How do we change our apprenticeships for dealing with Industry 4.0?

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Foreword

The advent of the Fourth (4th) Industrial Revolution is leading us into a period of great transformation. The current wave of digital transformation is rapidly changing industrial production processes, not only in the manufacturing sector but also in distribution, health and education. The Internet of Things (IoT), Cyber-Physical System (CPS), artificial intelligence (AI) and other innovations facilitate a more software-driven, individual and efficient way of producing goods and services.

The 4th Industrial Revolution has also brought changes in the supply and demand of workforces and skillsets in the labor market. According to the report of the World Economic Forum of 2016, it is expected that more than 5 million jobs will disappear and more than 35% of occupation's core skillset will change in 15 countries in 5 years. This shift in the world's labor force will present a formidable challenge to work-based learning and apprenticeships.

In accordance with these new strategic objectives, the Korean government announced a plan to reform vocational education and training (VET) policies in readiness for Industry 4.0. The plan provides a broad canvass; how to establish a prompt reactive system to industry demands, how to manage training qualities and outcomes, and how to solve unforeseen areas of training. However, it is nonetheless a challenging task to transform VET and apprenticeships primed for future industries. Therefore, it will be highly useful to examine and compare how apprenticeships have been evolving in different countries, with the focus rooted to the economies of the 4th Industrial revolution.

This is the 4th proceeding paper in a series by KRIVET's International Conference on Apprenticeships. The 1st provided an overview of apprenticeship system and its

quality management framework in various countries. The 2nd delved into policies of developing and operating apprenticeship programs, evaluation and support services for apprenticeships. The 3rd focused on costs and outcomes of apprenticeships and methods to encourage companies' participation and investment in apprenticeships. The current paper will explore the recent trends of apprenticeships, particularly related to Industry 4.0 and strategies for future industries.

As a public research institute on vocational education and training policies, Korea Research Institute for Vocational Education and Training (KRIVET) is organizing this international conference, with support from the Korean Ministry of Labor and Employment (KMOEL) and HRD Services of Korea (HRDK), to bring together policy approaches from various countries to examine their current trends and strategies of apprenticeships pertaining to Industry 4.0. This is a compilation paper showcasing experts (from their respective countries) who have participated in the conference. We believe that this paper will help identify a multitude of promising policy measures and provide practical applications for the betterment of Korean apprenticeships.

December 31, 2017
Dr. Young-Sun Ra
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Chapter

Digitalization - Trends & Challenges in Dual VET in Germany

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Digitalisation – Trends and Challenges
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Abstract

Several recently published long-term forecasts on the impact of digitalisation - "Economy 4.0" - on German employment have come to the conclusion that there will be significant shifts between occupational groups, but no significant job losses. For the German labour market, accelerated digitalisation would mean, in effect, a continuation of structural change.

In the current debate and ongoing consultation process of the Federal Government, the importance of education, initial and continuing vocational education and training, and skills development for successfully managing the digital transformation is repeatedly emphasised and confirmed by several studies. In line with this, current research projects of the Federal Institute for Vocational Education and Training (BIBB) deal with questions about the effects of digitalisation on the economy, the associated changes for human work, the future need for qualifications and a corresponding design of the vocational education and training system in Germany.

The presentation will highlight important characteristics of the German dual vocational education training system. As can be shown, the current structure and organisational principles of the German VET system already offer a number of starting

points in responding to the changing demands in the short and medium term labour market. Furthermore, challenges for the German (vocational) education and training system as well as currently discussed strategies will be presented, which are regarded as crucial for successfully managing the emerging structural change and the future of Germany as a business destination in the long run.

Overall, "Economy 4.0" is currently seen as an opportunity by all stakeholders to make vocational education and training more attractive again. However, what will become reality in the future depends not only on technical feasibility and economic profitability, but also on how society negotiates and shapes these developments. Hence, it requires an intensive debate in society and workplace about the goals in the application of digital technologies and intelligent machine systems.

1. Towards an "Economy 4.0"

The term "Industry 4.0" - which describes the implementation of new manufacturing concepts - was coined in Germany and was used publicly for the first time at the Hannover Fair in 2011. Since that time, "Industry 4.0" has dominated the debate in Germany on the medium and long-term effects of digitalisation and the associated technological developments.

Studies, such as the one by the Oxford economists Frey and Osborne (2013), predict an increase in knowledge-based activities at the workplace and thus, a growing demand for academia. This thesis is based on the assumption that increasing potential for automation in the economy is mostly occurring at the expense of skilled professionals. However, academic and public debates are reluctant to conclude that such a calculated potential for "automation of tasks" cannot predict as to how far companies will actually exploit this potential in the future. Often, they cite legal, societal and economic limits on automation and argue that workers will adjust their activities and take on more complex tasks (BMAS 2017:47). Nevertheless, these scenarios lead to the question as to how new technologies will change the nature of jobs in different occupations and on different requirement levels. How are such changes in working conditions reflected in qualification requirements?

Against the backdrop of these developments, the success of vocational education and training in Germany is by no means self-evident. The challenges described, here in, reflect the context of technological developments which go hand-in-hand with an increase in social preference for academic education and an unfavourable demographic development. Thus, the question remains whether the success model of Dual Vocational Education and Training can still be a driver of competitiveness and innovation in the future workforce. The significance of these questions related to the digital transformation is reflected in the German Federal Government's Digital Agenda and its priorities for action. The implementation of Industry 4.0, broadband roll-out,

internet access and data security are at the centre of the national digitalisation debate in Germany (cf. Digital Agenda 2014-2017 of the Federal Government). The National Digital Summit is the main platform to address and discuss those topics related to the digital transformation. In addition, the Federal Ministries are engaging with this issue through various initiatives and platforms. The aim is to create a public forum for dialogue and to develop sustainable strategies and recommendations for action, collaborating with stakeholders from science, business and civil society.

The Federal Institute for Vocational Education & Research (BIBB) also takes an active role in this debate, and is, e.g., involved in the platform "Digitalisation in Education & Research," initiated by the Federal Ministry for Education and Research. Furthermore, in a joint initiative "VET 4.0" started in 2016, the Federal Ministry of Education and Research (BMBF) and BIBB address issues in research and development, which are related to the digital transformation of the work economy. The initiative brings together a wide range of projects (cf. BIBB 2016). These include projects already under way, such as, an evaluation for a potentially necessary modernisation and restructuring of IT occupations and the joint VW-BIBB project on operational maintenance 4.0. Three additional projects are new:

Pillar 1: Occupation and sector screening - The focus is on the analysis of selected training occupations, advanced training regulations and sectors which are already partially or fully affected by digital transformation. The goal is to create recommendations for the organisation for initial and continuing education and training and the further development of systemic framework conditions.

Pillar 2: Digital literacy / media competency - Another project aims to define media competencies, which should be considered as an entry requirement and as a key competency across occupations in vocational training.

Pillar 3: Demand for skilled workers - A third project aims to establish a monitoring

and forecasting system across occupations and sectors. The existence of such data would determine which qualifications will be needed for Vocational Education and Training 4.0.

By combining the many individual results from the particular projects of the VET 4.0 initiative, overarching conclusions for the future design of vocational education and training should be derived and disseminated among policy-makers, academia and workforce.

2. The German labour market in transformation

In fact, digitalisation is not a new phenomenon. When observing the development of VET in specific sectors such as the manufacturing industry, we can notice changes in the demand for skilled workers.

[Figure 1] New trainees for selected training occupations 2000 – 2016
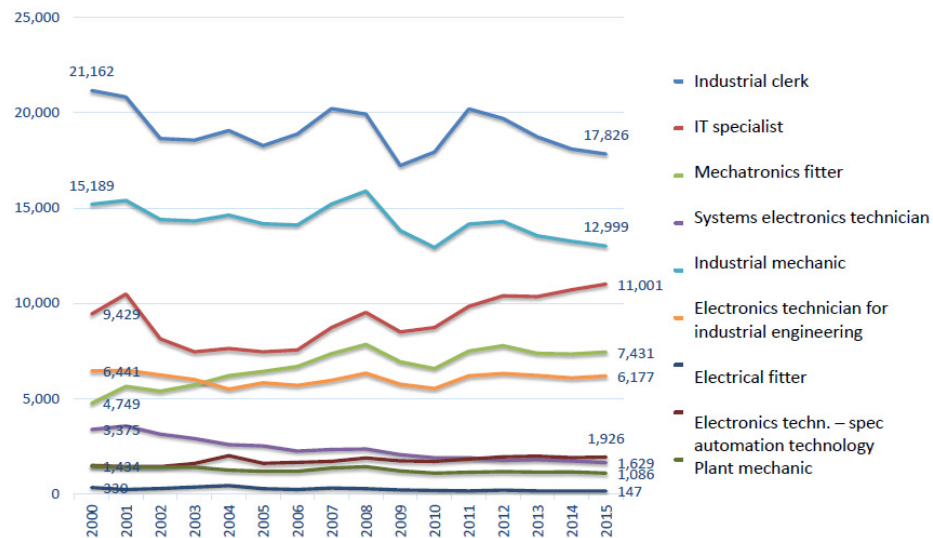
Source: "DAZUBI" BIBB on basis of data from the VET statistics of the Federal and Länder statistical offices (survey as of 31 December).

