AIR IN VET

Applied Innovation and Research in Vocational Education and Training

APPLIED RESEARCH IN VET GLOSSARY

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D2.1 Applied Research in VET Glossary

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Publishable executive summary

This is deliverable D2.1 of the Applied Research and Innovation in vocational education and training, AIRinVET, project. The aim of the document is to provide a set of definitions, a common ground, to avoid misunderstanding among the project partners. The document will also be useful for external users with an interest in the topic.

The document is composed by two parts:

- A brief historical introduction.
- The glossary itself.

The document might suffer modifications during the lifetime of the project.

Contents

1. Introduction

This document is a glossary of research-related activities for vocational education and training. For the definitions, whenever it is possible, we followed official sources. We try to follow OECD's standards for most of the terms related to R&I, and Cedefop for the terms related to VET. When neither gives an answer, we either look at other sources or propose a definition ourselves. The reason to use existing sources and avoid proposing definitions of our own is that, on the one hand, we know we are not inventing new words, but just exploring the potential of extending their use to VET. On the other hand, we want to be able to talk to others at the international level and not invent terms that can only be understood in the small circle of the partners of our project.

Our glossary aims at defining:

- The actors that can be involved in an innovation system: VET centres, Higher VET centres, Universities, Enterprises, SMEs, Clusters, Research organisations, etc.
- The main R&I type of activities: basic research, applied research, experimental development, production, commercialization, innovation, etc.
- The main methods for conducting research: quantitative research, qualitative research, experimental research, etc.
- The main type of activities conducted in R&I: focus group meetings, prototyping, design, questionnaires, etc.
- The main results of the activities: papers, books, prototypes, products, services, patents, etc.

The document is a deliverable of the AIRinVET project and, as such, it is submitted in a PDF format to the Funding and Tenders Portal of the European Commission. But we will also build an online version of the glossary on the project webpage. The online version will allow us:

- To give users a better experience through an interactive way of consulting a given word.
- To change the definitions as the project evolves, to add new terms and to eliminate others.

In other words, the online version of the deliverable will allow us to keep things alive. Just in the same way in which the terms we define here are alive.

Two main parts make the document:

- A brief historical reflection about science, applied science, technology, research, innovation, and other terms that wishes to explain two things:
  - Where the terms come from and why it might be worth defining them.
  - The changing nature of things.
- The glossary with the definitions of the main terms of the taxonomy. The terms are displayed in alphabetical order and for each term we provide:
  - Its definition.
  - The source of the definition.

2. A brief historical reflection

Research can be defined as creative and systematic work undertaken to increase the stock of knowledge and devise new applications of available knowledge (OECD 2015: 44). The term "research", together with some subdivisions of it like applied research, basic research, pure research, action research, and others, are gaining relevance in the public discourse, but if compared to science, the reflection about research is still small in quantity. Philosophers, sociologists, historians, and others have paid much attention to science: we have a philosophy of science, a sociology of science, a history of science, and fields like science technology and society studies which mix contributions from disciplines just mentioned. But we are moving from discussing about science to discussing about research. We can indicate some different features between science and research (Latour 1998):

Science	Research
Certainty	Uncertainty
Cold, straight, and detached	Warm, involving, and risky
Puts an end to the vagaries of human disputes	Creates controversies
Produces objectivity by escaping as much as possible from the shackles of ideology, passions, and emotions	Research feeds on all of those to render objects of inquiry familiar.

There is therefore something (knowledge) that can be acquired (discovered, unveiled, created, etc.) through an activity (research). The reflection about knowledge, types of knowledge, knowledge disciplines and methods to acquire or disseminate knowledge is thousands of years old. Our conception of research, of knowledge in general, is heir to the first philosophical reflections in Greece and of their development through history. Greeks invented the attitude of "knowing for the sake of knowing", without any view to utility, from which our current idea of basic research is close[1]. Aristotle claimed mathematics was invented in Egypt when a privileged group of priests with all their needs met had time to get bored. He held a similar hypothesis of the origin of philosophy. This idea of not being moved by material motives lasted long in Europe and continues to be part of our discourse. We still defend, for example, the independence of pure science from the state, from ideology or the economy. Calvert relates it to the fact that, for centuries, this activity could be pursued only by those who did not need external sources of money, the practitioners tended to be a leisured upper class who could finance themselves. These social connotations carried through to the organisation of scientific research in Europe, in which scientists had a status based on traditional elites (Calvert 2006).
Most ancient sages devoted some thoughts to knowledge. They developed knowledge theories and drew classifications of the types of knowledge that are related to the way we understand things nowadays. To take

[1] I am not talking about methods and techniques for conducting research, but about the way of understanding what is basic research.

a small sample of a huge production, Parmenides of Elea wrote an extensive poem describing what the "goddess" revealed to him and depicting the "right way of inquiry", Heraclitus defended a processual view of reality which made some types of knowledge difficult, Socrates and Plato famously opposed a group of philosophers labelled as "sophists" because they considered them in possession of a "false knowledge", and they introduced very influential ideas such as idealisation because it is impossible to know directly from the facts, universalism, and causality. Aristotle, in a not-so-well-known text, distinguished different types of knowledge, which is of utmost topicality:

- What one should know to survive, is an important type of knowledge for "primitive" societies.
- What one should know to manufacture things, what Greeks referred to as "techné", Romans as "ars", and we have later understood as "technology" and "art", and even "applied science".
- What one should know to organise a city, the type of knowledge shared by most of the so-called "Seven Sages" or "Seven Wise Men". This is close to social sciences, such as economy, sociology, political sciences, law, etc.
- The type of knowledge about the principles of the universe, how things work, the movement and what we will nowadays refer to as "natural sciences" and what was historically referred to as "natural philosophy".
- The type of knowledge that is very abstract and learns about the principles of knowledge, reality, rationality, and this kind of this that from a modern-day perspective we will refer to as "philosophy".

