FuturVoc

Landscape for new forms of work in Europe

With the support of the Erasmus+ Programme of the European Union

Colophon

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Project team: Rosemarie Klein, Gerhard Reutter, Franziska Haydn, Rudolf Götz, Johanna Lenitz, Peter Sommerauer

Text: Rosemarie Klein, Gerhard Reutter, Franziska Haydn, Johanna Lenitz, Rudolf Götz, Peter Sommerauer

Layout: Peter Sommerauer

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i-smARt Trust reg.
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Principality of Liechtenstein

E-mail: verlag@laurentius.li
Web: www.laurentius.li Tel: +423 / 370 24 01

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FOREWORD:

The challenge

Increasing digitalisation is contributing significantly to a change in the labour market. The transformation from traditional employment models and workplace situations to new forms of digital work and employment such as the "platform economy", "sharing economy" and "digital labour entrepreneurs" (digital solo entrepreneurship) is increasingly shaping our working world and leading to a strong further development of individual occupations in Europe. This transformation is additionally and simultaneously giving rise to a new, digital labour market in which new digital occupational forms are also emerging.

This also promotes the development of borderless careers, where employees work for several employers and on several projects at the same time in a short period of time. In newly designed, digitalised labour markets, as well as through the steady development of the platform economy as a digital match-maker, the trend towards (enforced) self-employment is intensifying, which in turn leads to increasing pressure for self-optimisation of modern employees.

The project

The project "FuturVoc" aims to identify and analyse the current situation of digitisation effects for the labour market in the countries of the consortium, to provide a representation for the respective trends and finally to develop a map for the landscape of the individual professions in Europe in order to give an overview of the current status quo in the partner countries of the consortium, in particular to analyse the current situation with regard to digitisation-related professions and to support entrepreneurs, coaches, (VET) teachers, trainers, mentors as well as practitioners of educational and vocational guidance.

In the three work phases "Analysis - Evaluation - Prediction", the project deals with various questions such as the already existing forms of digital work and employment, the (geographical) regions most affected, the local separation of client and service provider, as well as the effects on the various professions. Furthermore, in a look into the future, it considers how the landscape of the individual professions may change due to the influence of digitalisation.

The "Map of New Forms of Occupation in Europe" describes new forms of digital work and their impact on employment and entrepreneurship, as well as the associated new demands on professionals and the self-employed. The professions presented are those that have undergone major changes, particularly as a result of digitalisation. In addition, it shows the skills that are required for successful positioning in the new labour market. Thus, the map acts as an information/learning tool and shows strategies for overcoming challenges, supports the acquisition of knowledge and skills at the levels of education, governance and practice with a special focus on disadvantaged groups such as adult learners and people in the second half of life with different levels of education and backgrounds (new precariat).

The project addresses target groups such as entrepreneurs and coaches, (VET) teachers, trainers, mentors and other counsellors who are facing new challenges for education and training as well as new requirements for counselling the target group.

A study by McKinsey (2016) shows that 20-30% of the working-age population in the USA and the EU work "independently", which requires a high degree of autonomy, means payment according to tasks (performance) and a short-term relationship between worker and client. The change between primarily project-based engagements is fluent, often overlapping or with multiple, project-based jobs being carried out in parallel. Digital platforms are increasingly contributing to this.

This "liquefaction" of work and career not only poses great challenges to the individuals concerned, but also to those systems and services that are supposed to support individuals in coping with these challenges. In addition to entrepreneurial education and training, a centrally affected field is educational counselling and career guidance with its task of providing orientation in questions of education and career.

Cross-border success

The new forms of digital work are developing without borders. This is why the project is also being carried out transnationally, together with partner institutions from Germany, Liechtenstein, Austria and Switzerland. Working in an international consortium makes it possible to identify those trends that are particularly affected by internationalisation. The country-specific reports on the national situation regarding new digital professions are an essential part of the project work. This report is divided into sections on the definition and delimitation of new, digital occupations and the presentation of the country-specific situation on the basis of a survey with national experts from VET. On the basis of these reports, a common map for new occupational forms in Europe is being created.

The Erasmus+ project "FuturVoc – Landscape for news forms of work in Europe" aims to:

- Raise awareness of the development of new forms of work in the digitalised labour markets and highlight the resulting transformation of professional identity
- Provide tools and strategies to understand and address this challenge.

The project is implemented by a European consortium consisting of: i-smARt Trust reg. (LIE) as coordinator, ÖSB Studien und Beratung GmbH (AT), bbb Büro für berufliche Bildungsplanung (DE), ZHAW Zurich University of Applied Sciences (CH).

Recommendations for using the map

This document is first and foremost a tool to provide information on the basics and background of the new forms of occupation that have been created as a result of digitalisation. The first chapter contains the results of the analysis phase of the project, which show which new forms of digital work and employment exist in Europe, with a focus on the partner countries of the consortium. This chapter also gives a good insight into the thematic world of new forms of work, digital activities and employment, digital work and digital professions. Additions from the interviews with experts have also been included.

The second chapter summarises the results of the evaluation phase of the project. These results were complemented by national contributions, which were developed and discussed on the basis of interviews with experts from the target group. This made it possible to identify similarities and differences and to discuss the effects of the new forms of digital work and employment on the landscape of the individual professions with the experts. In consultation with the experts, a prediction was also made for the future as to what the landscape of the individual professions will look like in the near future and how digitalisation will lead to changes for the professions.

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1. New forms of digital work

Preliminary remark

In recent years, a plethora of forms of work have emerged that not only differ from the normal employment relationship - dependent full-time employment - but in which aspects of digitalisation play a decisive role. It is clear that the internet and new technologies have not only succeeded in establishing new professions, but have also fundamentally changed existing ones.

In the academic discourse, the new digital forms of work are a sub-area of the new forms of work (abbreviated “NFW”). With regard to NFW, we were able to establish that the academic discourse around NFW has so far lacked a clear definition or at least a common understanding of what constitutes "new forms of work"; they are linguistically shaped into "new forms of work" or "new forms of employment".

Although this report focuses on the forms of digital work in Germany, Liechtenstein, Austria and Switzerland, we would like to briefly refer to the status of the discourse on NFW based on international and European sources (source: Country Report GIVE Project, chapter 2.1), because the influence of digital forms of work is already evident here.

In a report published in 2019, the OECD finds that the following "new forms of work" receive the most political attention in 44 selected OECD, EU and G20 countries:

- Platform work: matching clients and customers by means of a virtual platform (most frequently cited)
- Self-employment with a special focus on "bogus self-employment" and self-employment for own account (self-employed without employees)
- Temporary work and temporary employment
- Contracts with variable hours: Contracts that contain a clause stating that the working hours can vary from one week to the next

Eurofound (2015, 4/5) states on the basis of the "indicators" for NFW:

- Relationship between employers and employees that differs from the established one-to-one employment relationship
- Provision of work on a discontinuous or intermittent basis
- Networking and cooperation agreements between self-employed people
- A place of work other than the employer's premises
- Strong or widespread support for ICT

Eurofound (2015, p. 4-9) defined the following "new forms of employment":

- Employee participation: An individual employee is jointly recruited by a group of employers (excluding employment agencies)
- Job sharing: A single employer hires two or more workers to jointly fill a specific position.
- Interim management: A worker is hired for a temporary period by an employer with the status of an employee and not by an external consultant
- Casual work: Irregular work on call

- ICT-based mobile work: Workers working in different possible locations are supported by ICT. Different from traditional telework, as they are even less "location bound"
- Voucher-based work: The employment relationship is based on a voucher and not on an employment contract.
- Portfolio work: Several small assignments/contracts for a large number of clients
- Mass employment: Platform adapted work
- Collaborative employment: New models of cooperation among the self-employed

For the situation in Europe, it should be noted that not all of these new forms of work are to be found on a relevant scale in all European countries.

For the work in the project, we concentrate on the most widespread and best documented forms in the countries of the consortium, with a clear focus on the new forms of digital work.

In Europe, not all countries are equally considered pioneers in digitalisation. While in Scandinavia and the Netherlands in 2017 more than 80% of all surveyed residents said they used the internet daily, this percentage was only 64% in Austria, 71% in Germany and around 75% in Switzerland and Liechtenstein (Atlas of European Values 2017). For a long time, electronic appointments for administrative procedures were a thing of the future and "home office" was a foreign phenomenon for many employees, not only linguistically. Covid has helped these developments in many countries in Europe as well as in large parts of the world and has further normalised digital tools. All of a sudden, the digital transformation is palpable even to "digital natives" because suddenly big innovations are being implemented in the shortest possible time. However, the broader digitalisation of the world of life and work began long before and has significantly changed job profiles, activities and requirements.

In 2017, the Swiss Federal Council published a report on the impact of digitalisation on employment and working conditions in Switzerland (Bundesrat, 2017). This report indicates that digitalisation is a central driving force for sustainable structural change in Switzerland. However, technological progress in Switzerland is not only having a positive effect. According to current analyses, up to 11% of jobs will be lost in the coming decades, while at the same time it is noted that not only will jobs be lost due to structural change, but - according to estimates - over 250% more new jobs will be created in comparison. In the overall balance, digitalisation produces a positive development for Switzerland as a business location.

However, there are also some risks that need to be considered with regard to the development of digitalisation. One focus here is placed on the education sector. Only those who have the appropriate knowledge, skills and abilities can keep pace with the progress of digital development.

If one observes the development of the education landscape, especially with regard to educational goals in vocational education and training, a trend towards preparing for a digital world of work can be identified. In a study by the Bertelsmann Foundation on the digitalisation of vocational education and training, it is formulated as follows:

> *"Digitalisation affects VET faster and more pervasively than other areas of education that are further removed from professional practice. It has a direct impact on the skilled work in many occupations, therefore also on the occupational profiles of the future and on the qualifications and competences to be taught."* (Euler & Severing, 2019, p. 32)

Thus, vocational education and training in particular is affected by the influence and degree of development of the digitalisation of the world of work and is even challenged to provide for the necessary qualification of skilled workers. This is by no means only about changes in vocational content, but also very significantly about new forms of teaching and learning. This affects training in all professions.

A central question resulting from the above consideration is whether professions are "only" changing due to digital progress or whether this has led to the development of new, purely digital professions. The FuturVoc project addresses this question by exploring the hypothesis that a number of purely digital professions already exist and that further, new digital professions will develop in many areas in the future.

Digitalisation and work

Digitalisation is a process that has been affecting companies and workers for years through restructuring of employment, bringing new conveniences in private life and leading to a change in our society. The majority of society experiences digitalisation only very superficially. And yet it encompasses more than just the internet and social media.

Switzerland and Liechtenstein, for example, have high labour market participation and low unemployment in an international comparison. The labour market in these countries has been able to cope very well with the consequences of digitalisation to date. This shows that these labour markets are in a good position to master future challenges that may arise in the context of advancing digitalisation.

The role of males and females in digitalisation

However, digitisation is still ostensibly male - up to now. Because digitisation also holds a high career potential for women. For years, numerous initiatives and organisations have been promoting young women's interest in STEM (mathematics, informatics, natural sciences and technology) and thus also in many digital jobs. Various training and further education offers are created specifically for female digital natives. Current studies survey how these offers are accepted and what they can achieve as well as what would be necessary to pave the way for more women to enter STEM professions or digital professions. To this end, opportunities and challenges are discussed and supplemented by the practical perspective and recommendations for action of female experts.

Different definitions of work

The personal evaluation of work has undoubtedly changed in recent years. Buzzwords such as work-life balance and the flexibilisation of work in favour of a better work-life balance occupy a high priority according to many surveys on the work situation. But this does not mean that for young workers, for example, work is no longer important - they just define it more broadly. Strictly speaking, they are more performance-oriented than they used to be, because they see it as a matter of course to continue their education in different areas, to keep their level of information up to date and to acquire niche skills. However, they see these efforts not only in the context of the company, but holistically and strive for fulfilment in all areas of life. Fun, meaningfulness and challenge come first.

Trends and drivers

New, digital business models and business areas, digital innovations and digital companies are part of the development of digitalisation. The Swiss Federal Council characterises four overarching areas as drivers for technological advances in digitalisation (Bundesrat, 2017, p. 11).

- *Advances in processor and memory technology:*
  Exponential growth in processor performance and improvements in storage technology are increasingly expanding the uses of cloud technologies and mobile applications to facilitate and simplify functions such as communication, control and monitoring of production and management processes.
- *Advances in software development:*
  Computers and software are constantly becoming more adaptive and are able to derive algorithms from unstructured information without having been programmed to do so. Applications from the field of artificial intelligence based on algorithms and machine learning are diverse (e.g. speech recognition software such as Siri/Watson or translation software such as Google Translate) and are constantly being developed and improved.
- *Advances in robotics and sensor technology:*
  Increasingly complex tasks are being performed entirely by robots or computer systems or in close cooperation with humans. This reduces the costs, while at the same time the application possibilities increase and the simpler operability makes the systems increasingly interesting for small and medium-sized companies as well as for individual production. The trend is emerging that these systems will not only be used in the manufacturing industry, but that much broader application possibilities are conceivable in the future, especially in the service sector. Examples include flexible, biocompatible microchips for new applications in the health and environmental sectors. In addition, new manufacturing technologies, such as additive processes (3D printing), offer flexible and individualised production possibilities and potential for increasing efficiency.
- *Industry 4.0:*
  Another driver of digitalisation is the increasing networking of information or objects, in so-called cyber-physical systems. These networks of small computers, which are equipped with sensors and actuators and can thus communicate and interact with each other via the internet ("internet of things"), offer great efficiency potential in the control of production, logistics and transport processes. "Big data" and "cloud computing" - the collection and evaluation of extensive amounts of data - are aligned with this.

1.1. Definition of "digital work"

The impact of digitalisation on the world of work and its effects are multi-part: on the one hand, digital change leads to changes in existing work, on the other, it also creates new forms of work. In order to find a uniform understanding in this context and to be able to conduct the discourse around new forms of work, a clear definition of terms is necessary beforehand.

'Digitisation of work' is the process of changing already existing forms of work through digital tools - *"it is not so much what we work that changes, but much more how we work"* (Mag. Wolfgang Bliem in AT expert interview).