Since 2000 (and before), an increasing demand by companies for IT specialists (specialised in application development and system integration) as well as for Mechatronics fitters can be observed. Concurrently, less training contracts were closed for occupations such as IT systems electronics technicians, whereas the demand for "pure" electrical and mechanical occupations were even more depressed. This data clearly shows a shift in the demand for qualifications; as the case of the mechatronics fitter shows, work tasks become increasingly complex, while purely mechanical and/or electrical "hardware" skills become less relevant. In addition, as the growing training numbers in IT occupations illustrate, the demand for software skills is increasing.

As previously stated, another line of discussion about the future of work focuses on the growing potential of replacing humans with automated technical processes, which

will likely happen at the expense of professionally qualified employees.

Again, bear in mind, such a calculated potential for "automation of tasks" cannot be accurately predicted as to how far companies will actually exploit this potential in the future. Aside from the mere possibility to "automate" processes, a large number of variables play a role which might impact the labour market in the broadest sense (e.g., disappearing vs. newly created jobs, changing workplace requirements, a growing potential for more efficient production as well as the development of new products that will lead to new income, and the adjustment of wages and prices in line with labour supply and demand, etc.).

A joint study by BIBB and the Institute for Employment Research (IAB) (cf. Wolter at al. 2016) is the first model-based analysis in Germany that aims to identify factors that influence the transition to Economy 4.0. Furthermore, the study investigated the consequences of these changes on requirement levels at the workplace, as well as for occupations, sectors and the overall economic development.

In a 5-step analysis, a chronological scenario was modelled based on empirical parameters. It assumed that the implementation of "Economy 4.0" will – over time – be accompanied by:

- **Increase in investment in equipment** (new machinery or upgrades, e.g., with sensors in the manufacturing industry, associated IT services)

- **Increase in construction investments** (expansion of the "Fast Internet" network structure and associated civil engineering)

- **Changes in cost and profit structures** (e.g., through continuing education, consulting services, digitalisation, decline in raw materials and supplies, decrease in logistics costs, rising labour productivity)

- **Change in the occupational field and requirement structures** (according to sectors, taking into account routine proportions in occupations, i.e., potentials for

substitutability, adjustment of labour productivity to new wage structure)

- **Increased demand** (higher government spending on security, additional demand from private households, higher willingness to pay, increased exports)

The calculations are based on the 4th survey wave of the BIBB-IAB qualification and occupational field projections (QuBe project), which have been carried out since 2010. The projections use model calculations to show how the supply and demand for qualifications and occupations could develop in the long term. The data is based on the Microcensus, a representative official population sample. Thus, the corresponding projection is empirically based, i.e., only behavioural patterns that can be proven up to now are projected into the future and behavioural changes that cannot be detected in the past are not part of the basic projection.

[Figure 2] List of assumptions BIBB–IAB qualification and occupational field projections

Assumptions	Partial scenarios
Equipment investments	
❶ Additional investments	
❷ Conversion of capital stock sensor technology	PSC 1
❸ Conversion of capital stock IT services	
Building investments	
❹ Capital expenditure "high-speed Internet"	
❺ Distribution on industries	PSC2
❻ Balanced Government budget	
Cost and profit structures	
❼ Continuing education	
❽ Consulting services	
❾ Digitisation	
❿ Decrease in raw materials, consumables and supplies as well as purchased services	PSC3
⓫ Decrease in the cost of logistics	
⓬ Increasing labour productivity	
Change in the structures of occupational fields and requirements	
⓭ Adjustment in occupational structure with industrial sectors considering routine	PSC4
⓮ Adjustment in labour productivity	
Increases in demand	
⓯ Higher government spending on security	
⓰ Additional demand from private households	PSC5
⓱ Higher willingness to pay	
⓲ Increases in export	
Comparison with the baseline scenario (baseline projection) QuBe project	

Source: IAB Forschungsbericht 13/2016, p. 21

The scenario analysis "Economy 4.0" compares a fully digitalised working environment 2025 (= sub-scenario 5) with a working environment in which technical progress by 2025 will be oriented on the development path as observed until today (=4th wave of QuBe basic projection). The results of the model-based analysis show that the changes in workplace requirements and in the demand for labour will not necessarily result in significant job loss, but rather significant shifts among occupational groups (cf. ibid.: 59ff.):

- The comparison between the "Economy 4.0" scenario and the baseline projection shows that **the impact of digitalisation on the overall level of labour demand is relatively small** - the loss of jobs (1.5 million) is largely compensated for by new jobs (1.5) (7% difference to the baseline scenario).

- Numerically, fewer support activities are affected by digitalisation. Instead, compared to the basic projection, **specialist activities are less required whereas more highly complex activities are in demand**. Importantly, this is not to be equated with formal educational attainment; as other studies show, currently, more than 35% of all highly complex activities are carried out by persons without academic training (cf. Maier et al. 2016).

- This means that despite the increase in the proportion of academic graduates, there will also be **a long-term demand for skilled workers** who will carry out highly complex activities, provided that skills are continuously developed further.

- Concurrently, accelerated digitalisation is leading to significant changes in the structure of industries, occupations and requirements, which means that **structural change is accelerating**, e.g., manufacturing industries continue to lose importance in terms of the number of people employed (despite high shares of value added in GDP). Conversely, the "information and communication" and "education" sector benefit from the transition to an Economy 4.0.

- **Education and further training play a central role.** In the event of evolving and increasing requirements, continuing education and training will become decisive after initial training, in order to further develop skills on an ongoing basis. What does this mean for the organisation of vocational education and training in Germany? Prior to a more expansive response, it is important to consider certain specific features of the German vocational education and training system, vital to understanding the strategies currently under discussion.

3. Important characteristics of German Dual VET

The strength and innovative capacity of vocational education and training in Germany is considered to be based on five organisational principles:

Firstly, there is **close cooperation between the state and the economy**. Together, they secure the framework for vocational education and training - from the proportionate financing to the development and implementation of the curricula and the examination and certification of the skills acquired.

Secondly, vocational education and training is **geared towards learning within and for the working process**. Learning within the course of real-work situations in combination with school-based learning generates a comprehensive professional competence that enables independent, responsible problem solving and professional behaviour.

Thirdly, there is **a nation-wide acceptance of standards**. The uniform training and examination standards ensure a consistently high quality of qualifications, which are recognised and appreciated in both business and society.

Furthermore, this quality of vocational education and training can only be achieved by **training personnel, which takes responsibility for the organisation and design of the learning process** to combine the technical and pedagogical aspects and can integrate theory and practice.

Last but not least, developments in vocational education and training are prepared, analysed and supported by **institutionalised research and advice**.

Currently, there exist 327 nationally recognised training occupations which fall under the scope of the Vocational Training Act and the Crafts Code in Germany. On the labour market side, however, there is a much higher number of occupations that characterise labour demand in Germany. This means that training occupations generally have a rather broad profile, which qualify for a certain spectrum of

professional activities in the labour market.

A training occupation defines individual occupational abilities, skills and experiences that should be imparted during training. In this perspective, an occupation is seen as a socially defined position defined by cross-company qualification requirements, whose access is regulated and whose attainment guarantees more or less continuous employment opportunities and a biographical identity. In the labour market, in contrast, vocational needs and professional requirements are claimed, which are to be covered by the training occupations. Of significance, changes in qualification requirements therefore have an indirect impact on training occupations.

4. Changing demands in Dual VET

The existing organisational structure of the VET system allows for reacting flexibly to changing requirements: first, vocational training regulations and school curricula are designed in such a way that they allow companies room for flexibility in training design and are independent of the use of specific technologies. That is why the official training regulations and framework curricula are considered "minimum standards." Changing professional requirements can thus quickly be communicated through the adaption of in-company training programmes geared to the working process and through company-specific further training programmes. Furthermore, if the need arises, new training occupations can be developed and existing standards adapted in line with the evolving needs of the economy.