He also did some distinctions that are still relevant to our understanding of science, research, and technology. For example, in his *Nicomacean ethics,* he distinguishes, on the one hand, things that cannot be in any other way. We can know of them (science). This is the type of object our natural sciences research about: things that can only be in a way because they respond to what, very generally can be labelled as a "natural law". On the other hand, some things can be in many ways. We can deliberate about them, like the topics of the social sciences. The reflection knowledge continued during Hellenism and the Middle Ages. It was also behind the birth of modern philosophy with authors like Bacon and Descartes, and it marked the whole period with discussions between "rationalists" and "empiricists". At the turn of the 19th and early 20th century, a scientific revolution took place with Planck, Einstein, Bohr, etc. and some intellectuals started to worry about the lack of progress in the social sciences if compared with the progress made in the natural sciences. Intellectuals, like the members of the Vienna Circle, argued that this was due to the "scientific method", and they started to study it with the aim of extracting its principles and translating them to social sciences and philosophy. This marked the beginning of the subfield of epistemology, and a famous branch of philosophy, known as "philosophy of science", but more importantly popularised the notion that there is a scientific method, although methodological treatises were centuries old by that time.

Our current concepts of art, technology, and science (or sciences) also derive from antiquity. Etymologically, both art and technology come from the Greek word "techné" and from its Latin translation "ars" (Tatarkiewicz 2007: 39; Schatzberg 2012). Using the word "art" to talk indistinctly about things that we would now consider differentiated as technology, or science, or fine arts, is strange for us but the concept of applied science and the concept of technology, both owe a certain way of understanding the arts. The most widely accepted division of the arts among the ancient Greeks and Romans consisted of the division between the liberal and the vulgar arts. Related to the attitude of "knowing for the sake of knowing, without any utility in mind", this division reflected an aristocratic system and the aversion the Greeks felt towards physical labour. They thought that the liberal or intellectual arts were superior (Tatarkiewicz 2007:82-83). The Middle Age maintained the division between vulgar and liberal arts, but it changed the terms by referring to the liberal arts as only arts and to the vulgar arts as mechanical arts. The liberal arts consisted of logic, rhetoric, grammar, arithmetic, geometry, astronomy, and music. The list of mechanical arts was varied but included disciplines such as architecture, construction, agriculture, navigation, medicine, etc. The division of the arts continued evolving along these lines. Suffice it to say that many parts of what we now consider technology, engineering, and applied science, were considered as arts until the 19th century. The independence of the fine arts from the sciences meant that what at a time where considered as mechanical arts, lost their prestige. It is interesting to note that on many conceptions of science and research, we still maintain such an "ideology" echoing the liberal and vulgar arts: basic research and basic science are superior to applied research and applied science. During the 19th and early 20th century, in many European countries we could find the name "art" used to name VET type education in Spain (Escuelas de Artes y Oficios, Escuelas de artes e industries), in France (arts et métiers), etc.

Science, although it is an old term, is a rather new label for a group of disciplines. What we now call "philosophy" and "science" had no strict boundaries until around the 19th century. Both were intermingled in "natural philosophy". It might be striking for our modern view to find out that the big names behind the so-called "scientific revolution" of the 17th century (Galileo, Descartes, Newton, Kepler, Copernicus, Leibniz, etc.) did not consider themselves scientists. It was not until the 19th century that a group of natural philosophers started to refer to themselves as "scientists". On June 24, 1833, in the third meeting of the British Association for the Advancement of Science, at Trinity College in Cambridge, the famous romantic poet Samuel Taylor Coleridge commented after William Whewell's speech that the practitioners gathering there (referred to at the time as "savants" or "natural philosophers") should not refer to themselves as "natural philosophers". Whewell, agreeing with him, replied that "by analogy with artist, we may form scientist" (Snyder 2011: 3).

A few years before his provocation to Whewell and to all the other wise men gathered at Trinity College, in his 1817 *Treatise on Method,* Coleridge coined the term "applied science (Bud 2012), closely followed by authors such as Ure and Babbage (Schatzberg 2012). But it is important to note that these applied sciences were not conceived at all as applications of a prior pure or basic science. They were rather considered an independent body of knowledge, the body of knowledge of engineers and industrialists. Before the invention of the term "applied science", authors spoke of "mixed science" and did not refer to anything like technology with it.

But the conception of applied science as an independent body of knowledge did not last long. Soon the relationship between pure science and applied science became one of dependence: applied science depends on basic science. Nowadays, many people still tend to consider, and perhaps rightly so, that engineers apply science (Aleksander 2012). Indeed, the terms basic or pure science and applied science, the same as basic and applied research, can provoke different reactions:

- Science is science, or research is just research, those divisions such as pure and applied are pointless.
- Only basic science, or basic research, is proper science (or research). The rest are second level disciplines. For example, in 1883, American physicist Henry A. Rowland spoke in front of the American Association for the Advancement of Science and claimed things like "American science is a thing of the future, and not of the present or past; and the proper course of one in my position is to consider what must be done to create a science of physics in the country, rather than to call telegrams, electric lights, and such conveniences by the name of science" (Cohen 62). This attitude was common until quite recently.
- Basic science and applied science, or basic research and applied research, can be distinguished analytically, but we cannot distinguish them in practice because everything is merged in a seamless way.
- Basic science and applied science, or basic research and applied research, are collaborative endeavours but the primacy is on basic science or research because it is the seed from which the applied variations grow. One of the oldest and most popular conceptions of technological innovation in the 20th century deepens in the last sense depicting innovation as a series of steps from basic research to commercialisation. This was indeed a convenient way for universities to justify the funding of their work, a way of attracting scientists to industry, and to raise the status of some disciplines, like engineering (Godin 2017).

The main postures regarding the relationship between technology and science are a) technology and science are autonomous, b) technology and science form a seamless web, and c) technology is applied science.