Flecker et al. (2017, p. 381) distinguishes the following stages of informatisation and digitalisation:

- *Extending the use of electronic devices and software to more and more professional activities and workplaces*
- *Linking the computer as a work tool with communication technologies*
- *Use of the Internet as a global information and "workspace" [...].*

- *Enabling cross-border value chains also in services*
- *Reinforcing the digitalisation of work through increasingly immaterial work objects and products, not least in the internet-based economy itself*
- *Location-independent mediation and appropriate design of digital work through internet platforms*

The result of the digitisation of already existing occupations is called **digitised work** (Hoose 2018). The experts involved and interviewed in the project stated that digitised work is typically characterised by a shift from manual to cognitive activities, while the share of routine remains roughly the same. However, digitisation does not automatically mean that employees themselves necessarily work more with digital tools. The digitisation process can also lead to the outsourcing of tasks to customers with the help of digital technologies. On the one hand, this shadow work, as sociologist Craig Lambert calls it, shifts the workload to customers; on the other hand, it creates new activities for employees. Instead of performing manual tasks themselves, they increasingly advise and accompany customers. This is the case, for example, in banking and in supermarkets with the advent of self-service machines and unmanned checkouts.

In other industries (including manufacturing), experts see a shift away from doing things oneself to controlling and monitoring the machines that do them. Instead of manual actions, cognitive activities such as quality assurance are coming to the fore.

Digitised work has changed enough through technology, depending on the sector and the job profile, that the actions today have little in common with the actions that workers in the same profession performed a few decades ago. What unites them is an occupational profile that existed before the invention of digital technologies**.**

Digital work, on the other hand, is work that has only been made possible by digital technologies. UX designers, web developers and IT architects have only existed since technology created their field of work. These professions, which are mostly in the STEM area (mathematics, computer science, natural sciences and technology), perform work with digital tools on digital objects (Schwemmle, Wedde 2012).

Digital work can be grouped in different ways. The expert interviews revealed three different ways of grouping. On the one hand, these professions are divided into those who work on and drive digitalisation and those who use it but are not actively involved in its further development. Another differentiation is based on the intensity of the use of digital tools, which can be expressed as a percentage of the time the tool is used. Another form of grouping assigns input and end product to the digital or analogue field of action. For example, analogue newspapers are mostly produced with digital input, while many downloadable songs are primarily produced with analogue tools.

For example, for the discussions on the definitions of "digital work", the following applies in Germany:

> *"With regard to digitisation occupations, there is not yet a definitive definition nor a finalised list of relevant competences and activities that characterise a digitisation occupation."* (BMWE, 2020, 3)

There are two definitions that need to be mentioned in relation to the situation in Germany according to our research.

On the one hand, the rather broad definition of the sociologist Papsdorf (2019, 21):

"In the following, digital work is to be understood as all activities which

- *Based on, using or referring to, digital technology,*
- *Have a direct or indirect economic link and*
- *are carried out by humans or other actors capable of acting."*

On the other hand, a more focused definition by the economist Burstedde from the Institute of the German Economy:

The author states that while most workers work with digital technologies, *"not every use of computers, data and the internet makes occupations digitalisation occupations"* (BMWE, 2020, 3). **He defines digitisation occupations as those that produce new key digital technologies or enable their use and dissemination through special technical knowledge** (cf. ibid. 3-4).

1.2. European discourse on new forms of "digital work

Technological progress not only affects occupational profiles and content, but also brings with it broader trends relevant to labour policy. In particular, the platform economy and the discourse around digital skills were hotly debated topics even before the pandemic.

Although it is estimated that only 0.5% to 2% of workers are employed in the **platform economy** (OECD 2019), there is a particular focus on the topic in international discourse. New opportunities, but also the potential dangers of precarisation through platform work are particularly highlighted.

Excursus: The platform economy as exemplified in Austria
(cf. GIVE - Guidance for Individual Vocations in Europe iO1 Austria Country Report)

In Austria there is a number of different platforms for crowdwork and gig work. Almost all of them are based abroad. The biggest players offering local platform work or work on demand via apps are driving services (e.g. Uber and Taxify) and delivery services (e.g. Foodora, Uber Eats and Lieferservice.at).

Online platform work or crowdwork is represented by international micro-task platforms such as Clickworker and contest-based platforms such as GoPillar. The services offered (small to large, with basic or additional skills) and the type of platform work vary greatly. (cf. De Goren, Willem Pieter et. al. 2018, 3).

According to a study by Huws and Joyce (2016), the most common types of work performed by platform workers in Austria are:

- Office work, short tasks or "clickwork"
- Creative or IT work on your own computer
- Regular work in the home of another person

Distribution and characteristics of platform workers

The two available studies on the quantitative recording of the spread of platform work in Austria come to quite different results.

According to Huws and Joyce (2016), 18% of a representative sample of the Austrian working-age population (18-65) have done platform work in the last year, 15% in the last six months, 9% in the

last month and 5% in the last week. The majority of platform work is done as a part-time job. Only 2% of platform workers derive their entire income from platform work. In contrast to these rather low figures, 36% of the respondents said they were interested in platform work, which indicates a possible increase in this form of work in the future.

In the context of the study's findings, some experts criticised that the scope of platform work in Austria was overestimated, as the survey was conducted online and thus reached a rather platform-affine pool of respondents. Moreover, respondents in the study may have also counted online job boards offering traditional employment as "using online platforms to find paid work". (cf. De Goren, Willem Pieter et. al. 2018, 4)

This critical perception is supported by a Eurobarometer telephone survey (2016), which counted less than 2% regular platform workers (on a monthly basis) in Austria. Austria is in the middle of the EU-27 with these figures, while Latvia, France and the Netherlands record the most platform workers. Platform work in Austria tends to be carried out by younger people, but is distributed across all age groups. According to Huws & Joyce (2016), 57% of Austrian platform workers are men, 43% women.

Unfortunately, neither study provides information on the education level and skill requirements of platform workers in Austria. An analysis of the skill requirements of 200 platforms in the EU28 (2017) shows that most platform jobs require only low to medium qualifications (Fabo et. Al. 2017, 15: 55% low skills, 20% low-medium, 4% medium, 6% medium-high, 15% high skills). In contrast to these skill requirements of platform work, a survey of UK platform workers (BEIS, 2018) shows that they tend to have high qualifications (25% high school, 12% university not completed,1% diploma, 45% university completed, 17% postgraduate). It is likely that these results also apply to Austria, suggesting a strong de-skilling effect of platform work.

For more information on the status and hotspots of platform work, see subsequent studies by OECD and EUROFOUND:

- Measuring platform workers (OECD 2019)

  The 2019 study provides an overview of the number, characteristics and fields of activity of platform workers in OECD countries. It is based on a common understanding of what the term platform work encompasses.

- New forms of work in the digital economy (OECD 2016a)

  The OECD study from 2016 examines how platforms influence and change the production and, above all, the organisation of work. It also discusses developments, opportunities and challenges in selected platform markets and identifies policy-relevant issues.

- New markets, new jobs (OECD 2016b)

  In this study, the OECD looks at the opportunities and challenges presented by the digital economy. Policy intervention aimed at fair competition and protection of workers as well as investment in innovation and skills are identified as key factors for successful change.

- Platform work: Maximising the potential while safeguarding standards? (Eurofound 2019)

  In this Eurofound study, the employment opportunities, advantages and disadvantages of platform work are examined in order to finally arrive - with the use of best practices - at intervention recommendations.

- Employment and working conditions of selected types of platform work (Eurofound 2018)

This study explores the working and employment conditions of the three most common types of platform work in Europe with a focus on physical and social working environment, autonomy, employment status, income, taxation and social protection. It also analyses the regulatory framework for platform work in 18 EU countries.

Digital skills have been in the spotlight for some time. Particularly relevant are the questions of which skills are in demand, to what extent the labour force in different countries can provide them and what solutions there are for the skills deficit or mismatch. Chapter 1.6. discusses the requirements for digital skills in Austria in more detail. The following publications and web tools provide an insight at the international level:

- New skills for the Digital Economy (OECD 2016c)

The 2016 OECD study attempts to categorise digital competences and skills and analyses how technological progress is changing the demands on workers. It also compares the supply and demand of technically relevant skills.

- Insights into skill shortages and skill mismatch (Cedefop 2018)

Cedefop calls in this 2018 publication for mitigating skills mismatch through sustained activation, end-to-end learning opportunities, differently positioned job profiles and better management.

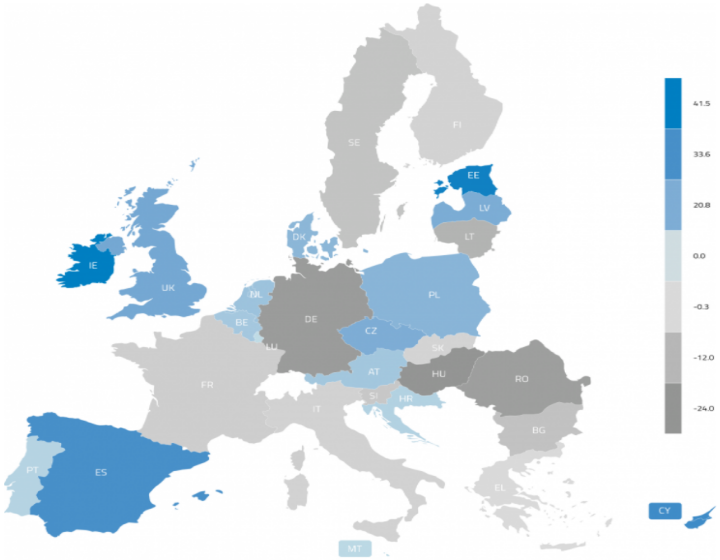

Figure 1: Cedefop Skills Panorama "Future employment growth for ICT professionals" (Source: https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/ict-technicians-skills-opportunities-and-challenges-2019-update)

- Understanding technological change and skill needs (Cedefop 2021)

This Cedefop handbook provides policy makers and analysts with insight into the expected changes in demand for skills and capabilities in order to respond with active interventions.

- Skills Panorama web tool (Cedefop)

*Another possibility to view current developments and forecasts concerning occupational groups and skills is Cedefop's **Skills Panorama**. The interactive online tool provides insight into education levels per sector, the expected growth rates of different occupational groups and the distribution of occupational profiles across sectors at country and EU level.*

1.2.1. Digitisation in a country comparison

Worker productivity, competitiveness and efficiency of the public and private sectors there are hardly any indicators where the degree of digitalisation does not play a role. International comparisons within and outside the EU are therefore important. One tool for making this comparison between EU countries is the **Digital Economy and Society Index** (**DESI**). The DESI measures five dimensions of digital progress:
Connectivity, Human Capital, Internet Use, Digital Technology Integration, Digital Public Services;

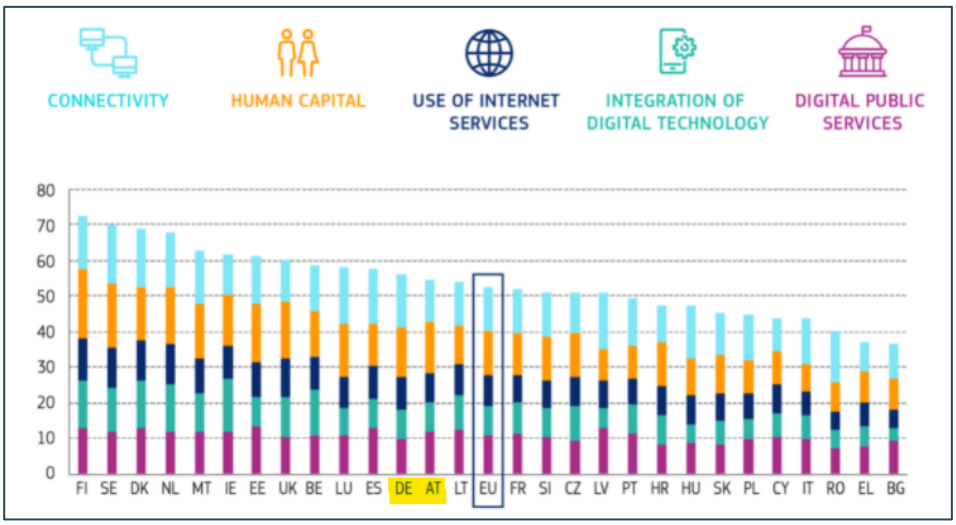

Figure 2: Comparison of EU Top 4 and Bottom 4 with other economies worldwide (Source: https://digital-strategy.ec.europa.eu/en/library/i-desi-2020-how-digital-europe-compared-other-major-world-economies)

The International Digitisation Index (**I-DESI**) makes it possible to compare EU countries with 18 countries outside the EU. Only a few EU countries can place themselves in the top field in the comparison. The EU-27 has the most room for improvement in 'e-government', the digital public services. In an international comparison, the majority of EU countries lag behind non-EU countries such as Korea, the USA and Australia, but also China and Russia in this area (I-DESI 2020).

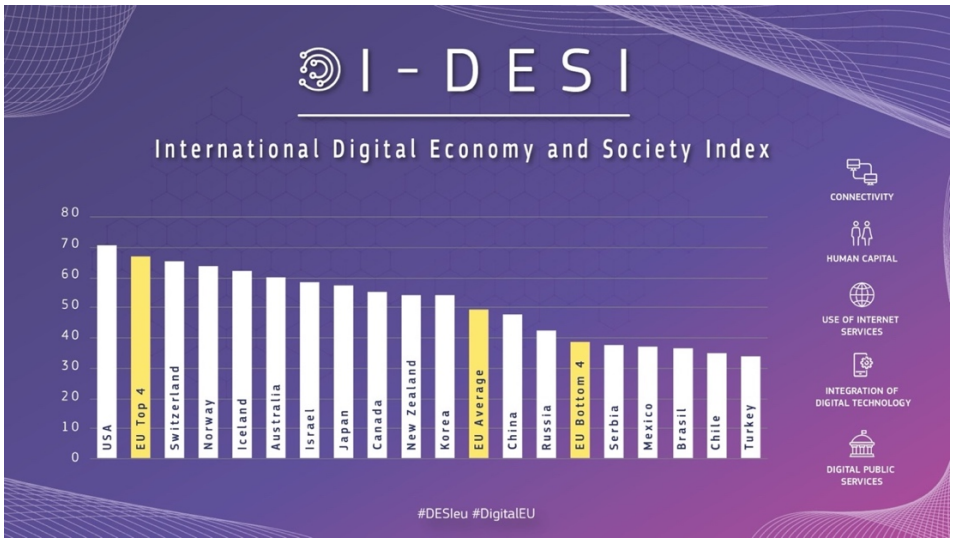

Figure 3: DESI 2019 (Source: https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi)

Austria is in the upper middle field in the DESI 2020 in an EU comparison. The integration of digital technology lags behind the Scandinavian countries, which position themselves at the top of the ranking, and improvements could also be made in the area of human capital.