[Figure 3] Newly concluded training contracts of IT occupations in Germany
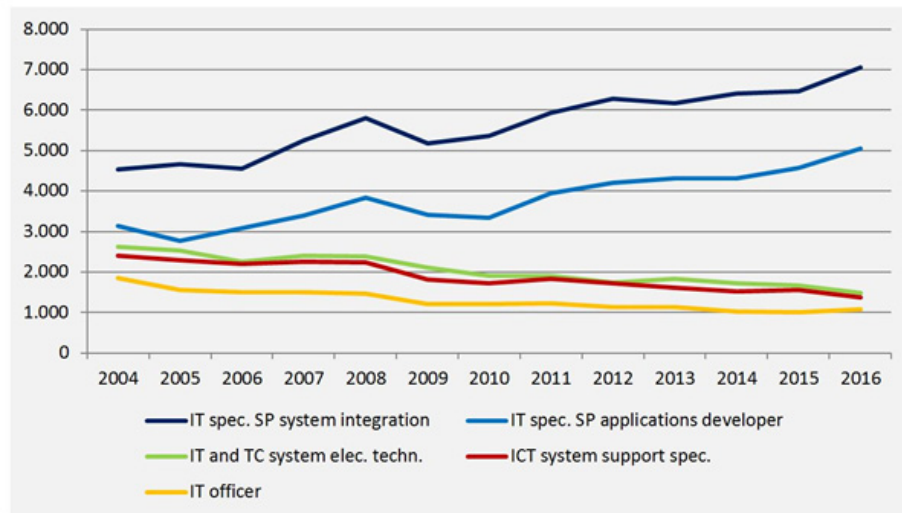
Source: Schwarz et al. (2017)

For example, training occupations in the field of information and communication technologies were newly developed in the 1990s in order to meet the increased demand for skilled workers by companies after the beginning of digitalisation in the 1980s. With approximately 15,000 new training contracts per year, they now rank among the most successful training occupations in Germany. However, also in the IT occupations, the latest technological developments and ever-changing company requirements now have to be taken into account by updating the training contents.

An evaluation study of the IT occupations (i.e., IT specialist, IT and telecommunications systems electronics technician, IT and telecommunications system support specialist and IT officer) conducted in spring 2016 produced the following results (cf. Schwarz et al. 2017):

- As reflected in the training numbers, there is a high demand for IT occupations in general and **a growing demand in particular in the field of software development**.

- Interviews with IT professionals, managers and CEOs as well as trainers and teachers, IT associations and the chambers showed the need to modernise the contents of the training regulations. Most importantly, essential aspects which have gained in importance over the last few years, such as "**data protection and security**," big data, cloud computing, etc., are now considered essential (last revision took place early 2000s).

- Furthermore, there is an increasing demand on behalf of the industry **to integrate industrial applications** (e.g., robotics, sensor technology, etc.) in vocational education and training of existing IT occupations.

- Another interesting finding of this project is that there is a rather marked **difference in the satisfaction of trainees with VET in the companies and in the schools**: the majority of trainees considered the quality of their training within the company as "very good" or "good." The quality of education taking place in vocational schools during 30% of the training time was rated not satisfactory by a large share of trainees. This result points to an essential challenge within Dual VET, as schools are usually not immediately involved in the digital transformation - taking place in the companies - they often provide outdated equipment or learning materials and teachers lack essential skills and qualifications.

Another example, the VW-project was conducted in collaboration between the VW group and BIBB in order to re-assess skill requirements in the areas of operation, maintenance and repair of production systems (cf. Katzer et al. 2016). In view of the changes already taking place with regard to work organisation, work processes and tasks due to the increasing digitisation in "early adopter" companies, such as VW, the project aimed to derive recommendations for regulatory work and training practice.

During interviews with specialists on company-level and from training practice, it became evident that it was increasingly important for the operation and maintenance of production systems to think in terms of software, to know process flows and to be able to solve problems independently. How can these findings be taken into account in vocational education and training?

One major conclusion is that it requires **a conceptual shift in the didactical concept and training practice;** for instance, instead of extensively teaching the basic courses and principles (in this case, in the fields of metal and electrical engineering) at the beginning of the training course, the system and its underlying processes could be the starting point. By choosing appropriate models, projects and work assignments at the beginning of the training course, a basic understanding of the system could be ensured.

Furthermore, digital devices have become a typical work tool. However, often, their use in training does not take place until the advanced years of training. It needs to be evaluated as to whether and how new technology could be integrated into the training at an early stage (nonetheless, it is important to ensure that the basic knowledge and skills, i.e., basic media literacy - necessary for competent use in training). Nevertheless, digital devices should be the means and not the ends in themselves, and it needs a strategic approach for their use in teaching and learning needs.

Lastly, it is also worthwhile to involve trainees in projects and to allow them responsible for tasks, in order **to promote their independence and problem-solving ability** with some semblance of guidance from above. Teachers and trainers would, in effect, then have the role to assist trainees in their learning process as "coaches."

5. Summary

What implications do these findings have for the organisation and governance of VET? As shown in the examples of the VW project and occupations in IT, the evolving nature of work must be reflected in the teaching and learning formats accordingly.

In addition to exemplary learning and the understanding of basics and principles, it requires a conceptual shift in teaching and learning - **understanding complex and IT-based systems and processes** - independent of specific technologies; it must become an elementary part of learning for and in the work process (cf. Katzer et al. 2017).

As discussed, changing requirements also impose new requirements on training personnel: thus, **the (further) qualification of training personnel** must be at the centre of future actions to meet changing needs in VET. These include a comprehensive media competency which require better networking between schools and companies to ensure that schools receive the necessary stimuli in a timely manner.

With regard to the speed of transformation taking place in society and economy (e.g., new technologies leading to new requirements in the IT sector), it is also important to further develop the form and scope of continuing vocational training in order to ensure **lifelong learning**.

Furthermore, new requirements in the workplace call for changing competence requirements in occupational profiles – basic knowledge in IT is also a must beyond the IT sector. Provided that there is a broad consensus on the part of industry - regarding the need to modernise training occupations, it is possible to react within the framework of existing organisational structures. In view of the current state of digitisation in the German economy, however, it seems appropriate to react to the changing requirements by creating additional qualifications to the existing occupational profiles. Germany's current economy shows different qualification demands due to the uneven pace of technological adaption in companies. It is the responsibility of the German Dual VET system to cater to the demand of the whole

economy. Heretofore, discussions have thus focused on (nation-wide recognised) additional qualifications for companies that are early adopters of new technologies and work processes, while keeping an established set of regulations and vocational competencies for other companies.

Finally, it seems likely that a VET 4.0 can lead to a renewed appreciation for vocational education and training as well as more attractive employment and career prospects. Digitalisation can become an opportunity for VET, as long as the system can offer adequate approaches to adapt to the ever-changing work economy.

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Australian Apprenticeships:
Trends, Challenges
and Future Opportunities

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Australian Apprenticeships: Trends, Challenges and Future Opportunities

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Abstract

The Australian economy is in transition. Future prosperity will depend on greater economic diversification and on innovation and entrepreneurship, hallmarks of Industry 4.0. This has implications for skills development for future workers and for those needing to move into new jobs or roles. It has a direct impact on apprenticeships - an enduring and well-respected feature of Australia's skill development landscape. It is concerning then that overall apprenticeship commencements and completions have been declining. What is being done to avert this trend? And what impact does Industry 4.0 have on the future of Australian apprenticeships? This paper and presentation will explore the challenges and constraints within the Australian system of apprenticeships to adequately respond to Industry 4.0. It will also cover directions in government policy and opportunities within industries and the training system itself to create change.

1. Introduction

1.1. Setting the scene: Australia's economic and policy context

The Australian economy is in transition. Of significant impact has been a decline of the mining investment boom coupled with the loss or redesign of jobs in the automotive manufacturing industry, together with a more general decline of the traditional manufacturing industry in Australia (Stanwick, Circelli & Lu, 2015).

As Stanwick, Circelli & Lu (2015) identify, manufacturing's relative contribution to Australia's economic output has been steadily declining, a common trend among developed countries (Australian Workplace and Productivity Agency 2014). Manufacturing's share of Gross Domestic Product (GDP) declined from 13.2% in 1975 to 6.6% in 2013, while in the same period, mining's share of GDP rose from around 6.5% to 10% (Australian Workplace and Productivity Agency 2014, p.31). Furthermore, labour force data from the Australian Bureau of Statistics (ABS) highlights that, in the ten-year period from May 2005 to May 2015, the total number of people employed in the manufacturing industry has declined from 10.4% of all employed people to 7.8% (ABS 2015a, 2015b). The reasons for the decline in employment numbers are many but encompass technological advances (for example, robotics and automation of manufacturing processes), changes in consumer preferences, and government policies (Bradley 2015).

The competitiveness of Australian companies in the future will be largely determined by the scope and penetration of new and yet-to-be-developed technologies and how professionally and consistently they are utilised; it will also depend upon companies embracing a holistic approach across their value chain (Megan Lilly, cited in Couldrey & Loveder 2017). This has implications for the types of skills needed in the labour market as future prosperity will depend on greater economic diversification and on innovation and entrepreneurship. It has consequences for skills development

for future workers and for existing workers needing to move into new jobs or roles, including apprenticeships.