Let us starts by summarising the first posture of the autonomy of science and technology. Technology is much older than science: throughout human history, the ability to make tools and transform the environment has been essential. As Wolpert puts it, agriculture was "invented" around 7000 BC. Livestock were probably domesticated at the same time, but there is no reason to think that these farmers had any scientific understanding of the phenomena. By 3500 BC there was a great mastery of metallurgy, and around 3500 BC craftsmen in Mesopotamia succeeded in making bronze, for which the furnaces had to reach temperatures of over 1000°C. Glass working also dates to ancient times. On the coast of Peru, they knew how to make copper in 500 B.C., and so on. In short: the technological achievements of ancient cultures were enormous, but this was not science. There is no evidence of any theorisation of the process or the reasons why it worked in a scientific sense. Technology is universal, we find it everywhere, and necessary for survival. Science is not universal, not all cultures in the world have science, and is (or at least it has been until quite recently) totally irrelevant to most people's lives: one can live perfectly well without knowing anything about

Newton, Einstein, molecular biology, or quantum physics, but one cannot live without tools or shelter. Another typical argument regarding the relationship between technology and science is that in some cases it is difficult to decide if technology owes to science or if science owes to technology (Sismondo 2009). Critics of the autonomy of technology and science may argue that autonomy may well be true when we talk about the technological achievements of ancient cultures, but that when we move to later inventions such as the telescope, the compass or the steam engine, science had to play an important role. Perhaps because of that, terms like "technoscience" emerged in the last century.

Other authors defend the posture of indistinctness or of close relationship between science and technology. Some authors consider it in systemic terms, while others consider it in terms of dependence, usually of technology on science. We can find the systemic attitude behind terms such as "technoscience" or "big science" or "heterogeneous construction" and the authors who defend them. They argue that successful technological work draws on multiple resources and addresses simultaneously multiple domains. Technology builders solve technical, social, and economic problems all at once. In developing an artifact, the engineer is helping to produce knowledge, social realities, and material and social things. Scientific work is also heterogeneous, they combine isolated parts of the material and social words: laboratory equipment, established knowledge, patrons, money, institutions, etc.

The view of technology as dependent on science emerged in the late 19th and early 20th century, closely linked to a certain way of understanding innovation as a linear process starting in basic research and to its crystallisation in governmental policies to support innovation (or research). No matter how much science progressed at that time, at the beginning of the 20th century, the public support for research of any type was small. We argue that three key influences made research become an important thing for policy: the creation of industrial laboratories and how effective they were in making some companies become world leaders; the experience of the world wars and the cold war which led governments to realise that if scientists, engineers, and industries worked together, incredible innovations could be done fast; and the relevance economists gave to technological innovation, realising, against neoclassical economists, that the main factor affecting economic growth was technological innovation.

Industrial laboratories arose because, despite the advancement of science between the late 19th and early 20th century, scientific advances were of little use to industry, and industry needed a type of research that met its needs (Chesbrough 2003). Scientists of the time were proud of being disconnected from commercial aims. As universities were not able nor willing to help industries in the development of new products, the industry itself took care of industrial research, which later came to be named "applied research". Industries with what we would nowadays call internal R&D labs became market leaders and, thus, proved that research pays dividends in the form of economic profits. But it seems that we are talking more about research of the applied type and development work carried out by engineers, rather than applications of basic science. Several taxonomies of research, or knowledge activities that led to innovation emerged in the early twentieth century. These taxonomies usually classify terms such as "basic research", "pure research", "uncommitted research", "applied research", "development", etc. These types of distinctions are still common, especially since the OECD standardised them in the 1963 edition of the Frascati manual as "basic research", "applied research" and "experimental development" (OECD 2015). However, it can be rather vague to understand if we are referring to differences in terms of epistemology, intention, the distance between the research and its practical applications, the institution producing the research, disclosure norms or the scientific field (Calvert 2006). In any case, industries started lobbying and arguing in favour of industrial research, or applied research and development, and this had an economic and political influence.

The second influence relates to the war. In the two big conflicts of the 20th century, particularly in the Second World War, countries like the United States learned that by investing in research and making researchers and industrialists work together they were able to create incredible innovations, such as the atomic bomb. A natural tendency for the government, once the war was finished, was to exploit the system for peacetime. According to the popular story, on November 17, 1944, President Franklin Delano Roosevelt addressed a letter to Dr. Vannevar Bush asking for advice to apply the lessons learned during the wartime to continue supporting fast technological progress during the peacetime "New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we waged this war we can create a fuller and more fruitful employment and fuller and more fruitful life". (Bush 1945) and Dr. Bush answered with the world-famous report *Science, the endless frontier*.

The third influence is economists' reflection on technological innovation as the key growth factor. The relationship between innovation and its relevance for economic growth is a key aspect of the relevance of science, technology, and innovation policy, and the fact that we are discussing research today.

These three influences led to governments' willing to support research with the hope that it will create innovation and they also led to the taken-for-granted vision of technology as an application of science. A model was put together according to which basic research is followed by applied research, then development, production, and commercialisation. The invention of the model, also known as the "science push" model, is usually attributed to Vannevar Bush or to Joseph Schumpeter, but Benoît Godin (2017) argues that the Science Push model is the construction of several agents, industrialists, consultants, business schools, and economists. It was probably the interest of those actors to defend the model. For scientists, they were giving social importance to their work and justifying public funding. For industrialists, it was a way of attracting scientists to work in their R&D labs. For engineers, it was a way of improving the status of their discipline. For some governments, it was a way of defending democratic values in defending uncommitted research, especially in comparison with Nazi Germany. (Godin 2017)

The main idea of the science push model is that researchers at some organisations, normally universities, discover new knowledge, without any practical application in mind, it is just pure knowledge. There are then other organisations, normally applied R&D divisions in the industry, which work on researching to find potential applications. The potential applications of applied research are still far from being used but the research is carried out with practical applications in mind. The results of applied research are transferred into production by means of development. Development is an activity, normally carried out by engineers in industrial development labs, that consists of finding productive applications for applied research results. Then these developments, if successful, are implemented in production and then new products are commercially available. This theory is related to the idea that technology (applied science) comes from basic science by finding applications of science. The implications for policymakers who want to design innovation support policies are clear: they should support basic research and scientists as knowledge and truth seekers with the hope that then industries and public organisations, through their applied research laboratories will be able to find some promising applications, that could then be put into development and, if they are successful, moved to production and then to the market. The implications for companies are similar: invest in laboratories where scientists are allowed to research things. Most of their findings will be useless but the company will be able to put some of their findings into production (and then into the market) through the development unit.