A detailed look at the indicators on digital skills reveals that Austria, for example, does well especially in the graduation rates in STEM subjects (mathematics, information technology, natural sciences, technology). In recent years, however, Belgium, the Netherlands and Scandinavia have made gains, while a decline was reported in e.g. Austria in 2018. Compared to DACHIT (Germany, Switzerland, Italy) and CEEC5 (Poland, Czech Republic, Slovakia, Hungary, Slovenia), Austria scores high in basic digital skills and ICT professionals. However, Austria lags far behind the EU leaders in internet use, especially among older target groups; Germany and Switzerland can also position themselves better in internet use among all age groups (WIFO 2019).

Working conditions 4.0

The influence of the digitalisation of work is not only changing the way we carry out tasks and which work tools we use for carrying them out. The use of digital tools is also changing working conditions by supporting and promoting local, temporal and organisational / workplace flexibilisation. Working conditions are becoming more networkable due to ever greater availability and the greater expansion of ICT, and can thus be designed much more flexibly in terms of location and time. The experiences from the COVID-19 pandemic have shown how easily and quickly a change to flexible working models (e.g. home office) can be realised.

In addition, the development of new, digital business models has created new marketplaces and employment opportunities that are part of, for example, the sharing economy or the platform economy. In connection with the newly emerged internet-based platforms, terms such as "crowdwork", "on-demand economy", "collaborative economy" or "gig economy" are also used. According to the study by Ecoplan (2017), the various forms of platform economies can be classified as follows:

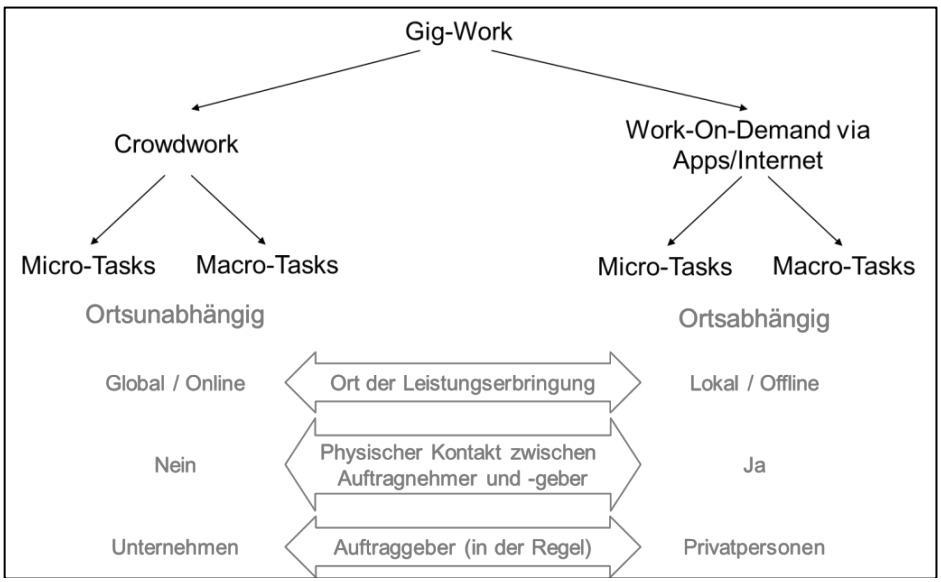

Figure 4: Platform economy: forms and distinguishing features (Ecoplan, 2017)

So far, existing statistics almost completely fail to directly record the spread of platform-based forms of work in Liechtenstein (and also in Switzerland). Therefore, the spread of platform economies cannot currently be measured directly, but can only be estimated using various indicators. However,

these suggest that the share of platform employment is still likely to be very low. For example, salaried employment is still the dominant form of work in Liechtenstein and Switzerland, with a share of around 85% (cf. Federal Council, 2017).

Other indicators should also be taken into account, e.g. the share of short, fixed-term employment relationships, the share of solo self-employed, the prevalence of on-call work and employment with several employers. With regard to atypical forms of work, such as on-call work, there has been no increase in recent years. According to the Swiss Labour Force Survey (FSO/SAKE), in the second quarter of 2005 around 6.4% of the employed population worked on call, while in the second quarter of 2016 the figure was 5.0%.

The share of solo self-employed decreased from 8% in 2005 to 6.7% in 2016. On the other hand, the share of temporary employment contracts of less than six months increased slightly from 1.9% in 2005 to 2.5% in 2016. An increase can also be observed in the number of employees with several employers. In 2005, around 6.5% of those in employment stated that they had several employers. However, at around 7.7%, the proportion is still relatively low in the second quarter of 2016. It can therefore be assumed that there is no direct connection with digitalisation, as the increase has been rather weak, especially since 2010.

Forms of digital work

It should be noted that the share of purely digital work - especially in the new forms of work - is marginal compared to the total economic power of all countries in the partner consortium. No clear data is currently available, but developments are emerging that indicate an increase in this share and allow an assessment of its future importance. According to a study by the trade union syndicom on the spread of crowdwork in Switzerland, it is at least possible to estimate the degree of awareness and distribution. According to syndicom, around 18% of respondents said they had already found work on platforms such as Upwork, Uber or Handy. In a study, Credit Suisse was able to calculate the sharing economy's share of GDP at 0.251% of the domestic product.

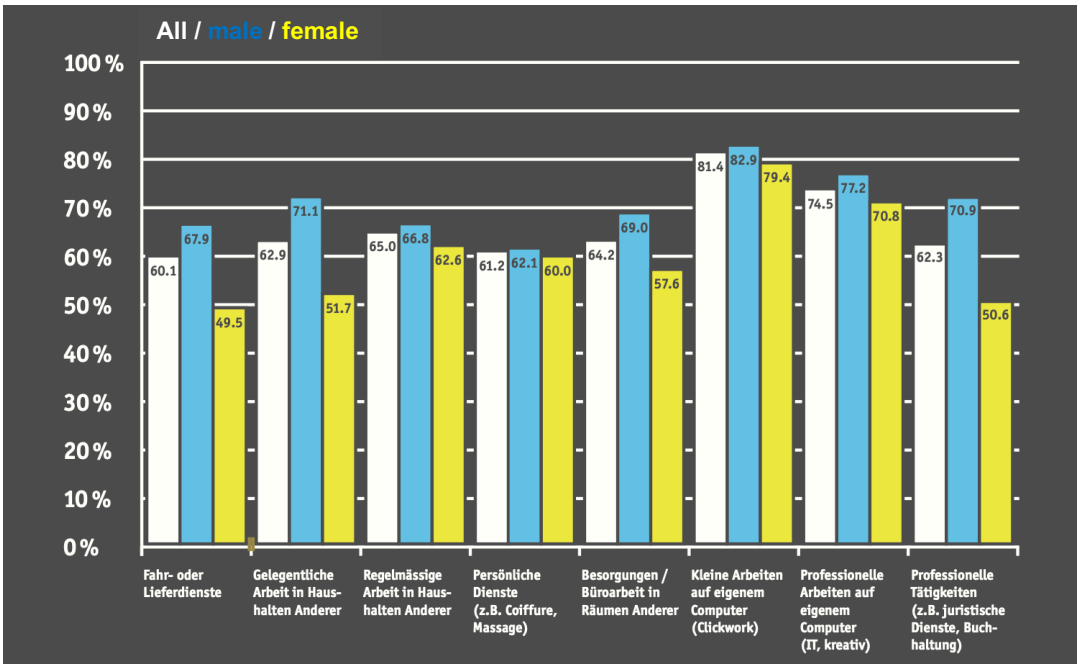

Figure 5: Crowdwork activities in Switzerland (Ecoplan, 2017)

Region	Befragte	Anteil
Genfersee	393	18.2 %
Mittelland	465	15.2 %
Nordwestschweiz	253	19.8 %
Zürich	351	20.9 %
Ostschweiz	267	13.4 %
Zentralschweiz	192	18.7 %
Tessin	80	31.7 %

Figure 6: Distribution of crowdworkers in Switzerland (Ecoplan, 2017)

The new forms of digital work and employment in Liechtenstein and Switzerland show that digital tools are used for practice, especially with regard to commissioning and processing. However, only a certain part of it can be classified as purely digital work, in which all work processes are digitally supported and relate to purely digital input and output factors.

1.3. Digital professions in Germany

The difficulties of taking stock

It is hardly possible to make statements about the status and prospects of digital professions in Germany for various reasons. The speed with which gainful employment in Germany has been digitised means that a distinction must be made between the learned profession and the real work activity. For example, digitisation still plays only a marginal role in the job description of a warehouse worker or logistician; in practice, many large logistics companies are largely digitised. Employees can only meet the requirements of digitised logistics if they have further qualifications or have the opportunity to learn in the process of working. Thus, under the same job title, one finds on the one hand skilled workers - especially in smaller logistics entrepreneurs - who have to cope with traditional requirements for which their knowledge acquired in training is sufficient, and on the other hand digitally highly competent skilled workers. The job title itself says little about whether one can talk about a digital PROFESSION or not. The same applies to medical assistants or mechanics, whose fields of work include very different dimensions of digitalisation. Another difficulty arises from the fact that people often talk about new professions which, on closer inspection, are rather activities or business models (see 1.5.2).

The situation is relatively transparent for apprenticeships in the dual system and in full-time school-based training. The Federal Institute for Vocational Education and Training (BIBB) has a central regulatory function here and designs new content for the occupational profiles, which reflect technological or technical changes and reforms the occupations accordingly.

In 2020 this was the case for example for

- IT specialist
- IT system electronics technician
- Management assistant for digitalisation management
- Management assistant for IT system management
- Media designer in education and sound

These vocational training courses, which usually last three and a half years in Germany, can now only be obtained with a school-leaving certificate (Abitur) and for many graduates represent the preliminary stage of a subsequent relevant course of study. The digital professions are dominated by those who have a relevant degree and have starting salaries that are significantly higher than those that can be achieved in classic apprenticeships. But it is true for all digital occupations that there is a compulsion to continue learning even after completing an apprenticeship or degree because the level of technical and technological innovation is so high that initial professional knowledge is no longer sufficient to cope with the job requirements.

The situation is quite different in study programmes at universities of applied sciences, universities and dual study programmes. In Germany, a total of 18,745 Bachelor's and Master's degree programmes were offered in the winter semester 2020/2021 (KMK 2021). It is not possible to ascertain how many of the students aim to work in a digital profession in some way - which is also due to the fact that there is such creativity in the designations of the study programmes that it is hardly possible to draw conclusions about the type of subsequent professional activity from the designation. It can be assumed that a high degree of digitalisation has been achieved in at least three fields:

- Engineering sciences with 2020 Bachelor's and 1717 Master's degree programmes
- Maths/Natural Sciences with 1560 Bachelor's and 1583 Master's programmes
- Art/Music/Design with 797 Bachelor's and 796 Master's degree programmes

If we follow the definition of digital work already introduced by Pangsdorf (2019, 21), the majority of all jobs will probably belong to the field of digital work. In addition, there is another difficulty that could be observed in every initial phase of the four industrial revolutions. It can be illustrated by the example of the job of network administrator. Before this work was defined in a job description or a degree programme, it was mostly done by self-taught people who were technology savvy and had acquired their expertise in practice and sometimes carried it out with a high degree of competence. The problem only became clear when network administrators with certificates and degrees entered the market. When companies closed or laid off, the self-taught pioneers were given the status of unskilled, regardless of their actual competences and regardless of how long they had worked as network administrators, and in Germany they became Hartz IV recipients after one year of unemployment.

It will only be possible to collect solid, sustainable figures on the digital professions when the process of digitisation reaches a certain level of consolidation; this does not seem possible in the current development dynamics.

1.3.1. Digitisation professions in Germany

In 2020, the Federal Ministry for Economic Affairs and Energy commissioned a study on digitisation occupations in Germany (BMWE, ed., Digitalisierung der Wirtschaft - Kompetenzbarometer - Digitalisierungsberufe in Deutschland, Definition, Methodik und Abgrenzung, Alexander Burstedde,

Institut der Deutschen Wirtschaft). It is believed to be the first methodologically very elaborate work that offers a differentiated overview of digitisation occupations in Germany.

> *"With regard to digitisation occupations, there is not yet a definitive definition nor a finalised list of relevant competences and activities that characterise a digitisation occupation."* (BMWE, 2020, 3)

- **Definition of digitisation professions**

The author states that although most of the labour work with digital technologies, "not every use of computers, data and the internet make occupations digitalisation occupations" (ibid.) **He defines digitalisation professions as those that produce new key digital technologies or enable their use and dissemination through special technical knowledge** (cf. ibid. 3-4).

Supporting professions are excluded because it is assumed that "there is not a sufficient amount of digital competences at this requirement level to justify classification as a digitisation profession". (ibid., 5) The author points out that the requirement level of the activity is decisive for classification as a digitisation occupation and not the formal qualification (cf. ibid., 5). "Atypical CVs are likely to be common, especially among older IT workers who acquired their skills before the occupations were widespread and standardised (cf. ibid., 6).

- **For the identification of digitisation professions**

The methodologically differentiated procedure for identifying digitisation occupations in the study will not be retraced in detail here. Thirty fields of activity were investigated. As a result, the German author of the study classifies 93 types of occupations as digitisation occupations (see list of digitisation occupations in the country report on Germany), which surprisingly do not only include highly qualified people.

> *"19 digitisation occupations are for skilled workers, whose employees have usually completed vocational training. 28 digitisation occupations are for specialists who have often completed advanced training such as master craftsman or technician or a bachelor's degree. 46 Digitisation occupations are finally for experts, most of whom have a master's degree or diploma and some of whom also have research experience."* (ibid., 17)

This makes it clear that skilled workers from the dual training occupations also have the chance to advance to the circle of specialists through appropriate further qualification.

1.3.2. New digital professions or new digital jobs?

The development towards individual occupations can also be traced well by taking a closer look at the entry requirements of some new occupations. Only a few of the new occupations will be presented here as examples.

- **Account Manager, SEO Manager**

He/she analyses websites, analyses and evaluates keywords, optimises texts and websites.

- **SEA Manager**

He/she takes over the conception, set-up, control, optimisation of search engine marketing campaigns.

- **Customer Experience Manager**

He/she develops strategies on how to meaningfully involve the customer in the development process of a product or service.

- **(Big) Data Scientist**

He/she develops and establishes procedures for processing large amounts of data in order to support important decisions in this way through data.

All these professions, which represent only a small section of new 'professions', have in common that they are not actually professions, because training backgrounds and initial access to these professions are neither tied to specific prerequisites nor do they require specific courses of study or training. They represent activities rather than professions. Even though IT experts make up the majority of these fields of activity, there are also linguists, lawyers, business economists, but also self-taught people who have acquired their expertise outside of studies or training.