Snapshot: Advanced manufacturing technologies: industrial robotics and Australia's positioning

The number of industrial robots deployed worldwide will increase to around 2.6 million units by 2019. Broken down according to sectors, around 70% of industrial robots are currently at work in the automotive, electrical/electronics and metal and machinery industry segments. In 2015, the strongest growth in the number of operational units recorded was registered in the electronics industry, which boasted a rise of 18%. The metal industry posted an increase of 16%, with the automotive sector growing by 10%. It is interesting to note that the number of industrial robots per 10,000 employees in the manufacturing industry is 531 in Korea, 398 in Singapore, 305 in Japan, 301 in Germany, 212 in Sweden – as the top five users. **This is compared to Australia which is close to the global average of 69** (International Federation of Robotics, 2016; Roos, 2017).

Australia's physical climate is also changing and the population is ageing, driving labour and skill demand in the community and health services sector as well as in finance and insurance services, and in the energy and utilities sectors. And the world is becoming more inter-connected, providing opportunities for new markets for Australian goods and services, particularly in the areas of food, education and tourism, as well as threats in areas of biosecurity, cyberspace and terrorism (Figure 1).

[Figure 1] Critical factors affecting industry

Snapshot of Issues

Technological
Rapid Development
Connectivity
Energy Efficiency

Environmental
Climate Change
Extreme Events
Waste Diversion &
Re-use

Population
Ageing
Lifestyle Seekers
Urbanisation

CRITICAL INPUT FACTORS

Labour Markets
Higher Skilled Occupations
Regional requirements
Regulation
Volunteering

Political & Economic
Renewable Energy Target
Greenhouse Gas Emissions
Reduction Target
State and C'wealth
Budgets
Public Debt

Law and Order
Global and Regional Security
Terrorism
Drug Epidemic
Domestic Violence and local
priorities

Energy
Distributed Generation
Storage
Changing consumer
habits

Source: Electrical Utilities and Public Administration Training Council Industry Workforce Development Plan p. 5

In 2015, the Committee for the Economic Development of Australia (CEDA) saw Australia as being on the cusp of a new industrial revolution. It examined the implications of rapid and continuing technological change on Australia's future workforce. It is predicted (Durrant-Whyte et al. in CEDA 2015, p. 58) that up to 40% of jobs in Australia could be susceptible to computerisation and automation in the next 10-15 years. Jobs in administration and some services are particularly susceptible, as are regions that have historically associated with the mining industry. Jobs in the professions, technical and creative industries, and in personal service areas (health for example) are least susceptible to automation.

Industry is being transformed by technology, which is also breaking down traditional sectoral divisions. For example, Mining Equipment, Technology and

Services (METS) companies have developed ways to smooth fluctuations in the mining lifecycle by transferring their skills to other sectors such as renewables, defence, marine, and infrastructure (Austmine 2013, p.7). Standard industry groupings are also being broken down by the rising importance of enabling services.

All this has implications for workers, who have to become more autonomous, managing their careers (and continuing education) and relying more on entrepreneurial skills. Even employees are being asked to become more creative as well as more technically proficient so they can perform well in the digital age (Beitz in CEDA 2015, p. 161). Others within the vocational education and training sector, such as the building and construction industry, remind us we are being seduced by notions of rapid innovation, change and skilling for tomorrow. While it is important to consider the future, the primary concern and focus for many industries is skilling for today.

Whether you choose an optimistic or pessimistic response to these trends, one thing is clear: Australians will need higher and different skills to operate both in the current labour market and beyond. As Megan Lilly, Head of Workforce Development for the Australian Industry Group (Ai Group) adroitly puts it - 'we need to retool the nation' (cited in Couldrey & Loveder, 2017 p. 26).

Developing new and different skills utilising the right digital technology will be vital. This has major implications for our education and training provision, as well its intersection with work. The apprenticeship system sits neatly in this space. It is capable of providing a high-quality, fully integrated learning and employment experience at the leading edge of economic transformation. The education and training system should not always have to chase the future; it should be part of it (cited in Couldrey & Loveder, 2017 p. 26).

1.2. Setting the scene: latest apprenticeship data

The latest release of NCVER's apprentice and trainee data show there were 275,200 apprentices and trainees in-training as of 31 March 2017, a decrease of 3.7% from 31 March 2016 (NCVER 2017). This equates to 2.3% of Australian workers who are employed as an apprentice or trainee (NCVER 2017).

In the 12 months ending 31 March 2017, compared with the 12 months ending 31 March 2016:

- commencements decreased by 1.9%, to 166,700

- completions decreased by 15.1%, to 97,300

- cancellations and withdrawals decreased by 0.5%, to 93,400

For trade apprentices alone, in the 12 months ending 31 March 2017, compared with the previous 12 months, trades commencements decreased by 9.0% to 72,300 and completions decreased by 13.2% to 43,800 (NCVER 2017).

For the first time since 1996, the decline in the number of non-trade apprentices has resulted in converging proportions of trade and non-trade apprenticeship commencements (Figure 2).

[Figure 2] Quarterly commencements for trade and non−trade occupations, seasonally adjusted and smoothed, 2006−16 ('000)
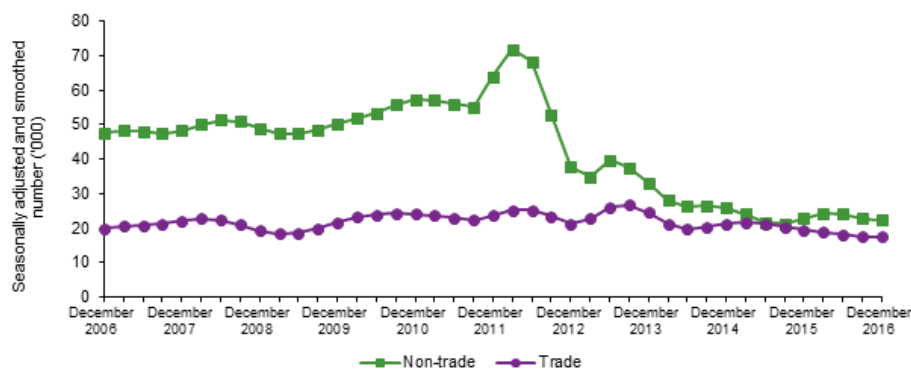
Source: NCVER 2017, Australian vocational education and training statistics: apprentices and trainees 2016 ― annual, NCVER, Adelaide.

Structural changes to the economy and make-up of Australian industries, the changing nature of work, supply and demand factors as well as policy will inevitably impact on the ebbs and flows in apprenticeship data. It is also important to appreciate the nuance in the NCVER data, separating apprenticeships (mostly trade) from traineeships (mostly non-trade) is not ideal and acknowledging industry and jurisdiction variation. Yet it remains to be seen whether responses to the challenges of today and the foreseeable future will be enough to counteract the shifting demand and interest in apprenticeships over the next twenty years to ensure they remain an effective skill development model.

> **Snapshot: Advanced manufacturing and access to leading edge technologies[1]**
>
> In August 2017, engineering giant Siemens announced a record $135 million industrial software grant for the Swinburne University of Technology to create Australia's first fully immersed Industry 4.0 facility. The grant will be used to digitalise Swinburne's Factory of the Future, giving students and researchers access to the same apparatus being used by leading companies on advanced projects in the highly-competitive digital manufacturing sphere and will assist with preparing students to participate fully in the emerging global innovation economy.

2. Changes to apprenticeship governance and delivery according to the change of future industry

2.1. Broader government initiatives

2.1.1. Industry 4.0 Taskforce

> Australia should see the 4th industrial revolution as an opportunity. If we establish a broad-based capability to use global engineering and manufacturing platforms based on advanced materials, the often spruiked (touted) access by our SME's to global supply chains are more a reality now than they have been at any time in the past.
>
> Jeff Connolly, Chair of the Prime Minister's Industry 4.0 Taskforce

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1) http://www.australianmanufacturing.com.au/46568/siemens-announces-135m-grant-to-digitalise-swinburnes-factory-of-the-future

On 25th April 2017, the Prime Minister's Industry 4.0 Taskforce signed a cooperation agreement with Platform Industrie 4.0 (Germany)[2]. The agreement fulfils a recommendation by the Australia-Germany Advisory Group to increase collaboration on digital transformation. The agreement also forms part of the broader cooperation between Australia and Germany on science and innovation. Platform Industrie 4.0 and the Taskforce have agreed to cooperate across five work streams, representing key challenges in the transition to Industry 4.0: reference architectures, standards and norms; support for small and medium sized enterprises (SMEs); industrie 4.0 testbeds; security of networked systems and; work, education and training. This cooperative work will be supported by government, industry, and standards and research organisations within both countries, with the Advanced Manufacturing Growth Centre coordinating work in Australia.