Few will accept such a view of innovation today, but why did it then become so prevailing? According to Godin (2017), this form of understanding innovation became an accepted fact when the OECD crystallised it in the first edition of the OECD Frascati Manual in 1963 (OECD 1963). In fact, statistics contributed considerably to the construction of the official definition of research. It took decades before research came to be defined for statistical purposes. Yet this did not prevent measurement. In the early 1960s, the OECD took the task of concentrating on different practices (mainly from the US, Canada, and Britain) for measuring research. OECD member countries adopted the Frascati Manual, a methodological manual concerned with conventions to follow in conducting surveys of R&D. The manual, still in use, proposes concrete definitions of concepts to be measured, it suggested the classification of the activities measured, and it made recommendations on numbers and indicators to be produced. However, the differences between the main terms of the taxonomy, "basic research", "applied research", and "development", continue to be vague. This might be the reason that led the NASA to develop Technology Readiness Levels, TRL, as a more precise means of determining how far research is from applications. The European Commission employs the TRL classification in the Horizon Europe programme.

The conception of innovation as a series of steps from scientific discovery to the market has been opposed by demand pull, coupling and systemic views of innovation (Godin 2017). According to the demand-pull model, innovation starts with a market need and then applied research and development are carried out to create a new product that meets the need. This second "model" of innovation downplays the importance of scientific research and makes market needs the key driver of innovation. Good arguments can be found in favour of both the science push and the demand-pull model of innovation, which led some authors to talk about the "coupling" of market needs and research.

There is still a third group of theories that understand innovation as a systemic endeavour. Since the 1980s, it has been influential in policymaking through the national and regional innovation system concept. The concept appeared in an unpublished paper by Christopher Freeman in 1982, Bengt-Ake Lundvall used it in a booklet in 1985, Freeman used it again in 1987 and, in 1988, Freeman, Lundvall and Nelson used it again. Since the 1990s, the OECD adopted the concept and, through the OECD, it was very influential for policymakers. The main messages of the new approach were (Chaminade, Lundvall and Haneef 2018):

- Move from a science push view of innovation to a paradigm of interaction and networking.
- Move from a linear view (whether it is science push or demand-pull) of innovation to a systemic view.
- Include new sources of innovation apart from research. For example, experience-based learning taking place within firms or the learning interactions between research and industries are important sources of innovation.
- The importance of the context, there is no one size fits all policy.

Systemic theories were influential in policymaking. In the 1990s, many governments adopted the national /regional system approach for innovation policy. OECD's work was very relevant to it. In Europe, they have been further strengthened through Smart Specialisation Strategies (S3). The idea of Smart Specialisation emerged in the Knowledge for Growth expert group created by the European Commission to assess DG Research by analysing the causes of the lag of the European economy if compared to the United States. The concept was developed around 2008 (Hall 2011) and was very influential in European policymaking. S3 became part of the 2020 innovation plan of Europe, the Europe Flagship Initiative on *Innovation Union: Transforming Europe for a -post-crisis world* (European Commission 2010). S3 became an ex-ante conditionality and every Member State must have a S3 to receive European Structural Fund support (European Commission 2012).

We believe that the more important element when discussing applied research in VET is to identify if VET plays a role in S3 and, consequently, has a positive influence on innovation systems. What we would like the project to evidence is that VET is, or can become, a relevant actor of an innovation system in activities that go further from skilling, upskilling, and reskilling. Literature on the topic is still scarce but we hope it will grow. Mikel Navarro (Navarro and Retegi 2018) pointed out that VET shows its full potential just in the parts ignored by the literature about innovation systems. This is probably the reason why universities have been included as important agents of regional innovation and not VET:

Focuses on regional innovation literature (strengths of the university)	Omissions of regional innovation literature (strengths of VET)
Knowledge generation It has focused on universities, financial markets, and capital, and ignored the labour force and labour market.	Knowledge diffusion and exploitation

Science push model of innovation	Innovation based on interaction, experience and collaboration (Lundvall's DUI model for example)
High technology sectors and big companies	Traditional, low-technology, sectors and SMEs
Minority of people with very high qualification levels (PhDs., engineers, scientists, etc.)	Intermediate technical levels
The region	Varying local contexts within a region

3. Glossary of terms

Academic education

An intellectual, non-practical, style of education. It is mostly concerned with "know-what" and "know-why". See "knowledge".

Action Research

Action research is conducted to solve problems, inform policy, or improve the way that issues are addressed, and problems solved. There are two broad types of action research: participatory action research and practical action research.

Source: Research Glossary | Research Connections

Applied research.

An original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.

Source: OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris, https://doi.org/10.1787/9789264239012-en

Article

A document sharing the results of research (an original investigation undertaken to acquire new knowledge) or reviewing the research carried out by others.

Basic research

Experimental or theoretical work undertaken primarily to acquire knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

Source: OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris, https://doi.org/10.1787/9789264239012-en

Book

A written text which provides information about a field, a topic or a theme. They can be written by a single author or made up of contributions by several authors.

Case Study

An intensive investigation of the current and past behaviours and experiences of a single person, family, group, activity, project, organisation etc.
Source: [Qualitative Research Methods Tulsa - Child and Family Agency]

Chapter
A part of a book.