The following applies to all sectors that are confronted with digitisation requirements: "Digitisation knowledge cannot, however, be limited solely to formal expertise certified by training and certificates". (Brendel et al. 2020,p. 8) In the companies, there are core groups with a high level of digitisation knowledge, primarily IT specialists and managers, as well as an extended group of in-house employees who are strongly to highly affected by the implementation of digital technologies in their fields of activity or are involved in top-down induced pilot projects for the introduction of new digital tools. They represent a potentially highly heterogeneously structured group with a wide range of qualification levels. (cf. ibid., p.8)

A stocktaking of the Fraunhofer Institute for Systems and Innovation Research shows "that digitalisation promotes atypical employment models such as flexible part-time work or intrapreneurship, creates new forms of work such as crowdworking and clickworking, and gives rise to new business models such as those of the sharing economy and new collaborative economic forms. Increasingly, the social divide runs along the dividing line between actors with or without digital skills." (Vodafone Foundation, n.d., n.d. 20f)

Digitally competent on the winning side?

However, the split does not mean that the digitally competent are on the winning side. It is becoming apparent that especially in the IT professions the figure of the labour entrepreneur of Voss/Pongratz (1998) has become the norm, who offers not only his labour but his personality. "It is a matter of taking over the 'whole' person, who puts all his or her subjective potential and resources, i.e. also his or her motivational orientations, aspirations and competences that guide action outside of work, into the service of work. At the same time, the separation of work (or professional life) and leisure (or private life) that is constitutive of industrial society becomes obsolete." (Ewers et al., 2006, 37) This subordination of the private to work leads to the fact that "for the majority of young women and men.... private goals are less relevant than professional goals at the time of the survey" (cf. Schraps, 2006, 214).

As a consequence, "almost two thirds of the respondents with this form of life organisation (live) as singles, the other respondents live predominantly in more egalitarian partnerships". (cf. Ewers et al., 2006, 180)

The entrepreneurial profile of the workforce entrepreneur is also visible at the level of requirement profiles. According to the Fraunhofer Institute, employees in digitalised companies are expected to

have a strong ability to organise and market themselves. They must be able to assess and present their strengths and competences. Through digital, wearable measuring devices (wearables), one's own health and performance can be assessed and shared on the internet. (cf. Vodafone Foundation, n.d., n.d., 5) The more employees voluntarily share this data and understand it as an instrument of self-marketing, the greater the risk that companies will demand this data when hiring new staff or terminating contracts.

Advantages and disadvantages of digital work

For clients as well as contractors or supervisors and employees, it is pointed out in career counselling, among other things, that both can benefit significantly from these forms of new work, but at the same time the downsides for the employee or contractor are pointed out.

Advantages	Disadvantages
Flexibility	Permanent availability
Motivation	Difficult communication
Increased creativity	Inadequate structuring of the daily work routine
Time saving (elimination of work routes)	Increased difficulty to build up a team culture
Better reconciliation of work and family life	Global competition depresses prices

(Source: Arbeits-abc.de: https://arbeits-abc.de/digitales-arbeiten/)

1.3.3. Findings and conclusion

In particular, the presented BMWE study (2020) provides a comprehensive overview of the number and development of digitisation occupations in Germany and presents a differentiated definition of digitisation occupations. However, the claim to create a map of the distribution of digitisation occupations by region cannot be fulfilled. Corresponding empirically validated studies are not available and are not to be expected for the time being.

There are understandable reasons for this: Especially the so-called hidden champions which are often world market leaders in their segments, are drivers in the digitisation of professions and activities. They are often small and medium-sized enterprises that are hardly known outside their region. There are rural regions in Germany, such as the Hohenlohekreis in Baden-Würtemberg or the Sauerland in North Rhine-Westphalia, with a large number of highly digitised hidden champions; however, there is no comprehensive overview of the regional distribution.

1.4. Digital professions in Austria

Digitalisation affects all existing industries. It influences in and changes already established professions, sometimes massively, and also creates additional new professions. The newly created occupational fields are partly involved in digitisation themselves, partly they only make use of the results of the digitisation process. Based on occupational databases such as bic.at, the project team has developed a cluster structure of these new, digital occupations:

Web as a platform/application and operation of digital tools

All professions in which internet platforms (digital marketplaces) play a central role fall into the category "web as a platform". Examples:

- Everything in the context of e-commerce and digital business processes (e-commerce merchant, brand manager, online marketing, business analyst, SEO/SEA manager, information broker, etc.).
- Everything related to online media and social media (social media manager, campaign manager, community manager, media consultant, online editor, multi-media designer, new media consultant, etc.).
- Everything in the context of e-entertainment (blogger, influencer, youtuber, e-gamer, etc.)
- Everything in the context of e-learning (deep learning engineer, content manager, e-learning author, media didactician, etc.)

IT software (coding) and web design

Coding and web design include all professions that have to do with the development of IT programmes and provide programming and support for programmes in a broader sense. Examples:

- Everything related to programming (software programmer, app developer, computer linguist, computer scientist, medical computer scientist, robotics technician, etc.).
- Everything related to networks (web developer, cloud engineer/architect, network designer, etc.)
- Everything related to design (graphic designer, 3D designer, computer visualist, etc.)
- Everything related to applications and support (application consultant, IT consultant, IT project manager, network administrator, etc.).

IT hardware, network technology and IT architecture

People who work with IT hardware and architecture and network technology can be grouped together. Examples:

- IT technician (computer technician, IT systems technician, electronics technician, hardware developer, IT systems electronics technician, implementation of cloud technologies, etc.).
- IT technical support (IT service technician, etc.)
- IT sales (IT sales manager, etc.)

Data and Data Science

Data occupations include all activities that focus on data and information. Examples:

- Everything related to the management of data and information (content manager, data scientist, data warehouse analyst, data analyst, database developer, information manager, etc.).
- Everything related to data calculations and AI (AI specialist, bioinformatician, cognitive developer, data scientist, data analyst, data modeller, etc.).
- Everything related to data protection and data security (data security advisor, fraud analyst, IT security manager, encryption technician, etc)

1.4.1. Formal educational pathways to an IT profession

For many digital professions, higher education is indispensable, but digitalisation has also become apparent in recent years through new apprenticeships. Since September 2018, there have been more opportunities in Austria to complete IT training in the form of an apprenticeship. These new apprenticeships are divided into app development, systems engineering and operations engineering, each of which specialises in a different focus of IT.

In addition, there are also apprenticeship programmes with a focus on IT, e-commerce and media (BMDW 2020):

- Apprenticeship for application development: programming/coding of applications/ parts
- Apprenticeship for information technology (focus on systems engineering):
  working with hardware, software, cloud solutions and databases
- Apprenticeship for information technology (focus on operating technology):
  working with hardware technology with specialisation in manufacturing companies (internal company networks, networking of machine tools).
- Apprenticeship for IT business administration:
  purchase and sale of computer software and hardware.
- Apprenticeship for e-commerce clerk: selling products over the internet
- Apprenticeship for media specialist:
  focus on online marketing or web development and audio-visual media

In the tertiary sector (universities, universities of applied sciences, colleges), there is still a rather limited range of Bachelor's degree programmes at the universities (computer science, computer engineering, business informatics, applied computer science, media informatics, visual computing, medical informatics, software & information engineering, technical informatics); the range is becoming broader in the Master's degree programmes. At the universities of applied sciences, the choice of study areas is already greater in the Bachelor's programme (including IT infrastructure management, systems engineering, IT security, hardware-software design, media technology, mobile computing, e-health). This diversity also continues in the Master's degree programmes (BMBWF study selection).

1.4.2. Further development of professions in the digital field

Amara's Law states that we tend to overestimate the short-term impact of a technology and underestimate the long-term impact (Bröckl and Bliem 2020). This can be seen, for example, in the former hype about Second Life as a business opportunity and the initial scepticism regarding the long-term potential of the internet (Benke 2014, Kühne 2009).

In reality, relatively few occupations disappear completely due to technological change, but changes occur in all occupational groups to varying degrees. Driven by technological progress, professions are changing faster and more frequently, with many innovations emerging in the high-tech sector. In our fast-changing world of work, additional qualifications and specialisations are gaining importance and lifelong learning is becoming more important to "stay on the ball" (Bröckl & Bliem 2020).

The Austrian experts interviewed see major developments in the mechatronics sector, including construction or care mechatronics, as well as in the mobility and logistics sector, where self-driving systems, drones and automated logistics programmes can have a major impact on the future working reality of employees. Manual tasks are becoming less important, while the demand for control, monitoring and quality assurance is increasing. Due to the increasing predominance of digital work steps, an increase in the value of social skills and manual activities that cannot be meaningfully automated (e.g. art) is to be expected.

Occupations are also becoming more and more fragmented into bundles of activities, with the effect that it is becoming difficult to identify the basic occupation and the training associated with it. Jobs as bundles of individual activities are increasingly replacing occupations as comprehensive qualifications. The individual occupation is increasingly becoming the norm (Bliem 2019).

1.4.3. Digitalisation and work - requirements for (digital) competences

With the growing importance of digital professions, digital skills are becoming increasingly important in the labour market. For many employers, basic digital skills are a prerequisite for employment, and demand is also increasing in professions that were previously less digitised. For example, tablets or other digital aids are increasingly replacing the writing pad of waiters and waitresses in the catering industry, and the experts stated in the interview that the use of digital technologies is also increasing in nursing professions.

Nevertheless, the differences between sectors remain large. While basic skills are more than sufficient in some occupations, other jobs require deeper knowledge of technology and computer programmes (Schleiter and da Silva Zech 2020).

However, the umbrella term 'digital skills' must be understood more broadly than just the ability to deal with new technologies. The term also includes complementary competences, i.e. *"technical, social, methodological as well as personal attitudes and characteristics"* (Bröckl and Bliem 2020, p. 34). Advancing digitalisation is leading to a technology-rich work reality that has new requirements in terms of work competences in general (OECD 2016a).

Complementary skills are used in both digital and digitised work. For example, the creation of software is often accompanied by its own planning processes (e.g. Agile, Scrum) and some innovations, as mentioned above, lead to employees increasingly advising and accompanying customers during their self-execution. This requires not only knowledge of digital technology (e.g. self-service machines in banks), as the experts interviewed emphasised, but also social competence in customer service, which was not necessary in the past, or only to a limited extent.

Excursus: Digital competences: DigComp 2.2 AT - digital competence model for Austria

Unlike qualifications, competences are often diffuse and it is difficult for employers to assess the truthfulness of the jobseeker's own statements. DigiComp 2.2 AT was developed in 2018 to remedy this situation with digital competences (understood here in purely technical terms).

This competence model is based on the European Reference Framework for Digital Competences (DigComp 2.1), but extends it even further. All information on this can be found on the website https://www.fit4internet.at/.

The DigComp 2.2 AT consists of six competence areas to which 25 individual competences are assigned. In a further step, all of these individual 25 competences are divided into a further 8 levels: two levels each in Basic, Independent, Advanced, Specialised.

Based on the model, individual competences can be assessed and development potential identified. Not all competences have to be mastered as a specialist.

6 Competence areas and 25 sub-competences in DigComp 2.2.AT

0. Basics and access
- 0.1 Understand concepts of digitisation
- 0.2 Operate digital devices
- 0.3 Use and provide inclusive forms of access to digital content

1. Handling information and data
- 1.1 Research, search and filter data, information and digital content
- 1.2 Critically evaluate and interpret data, information and digital content
- 1.3 Manage data, information and digital content

2 Communication and collaboration
- 2.1 Communicate using digital technologies.
- 2.2 Use digital technologies to share data and information, to collaborate.
- 2.3 Use digital technologies for social participation
- 2.4 Make purchases and sales
- 2.5 Use appropriate forms of expression
- 2.6 Create digital identity

3. Digital content creation
- 3.1 Develop digital content
- 3.2 Integrate and recreate digital content develop
- 3.3 Work usage rights and licences
- 3.4 Programming/automating processes

4. Security
- 4.1 Protect devices
- 4.2 Protect personal data and privacy
- 4.3 Protect health and wellbeing
- 4.4 Protect against fraudconsumer rights abuse
- 4.5 Protect the environment

5. Problem solving and further learning
- 5.1 Solve technical problems
- 5.2 Identify needs and technological responses to them.
- 5.3 Be creative with digital technologies
- 5.4 Identify digital literacy gaps

1.5. Digital professions in Switzerland and Liechtenstein

Digitalisation affects all existing industries. It influences and changes already established professions, sometimes massively, and also creates additional new professions. These new, digital professions have a special IT focus and not only deal with questions about the possibilities and benefits of digitalisation, but also deal with concrete questions such as the influence and effect of concrete applications of algorithms, digital analysis and decision-making systems as well as artificial intelligence on society. Digital professions include specific professions such as social media manager or content marketing manager as well as professions such as business informatics specialist, medical engineer and IT security manager.

The digital transformation has so far led to an increase in employment primarily in technology- and knowledge-intensive occupations and in occupations with a high proportion of creative tasks and entrepreneurial, conceptual or abstract thinking. These include, for example, scientific specialists, technical specialists, engineering specialists or managers and entrepreneurs. Occupations with a high proportion of human interaction or manual non-routine activities also have a low probability of automation. These are, for example, care and health professions, personal and beauty care professions, cleaning professions, order and security professions or education professions.

Occupations with a high proportion of routine work, on the other hand, are likely to lose importance in the course of the digital transformation. In the recent past, agricultural occupations and manufacturing occupations have been strongly affected by automation. In the service sector, this applies for example to accountants, clerks, bank employees or administrative professions. These trends are likely to continue in the future.

1.5.1. New professions emerge

In addition to the shifts mentioned above, digitalisation also opens up employment opportunities in **newly emerging professions**. For example, technological progress in research and development creates new jobs and new professions. In the past, the development of information technologies brought with it a sharp increase in demand for IT specialists. The availability of large amounts of data (big data), increasing networking (Internet of Things) and advances in robotics are creating new jobs such as software and application developers, network specialists, data architects, data protection experts or developers of hardware and robots. Furthermore, new professions that have emerged in interdisciplinary areas, such as bioinformaticians, should also be mentioned.

Ultimately, technological developments primarily lead to a change in job profiles within existing occupations. Automation has already led to a strong change in work processes in the past. In many cases, manual routine activities, especially repetitive and clearly defined procedures and work processes, but also simpler office work were automated. New automation technologies enabled improvements in automated mass production, led to productivity increases and reduced the need for labour. Thanks to rapid advances in robotics, even more complex manual tasks can now be automated. For example, robots can increasingly be used for the fine and final assembly of products, which previously required the use of manual labour. Artificial intelligence, machine learning and the growing possibilities in data analytics (Big Data) also make cognitive activities (e.g. data processing and analysis) automatable. Activities with a high degree of creativity, social interaction or entrepreneurial thinking as well as manual non-routine activities, on the other hand, are likely to remain less at risk from automation.