Under the work, education and training work stream the initiative recognises that digital skills are the key factors in the competitiveness of industry in both countries. There is a need to promote digital skills in vocational education and training as well as on-the-job training in order to make employees ready for the age of digital transformation. **The key action items are not directly or specifically linked to apprenticeships per se**, but they will focus on sharing information and best practices on work, education and training in sectors relevant to Industrie 4.0 and aim to facilitate cooperation on digital re-education for existing employees (Australian Government, 2017).

2.1.2. Reducing 'red tape' and business simplification

More recently, at a meeting held on 4 August 2017 the Council of Australian Governments agreed to two key broader initiatives[3].

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2) https://industry.gov.au/industry/Industry-4-0/Pages/PMs-Industry-4-0-Taskforce.aspx

- Regulatory frameworks need to be responsive to change, reduce barriers and minimise red tape, in an environment where technological innovation and disruptive business models are displacing established firms, products and alliances and at the same time potentially providing more consumer choice and improved products and services. Ministers discussed a specific reform opportunity to be reviewed as a matter of priority out of session. Ministers agreed to adopt principles to guide nationally consistent approaches to regulating technical innovation and disruptive business models. Jurisdictions have been proactive in addressing the regulation of new technologies, and ministers noted the inter-jurisdictional collaboration under way in these areas.

- The National Business Simplification Initiative is about making regulation less complex for businesses and streamlining business interaction with all levels of government. Ministers and officials from all jurisdictions met in November 2016 and agreed to work together to make it simpler to do business in Australia under the National Business Simplification Initiative. All jurisdictions agreed to continue working together on business simplification and that simplifying the process of employing a person was a national business simplification priority. Ministers further agreed to prioritise collaboration to reduce the burden on small business. Small business has a big impact on the Australian economy. If it was easier for these businesses to employ staff, owners might not think twice about hiring an additional person. If one out of every 50 small businesses currently without employees started employing just one person, this could create 25,000 jobs.

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3) Communiqué COAG Industry and Skills Council Meeting 4 August 2017

2.2. Australian policy response with an apprenticeship focus

> **Is the Australian apprenticeship model well placed to meet the challenges of developing skills in this rapidly changing world?** I would contend that the core principles of the apprenticeship model are well placed to develop many of the skills required into the future, but I am less confident that our apprenticeship system is up to the task. Megan Lilly, Head of Workforce Development at Ai Group (Couldrey & Loveder, 2017).

The current Australian Government's championing of innovation has put a more intense spotlight on skill requirements in response to Industry 4.0. **However, there have been no significant modifications to apprenticeship governance arrangements according to the change of future industry.**

There have been many reviews in the area of apprenticeships over recent years and there is a solid base of research that identifies some of the critical factors, both in Australia and internationally. Recently, major reports in Queensland (Jobs Queensland 2016) and New South Wales (NSW Business Chamber 2016) spell out clearly some of the important factors in re-invigorating apprenticeships including early apprenticeship participation, sound industry-led career advice and restoring consistency, coordination and an outcomes focus to the system. However, there are still ubiquitous questions surrounding the future success of the system. Many participants at a national forum on The Future of Australian Apprenticeships expressed the need for a more comprehensive understanding of the factors most open to influence, which would assist in informing cost-effective interventions at the right time (Couldrey & Loveder, 2017).

Two recent Australian government policy papers are of some interest:

- Apprenticeships for the 21st Century Expert Panel 2011[4]
- Apprenticeship Reform Advisory Group (ARAG) 2016[5]

While the Apprenticeships for the 21st Century Expert Panel report acknowledges the Australian Apprenticeships system 'will require significant improvement to performance, such as retention, completion outcomes and its impact on productivity and innovation, if Australia is to respond effectively to the challenges of competing in a global marketplace,' no specific recommendations were made with respect to governance arrangements. The ARAG report in 2016 is perhaps even narrower with a focus on three pillars of change: a restructuring of incentives, a new pre-apprenticeships program and piloting alternative models of apprenticeship delivery. In response to Industry 4.0, one of those alternative models is focusing on the notion of **Higher Apprenticeships**, considered in more detail below.

Potential for change in the future

The Australian government is continuing to explore systemic challenges in the apprenticeships system. Phillips KPA (an Australian consulting firm) has been awarded a contract from the Australian government to conduct five forums on apprenticeships in 2017-18. The themes of those forums include: the impact of changing nature of work on the apprenticeship model, a forum looking at different approaches to the educational model that underpins apprenticeships, one looking at regulation of the apprenticeship system, another on program support and then a final forum in May 2018 which will draw the outcomes of those four together. It is expected the results, and any subsequent government policy recommendations, will not be available until the latter half of 2018.

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4) https://www.australianapprenticeships.gov.au/sites/ausapps/files/publication-documents/apprenticeshipsforthe21stcenturyexpertpanel_0.pdf

5) https://www.australianapprenticeships.gov.au/sites/ausapps/files/publication-documents/arag_recommendation_report_2.pdf

2.2.1. Funding and targets

The most recent major VET policy initiative by the Australian Government was in May 2017 with the announcement of the Skilling Australians Fund which supersedes the National Partnership Agreement on Skills Reform. The new fund underpins a new partnership between the states and territories and will provide ongoing funding for VET, primarily through supporting up to 300,000 apprenticeships and traineeship, pre-apprenticeships and higher-level apprenticeships, and training for occupations in high demand areas and in rural and regional Australia. To receive funding, states and territories will need to match Commonwealth funding and bid for finance; proposals must align with the priorities and criteria set by the Commonwealth. The Skilling Australians Fund commenced from 1 July 2017 with an estimated $1.5 billion being available from 2017-18 to 2020-21.

Previous targets had been set to ensure all Australians gain higher level qualifications (Certificate III and above) and introducing entitlements to help achieve those targets and by opening up education markets. The experiment in the training system with de-regulation and market contestability is still underway making it difficult for education providers (in VET and higher education) to plan. Particularly opaque at present is how higher qualifications (diploma and above) will be funded. Given that, it is more than likely that increased competition is here to stay and that students (or their parents or employers) have to pay more of the cost of their education and training, they will become increasingly savvy about their requirements.

2.2.2. A focus on mentoring

The Industry Specialist Mentoring for Australian Apprentices program was also introduced in the 2017-18 Budget. It will provide intensive support to apprentices and trainees in the first two years of their training in industries that are undergoing structural change. The Department of Education and Training intends to appoint

providers that are well equipped to provide comprehensive mentoring services through a procurement process. More information about the Industry Specialist Mentoring for Australian Apprentices program is available from the Australian Apprenticeships website.

2.3. Jurisdiction (state/territory) policy responses with an apprenticeship / Industry 4.0 focus

The primary focus of skilling and training programs in all jurisdictions is jobs. The provision of apprenticeships and traineeships dominates, with all jurisdictions committing funding to this training to leverage recent state/territory budgets or election promises. For example:

- The Victorian Government released its 2017-18 budget on 2 May 2017 with large infrastructure projects in the regions as the primary focus. Included was the announcement to provide $8.2 million to support Apprentice Support Officers to ensure apprentices and trainees, under the age of 25 years, get the support they need to finish their training. The 25 support officers will be based in TAFEs across Victoria so they can continue mentoring and helping young apprentices. This initiative underpins other initiative such as the Major Projects Skills Guarantee which ensures that apprentices and trainees do at least 10% of the work on Victoria's major projects.

- The South Australian Training and Skills Commission (TaSC) will produce the Skills for Future Jobs 2020 series. The Commission has already identified a number of topics of strategic importance that will be part of the 2020 series, including apprenticeships and traineeships, adult and community education, industry priority qualifications, workforce development needs of industries identified as being strategic to SA, such as defence, and VET system funding. More information about the Skills for Future Jobs 2020 series is available on TaSC's website.

- In its 2017-18 budget, the NT Government committed $101 million to help get Territorians work ready and ensure responsive training programs are aligned to the needs of NT businesses, industries and workers through the Northern Territory Training Entitlement and apprenticeships and traineeships.

3. Integrating future prospective occupations into apprenticeships

3.1. Which competencies are required and which occupations are revised and newly developed

Currently in Australia, there are a number of frameworks, standards, descriptors and initiatives supporting the development of core skills needed to gain and maintain jobs. An industry-led training products framework remains a cornerstone of the national training system, with industry playing a key role in defining the skills required by the labour market. This is done through the work of Skills Service Organisations and Industry Reference Committees, under the auspices of the Australian Industry Skills Committee (AISC) in developing training packages. Ideally, training packages and their associated products: establish occupational standards, enhance the capacity of learners to enquire and analyse, support dialogue between industry and educators, enable effective regulation to support training quality and encourage lifelong learner involvement and empowerment in the development of skills and knowledge (Beddie, Hargreaves & Atkinson, 2017).