Cluster
Groups of firms related to economic actors, and institutions located near one another that have reached a sufficient scale to develop specialised expertise, services, resources, suppliers, and skills.
Source: [Cluster policy (europa.eu)]

College
Depending on the country, it can refer to different types of institutions. In most cases they are different from universities and more related to what we could label as "higher VET" or VET at EQF level 5 or above.
Source: [TVETipedia Glossary (unesco.org)]

Continuing Vocational Education and Training
Education or training after initial education and training - or after entry into working life, aimed at helping individuals to:

- improve or update their knowledge and/or skills.
- acquire new competences for a career move or retraining.
- continue their personal or professional development.

Source: Cedefop: Terminology of European education and training policy. [Terminology of European education and training policy | Introduction | CEDEFOP (europa.eu)]

CoVEs
Cedefop defines CoVEs as follows:

> In education and training, ecosystem of local partners, such as VET providers, employers, research centres, development agencies, and employment services who cooperate to develop high quality curricula and qualifications focused on sectoral skill needs, and contribute to regional, economic, and social development, innovation, and smart specialisation strategies.

As we can see, Cedefop sees CoVEs as ecosystems aimed at:

- Developing high quality curricula and qualifications focused on sectoral skill needs, and
- Contributing to regional, economic, and social development, innovation, and smart specialisation strategies.

Based on the following typology, the ETF has a definition which includes a variety of options:

- One single institution. A VET provider providing high quality VET and setting the example in the country/region.
- One institution (not necessarily a VET provider) coordinating VET providers, companies and other stakeholders and promoting VET excellence in the country/region.
- A cluster of organisations collaborating at the local/regional/national level. This has often a sectoral dimension.
- An international approach. A platform, a big array of actors that engage with stakeholders.

We will understand a CoVE as a multifunctional vocational education and training centre which, in addition to training, has an impact on the interaction with other actors and on the competitiveness of the region (considering competitiveness in the sense of beyond GDP) within its regional (and especially local) system.
Sources: TVETipedia Glossary (unesco.org)
Glossary | CEDEFOP (europa.eu)

Data

Data are the raw unorganised facts gathered about the topic being researched, that need to be processed to let it make sense by a process of data analysis.
Information about the topic being researched collected through various techniques (surveys, observation, questionnaires, etc.) and that can be made useful through a process of data analysis.
Source: Data vs Information - Difference and Comparison | Diffen

Data analysis

Is the process of analysing data to make sense of it for a specific field.

Data Mining

Data mining is an automatic or semi-automatic technical process that analyses large amounts of scattered information to make sense of it and turn it into knowledge. It looks for anomalies, patterns, or correlations among millions of records to predict results.
Source: Data mining, definition, examples and applications - Iberdrola

Dataset

A description of a collection of data from a data owner. This can be, for example, a single table of data or a collection of tables with related data, for example, all tables by year over the period 2005-2016.
Source: Begrippenkader | Data overheid.

Demonstration model

A complete model, but not build in the normal production process. Like a prototype.

Ecosystem

The ecosystem concept is built on the natural ecosystem analogy, defined as a biotic community, its physical environment, and all the interactions possible in the complex of living and non-living components. The concept of (business, entrepreneurial, innovation, skills) ecosystem is focused on the co-evolution in social and economic systems, in particular networks of organisations that together constitute a system of mutual support and co-evolving contributions with specific goals (business goals; entrepreneurial activity; innovation purposes; skilling activities). The concept challenges the idea that the market principle is the only principle structuring relationships in the economy As a new form of economic coordination, the ecosystem concept allows us to make understandable how practices are structured in another way that would be expected from market exchanges. Trust, relationships, co-creation, alignment, and collective learning are needed to create and sustain new value in specific contexts.

Source: BEYOND 4.0 research project (Warhurst et al 2019)

Engineers

It can refer to:

- A person who has studied engineering and has a certificate that proves it.
- A person who is employed as an engineer (they normally have studied engineering as well).

Enterprise

An enterprise is any entity engaged in an economic activity, irrespective of its legal form. This includes self-employed persons and family businesses engaged in craft or other activities, and partnerships or associations regularly engaged in an economic activity.

Source: European Commission Recommendation of 6 May 2003, concerning the definition of micro, small and medium-sized enterprises.

Experiment

Depending on the discipline and/or the researcher's goal, experiment can refer to different things.

- In the natural sciences and in engineering, it refers to a test conducted under controlled circumstances, usually in a laboratory, with the aim of gaining new knowledge about how something works (reacts, behaves, etc.) or with the aim of confirming (or refuting) a hypothesis or theory.
- In sociology, a procedure typically used to confirm the validity of a hypothesis by comparing the outcomes of one or more groups to a control group on a given measure.
- In psychology, an experiment involves the manipulation of an independent variable, the measurement of a dependent variable, and the exposure of various participants to one or more of the conditions being studied. Random selection of participants and their random assignment to conditions also are necessary in experiments.

- Experiments can be carried out with different aims, such as, confirming an hypothesis, gain knowledge about a specific cause-effect relationship, test a theory, test the efficiency and efficacy of a product, test new medical treatments, etc.

Sources:

- experiment definition I Open Education Sociology Dictionary
- APA Dictionary of Psychology

Experimental development

Systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.

Source: OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris, https://doi.org/10.1787/9789264239012-en

Feasibility study

Evaluation and analysis of the potential of a project, which aims at supporting the process of decision-making by objectively and rationally uncovering its strengths and weaknesses, opportunities, and threats, as well as identifying the resources required to carry it through and ultimately its prospects for success.

Source: EUR-Lex - E2022C0230 - EN - EUR-Lex (europa.eu)

Field Research

Research conducted where research subjects live or where the activities of interest take place.

Source: Qualitative Research Methods Tulsa - Child and Family Agency

Focus group

A meeting or interview in which a group of individuals with relevant opinions, information, knowledge, or experience for the research project are interviewed in an open way.