1.5.2. Digital professions in vocational education and training

The digital transformation process requires skills in dealing with new technologies as well as creative and critical thinking. The teaching of suitable skills and the provision of corresponding education and training programmes are of great importance in Liechtenstein and Switzerland, as noted in the Swiss Federal Council's strategy paper[1] , which is also relevant for Liechtenstein. Already in 2018, a joint initiative was launched by the Confederation, cantons and professional organisations with the aim of making VET fit for the future: "VET 2030". Liechtenstein's VET is directly linked to that of the Swiss canton of St. Gallen, where an IT education offensive was recently launched for all apprenticeship occupations[2] .

[1] Digital Switzerland Strategy, 11.09.2020, https://www.bakom.admin.ch/dam/bakom/de/dokumente/informationsgesellschaft/strategie/strategie_digitale_schweiz.pdf.download.pdf/Strategie-DS-2020-De.pdf

[2] Canton St. Gallen (2021): IT education offensive in vocational education and training, www.itbo.sg.ch

The topic of digitalisation in VET is given an important focus in Liechtenstein and Switzerland. There is a growing awareness of the need to teach digital skills at an early stage for all professions. At the same time, digital professions are to receive increased attention with regard to needs-based expansion and sector coverage.

On the website of ICT-Berufsbildung Schweiz, the following **professions with basic training are** currently assigned to the digital professions which are also established in Liechtenstein:

- Computer scientist EFZ[3]
- EFZ media technician
- ICT specialist EFZ
- Building computer technician EFZ
- IT specialist EFZ

With the initiative of ICT-Berufsbildung Schweiz (ICT Vocational Training Switzerland), since September 2020 the aim has also been to develop a **new basic training course** with the working title "Digital Business EFZ" together with representatives from the commercial and ICT sectors. This new occupational profile will also be available in Liechtenstein in the near future and is intended to cover those areas of activity that are at the interface between technology and business. The aim is to address companies across all sectors that are in the process of digital transformation and want to gain knowledge from data on an ongoing basis - both for their own company and for customers.[4]

[3] EFZ: Eidgenössisches Fähigkeitszeugnis (Federal Diploma of Vocational Education and Training)

[4] Source: www.ict-berufsbildung.ch; last accessed: 29.10.2021

2. Country reports

Based on the country reports, the current situation of the effects of digitisation on the labour market in the countries of the consortium, i.e. Austria, Germany, and Liechtenstein (as well as Switzerland) will be surveyed and evaluated. At the same time, in a discussion with experts from the field of vocational education and training and educational counselling, a forecast for the future development and the respective trends will be developed, which will make the landscape of individual occupations in Europe understandable.

The following summary in this chapter of the results and findings from the project with a focus on the consortium countries serves to answer the questions posed in the project:

- *What new forms of digital work and employment do exist?*
- *Which regions (geographically) are most affected?*
- *Where are the client and the service provider located?*
- *How does this affect the landscape of the individual professions?*
- *What will the landscape of the individual professions look like in the near future and how will digitalisation lead to changes for the professions?*

2.1. Results from the "analysis" project phase

The results and findings from the "analysis" phase of the project are based on a literature review and are incorporated and presented in detail in Chapter 1, particularly in order to analyse the current situation with regard to digitisation-related occupations and to answer the first three of the above questions. The central statements can be summarised as follows:

New forms of work

- Digitalisation is fuelling the emergence of atypical employment models such as flexible part-time or intrapreneurship, creating new forms of work such as crowdworking and clickworking, new business models such as the sharing economy and new collaborative economies.
- New forms of work are found in the platform economy, the sharing economy, internet-based workplaces and within the digital, collaborative economy. Typical terms are blogger, YouTuber, TikToker, influencer.
- It can be seen that especially in the IT professions the figure of the labour entrepreneur of Voss/Pongratz (1998) has become the norm, who offers not only his labour but his personality.

Digital work vs. digital professionalism vs. the designation "digital profession

- Digital work is characterised by digital skills, abilities and competences, while digital professionalism focuses on the (digitally) supported work processes.
- Digital professions can be described as such if the core activities are based on a digital input that leads to a (processed, changed) digital output by means of digitally executed work processes.

Special results from the analysis in Germany

The existing empirically validated material is not sufficient to list meaningful results for individual sectors. Although it can be assumed that digitisation is well advanced, especially among the highly innovative *hidden champions in* Germany, these companies are predominantly involved in the production of high technology and special services; only a few have their focus on the IT or software sector. In general, it can be said that large companies are significantly more advanced in the digitisation process than SMEs; highly productive sectors are more digitised than others.

In the digital index, the "information and communication" sectors lead with 6.5 points, followed by the manufacturing sector with 6.5 points, primarily in the chemical, pharmaceutical and electrical industries and in mechanical and vehicle engineering. At the lower end of the digital index are construction, agriculture and forestry, and mining, with the latter two sectors being rather marginal in terms of both employment and turnover.

In particular, the BMWE study presented (2020) provides a comprehensive overview of the number and development of digitisation occupations in Germany and presents a differentiated definition of digitisation occupations. However, the claim to create a map of the distribution of digitisation occupations by region cannot be fulfilled. Corresponding empirically validated studies on this are not available and are not to be expected for the time being.

There are understandable reasons for this: Especially the so-called *hidden champions,* who are often world market leaders in their segments, are drivers in the digitisation of professions and activities. They are often small and medium-sized enterprises that are hardly known outside their region. There are rural regions in Germany, such as the Hohenlohekreis in Baden-Würtemberg or the Sauerland in North Rhine-Westphalia, with a large number of highly digitalised *hidden champions*; however, there is no comprehensive overview of the regional distribution.

The only empirical evidence is that the degree of digitalisation in East Germany is significantly lower than in West Germany. This is partly due to the fact that in the first years after German reunification, the East was seen more as an "extended workbench of West Germany" and the development of independent industries had little priority.

2.2. Results and findings from the project phase "Evaluation"

The results and findings from the evaluation of the literature research have already been prepared for the interviews with experts from the field of vocational education and training and educational guidance, as described in Chapter 1. These interviews served to reflect on and supplement the findings from the analysis phase in the project. The interviews were based on the following questions:

- ANALYSIS: What are the new forms of digital work and employment?
- EVALUATION: How does this affect the landscape of the individual professions?
- PREDICTION: What will the landscape of the individual professions look like in the near future and how will digitalisation lead to changes for the professions?

Interview guidelines and questionnaire for discussions with experts

In the interview, not only an answer to the underlying questions is to be found, but also the experts' view of the topic is to be captured. In addition, besides the specific answers to the questions, there should be enough room for discussion and reflection on various aspects. The following questions were asked in the interviews; these served primarily to shape the framework of the discussion.

Interview questions:

→ What is your understanding of digital professions / occupations / fields of activity; what do you associate with the term digitalised profession/occupation/field of activity?

→ What influence does digitalisation have on the professional world?

→ Which professions / fields of activity have undergone a radical change, a reformation through digitalisation?

→ Which (purely) digital professions / occupations / fields of activity have developed so far?

→ How can these (purely) digital professions / occupations / fields of activity be grouped? (What differences are there between the digital professions / occupations / fields of activity? -> regarding possible clustering, filtering, grouping, ...)

→ From your perspective, how will the landscape of the individual professions / occupations / fields of activity change in the foreseeable future?

The interviews were either recorded and transcribed or recorded via a keyword and memory protocol, which was subsequently proofread and supplemented by the individual experts.

2.2.1. Results from Austria

The following people were involved in the interviews with experts:

- Jan Weinrich, MBA (Head of Corporate Communications and Business Intelligence at the Vocational Training Institute BFI Vienna).
  Area of expertise: - Implementation and management of PR and corporate communications
  - Development of data-based management

- Wolfgang Bliem (project manager and researcher at the Institute of Research on Qualifications and Training of the Economy, IBW in Vienna).
  Field of expertise: - Development of career guidance materials (e.g. BIC.at)
  - Research and development in the task area of dual vocational education and training
  - Research in the task area of competences and qualifications
  - Teaching at Donau-University Krems [University for Continuing Education Krems] (Master in Educational and Vocational Guidance)
- Susanna Kuncic (Head of Management Consulting Programme ÖSB-Consulting)
  Field of expertise: - Employer consulting
  - Equality

Current situation of various sectors in Austria

The digitalisation of work requires digital skills in various sectors and occupational fields. In the Labour Market Service project "New Digital Skills" (Bröckl and Bliem 2020), the challenges and competence needs of company representatives and experts in various sectors were surveyed.

The company experts see a low risk that digitalisation could endanger jobs in the **construction industry.** However, technological progress has an impact on the content of work; new technologies are being introduced in larger companies in particular. SMEs sometimes have problems keeping up

with digital progress. They simply lack the time and resources to integrate new technologies into the work process, partly due to the lack of skilled workers. Managers also often lack concrete knowledge about how new technologies can be used profitably.

Digitalisation carries the risk of creating a "digital divide" between the building and planning professions. While everyday work has hardly changed for the builders, new technologies have long since found their way into the work of planners and technicians. Young apprentices are familiar with the use of programmes and digital devices, while old hands are sometimes sceptical about new developments.

As in other sectors, new technologies open up opportunities, but also increase the complexity and demands on employees, who are not always up to the task. In order not to lose touch internationally, the Austrian construction industry must invest in education and training and create a common understanding of the benefits of new technologies.

Workers in **offices and administration** are well acquainted with the effects of digitalisation. New technologies have already found their way into their working reality years ago and have changed it significantly. Basic IT skills are a prerequisite and continuous maintenance and adjustment of digital skills is necessary to stay on the ball.

In contrast to the construction industry, small companies in this cluster see themselves at an advantage. They can adapt their structure and systems more quickly to changing framework conditions and thus tune in to the acceleration of processes and communication.

Pioneers in the office and administration cluster are less hierarchy- and department-oriented and instead focus on processes and projects. These new forms of work offer opportunities, but also demand flexibility and a willingness to change from employees. Home offices and mobile phones can jeopardise the work-life balance, as they blur the line between work and leisure. Some experts also express concern that digitalisation has made new technologies indispensable to the extent that any failure has a major impact. The reliance on digital tools also makes the sector vulnerable.

The challenge for the office and administration cluster is not only to let technology be the guiding factor, but also to consider the potential and needs of the employees. Further training is also indispensable in order to be able to meet the constantly changing requirements.

Unlike other industries, **retail** is facing a dichotomy due to digitalisation. E-commerce is a completely new business field that interacts with traditional retail. Stationary trade has to redefine itself in the changed context, which is associated with changing success. Many companies rely on mixed models, whereby the right balance is not always easy to find.

Just as in the construction industry, smaller companies often lose out. Online shops as a supplement to a business premises are expensive to build and maintain and are not always profitable for SMEs. The combination of online and brick-and-mortar also places great demands on logistics and warehousing systems and on the skills of the employees, who need to know the systems well and meet the high demands of customers for advice. Older employees in retail often lack the naturalness with which "digital natives" handle technical devices; however, they have fewer problems in personal communication due to years of experience. Here, too, further training can help, as can software that has been optimised for the online/stationary combination.

Company representatives see further challenges in data use, data protection and malware as well as digitally enabled fraud.

The **manufacturing sector** is taking a pioneering role in digitalisation - keyword "Industry 4.0". One of the biggest challenges in the sector is the creation and implementation of an overall strategy that runs through the entire supply chain. Managers are in great demand in this process; they have to take away the employees' fear of change. Furthermore, as technology becomes more complex, the life span of equipment is reduced and companies become more dependent on external suppliers for the supply and maintenance of machinery, hardware and software.

Requirements for the skills of employees in the production industry are high and very technical. HR staff in manufacturing companies face the challenge of accurately assessing the technical skills of their (future) production workers. Training is very important in this industry, which can open up new opportunities for employees, but also requires a certain willingness to learn. Young employees often have basic digital skills, but sometimes lack the technical "common sense" of their experienced colleagues. Company representatives therefore emphasise practical training and knowledge transfer between the generations.

In **tourism,** there are major discrepancies in the degree of digitalisation. Digital tools are already used in many places for consultation and to obtain feedback. The size and location (urban or rural) of the business is often the deciding factor, but at least online bookings are now standard in the sector.

The human component remains the key concept in the **tourism and wellness sector**. The point of reference is that after the introductory phase, digital tools should improve the service for customers and in no way impair from it. Technology only serves as a background support. In any case, employees are expected to embrace the new technologies and to use them flexibly and confidently (especially when it comes to communication tools). This is not always self-evident. For example, the introduction of tablets for taking orders in a generation café with retired waiters can cause friction.

One consequence of increasing digitalisation is the possibility of tapping into previously unreachable target groups online; however, this also goes hand in hand with increased expenditure for complaint management (e.g. through ratings). The tourism and wellness industry sees the greatest changes in administration, where the demand for software skills is constantly increasing.

Due to the high value of personal service, the company experts do not fear that technological change could lead to a decline in employment in the sector. At the same time, digitalised application processes can become a hurdle for service workers with little IT knowledge and delay filling the position. At times, it can be beneficial to make digitised areas as simple as possible, or sometimes even to scale them back if it improves the service.

Conclusion

As Susanne Kuncic aptly put it in an interview, *"all professions [...] are digitalised* professions *nowadays".* Digitisation affects all professions, albeit to varying degrees. In the international discourse, much focus is on platform work and digital skills, sometimes forgetting that the digitisation of the world of work has much broader implications. These human factors can further drive digitalisation, but they can also inhibit it, and it is essential to pay attention to them at the company level.

In order to be able to integrate the digital transformation well into the company structures, employees must be addressed according to their individual needs. Further training offers form the basis, but the necessity of adapting to progressive digitalisation must also be supported and embodied by the management level.

Adapting workers to technology is not always the best strategy; sometimes programmes and processes need to be adapted to staff to achieve the best result. Even employees who are not necessarily digitally savvy ("digital immigrants") have skills that can be instructive for "digital natives", such as soft skills and technical savvy. Even if it is tempting to focus on the technical means, both digital and digitised work are still primarily characterised by the people who do it with the help of digital tools.

2.2.2. Results from Germany

The German project partner bbb conducted two expert discussions in video conference formats in summer 2021:

- Andreas Bendig, G.I.B. (Association for Innovative Employment Promotion), Bottrop; Research assistant, responsible among other things for the topic area of digitalisation/work 4.0
- Dr. Gert Zinke, BIBB (Federal Institute for Vocational Education and Training), Bonn, Department: Structure and Order of Occupational Profiles

What follows is a summary of the very different perspectives and understandings of the two interviewees.

