ideaworks to at times take the form of a consortium partnership, whereas at Tknika these could be described as a more commercial relationship.

Stakeholder benefits from participating in applied research

Although they were not part of the research questions, the benefits of VET engagement in applied research for other stakeholders were often discussed during the interviews and described in documents,

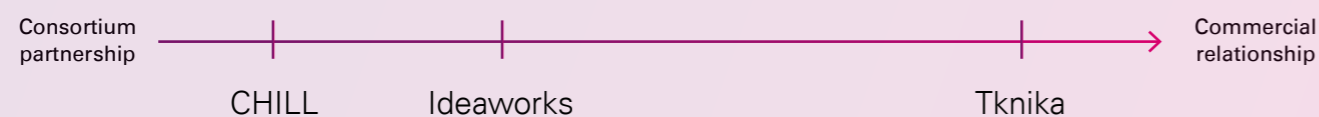
- VET centres – Connection to social and regional challenges, and to technological and social developments in the labour market. Promotion of innovation, excellence and flexibility in education. Diversify financial sources by engaging in commercial projects for companies. Create stronger added value as research and innovation partner to local companies and (public) organisations. Attract, motivate, professionalise and retain teachers as well as students. Diversify the school-teacher-student-company relationship.
- Companies – Access to additional research and development capacities for an affordable price, as VET centres bill the material and personnel costs without taking a large profit. This is especially valuable for SMEs which may not have their own R&D capacity and/or access to lab equipment and



who could otherwise not afford to invest in innovation. Working with students can also serve as a way to scout potential graduates through a first opportunity for collaboration. Another benefit to working on applied research in VET can also be the ability to retain intellectual property rights on innovations, which is not always possible when collaborating with other commercial organisations and/or universities¹⁷.

- Teachers – Co-create new expertise and know-how requested by partner companies and (further) development of their research skills. This promotes keeping up-to-date with the latest trends of the labour market by participating and contributing to innovation. In addition, we learned that applied research is highly conducive to teacher professionalisation, as it makes their careers more dynamic and enhances their motivation and curiosity.

FIGURE 5.5. COMPARATIVE ANALYSIS OF COMPANY ENGAGEMENT IN APPLIED RESEARCH PROJECTS



¹⁷ Intellectual property was mentioned by a small number of respondents. It was not part of the research questions, but this topic might be the subject of further research in the future.

ANNEX: OVERVIEW OF EXPERTS

COUNTRY	NAME AND ORGANISATION
The Netherlands	Boudewijn Grieverink (Katapult) Jorick Scheerens (Stichting ieder mbo een practoraat) Marc van der Meer (Tilburg University)
Canada	Saeed Walji (Colleges Ontario) Peter Soeraas (CiCan) Matthew Smit (CiCan)
Türkiye	Eren Sunar (MoNE) Cahit Ceren (TOBB) Hasan Caglayan Dundar (TOBB) Esen Caglar (Policy Analytics Lab)
Spain	Pili Alonso Suarez (Tknika) Iñigo Araiztegui Arraiz (Tknika) Beñat Konde Untzilla: programme manager Tkgune (Tknika) Iñigo Mijka Genbelzu: Coordinator Tkgune (Tknika)

LIST OF ABBREVIATIONS

CAAT	Colleges of Applied Arts and Technology
CFI	Canadian Foundation for Innovation
CHILL	Chemelot Innovation and Learning Labs
CiCan	Colleges and Institutes Canada
CoVE	Centre of Vocational Excellence
DSM	'De Staal Maatschappij' (the steel company)
ETF	European Training Foundation
EQF	European Qualifications Framework
IPR	Intellectual Property Rights
ISO	Istanbul Chamber of Industry
ITO	Istanbul Chamber of Commerce
MBO	'Middelbaar BeroepsOnderwijs' (secondary vocational education)
MoNE	Ministry of National Education
NGO	Non-governmental organisation
NSERC	Natural Sciences and Engineering Research Council of Canada
OCI	Ontario Centre of Innovation
OIZ	Organised Industrial Zones
ORF	Ontario Research Fund
PPP	Public-private partnership
R&D	Research and Development
SSHRC	Social Sciences and Humanities Research Council
TOBB	Turkish Union of Chambers and Commodity Exchanges
UAS	University of Applied Sciences
UniBus	University Business Collaboration Platform
TRAL	Turkish Research Area
VET	Vocational Education and Training
VTAH	Vocational Technical Anatolian High School

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