Higher Education Institution

A higher education institution is an institution providing education at level 5 of the European Qualifications Framework or above. There are different types of higher education institutions, such as universities, Universities of Applied Sciences, Polytechnics, engineering schools, VET schools, etc.

Higher Vocational Education and Training

As a subtype of higher education, higher vocational education and training refers to vocational education and training studies at level 5 of the European Qualifications Framework or above. According to the definitions of vocational education and training provided by Cedefop and UNESCO, higher VET is included under VET.

Hybrid teacher

A teacher who has more functions apart from teaching, formally included in his job description. If it is not formally included, we will have an amateur.

In the Netherlands a hybrid teacher can do the different functions under a different contract, for example: he is an engineer at a architect's office and a teacher in a VET centre on drawing or making calculations.

Hypothesis

The statement of the expected result of a research project.

Industry

An industry consists of a group of local kind-of-activity units engaged in the same, or similar, kinds of activity.

Source: [13719.pdf (europa.eu)]

Initial Vocational Education and Training

Cedefop defines Initial and continuing VET as "general or vocational education and training carried out in the initial education system, usually before entering working life".

This type of initial education can be followed at any EQF level and in different modalities: school-based training, apprenticeships, etc.

Source: [Glossary | CEDEFOP (europa.eu)]

Innovation

According to the OECD:

> An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).

Cedefop defines innovation, in the context of education and training:

> In education and training, introduction of pioneering approaches and practices in policies, systems, programmes and curricula, teaching and training methods and tools, to equip teachers, trainers and learners with the knowledge, attitudes, skills, and qualifications needed to cope with technological, cultural, economic and demographic change.

We will consider that Innovation in VET can refer to:

- Introducing improved products or processes (or combination thereof) that differ significantly from the VET centre's previous products or processes and that have been made available to potential users (product) or brought into use by the VET centre (process).
- The contribution of a VET centre to the local, regional, or national innovation system, especially when it goes further than skilling.
- The sum of both. If both happen at the same time and if this is added to a high-quality training provision, then we are talking about a centre of vocational excellence.

Sources: Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition | en | OECD
Glossary | CEDEFOP (europa.eu)

Innovation clusters

Structures or organised groups of independent parties (such as innovative start-ups, small, medium and large enterprises, as well as research and knowledge dissemination organisations, non-for-profit organisations and other related economic actors) designed to stimulate innovative activity by promoting sharing of facilities and exchange of knowledge and expertise and by contributing effectively to knowledge transfer, networking, information dissemination and collaboration among the undertakings and other organisations in the cluster.
Source: EUR-Lex - 52022XC1028(03) - EN - EUR-Lex (europa.eu)

International Standard Classification of Education (ISCED)

The International Standard Classification of Education provides a comprehensive framework for organising education programmes and qualifications by applying uniform and internationally agreed definitions to facilitate comparisons of education systems across countries. ISCED is a widely used global reference classification for education systems that is maintained and periodically revised by the UNESCO Institute of Statistics in consultation with Member States and other international and regional organizations.
Source: International Standard Classification of Education (ISCED) | UNESCO UIS

Intervention

Activity that has an effect in the environment or situation that is subject of the research to see of this results in a change in the object of the research (the status quo). This can be in a controlled environment (laboratorium experiment) of in real life (field experiment).

Interview

A research method in which a researcher asks an individual questions and records the responses.
Source: | Words | Open Education Sociology Dictionary

Invention

An invention is a new solution to a technical problem which satisfies the criteria of:

- novelty: the solution must be novel (new).
- inventiveness: it must involve a (non-obvious) inventive step.
- industrial applicability: it must be capable of industrial use.

Source: Glossary: Invention - Statistics Explained (europa.eu)

Knowledge

We will follow Lundvall in his classification of four types of economically relevant knowledge (Lundvall 2016: 112-115):

- Know-what: knowledge about facts that can be regarded as "information". Although, in general, the relevance of knowledge-what has diminished due to the easy access (in terms of effort and money) we all have too large amounts of information through the internet, it is also true that knowledge-what can still be important for some professionals as doctors or lawyers. Examples of know-what can be the name of the first king of France, the temperature at which water boils, the number of inhabitants of a city, and many others.
- Know-why: scientific knowledge about principles and causes of natural, social, or human phenomena. We have organisations, such as universities, specialised in the reproduction of this type of knowledge. Although it is true that, as we have indicated when discussing the science push model of innovation, this type of knowledge is not as important as they thought in the last century, it is also true that it has been, and still is, very important in some industries (chemical industry, electrical industry, electronic industry, and others.
- Know-how: skills to do things, practical knowledge. Although this type of knowledge has traditionally been related to production works and manufacturing, it is also true that all endeavours involve a large extent of know-how: management, research, and even consumption.
- Know-who (where and when): to know key persons and to relate to networks. This is one of the key elements for innovation when it is regarded as a systemic thing, understood as a social system where different elements interact around knowledge.

Large company

See "large enterprise".

Large enterprise

Undertakings which do not fall within the definition of small and medium-sized enterprises.

Literature review

A type of secondary research that consist of analysing the literature about the topic being researched. It relates to desk research.

Living lab

Living Labs (LLs) are open innovation ecosystems in real-life environments using iterative feedback processes throughout a lifecycle approach of an innovation to create sustainable impact. They focus on co-creation, rapid prototyping & testing, and scaling-up innovations & businesses, providing (different types of) joint-value to the involved stakeholders. In this context, living labs operate as intermediaries/orchestrators among citizens, research organisations, companies, and government agencies/levels. Within a wide variety of living labs, they all have common characteristics, but multiple different implementations.

Source: [What are Living Labs - European Network of Living Labs European Network of Living Labs (enoll.org)]

Methodology

See "Research methodology".

Method

See "Research Method".

Mixed methods research

Research using both qualitative and quantitative data. It is supposed to give a broad understanding of a topic.