Summary of the interview with Andreas Bendig/G.I.B. (AB)

AB explains at the outset that G.I.B. is "quite far away" from the term digitalisation and digital work and justifies this with the experiences G.I.B. has had in consulting with SMEs. *"There we have encountered a lot of incomprehension with the term digitalisation."*

SMEs know that they have to use new technologies, "*but where should they start?" The* G.I.B. understands digitalisation in dealing with SMEs as a *"change process, but with modern technology"*.

> "*We told the companies: take a step back from the technology, but concentrate on your work processes, how you can organise them sensibly and only in the second step how you can implement that technically."*

Understanding of digitalisation and digital work:

For AB, work is not digital work if only digital tools are used. *"These are tools like the spanner for the car mechanic."* For him, digital work essentially includes work that focuses on the production of hardware and software; this includes network, system administrators and experts in data security and data analysis. Using the example of the logistics specialist in Amazon's highly digitalised work environment, he distinguishes this work, which for him is not digital, from the digital work of the person responsible for logistics control. *"Digital jobs refer to constructing digital relationships and monitoring digital relationships."*

Account managers, customer experience managers or "pickers" are not digital professions. In his opinion, they are not digital professions, *"they all existed before".* He criticises the tendency to upgrade jobs with labels. *"I go to the supermarket and someone comes up to me with 'assortment manager' written on his chest. These people do nothing but stock shelves and sort the goods on the shelves according to their expiry date.*

Impact of digitalisation:

For AB, however, digitalisation has massive effects on the forms of gainful employment, which for him do not belong to digital work. *"Firstly, there is the compression of performance; work is becoming more abstract; it is becoming faster. Change processes are becoming more short-lived; change cycles are becoming shorter and shorter."* This applies to digital work "*equally*".

Development into an individual profession:

For him, the development towards the individual profession does not mean the end of the profession. *"The individual occupation does not make occupational profiles obsolete, because an occupational profile imparts certain basic qualifications, a foundation. As a rule, I can only acquire process competence if I have this foundation.*

Importance of continuing education:

In the future, further education will be a necessary prerequisite to be able to keep up professionally. For AB, lifelong curiosity, among other things, must become a basic understanding. *"Staying curious, knowing how I learn, knowing I'm never done: I'm never finished; that requires a high level of self-confidence and a very high level of learning competence."* When asked whether the figure of the labour entrepreneur is becoming increasingly prevalent in companies, AB answers ambivalently. Self-control is definitely on the rise. He is critical of the aspect of self-economisation, which reminds him of the entrepreneurial self, which moves in a project cosmos and in which the individual rationalises himself. Individuals are encouraged to live as if they were making a project out of themselves. Interestingly, for him this is not a necessity, but an expression of a certain "*egomania or egocentrism, a social zeitgeist.*" He states: "*I rather observe the opposite: Teamwork is in demand, especially in SMEs, because one can no longer master this complex knowledge and diversity alone."*

Where is the journey going?

"*Forecasts are difficult, especially when they concern the future."* AB can imagine the following topics gaining in importance: More collaboration (human/human; human/machine), flexicurity is becoming a basic social and economic concept (combining security with flexibility), diverse working models, the economy for the common good, moving away from work-life balance towards work IS life and vice versa (work-life dynamic). According to AB, this requires employees to have emotional, communication and network intelligence and to ask the question: Who am I and what do I want to be?

"*In short: learning will accompany people all the time!"*

Periodically, the spectre of radical scarcity haunts the realm of the labour debate. Work is not bread that is eaten up at some point. Like the famous flap of a butterfly's wings, every technological advance generates complex changes that lead to increased demands and new needs. And then the design aspect is needed. How secure will the jobs be, how well or poorly paid are they? Here, politics, trade unions and employers are called upon to set an appropriate framework.

Summary of the interview with Dr Gert Zinke/BIBB (GZ)

The interview results are partly underpinned with texts by GZ, which he kindly provided to us as a supplement to the interview. In accordance with the tasks of his department, digitalisation and its consequences for the training occupations in the dual system play a greater role and are presented separately here.

Understanding of digitalisation and digital work:

For GZ, digitisation of work refers to products, work equipment, process flows, communication channels and data collection in the context of the skilled work of the professions. According to this broad understanding of digitalisation, for him there are only very few non-digitalised fields of work left.

Digitisation is also a reality in personal services, in the catering and hotel industry or in the care sector. Even in location-based platform work, such as delivery, driving or cleaning services, there is talk of digitalisation because of digital work process planning.

In the companies he looked into, digitalisation is proceeding unevenly; a coexistence of conventional and digitalised work processes will exist in the longer term. Overall, the digital transformation is proceeding more slowly than expected. A certain *"sluggishness and inertia"* can be observed in the companies with regard to the pace of digitalisation. Routine work is generally decreasing.

In the majority of professions, a clear increase in the complexity of work tasks is confirmed by digitalisation and the changes in process flows that go hand in hand with it. This does not mean that a general shift towards filling skilled worker jobs with unskilled or semi-skilled workers or people with a university education can be observed. The skills of skilled workers generally appear sufficient to cope with the new demands. Additional qualifications for the use of digital media, such as those offered in metal and electrical professions, are used less than expected. Job titles such as logistics specialist or agricultural service specialist say nothing about the degree of digitalisation in these professions. The situation is different for media professions, for example, which consistently show a high degree of digitisation.

The end of professionalism:

For GZ, it is not possible to speak of an end to the comparability of occupations. Instead of talking about individual professions, we should rather talk about core professions, which indicate a very broadly diversified professional knowledge or a basic professional competence that enables the skilled worker to adapt to changes. In metal professions, for example, *"the manual processing of materials; the feeling for materials; dealing with materials; being able to read drawings; spatial awareness" are* enormously important.

The labour entrepreneur (entreployee):

GZ also has reservations about the image of the labour entrepreneur and illustrates this with the image of the solo self-employed, who are in fact mostly sham self-employed. Particularly in the electrical professions, it can be observed that solo self-employed workers are striving to return to salaried employment. They have been forced to become self-employed for economic reasons and not out of a desire for more autonomy and independence.

Competences for coping with the digital transformation:

For GZ, skilled workers are needed to manage the digital transformation:

- Learning competence
- Job-specific knowledge and skills
- Process/system understanding
- Digital skills
- Flexibility and spontaneity

Flexibility and spontaneity are becoming more important for mechatronics or hearing aid acousticians, for example, because they are increasingly confronted with situations that they could not have planned for at all. For example, counselling by a hearing aid acoustician is not only a technical challenge, but also demanding in terms of the customer's personal well-being and much more.

Digitalisation and its consequences for vocational training:

For GZ, digital devices are available across the board in companies, but digital learning formats are rather less important from the point of view of the companies. Overall, it can be observed that the media competences of young people are less present than generally assumed.

In most apprenticeship occupations, the opportunities of digitalisation are far from exhausted. In GZ's view, digital learning scenarios are not used enough in education and training; this also threatens a digital divide in training, especially among SMEs.

Overall, GZ takes a rather critical view of the developments in dual vocational training and states that the deficits in company vocational training management have increased. He sees one cause in the processes of personnel development (human resources) in the companies. In more and more companies, human resources development and vocational training are in the same hand. The formerly influential and assertive full-time training managers are becoming fewer and fewer. There are fewer and fewer training experts working in human resources development, but rather economists, business economists or lawyers, often without any vocational training experience of their own, i.e. without any deeper knowledge of the professions. For GZ, the consequence is that vocational training is losing its status. He sees another cause of the crisis in the vocational schools which have lost quality. One indication of this is that there is hardly any exchange on the use of digital media between the company and the vocational school. He also observes that companies are becoming more demanding of their trainees. Companies increasingly expect trainees to have qualifications and skills that they are supposed to acquire during their training.

Personal and social competences, which have become more important in all professions, can be acquired in training. They are a very important link in the completeness of a professional action and the professional action competences.

GZ assumes that conventional professions will be maintained because they are still used and needed in many areas. But a radical cut would also have to be made and new professions added. However, in his experience one can only assess after 6-8 years whether a new occupation is successful or not. *"We have already experienced crash landings there, too."* Example: The occupation of production technologist, developed in 2011, was established on the assumption that there would be about 1000 trainees per year, but in fact there were 80. *"Sometimes new occupations only take hold after 10 years."*

The future of dual training:

GZ assumes that the German vocational training system is living off its substance in many places and that its future is therefore at risk. However, a necessary readjustment would take 10-15 years. It also seems possible that full-time school models or dual study programmes will continue to replace the current system. But the cause for a readjustment of the dual system is not the digitalisation of gainful employment.

2.2.3. Results from Liechtenstein and Switzerland

The expert discussions were conducted on the basis of interviews and within the framework of project presentations. Experts from the Liechtenstein VET sector and from the Liechtenstein Chamber of Commerce and Industry were invited and informed in writing about the topic in advance (see document in the appendix).

Participants in the expert discussions:

- Werner Kranz; Head of the Office for Vocational Training and Career Counselling in Liechtenstein;
- Michael Andenmatten; vocational training expert and teaching supervisor at the Office for Vocational Training and Career Counselling in Liechtenstein;
- Patrick Elkuch; Project Manager at Liechtenstein Chamber of Commerce and Industry
- Dr. Christoph Thomann; President Vocational Education and Training Switzerland; former Prorector TBZ Technical Vocational School Zurich, Head TBZ Information Technology;
- Prof. Markus Wyss; Lucerne University of Applied Sciences and Arts - Computer Science; Project Manager berufsbildungdigital.ch, Switzerland

- Cécile Ziegler; Head of Vocational and Career Counselling Toggenburg, BSLB Canton St. Gallen, Switzerland
- Edgar Zurbriggen; Vocational, study and career counselling Upper Valais, Switzerland

Summary presentation

The interplay between Switzerland and Liechtenstein in VET was emphasised by the experts from the Office for Vocational Training and Career Counselling at the beginning. At the same time, it was pointed out that in Liechtenstein (and Switzerland) the training regulations are reviewed every 5 years. On the one hand, this is due to the constant change in the professional world and on the other hand, it shows that the high influence of digitalisation in particular is also taken into account.

In all the discussions, it was initially necessary to find a common understanding of the terms "digitalisation", "digital work" and "digital professions". The orientation paper (see appendix) made a first contribution to this. Some experts provided their own synopsis (see appendix) and their own sources as guidance (e.g. on Berufsbildung2030, berufsbildungdigital.ch, IT-Bildungsoffensive des Kantons St. Gallen).

The experts consider the influence of digitalisation in VET to be very high. It not only creates new opportunities, but also new challenges and problems. It is noted that the influence of digitalisation is reshaping society as a whole. Social life is shifting more and more to virtuality (e.g. physical meetings in clubs as in the past versus meetings in forums today) and this shift has been further reinforced by the influence of the COVID-19 pandemic.

In addition to digital apprenticeships, such as in the apprenticeships of computer science, application development and mediamatics, individual examples were highlighted in particular, but also in logistics there are now mostly digitally performed activities that could lead to a new job profile. In addition, VET itself is also generating new innovations through the creation of new job profiles. This is based on the requirements of the market itself. In the area of dual VET, a higher flexibility can be observed with regard to updating and adapting to market needs.

In the discussions with the experts, the level of information processing and- distribution was strongly discussed, especially against the background of the speed of dissemination and reach, but also topics such as influencing and verification of information and even fake news were addressed. The experts agreed that the integration of digitalisation will become even more established than before and that it will become more and more a matter of course that digitality is spreading and will continue to spread in all areas of life.

Behind these subject areas, references can be made to occupations that are relevant for the identification of new, digital occupations. The professional world copes with this social transformation surprisingly easily and smoothly; here the comparison was drawn to the acquisition of a new machine in production companies. It turns out that the adaptability of humans is perceived as a strength. Today, a change in companies triggered by digitalisation often takes place very flexibly. However, vocational training and further education do not keep pace in the same way in all specialist areas; in the future, greater flexibility will also be needed here, for example, for the underlying training plans.

Identification of digital professions

In order to identify digital professions, many different aspects were discussed in the expert interviews. Clearly, apprenticeships such as computer scientist EFZ, application developer EFZ and media scientist can be classified as digital occupations. Furthermore, it was necessary to create a common understanding of which criteria can be used to designate a profession as a "digital profession". There were various aspects here, which were also considered in the discussion. It was precisely these conversations and discussions that were valuable and fruitful for grasping the situation due to the different observations and points of view. There is (still) no solid and recognised basis for being able to clearly classify a profession as a digital profession. According to the experts, the question of classifying or categorising digital professions (note: for the possible formation of clusters/filters) may be possible on the basis of the development of new digital products and process orientation and with regard to the proportion of digitalisation of work processes.

A first approach to identifying a profession as a "digital profession" is the restriction that a person working in such a profession performs all work processes digitally. At the same time, it was recognised that this is already the case for a large number of occupations (such as brewer in a large brewery) and that they can by no means be considered digital occupations.

Another approach was aimed at the "digital" skills required for the production of a product or service and the share of these within the value chain. Here, too, there are many examples that do not allow for a clear classification (e.g. technical draughtsman/designer). The experts also brought up the aspect that in addition to skills, the use of digital means can also be considered in terms of scope and share in value creation. In this context, the question arose as to whether there is real value creation through digitalisation in an professional field and through the professional activity. As examples, the distribution via or the support of an online shop for the retail trade was named, which merely represents a facilitation in the ordering and provision of goods for daily needs. In the background, especially in the fresh segment and the product range, knowledge and skills are required for e.g. warehouse management and logistics, which are outside of digitalisation. Or, for example, searching Google for a suitable hotel, which merely makes travel planning easier. The discussion of the examples also led to the question of whether, in order to determine a digital profession, a digital output must then also necessarily be taken into account.

This third approach from the expert interviews aimed at the digital degree of the output (product or service) on the basis of the question: what are the products that result from it and "how digital is the output". This output-oriented approach found broad agreement among the experts as a valid criterion for defining a digital profession. However, it was noted in the discussion that, for example, the word "output" is already attributed multiple meanings in the Duden dictionary, namely an economic one (e.g. totality of goods produced by a company), a performance-related one (e.g. productive output or published work result), or a digital one (e.g. in the form of data, information as work result of a computer system). In the output-oriented view, for example, intelligent devices were mentioned or programmes in the sense of software.

In summary, it can be formulated from the expert interviews that a profession can very probably also be described as a digital profession if both by means of digitally executed work processes a digital input leads to a (processed, changed) digital output. This statement met with broad agreement among the experts.