The Australian Core Skills Framework (ACSF) and Core Skills for Work Developmental Framework (CSfW) focus on competencies needed to gain proficiency in non-technical skills. Training packages, which focus on technical or task specific skill standards (units of competency) also include these core skills for work/employability skills in units of competency descriptions. In regard to occupational profiles, brief occupation-specific/technical skill descriptions and their level of skill are found in the

Australian and New Zealand Standard Classification of Occupations (ANZSCO) but usually do not cover other skill types (Siekmann, forthcoming).

The Australian Skills Quality Authority (ASQA) ensures that registered training organisations are meeting the requirements of these industry-developed training packages, so that VET graduates have the required skills and competencies for employment.

Common to all is a relatively long update cycle which may miss crucial changes in some areas of skills and attitudes, for example, digital skills, communication skills or adaptability and resilience (Siekmann, forthcoming). Indeed some would argue the model of training packages and training product design is not agile and fast enough to meet evolving skill requirements. Others would argue the VET sector is better able to respond quickly to the evolving skill requirements of the Australian workforce because it offers shorter courses and they also have a very rich history in working directly with industry.

Indeed, the recent proliferation of skill sets may attest to this[6]. Since 2009 there has been a rapid increase in the number of skill sets in training packages (Table 1), suggesting strong industry support for them as a vehicle for meeting changing workforce skill development needs. Several industry skills councils have defended the idea of skill sets and the benefits they provide for upskilling their workforce. They recognise that industry needs to work with registered training organisations to provide shorter training programs, programs that specifically address workers' gaps in knowledge and recognise prior existing skills and experience. A manufacturing workforce study also found that short courses or skill sets are the preferred option as this form of training can be highly customised to efficiently upskill existing staff in new

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6) The VET system in Australia uses units of competency as its basic building blocks. Each unit of competency has defined learning outcomes (knowledge, skills and their application parameters), which are measurable in their own right, but which also contribute to larger education outcomes. When units of competency are combined into an interrelated set below the level of a full qualification, they are now commonly referred to as 'skill sets.' Skill sets enable performance of job tasks or functions.

technologies (Hargreaves & Blomberg, 2015).

[Table 1] Number of skill sets developed across all training packages, 2006–17

Date	2006	September 2009	August 2010	June 2012	June 2014	September 2017
Number of training package skill sets	Assume zero, no definitive data found	178	323	924	1,125	1,296

Source: https://training.gov.au/

3.2. Forecasting demand and emerging skills

The Australian Government's industry innovation and competitiveness agenda outlines a number of ambitions to strengthen Australia's economy, one of which is a more skilled labour force through a focus on reform of the VET sector. The current VET reform agenda is aimed at addressing Australia's needs for a skilled and flexible workforce to adapt to rapid technological change in the workplace, and improve our economic position in the face of increasing global competition. This raises questions about how current and future workforce development needs, at a national or regional level, are balanced with student choice and an increasing demand for tertiary education, and the role of the VET sector in this.

3.2.1. Forecasting emerging skills

Many assumptions and pitfalls underpin the modelling of forecasting emerging skills, often based on conjectures relating to trends in economic behaviour of individuals firms and governments. Data and information currently may be sourced from a number of reputable agencies, for example, the Australian Bureau of Statistics (ABS) and the Australian Treasury and Bureau of Resources and Energy Economics

(BREE). The magnitude of forecasts is mostly indicative, not prescriptive. Australia also does not share the tradition of many other countries (for example, the U.S., the UK, the Netherlands, Canada and the European Union) of producing labour market information on a regular basis, even though it has the data (albeit across different sources) to do so (Shah, forthcoming).

While the degree of skills mismatch in Australia on average and in comparison to other countries is not alarming, indeed a certain degree of mismatch is 'natural' and unavoidable, future developments like the 4th industrial revolution could quickly exacerbate existing issues. NCVER is therefore undertaking a study which considers the usefulness of models and initiatives in the field of skill information in the international arena to correctly identify and disseminate occupational skills in demand. Of particular interest is the detail of occupational skills profiles, their accuracy in regard to labour market reality and implementation of this skill intelligence in vocational training (Siekmann, forthcoming).

To navigate the increasingly complex skill landscape, Australia's availability of and access to skill information, both on the supply and demand side could be further consolidated, streamlined and updated based on an overarching skill information framework. This can be particularly useful in updating skill standards in training packages and linking VET accredited units to skills identified on the demand side (Siekmann, forthcoming). Ultimately, the goal is a single 'Portal' which brings together a range of data and intelligence to describe occupations better, in terms of skill types and the level of skills proficiency required in order to target training content and relevance.

In another project, NCVER is working closely with key industry stakeholders (through the Australian Industry Skills Committee and its secretariat) along with the Department of Education and Training to ensure broader industry interests in accessing timely and curated labour market and skills information are canvassed and understood. This includes successfully delivering the Annual Industry Insights report

portal for the Commonwealth during 2017.

3.2.2. Training for now or the future

A central tension in the Australian model was explored at a recent NCVER forum on potential reform to training products: how do we train for now – the primary interest, it appeared, to industries employing lower-qualified workers – and for the future.

While it is important to have the capacity to understand - to the extent this is ever possible - the future shape of work and the associated skills and knowledge requirements, not everything is new; there are some constants in human behaviour for which the economy and, in turn, the training system must provide (Beddie, Hargreaves & Atkinson, 2017, p. 18).

Participants in the training products forum pointed out that to train for something too far into the future will not serve employers or individuals in today's workplace. With better delineation of the fundamentals, it may be easier to preserve the integrity of national accredited training and build in the flexibility and forward-looking attitude it also requires (Beddie, Hargreaves & Atkinson, 2017).

Indeed, in contrast to the majority of submitters to a recent Parliamentary Inquiry into Innovation and Creativity the National Employment Services Association argued against a focus on specific skills, such as STEM (Science, Technology, Engineering and Mathematics). They argue that an education system which focuses on context-specific hard-skills to the detriment of the more fundamental requirements of adaptability and communication does not serve either its graduates or the labour market, and the skill-gaps created by such a system will only widen with time. Worse, attempting to second guess the unknowable future directions of job market evolution by focusing too narrowly on one type of educational stream (such as STEM) is dangerous and socially irresponsible (NESA, 2017).

3.2.3. Skills required for Industry 4.0

In Australia, research by CSIRO highlighted the impact of technology on jobs now and in the future. This has implications for the apprenticeship and traineeship system in terms of the knowledge, skills and experience to be acquired by apprentices and trainees and the method in which these are acquired. The existing flexibility in the system, as demonstrated by models such as hairdressing and aviation, may need further exploration. The speed with which digital disruption occurs also has implications for the current process for altering or updating accredited VET courses, which necessitates extensive and timely consultation and may limit the system's ability to respond in a timely manner to changes in workplace practices and skills requirements (State of Queensland, 2017).

The international skill literature univocally witnessed a major shift towards non－technical skills on the demand side. In vocational training, employability skills - including socio-emotional skills and transferable skills - will need to be equally addressed to technical skills if not more so (Siekmann, forthcoming).

Goran Roos (2017) suggests the key skills required for Industry 4.0 will include attributes such as cognitive flexibility and creativity, logical reasoning, mathematical reasoning as well as critical thinking, emotional intelligence, judgement and decision-making. This has implications for the delivery and assessment of such skills. He argues the speed of technological development accelerates beyond human ability to learn, i.e., by the time new knowledge and skills have been learnt, they are already obsolete. This is true if knowledge, as claimed, is increasing exponentially (Roos, 2016).

Internet job-vacancy data provide an up-to-date (although not comprehensive) picture of what is happening in the labour market, offering a succinct account of skills and attributes employers are actually looking for. NCVER is working with Burning Glass technologies to turn this data into insights. A couple of examples are offered

below (Figure 3) in relation to apprenticeship opportunities over the last 12 months, with an Industry 4.0 relevance.

[Figure 3] Recent apprenticeship job advertisements

<u>Automated Equipment Trainees</u>

Wagners - Australia, International

Retail

Wagners Composite Fibre Technologies (CFT) is a world leader in the application and development of composite engineering materials. The CFT vision is to revolutionise the global materials industry by being number one in composites, providing infrastructure with innovative engineered solutions capitalising on the inherent benefits of composites. An exciting opportunity currently exists for those with previous manufacturing or production experience and an interest in: mechanics, robotics and engineering to join our team as Automated Equipment Trainees.