Model

Model can refer to:

- representations, normally simplified representations, of the part (or parts) of the world under study. This type of model is important in the natural and in social sciences. Scientists devote a lot of effort to designing, developing, testing, interpreting, discussing, supporting, or arguing against models (Frigg and Stephan 2020). We can find models in physics, chemistry, biology, economy, or sociology to name just a few disciplines.
- o a way of doing something, like business models, management models, marketing models, etc. These models go further than describing how a part of the world under study works by trying to say how something will work, and they define objectives, activities, vision, mission, revenue streams, and similar elements. It is in this second sense of the word model that we should understand the open innovation community model.

Modelling

The creation of a physical or computer analogy to understand a particular phenomenon. Modelling helps in estimating the relative magnitude of various factors involved in a phenomenon. A successful model can be shown to account for unexpected behaviour that has been observed, to predict certain behaviours, which can then be tested experimentally, and to demonstrate that a given theory cannot account for a certain phenomenon.

Source: [Glossary of Research Terms - Organizing Your Social Sciences Research Paper - Research Guides at University of Southern California (usc.edu)]

Open access

Research available for free (online).

Patent

An original model was constructed to include all the technical characteristics and performances of the new product. Patent is about protecting knowledge and the rights on it, from unforeseen use by others.

Source: Glossary: Patent - Statistics Explained (europa.eu)

Peer review

Peer review is the process of research papers evaluated by other (anonymous) experts on the topic before publication of the document in which the research is presented.

PhD:

The highest level (EQF8) a person can achieve in the European Qualification Framework or the International Standard Classification of Education.

Practor (VET professor, knowledge broker)

A practor is a figurehead, inspirer and/or motor of a practorate. A practor is responsible for the development, application, and dissemination of knowledge, both within de VET -institution as in the ecosystem of an VET-institution. Practice-oriented research and the professionalization of teachers are also important tasks.

Practorates form the place (the innovative in-between space) where practice-oriented research takes place, where education and the business community share, connect and develop knowledge and experience aimed at making the curriculum both inside and outside the VET-institution more state of the art and therefore more sustainable.

Source: https://www.practoraten.nl/organisatie/

Primary research

Research that generates its own data.

Prototype

A preliminary, test version, of a product that includes the technical features of the new product.

Public-private partnership (PPP)

Arrangements whereby the private sector provides infrastructure assets and services that traditionally have been provided by the government, such as hospitals, schools, prisons, roads, bridges, tunnels, railways, and water and sanitation plants.

Source: Inventory-1-Private-Sector-Engagement-Terminology-and-Typology.pdf (oecd.org)

Qualitative data

Data describing non-quantified properties of the research objects.

Qualitative research

A field of social research that is carried out in naturalistic settings and generates data largely through observations and interviews. Compared to quantitative research, which is principally concerned with making inferences from randomly selected samples to a larger population, qualitative research is primarily focused on describing small samples in non-statistical ways.
Source: Qualitative Research Methods Tulsa - Child and Family Agency

Quantitative data

Data describing quantified properties of the research objects.

Quantitative research

Research that generates numerical data or data that can be converted into numbers.

Questionnaire

A set of questions that are designed to extract certain types of answers from people who have important information, knowledge, experience, or opinions for the research. Also: survey.

Report

A scientific report is a document that describes the process, progress, and or results of technical or scientific research or the state of a technical or scientific research problem. It might also include recommendations and the conclusion of the research.
Write Scientific Reports - The Library: University of Waikato

Research and knowledge dissemination organisation' or 'research organisation'

An entity (such as universities or research institutes, technology transfer agencies, innovation intermediaries, research-oriented physical or virtual collaborative entities), irrespective of its legal status (organised under public or private law) or way of financing, whose primary goal is to independently conduct fundamental research, industrial research or experimental development or to widely disseminate the results of such activities by way of teaching, publication or knowledge transfer. Where such an entity also pursues economic activities, the financing, the costs and the revenues of those economic activities must be accounted for separately.
Source: EUR-Lex - 02014R0651-20210801 - EN - EUR-Lex (europa.eu)

Research centre:

See "Research organisation".

Research ethics

The ethical principles to which researchers should stick when conducting research.

Research methodology

An analysis, reflection, and argumentation of why certain research methods are chosen for conducting research.

Research Method

The approaches, tools, and techniques that researchers use to study a problem. These methods include laboratory experiments, field experiments, surveys, case studies, focus groups, ethnographic research, action research, and so forth.

Researcher

Professional engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods.

Scientific paper

See "article".

Secondary research

The analysis and synthesis of primary research.

Sector

Segment of the economy in which enterprises have the same activity (economic function, products or services, technology).

Source: What Is an Economic Sector and How Do the 4 Main Types Work? (investopedia.com)

Semi-Structured Interview

A research method in which the researcher uses a pre-defined list of questions but in which the respondent is allowed to digress.

SMEs, Small, Medium and Micro SMEs

The European Commission Recommendation of 6 May 2003, concerning the definition of micro, small and medium-sized enterprises:

> The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million.

Next, they distinguish three subtypes of SMEs, within the category of SME (European Commission 2003):

- a small enterprise is defined as an enterprise which employs fewer than 50 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 10 million.

- a microenterprise is defined as an enterprise which employs fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million.

The definition above is not the only existing definition. Different organisations and countries can understand what an SME is in different terms. We consider it worth sticking to the definition of the European Commission.
Source: [Commission Recommendation of 6 May 2003 concerning the defin... - EUR-Lex (europa.eu)]

Startup

A startup is an independent, organisation, which is younger than five years and is aimed at creating, improving, and expanding a scalable, innovative, technology-enabled product with high and rapid growth.
Source: [VISION – European Startup Network]

Structured Interview

A research method in which the researcher uses a pre-defined list of questions but in which the respondent is allowed to deviate.