Professions in transition

The professions are affected by digitalisation to varying degrees. In the expert discussions, terms such as development, change and adaptation were repeatedly introduced, which on the one hand establish that professions were originally practised differently than today, but that digitisation has not yet progressed to the point where the professions in question have fundamentally changed to other / new professions. Examples given were:

- Businessman/ businesswoman: today everything runs via the computer; what is decisive here is not the output but the application/exercise of the profession;
- Baker at modern bakeries: the production process is mostly digital;

However, it is conceivable in expert circles that such professions will also continue to change in the future, so that a completely new job profile may emerge here. The short-lived nature of transitional profiles in the digital world is already noticeable today. Examples such as Facebook campaign or social media manager, blogger, YouTuber, TikToker, influencer or the transition from car mechanic to car mechatronics engineer and later to mobility computer scientist were mentioned.

Professions that have been replaced by digitalisation

No concrete answer could be found to the question of which occupations have already been completely replaced by digitalisation. Especially since a profession's profile in Western countries already differs significantly from how these professions are practised, for example, in companies in less developed (and digitalised) societies.

In the same way, there is a difference between modern production companies vs. traditional companies. It was concluded that the existing (basic) needs of people do not change much, but many new ones are added. Therefore, as long as an occupation serves the existing needs, it will not change much, except for the degree of digitalisation in the occupations themselves (processes, etc.).

On the side of advisory services, such as management consulting, new business models now show that these are increasingly being implemented digitally - also due to the COVID-19 pandemic situation. The environment of digital remote counselling certainly offers high potential to replace counselling by a person in the future through automatable systems in combination with artificial intelligence.

In general, the question arises: are there products or services that are no longer needed because of digitalisation? In this question, too, the experts agreed that demand is often subject to change and that digitalisation often does not completely replace it. However, the discourse on this question led away from the questions in the project regarding the identification of those professions that have been replaced by digitalisation.

One example, however, is of particular importance for Liechtenstein: until the mid-1970s, in many companies a separate office (or even department/unit) was entrusted with the task of carrying out the complex arithmetic operations that arose with the help of mechanical calculating machines. These "calculating assistants" were often mathematically trained persons who were specially trained in the use of these calculating machines. One mechanical calculating machine manufactured in Liechtenstein until it was replaced by the first electronic calculator was the Curta. The development of semiconductor technology in the 1970s made it possible to switch to digital calculators. As a result, not only did the Curta product lose its market, but also the people employed in the companies and entrusted with the task of performing manual calculations lost their jobs; they had to retrain/further qualify themselves for other activities.

Future aspects for the design and development of professions

In the expert discussions, some future aspects were discussed with regard to the design and development of existing and new occupations. The experts were quick to point out initiatives already launched by the federal government (e.g. Berufsbildung2030, Berufsbildung digital, IT-Bildungsoffensive Kanton St. Gallen) and the necessary change in VET to meet the new challenges created by digitalisation and to make (young) skilled workers "digitally fit" for the future. Results from the St. Gallen project and from "berufsbildungdigital.ch" offer a first approach to the identified digital competences and skills for an occupational field. The recommendations for action for vocational schools developed from the project offer a first starting point.

Not only the content of vocational education and training, i.e. by integrating the teaching of digital competences and skills to a higher degree, but also the form of vocational education and training must become digital. This requires not only new, digital forms of learning such as e-learning, but also the establishment of new, digital forms of learning and places of learning. The form of teaching and learning must be rethought (=digital).

The development of new, digital professions has often been discussed in terms of specific sectors. The profession of cyber forensics, digital forensics and computer forensics is an impressive, self-explanatory example of a new, digital profession that has already been created in the security sector.

In contrast, professions in all sectors that serve the sole purpose of developing, controlling and monitoring digital information and applications are increasingly affected by the progress of digitalisation. For example, the insurance, banking and finance industries with their new, digital products were addressed in this regard, such as in dealing with cryptocurrencies.

Digital professions and new professions

The digital professions most frequently named in the expert interviews are also listed on the ICT vocational training platform[5] . Some of them are listed below as examples and are not exhaustive.

ICT apprenticeships:
- Informatics technician EFZ
- Media technician EFZ
- ICT Specialist EFZ
- EFZ Building IT Technician
- EFZ Business IT Specialist

Professional certificate:
- Wirtschaftsinformatiker (EFA)
- Media technician EFA
- ICT System and Network Technician EFA
- ICT Application Developer EFA
- Cyber Security Specialist EFA
- Digital Collaboration Specialist EFA

Diploma:
- ICT Manager ED
- ICT Security Expert ED

According to the experts, the question on the classification or categorisation of digital professions (note: on the possible formation of clusters/filters) is also possible on the basis of the new, digital

[5] Source: https://www.ict-berufsbildung.ch

products. It was important for the experts to mention that access to new, digital professions must be made open for everyone, and particularly attractive access should be created for women. Another aspect was that one possibility or path/career path leads via self-employment or entrepreneurship.

2.3. Shared results and insights

This section once again summarises the results and findings of the entire project consortium from the three project work phases. The authors are aware that this section partly contains a repetition of the results from the previously discussed sections. Nevertheless, it is useful at this point to present a summary of the results and findings from the project and with a focus on the consortium countries Germany, Liechtenstein, Austria and Switzerland in an overview. To this end, it is recalled at the outset that this serves in particular to answer the questions posed in the project:

- *What are the new forms of digital work and employment?*
- *Which regions (geographically) are most affected?*
- *Where are the client and the service provider located?*
- *How does this affect the landscape of the individual professions?*
- *What will the landscape of the individual professions look like in the near future and how will digitalisation lead to changes for the professions?*

2.3.1. Results from the "Analysis" project phase

New forms of work

- Digitalisation is fuelling the emergence of atypical employment models such as flexible part-time or intrapreneurship, creating new forms of work such as crowdworking and clickworking, new business models such as the sharing economy and new collaborative economies.
- New forms of work are found in the platform economy, the sharing economy, internet-based workplaces and within the digital, collaborative economy. Typical terms are blogger, YouTuber, TikToker, influencer.
- It can be seen that especially in the IT professions the figure of the labour entrepreneur (entreployee) of Voss/Pongratz (1998) has become the norm, who offers not only his labour but his personality.

Digital work vs. digital professionalism vs. the term "digital profession"

- All professions today are digitalised professions. Digitisation affects all professions, albeit to different degrees.
- Digital work is characterised by digital skills, abilities and competences, while digital professionalism focuses on the (digitally) supported work processes.
- Digital occupations can be described as such if the core activities are based on a digital input that leads to a (processed, changed) digital output by means of digitally executed work processes.

2.3.2. Results and findings from the "Evaluation" project phase

Identification of digital professions:

- As a suggestion for the identification of digital professions, it is stated that those professions whose core activities are fulfilled exclusively digitally and lead to a digital output are to be considered digital professions.

Impact on the landscape of the individual professions:

- Many professions are undergoing change due to digitalisation. A certain short-livedness of transition profiles in the digital world is noticeable.

2.3.3. Results and findings from the "Prediction" project phase

Both professions and the requirements for professionalism, as well as vocational education and training itself, remain in a state of flux:

- Requirement 1: Strengthen digital skills and capabilities among the skilled workforce of the future in order to continue to meet the changing challenges of digitalisation.
- Requirement 2: Both the content of vocational education and training and the form of vocational education and training must be carried out digitally in the future.
- Digital professions are changing the profession itself towards more mobility and flexibility (in terms of space and time), as well as in terms of content (keyword: lifelong learning, individualisation). Replacing linear career paths with multi-layered ones.
- The already changed demands on working people due to increasing performance compression, the fast pace of life, shorter change cycles and towards ever more abstract work will continue to develop - without counteraction.
- There is a shift away from individual expertise and a stronger orientation towards collaboration, community & crowd and flexible workplaces.
- The development of further, new digital professions and occupational fields is foreseeable and favoured by the expansion of digital customer service management, the influence of digital currencies and digital financial systems, and data as the new currency.

3. The landscape for new forms of work in Europe

3.1. The prototype of the digital landscape for new forms of work in Europe

A second part of the "Landscape for new forms of work in Europe" is the digital tool which can be accessed via the project website www.futurvoc.eu. The technical development of this tool was primarily carried out by the project coordinator, i-smARt Trust reg. in Liechtenstein. The partner organisations in the project contributed to the content of the map with regard to the occupations and type clusters/filters it contains, as well as to the operation of the online tool. The current version of this tool is a fully functional prototype that is already prepared for possible further development (e.g. expansion of the clusters/filters, occupational data, country representations, languages, etc.).

3.1.1. Professions and type clusters / filters for digital occupations

An essential function of the digital map is to quickly find a specific, sought-after occupation according to a given profile. The prerequisite for this is a meaningful typification on the basis of predefined clusters or the filter option for this and the technical classification and allocation of the digital occupations in this system. In the following section, the individual type clusters are presented, which were developed as an interim result in the project from literature research and from the findings of the expert interviews of all consortium partners, on which the project consortium agreed. For all occupations entered in the prototype of the map, the corresponding clusters / filters were assigned as examples, so that the digital map is already operable.

Occupational groups (according to ESCO):

For the digital prototype of the map, the following occupational groups were differentiated according to ESCO (European Skills, Competences, Qualifications and Occupations) based on the occupational groups communicated in the European Union (2019). The ESCO system is particularly relevant as the European Commission is aiming for a uniform system to describe vocational and professional competences and skills in Europe in the future.

Table 1: ESCO Occupational Groups (European Union, 2019)

0	Armed forces occupations	http://data.europa.eu/esco/isco/C0
1	Managers	http://data.europa.eu/esco/isco/C1
2	Professionals	http://data.europa.eu/esco/isco/C2
3	Technicians and associate professionals	http://data.europa.eu/esco/isco/C3
4	Clerical support workers	http://data.europa.eu/esco/isco/C4
5	Services and sales workers	http://data.europa.eu/esco/isco/C5
6	Skilled agricultural, forestry and fishery workers	http://data.europa.eu/esco/isco/C6
7	Craft and related trades workers	http://data.europa.eu/esco/isco/C7
8	Plant and machine operators and assemblers	http://data.europa.eu/esco/isco/C8
9	Elementary occupations	http://data.europa.eu/esco/isco/C9

Education

The following educational pathways were distinguished for the digital prototype of the map. These largely cover the educational pathways recognised in the partner countries of the consortium.

Table 2: Educational pathways distinguished in the digital map (own selection);

Schools	Vocational schools	Extraordinary apprenticeship diploma
Academies	Courses	Vocational baccalaureate / university entrance qualification examination
Colleges	University of Applied Sciences studies	Master craftsman and qualifying examination
Other	University studies	Personal certification
	University courses	

Personality types / fields of work

The personality types and fields of work should serve users of the map for personal orientation for their own career choice. Holland published a description of occupational interest types in 1997 with his career choice/personality theory. These personality profiles are based on the development of characteristic personality traits, behaviours, skills, values, self-concepts and occupational preferences (Holland, 1997). The main purpose of Holland's theory is to explain occupational behaviour and to point out some practical ideas that support occupational choice or change regardless of age in order to achieve occupational satisfaction (Holland, 1997).

Essentially, the theory consists of the following four assumptions (Holland, 1997; Jörin et al. 2003):

1. Most people in Western culture can be assigned to one or more of six personality types (see table below).
2. There are six models of occupational environments that are classified in the same way as personality types.
3. Individuals seek out those professional environments in which they can use their skills and abilities and express their attitudes and values, as well as take on professional roles and tasks that they find enjoyable.
4. Professional behaviour is determined by the interaction between personality and professional environment.

Holland's theory of career choice is one of the most researched theories with a solid empirical foundation, with more than 500 studies internationally. For Holland, career choice is an expression of personality. The description of individual career interests is also seen as a description of individual personality, since career interests are at the same time that aspect of what is commonly called personality. The six basic types identified by Holland (see table below) have been empirically validated internationally in professional circles and have been described as very robust.

Table 3: Brief description of Holland's six basic types according to Jörin et al. (2004)

Basic type Code short description	**Realistic Code** R craft-technical	**investigative-Code** I investigating-researching	**Artistic Code** A artistic-creative	**Social Code** S educating-caring	**enterprising-Code E** leading-selling	**Conventional Code** C organising-administrating
Personality	close to nature, uncomplicated, robust, technically gifted, straightforward, skilful	analytical, perceptive, eager to learn, reasonable, intellectual, keen to experiment	imaginative, artistic, intuitive, expressive, idiosyncratic, emotional, original	helpful, sociable, tolerant, communicative, faithful, warm-hearted, selfless	determined, dynamic, willing to perform, decisive, enterprising, active, capable of leadership	Careful, accurate, conscientious, disciplined, cautious, dutiful, adapted
Professional environment	Technology, Craft, Agriculture	Science, Research, Laboratory	Art, Culture, Design, Fashion, Journalism	Counselling, education, health care	Sales, Management, PR, Advertising	Administration, secretariat, accounting

New professions vs. new fields of activity

As stated in this report, it is important for the work and the results - thus for the digital map - and also in this report to distinguish whether a digital profession is actually a new profession created by digitisation or whether the fields of activity in an existing profession have changed due to the influence of digitisation, towards a profession that is mainly to be carried out digitally. The assessment of whether a profession can be identified as a "new job" or a "new task" was made by the national experts involved in the project.

Example professions

In the present prototype of the digital map, a sample set of at least 20 occupations was stored for each country of the project consortium and the corresponding clusters/filters were linked to them. The occupation examples for Switzerland were taken from the database of the Swiss Service Centre for Vocational Training, Occupational, Educational and Career Guidance (SDBB) in Bern, Switzerland (www.berufsberatung.ch). The following table lists this selection of occupations.

Table 4: Digital professions in Switzerland; source: Swiss Service Centre for Vocational Training, Occupational, Educational and Career Guidance SDBB in Bern; Platform: www.berufsberatung.ch

ICT Application Developer	IT specialist EFZ	Media technician EFZ
Building computer technician EFZ	Cyber Security Specialist BP	Computer scientist EFZ
Web Project Manager HFP	Digital Supply Chain Manager	Cryptologist/login
ICT Helpdesk Staff	IT Business Process Engineer	Computer science trainee
Artificial Intelligence Specialist	Business Intelligence Consultant	Computer linguist
Specialist in GIS cartography	Interactive Media Designer EFZ	ICT specialist EFZ
Medical IT Specialist FH (BSc)	Database administrator	Data Scientist
Dipl. Designer HF Communication Design		

Visualisation overview of the clusters/filters in the digital map

The figure shows a visualisation overview of the above-mentioned elements in the digital map.