Key duties of this role:

- Learning operations of Automated Cell

- The setup and recipe changes required when changing product model

- Calculating and setting machine controls to regulate machine operation

- Contributing to daily, weekly and monthly preventative maintenance

- Maintaining the highest standard of quality control

The new members of our CFT team will possess:

- A strong commitment to following safe work practices

- Be mechanically minded

- Good communication and problem-solving skills

- A current Drivers Licence

- Ability to work within a team and autonomously

- The ability and willingness to work rotating shifts

- Experience with reading and understand engineering drawings is advantageous but not essential

- Experience working in a manufacturing environment is advantageous but not essential

- Forklift licence is advantageous but not essential

If you feel as though you have the relevant skills and the drive to work within a fast developing, diverse and ever-changing company apply today by following the link below.

Skillinvest is currently recruiting of behalf of O'Connors Farm Machinery for a 1st Year Apprentice to work at their Horsham branch.

This position represents an excellent opportunity for a self motivated person wishing to commence a career in both the automotive and agriculture industries. Precision Agriculture is one of many modern farming practices that make production more efficient. With precision agriculture, farmers and soils work better, not harder. There is a lot of technology used to make modern agriculture more efficient, such as GPS. The successful applicant ideally should possess the following attributes:

- GPS

- Farm Computer Software

- Drones

- Modern Farming Practices

- Computer experience

- Be able to problem solve

- The ability to work in a team environment with a friendly and positive "can do" attitude

- Be reliable, honest and trustworthy and punctual at all times

- Commitment to complete your apprenticeship

- Be eager to learn and follow instructions

- Ability to demonstrate customer service values

Snapshot: current NCVER funded project: The fourth industrial revolution –technological disruption implications for Australian VET

While there is growing consensus about the impact of this disruption to business models, there exists sharp polarisation between those who see these technologies offering limitless new opportunities versus those who see major job dislocation. This uncertainty and lack of agreement has slowed down adaptions among corporations, governments and communities, which have subsequently hampered proactive changes in the VET sector.

NCVER has funded research (Pi-Shen Seet et al.) which aims to navigate through this paradox by moving beyond the technological drivers of change to focus on the anticipated skills needed from both the innovators (technology producers) and

industry (technology users) perspectives, with a particular focus on future skills required from Australian VET graduates in the next 5-10 years. This is in line with the call for future research to focus on the link between innovations with more fine-grained occupational characteristics.

In so doing, it will examine the relationships between emerging technologies and skills and will delve below the aggregate technological forces of employment change to uncover important nuances and variations at existing and new occupations and job family level and at required skills levels in the Australian context.

The main research topic is: how does disruptive technology relate to future skill development (and vice-versa) in the VET sector as seen from the innovators (technology producers) and industry (technology users) perspectives.

The results are expected to be published early 2018.

4. Challenges, opportunities, limitations and strategies to reinvigorating apprenticeships to meet the demands of Industry 4.0

Apprenticeships have an honourable, well-respected and enduring history in Australia, and that belief remains true today. However, there are several challenges, along with opportunities, to meet the demands of Industry 4.0. In this section, we briefly look at the pool of apprentices and the role of employers and training providers – the three main stakeholders to the apprenticeship contract. As NCVER's national forum on The Future of Australian Apprenticeships confirmed, there is an identified need for a continued focus on the employment relationship in training, particularly the integration of on and off-the-job training, and the strengthening need for the tri-partite involvement and commitment of the employer, apprentice and training provider (Couldrey & Loveder, 2017).

4.1. Pool of apprentices

The challenge in reinvigorating apprenticeships for Industry 4.0 is magnified by the fact that increases in the number of young people going on to university study after school have affected the pool of young apprentices, with more coming from low socio-economic backgrounds and with lower academic ability, including literacy and numeracy deficits (Karmel, Roberts & Lim, 2014). The question remains how the VET, and the apprenticeship system, can stay attractive in view of the easier access to universities and the greater value on this by society (Roos, 2017).

A significant opportunity and challenge exists as to how the whole of the VET sector can work together to raise the profile of apprenticeships and the reputation of vocational careers and pathways. This includes applying new thinking as to how to effectively reach and inform the key influencers for young people — parents, career professionals and classroom teachers (Couldrey & Loveder, 2017).

Snapshot: Pathways in Technology (P-TECH) Program

http://www.ptech.org.au/

The P-TECH pilot is an innovative model of education-industry collaboration that provides students studying for their Senior Secondary Certificate with an industry supported pathway to a science, technology, engineering and mathematics (STEM) related diploma, advanced diploma or associate degree. The P-TECH pilot involves the establishment of long-term partnerships between industry, schools and tertiary education providers that enable businesses to play an active role in the learning and career development of their future workforce. This includes mentoring and providing pathways from school to further education, training and employment, including opportunities for employment with the school's industry

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partners. The model features opportunities for students to connect and build relationships with industry partners, and engage in hands-on, project-based activities, both at school and in the workplace. These experiences will help students to make informed decisions about their future careers and pathways.

Local employers include: IBM, Barwon Health, GMHBA, Bendigo Bank, Tribal Campus, Opteon Group, Sanitarium, Mars, PwC, Austal, Defence Teaming Centre, Varley Group, BAE Systems, Century Engineering, Jetstar Airways, Ampcontrol, Ergon Energy, Wilmar Sugar, Canegrowers Burdekin, Jayben, Maltec Engineering and the Elphinstone/William Adams Group (CAT).

4.2. Role of employers

Teaching, training, coaching and mentoring are the central plank of apprenticeship systems. This entails greater effort in ensuring that employers understand the importance of culture in the workplace as a learning site. Employers should be more involved in deliberations about the type of learning their apprentices require. There is a need for strategies which engage small enterprises more holistically in the apprenticeship system, and identifying how widely the support services offered through the Australian Apprenticeship Support Network and third party intermediaries are recognised and utilised (Couldrey & Loveder, 2017).

4.2.1. Employer (and apprentice demand) for fast-tracking skills development

This emphasis on the employer role and their needs is the strong theme emerging from the Engineering Excellence project managed by the Ai Group to help RTOs develop and implement systems to allow apprentices to progress through and complete their apprenticeship on the basis of achievement of competency (in engineering trades). The blunt message from the AiG (p. 53): it is a common belief for

many in the VET system, especially within public providers, that the real customer they service is government. Government provides the funds and sets the rules. Teachers need a better understanding of their role in the system, including that they are in a service industry and their livelihood depends on keeping customers satisfied, and that there is no apprenticeship without an employer.

NCVER's data confirms the increasing prevalence for a trade apprentice to complete in a shorter time, rather than the 'typical' four-year contract. Indeed, the proportion of adult apprentices completing a trade apprenticeship in two years or fewer has increased markedly over time, from around 28% in 1996 to over 50% in 2016 (Hargreaves, Stanwick & Skujins, 2017).

Competency progression is of course not a new phenomenon in Australia, however there remains a disparity between this approach and that of the time-based philosophy underpinning apprentice training.

Clayton et al. (2015) observed how the policy on competency progression and completion has been implemented in three trade qualifications: commercial cookery, engineering (metal fabrication) and carpentry. Their analysis identified uneven levels of support for the policy and a lack of provider flexibility in adopting the administrative, teaching and assessment approaches that facilitate progression and completion. VET language blurs communication. Training providers working with many small employers do not have the resources to get to know the nature of the business in depth.

To be productive, apprenticeship training plans must be living documents. With the advent of digital tools to aid assessment, apprentices now need to take considerable responsibility for collecting their assessment evidence. The authors conclude that competency progression demands strong provider-employer cooperation, such progression and early sign-off are appropriate only for 'the most gifted apprentices or those who are mature-aged and come with prior work experience' (Clayton et al. 2015, p.10).

A recent NCVER project investigated an alternative pathway to accelerate completion, namely the use of recognition of prior learning (RPL) to identify existing skills and knowledge in combination with gap training. Hargreaves and Blomberg (2015) found that use of RPL as a means of fast-tracking adult apprentices was still not widespread. This has to do, inter alia (among others), with a prevailing culture of time-based progression and the cost of RPL. They observe that when RPL is made available, it is important that eligible apprentices and their employer fully understand the process.

4.2.2. Employer demand for higher skills

Extending the concept of apprenticeships to higher-level qualifications, such as diploma and associate degrees, is seen as a logical progression of the Australian model to meet the needs of the 4th wave of industrial development and to ensure we are preparing for the skilled workforce of tomorrow (Couldrey & Loveder, 2017). A more flexible and responsive apprenticeships system is also essential to support evolving labour market demands. Higher apprenticeships have the potential to respond to the skilling needs of growing, high-skill industry sectors by combining on-the-job training with advanced level training.