Structured Observation

An observation carried out following a pre-defined schedule and paying attention to certain variables.

Student

A person who enrols as a learner in a course.

Survey Research

A research method in which data is collected through questionnaires or interviews.

Systematic observation

See “structured observation”.

Teacher

A person whose function is to impart knowledge, know-how or skills to learners in an education or training institution.
Comment:
A teacher may fulfil various tasks such as organising and carrying out training programmes/courses and transmitting knowledge, whether generic or specific, theoretical, or practical; a teacher in a vocationally oriented institution may be referred to as a ‘trainer’.
Source: [Glossary | CEDEFOP (europa.eu)]

Technician

A skilled employee with know-how style knowledge.

Technological centre

See “research organisation”.

Technology Readiness Level (TRL)

Technology Readiness Levels (TRL) are a type of measurement system used to assess the maturity level of a particular technology. There are nine technology readiness levels. TRL 1 is the lowest and TRL 9 is the highest. When a technology is at TRL 1, scientific research is and those results are being translated into future research and development. TRL 2 occurs once the basic principles have been studied and practical applications can be applied to those initial findings. TRL 2 technology is very speculative, as there is little to no experimental proof of concept for the technology.
When active research and design begin, a technology is elevated to TRL 3. both analytical and laboratory studies are required at this level to see if a technology is viable and ready to proceed further through the development process. Often during TRL 3, a proof-of-concept model is constructed.
Once the proof-of-concept technology is ready, the technology advances to TRL 4. During TRL 4, multiple component pieces are tested with one another. TRL 5 is a continuation of TRL 4, however, a technology that is at 5 is identified as a breadboard technology and must undergo more rigorous testing than technology that is only at TRL 4. Simulations should be run in environments that are as close to realistic as possible. Once the testing of TRL 5 is complete, a technology may advance to TRL 6. A TRL 6 technology has a fully functional prototype or representational model.
TRL 7 technology requires that the working model or prototype be demonstrated in a space environment. TRL 8 technology has been tested and "flight qualified" and it's ready for implementation into an already existing technology or technology system. Once a technology has been "flight proven" during a successful mission, it can be called TRL 9.
Source: NASA [Technology Readiness Level | NASA]

Trainee

A person receiving training in a vocational area or undertaking a traineeship.

Trainer

A person providing training in a vocational area.

University

Academic style, tertiary education institution. EQF levels 6 to 8.

University of applied sciences

A university of applied sciences does not only focus on theoretical teaching but on the application of academic knowledge. It focuses on the application of science by including practical elements into the students’

education. These practical elements include - for example - mandatory internships and professors who all have experience working outside academia. Students find a combination of scientific academic training and practical elements.
Source: [University of Applied Sciences in Germany 🏛 2020/2021 guide (mygermanuniversity.com)]

Unstructured interviews

A data collection method where there are no set questions.

Vocational education and training

In Europe "vocational education and training" refers to:

- Different levels of education according to the European Qualifications Framework (EQF). We can find VET studies from very low EQF levels to EQF level 8 and there is no homogeneity across Member States.
- Different duration of the study paths. There is no such thing as a definite duration of a VET degree.
- Different training modalities. VET could be studied in a variety of ways: different models of apprenticeships including dual education, blended learning, online, part-time, night offer, etc.
- VET systems are differently managed in Europe: public systems, public-private partnerships, private management, national government management, regional government, etc. And the same goes for VET centres and studies: there are very different management and leadership models with profound implications.
- Different functions of VET providers, ranging from countries where their only mission is to provide initial training, to countries where VET centres provide a wide array of services apart from initial training.
- Different types of institutions provide it.
- Varying levels of popularity of VET studies. How VET is perceived in a specific society.
- Different names.

UNESCO defines TVET (Technical Vocational Education and Training) as: All forms and levels of the education process involving, in addition to general knowledge, the study of technologies and related sciences, the acquisition of practical skills, know-how, attitudes and understanding relating to occupations in the various sectors of economic and social life. UNESCO-UNEVOC. TVETipedia Glossary.
According to Cedefop, VET is Education and training which aims to equip people with knowledge, know-how, skills and/or competences required in specific occupations or more broadly in the labour market. Cedefop. Terminology of European Education and Training Policy. Glossary.
There are some features in both definitions that deserve some attention (Hazelkorn and Edwards, 2019: 9-10):

- They identify VET with a specific educational approach rather than with a specific type of institution.
- They do not pay any attention to the qualification levels. They are dealing more with the approach, than with the level.

- They do not specifically refer to any age cohort as the recipient of VET.
- They encompass initial VET and continuing VET.

The *Council Recommendation on vocational education and training for sustainable competitiveness, social fairness and resilience* follows Cedefop's definition but adds a specific mention to the tertiary level:

> Vocational education and training is to be understood as the education and training which aims to equip young people and adults with knowledge, skills and competences required in particular occupations or more broadly on the labour market. It may be provided in formal and in non-formal settings, at all levels of the European Qualifications Framework (EQF), including tertiary level, if applicable

This definition implies that for the LCAMP Alliance VET:

- Involves young students and adults. In other words, all age groups, and all European citizens, are potential VET students.
- Aims to equip any person with knowledge, skills and competences related to the labour market. At the same time, VET can have other functions, such as entrepreneurship or research.
- Studies do not need to be connected to a particular occupation. They can be, but they can have a broader focus, although always in connection with the world of work.
- Take place in formal and informal settings.
- Covers VET at the tertiary level. We consider Higher VET a part of VET, not a part of Academic Education.

From an international perspective, this definition is convenient because it allows us to be inclusive by acknowledging that different contexts exist.

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Colophon

AIRinVET partners: TKNIKA - Department of education Basque Government, EURASHE, Berufliche Hochschule Hamburg, Hanse Parliament, KATAPULT, ISSO, AFM Cluster for Advanced & Digital Manufacturing and IMH - Advanced and Digital Manufacturing Campus.

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