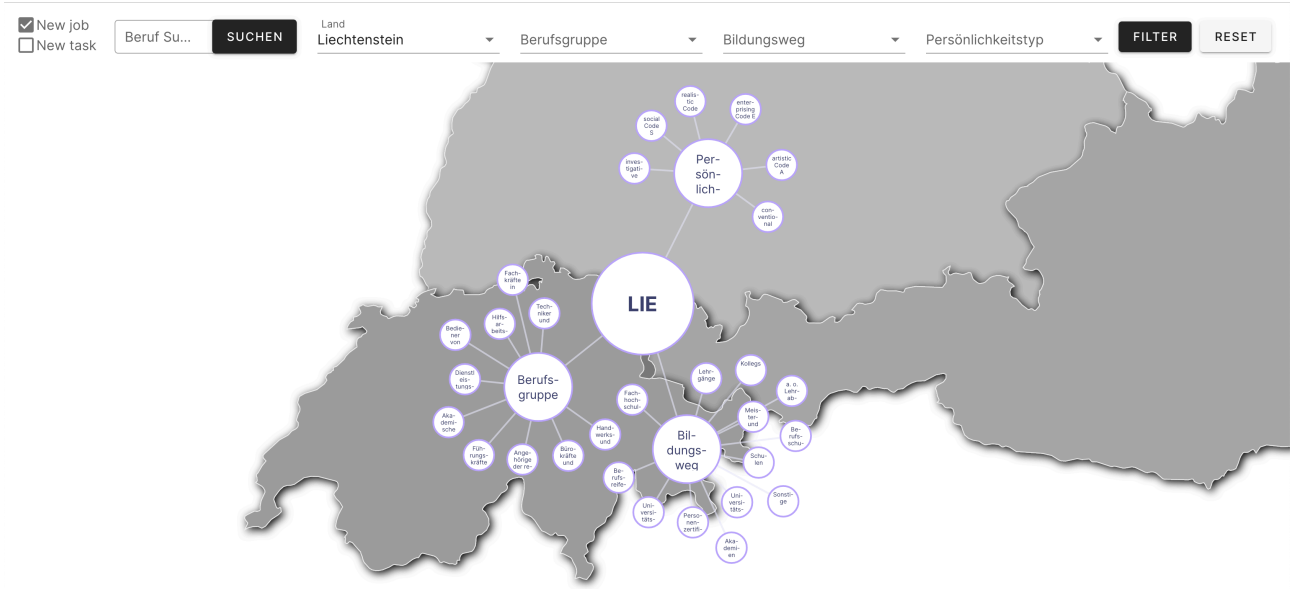

Figure 7: Digital map Liechtenstein for new digital professions; URL: https://futurvoc.eu/digimap

3.2. Possible applications of the digital map

The digital map is available at the URL https://futurvoc.eu/digimap. In this tool, country-specific digital occupations can be selected using appropriate filter / cluster settings and the result is shown as in the following image.

To get an overview, the map is designed in such a way that a country must always be selected first. At this level, you get an overview of the clusters occupational group, educational background and personality type with the corresponding characteristics. By clicking on one of the cluster elements shown, information on the element appears. In the example below, "academic professions" was selected from the occupational groups for Germany.

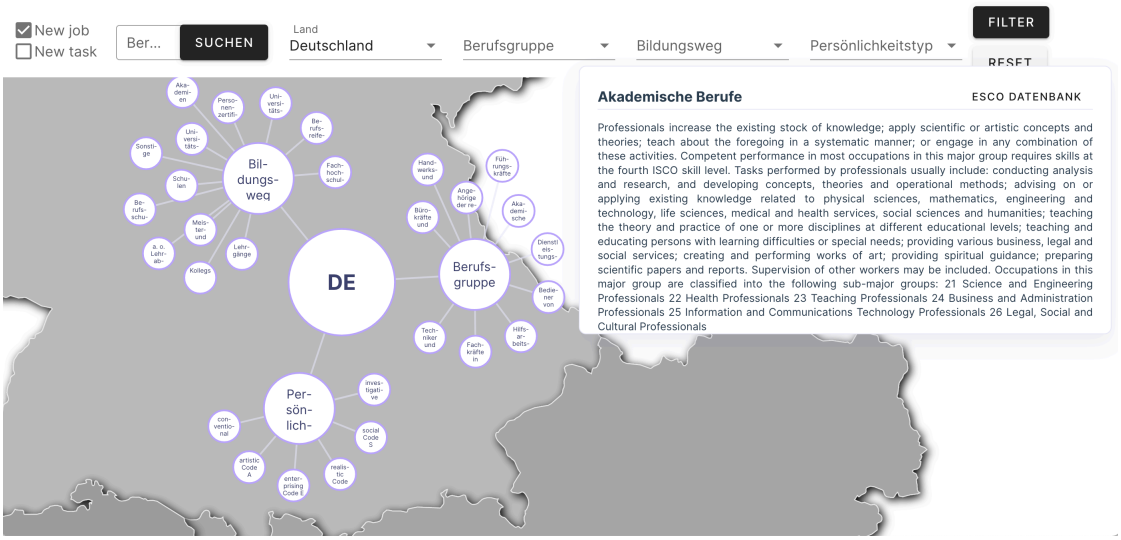

Figure 8: Example selection and application of digital map; URL: https://futurvoc.eu/digimap

Another option is to design the search according to one's own profile. Here, the map already offers a good insight in the present prototype version and provides relevant results. For example, a counselling interview in career counselling could provide an initial orientation with the help of the map and motivate users to play through different variants. In the present example, it was chosen that

- new occupations [New Job] in Liechtenstein should be displayed that correspond to the criteria for the
- professional group [Office workers and related professions], the
- educational path [vocational schools] and the
- personality type [realistic] (according to Holland, 1996).

By clicking on one (in this case two) of the professions displayed in the search result, e.g. "Interactive Media Designer", an info field is displayed in the digital map with links to the national country database and the ESCO database. Both links lead to the corresponding information, the occupational information in Switzerland and the competence profile stored in the ESCO database that corresponds to the profession.

Based on the various options for selecting the filter / cluster settings, it is possible, for example, to track which professions match a personality profile.

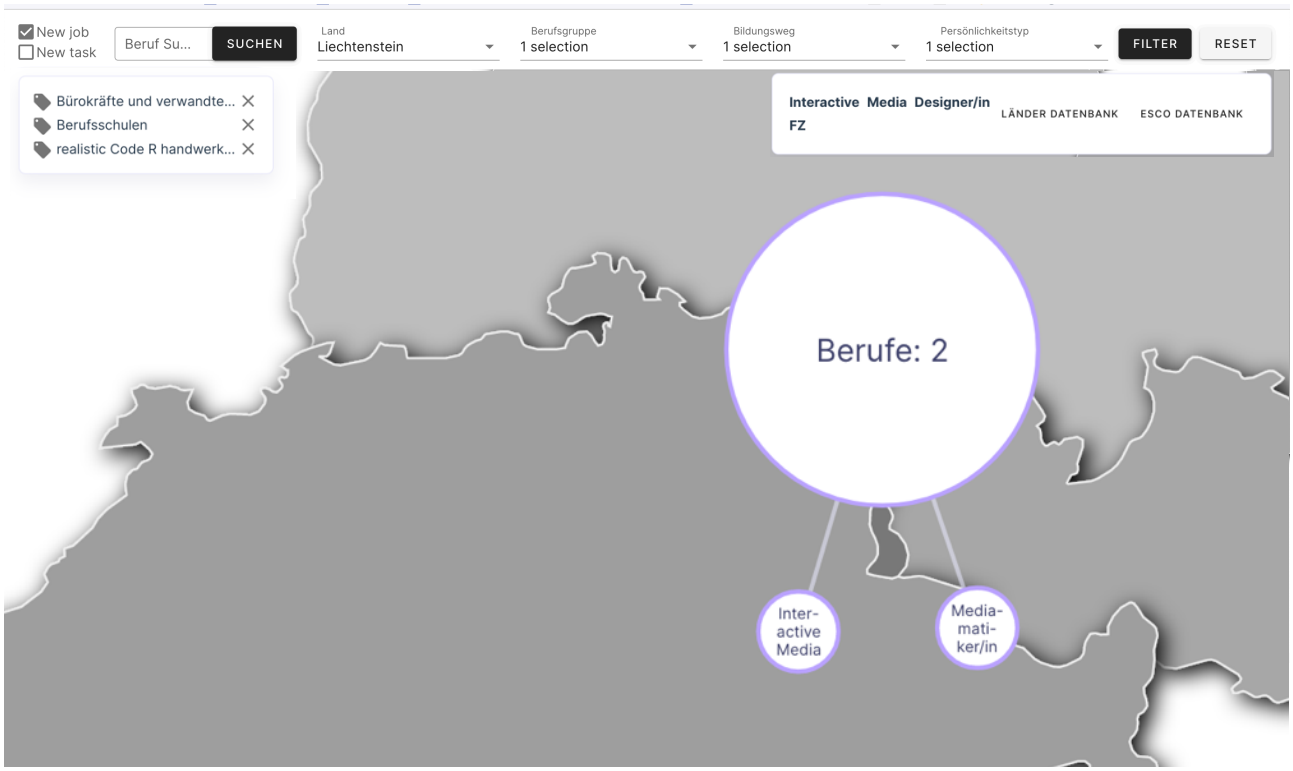

Figure 9: Example selection and application of digital map at https://futurvoc.eu/digimap

3.3. Further development of the digital Landscape of new forms of work in Europe

The present prototype for the digital "Landscape of new forms of work in Europe" has been designed in such a way that an extension to include other countries as well as additional clusters/filters is easily possible. Likewise, the data already recorded are to be regarded as examples; the respective can easily be added via the maintenance backend. It is also possible to create your own interfaces that automatically and permanently update the data connected to existing systems.

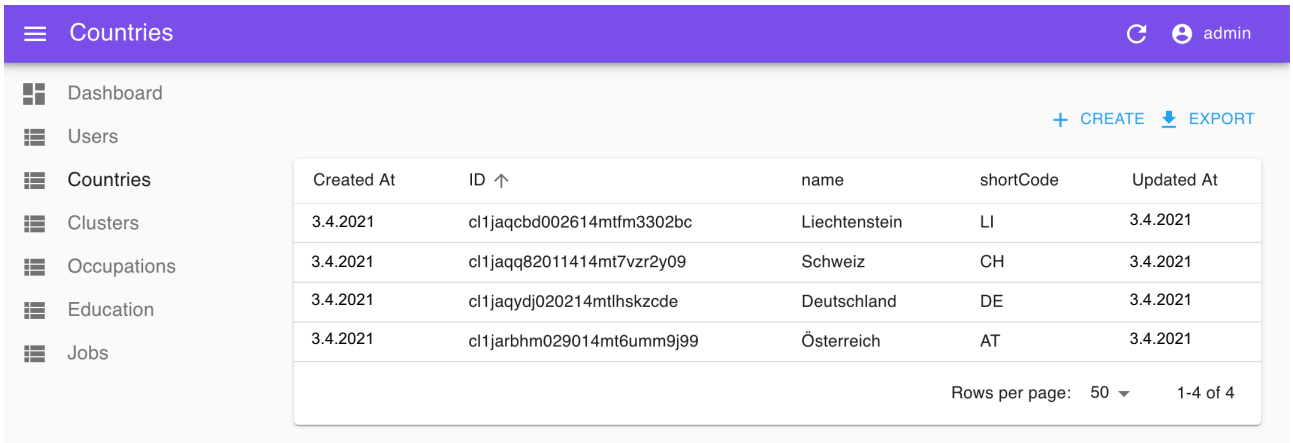

Figure 10: Backend for managing countries, clusters/filters and professions in the digital map.

List of digital professions

3D Artist
AI specialist
Application consultant
Application programmer
App developer
Application development - coding (apprenticeship)
Bioinformatician
Building Information Modeling (BIM) Manager
Office machine technician
Business Analyst
Cloud Engineer
Cloud Architect
Cloud Network Technician
Cloud Security Engineer
Cloud Software Engineer(m/f/d)
Cloud Systems Engineer
Cognitive Developer
Community Manager
Computer Visualist
Computer Animation Designer
Computer graphic designer
Computer animator
Computer book author
Computational linguist
Computer game programmer
Computer technician
Content Manager
Data Scientist
Data Security Advisor
Data Warehouse Analyst (m/f/d)
Database Professional (m/f/d)
Data analyst
Database administrator
Database developer
Data modeller
Deep Learning Engineer (m/f/d)
Digital Marketing Specialist (mwd)
E-commerce clerk (apprenticeship)
E-commerce manager
E-Gamer
E-learning author
EDV-Kaufmann / -frau (apprenticeship)
EDP service technician
EDP systems engineering
EDP trainer
Railway telecommunications technology
Electronics - Applied electronics (modular apprenticeship)
Electronics - information and telecommunications technology (modular apprenticeship)
Electronics - communication electronics (modular apprenticeship)
Electronics - Microtechnology (modular apprenticeship)
Electronics (modular apprenticeship)
Electronics technician - building and infrastructure systems
Field Support
Research & Development Technician
Photo and multimedia merchant (apprenticeship)
Fraud Analyst
Game Developer
Geoinformation technology (teaching)
Geoinformation technician
Hardware developer
IC-Designer (Electrical Engineering)
Infographics
Computer scientist
Information technology clerk
Information Broker
Information manager
Information technology - industrial engineering (apprenticeship)
Information technology - computer science (apprenticeship - discontinuing)
Information technology - systems engineering (apprenticeship)
Information Technology - Engineering (apprenticeship - discontinuing)
Information Technology (Teaching)
Interface designer
Internet system administrator
IT Assistant
IT Consultant
IT electronics
IT forensic
IT Organisational Consultant
IT Project Manager
IT Sales Manager
IT Security Manager
IT systems electronics technician
IT systems electronics technician (computer systems)
IT systems electronics technician (terminals)
IT systems electronics technician (fixed networks)
IT systems electronics technician (radio networks)
IT systems electronics technician (security systems)
Communication technician
Cyberneticist
Let's Player
Listbroker
Mathematician (Information and Data Processing)
Media didactician
Media specialist - graphics, print, publishing and audiovisual media (audio, video and animation) (apprenticeship)
Media specialist - web development and audiovisual media (audio, video and animation) (apprenticeship)
Medical computer scientist
Multimedia designer
Multimedia conceptionist
Multimedia programmer
Multimedia Project Manager
Communications engineer
Natural Language Processing Expert
Network administrator
Network designer
Network architect
Network technician (computer systems)
New Media Consultant
Pre-Sales Consultant
Robotics technician
SAP consultant
Screen designer
Social Media Expert / Social Media Expert
Software Architect
Software maintainer
Software developer
Software Lector
Software programmer
Software tester
System administrator
System analyst
Technical:r Project Manager
Telematics
Tuning & Monitoring Engineer
Usability Engineer
Traffic telematics
Encryption Technician (Cryptographer)
VFX Supervisor
Web designer
Web Master
Business informatics specialist
Knowledge manager

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