Skills ministers of the COAG Industry and Skills Council have agreed that an area of focus in apprenticeships is strategies to improve the status of apprenticeships. Opening up higher apprenticeships pathways that involve collaboration between employers, registered training organisations and universities can assist to lift the status of apprenticeships as a valued career path. Industry stakeholders are calling for higher level apprenticeships. The Australian Industry Group, Australian Chamber of Commerce and Industry and Business Council of Australia have called for an apprenticeships system that develops contemporary, relevant and higher-level trade and para-professional skills across the economy.

Significant reforms in the United Kingdom demonstrate the higher apprenticeship's model potential: graduates being rated as more employable, higher completion rates, better staff retention, and strong return on investment for government. Their approach is about encouraging higher or degree apprenticeships in areas such as advanced technology, construction and digital media, with opportunities intended to attract students not going to university. Entry standards are higher than traditional apprenticeships, with off-the-job training blending both vocational and university courses. This is coupled with collective industry input into higher quality design of apprenticeships under the Trailblazers programme.

Small-scale trials of higher level apprenticeships are underway in Australia (see below), but further scoping work and research is required at a national level to understand the potential for broader application for the higher apprenticeships concept. NCVER is currently undertaking a project which will research international practice and Australian perspectives on the potential for, barriers and their possible solutions in relation to higher apprenticeship models. The project will focus on industry and government jurisdiction's perspectives regarding differing higher apprenticeship models and their application to an Australian context. The results are expected to be released early 2018.

Snapshot: Industry 4.0 Higher Apprenticeship pilot project

The project utilises an apprenticeship framework to deliver a new Diploma and Associate Degree in Applied Technologies. The aim is to create an apprenticeship model that will support the higher skills needed for Industry 4.0. The project is led and managed by the Ai Group and will be implemented in collaboration with Siemens Ltd and Swinburne University of Technology.

The program will enable employers to train future technicians to a higher skills level to meet their increasing needs in the knowledge economy. Up to 20 school leavers will be employed as apprentices at Siemens for the duration of the project, from 2017 to 2019, inclusive. Swinburne University of Technology will design and deliver the program, which will include a range of elements, including Industry 4.0 and the Internet of Things, IT Disruptive Technologies, Engineering, Design and Business. The program will directly segue-way into a bachelor's degree, which will also be developed during the life of the project. It is anticipated that the greatest part of the program will be delivered in the workplace and be supported by the latest digital platforms.

The project will provide higher-level qualifications and appeal to a broader cross-section of young people than the current apprenticeship model. The young people will gain these qualifications while working in a company that is a technology leader. The qualification will meet the particular needs of industry, with a focus on the adoption of high-level technology skills and the tools required for the future workforce. The qualification brings together key industry initiatives and policies, such as the National Science and Innovation Agenda and the Growth Centres initiatives, into a practical experiential learning environment to address real industry needs. The pilot combines the best of university and vocational learning models and aims to improve the STEM skills of technically minded participants. It also incorporates skills for the new millennia in business and design (Lilly, cited in Couldrey & Loveder, 2017 p. 28).

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Imagine working in a company where your innovation and creativity can make a positive impact on the world around you while you study a Diploma of Applied Technologies. At Siemens, we focus on the biggest challenges facing Australia and New Zealand and provide technology based solutions for Water, Energy, Environment, Healthcare, Productivity, Mobility, Safety and Security.

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The successful 20 candidates will be employed by Siemens on an 'Apprentice Learning Model' where they will be earning an income while they are placed at Siemens in Bayswater and while studying at Swinburne at their Hawthorn campus.

Who we are looking for :

Our Apprentices are motivated, enthusiastic and flexible. They're passionate about engineering, making a difference, and the opportunity to learn about emerging technologies and practices. If this sounds like you, then we'd love to hear from you.

4.3. Role of training providers

Meanwhile, there is plenty that training providers can do to cater to the new world of work and its skills requirements. The UK Commission for Employment and Skills, *The Future of Work Jobs and Skills in 2030*, offers education and training providers - some pointers to action, many of these apply to the Australian context:

- collaborate closely with employers to support them in achieving their business and skills objectives and so ensure provision is responsive to their needs and forward-looking in a competitive learning market,

- be prepared to adapt to the continuing disruption of established income streams and business models arising out of the marketisation of learning,

- invest continuously in new modes and content of provision. Keep abreast of developments and understand the impact of technology on learning delivery,

- put in place systems to offer clear information on success measures from learning to inform investment decisions by learners and employers,

- adapt learning programmes to reflect the critical importance of an interdisciplinary approach to innovation in the workplace and the all-pervasive influence of technology,

- understand the increasingly diverse demands people place on modes of education and training and develop flexible learning pathways and bite-sized opportunities to reflect the changing employment landscape (Z-punkt et al. 2014, pp.108-9).

An AiG report recognises the obstacles RTOs face in implementing new models, including the changing policy and funding regimes and cutbacks in staff and industrial relations constraints (p.7), but its recommendations do not address the issue of cost. Among the strategies it does suggest are (pp.6-7):

- institute training plans that are suited to the apprentice's workplace and fit in with the industrial award. To ensure the plans reflect what the apprentice does at work, RTS developed equipment checklists that suit the workplace and, when necessary, open discussions about how an employer can confirm the assessment.

- seek confirmation of competency from employers by using paper-based or electronic systems such as <u>My Profiling</u> (a patented online system for tracking student workplace activity), which facilitates record keeping about tasks completed, RTO assessment and employer agreement that the workplace standard has been met.

- interpret training system 'speak' into the language of industry and give employers more information about their apprentices' progress, to help them monitor their progress and to pay the correct wage.

In their submission to a recent Parliamentary Inquiry, a large Australian private provider suggested that providers could better respond to the changing demands of the new economy if:

- the number of listed electives in training package qualifications reduced to one third of the total units to enable room for genuine electives;

- ASQA's timeframe for approving new courses reduced to enable more rapid accreditation of new courses;

- uncapping the number of government subsidised students which low risk VET providers can enroll;

- Commonwealth Supported Places extended to VET level V and VI courses, as these are programs often undertaken by learners who are already working and looking to up-skill or re-skill; and

- standardising credit students can receive for prior VET courses to avoid them having to pay to redo previously completed courses.

Stanwick, Circelli & Lu, in 2015, identified important considerations relating to training that need particular attention as a result of industry restructuring: committed resources from providers, the ability and capacity to tailor skills-recognition activities, and sufficient numbers of ongoing courses to meet demand. To cater for industry 4.0, it is important that training within apprenticeships should, wherever possible, facilitate the transferability of existing skills.

4.4. Potential limitation: Australia's innovation system and culture

Australia is ranked 23rd in the world, according to the Global Innovation Index. While this is not a bad performance, it is somewhat concerning we have dropped 4 places from last year[7].

We are outperformed in our region by Singapore, Korea and China as well as New Zealand (Table 2). It would appear Australia's regional neighbours are doing it far better, and we still have a long way to go to catch up to our regional and global counterparts.

[Table 2] Regional Innovation Leaders for South East Asia, East Asia and Oceania, Global Innovation Index 2017

Region/Rank	Country	G Ⅱ 2017 Global Rank
1	Singapore	7
2	Republic of Korea	11
3	Japan	14
4	Hong Kong (China)	16
5	New Zealand	21
6	China	22
7	Australia	23

Source: The Global Innovation Index 2017 report https://www.globalinnovationindex.org/gii-2017-report#

7) The rankings are not strictly comparable as there have been adjustments and refinements to the framework and technical factors over the years and 4 countries included in 2016 dropped out while 3 new countries were introduced.

While Australia scored quite strongly and well above average on innovation inputs, coming in at 12, it is underperforming in terms of innovation outputs – what innovations it produces – coming in at only 30.

In essence, Australia has a lot of the ingredients in place to be a more innovative economy, such as a reasonably strong skills base and some high quality research and development institutions, but for a few reasons, we are not doing as well as we should. According to the Global Innovation Index report, there are apparently 256 state and territory programmes and 83 federal government measures that aim to boost innovation in Australia. As innovation policy expert Roy Green points out, Australia has had 60 reports at the Commonwealth level on innovation in the last 15 years. The $9.7bn the country spends on 'research and innovation' is spread across 13 portfolios and 150 budget line items[8].

A snapshot of the Australian Innovation System is provided in Figure 4.

Innovation has become an increasingly important concept for Australian businesses in enabling them to continue to compete in an international market, but where does vocational education and training (VET) sit in this?

To date, the VET sector has been largely overlooked from the Australian Government's National Science and Innovation Agenda (NISA). NISA demonstrates the Federal Government's commitment to fostering innovation as an essential component of driving Australia's economy. The VET sector presents many opportunities for nurturing innovation, however this is currently under acknowledged by NISA where funding under this initiative is largely aimed at the university sector.

The House of Representatives has recently released its report on innovation and creativity (*Innovation and Creativity —Inquiry into innovation and creativity: workforce for the new economy*), and some of its recommendations relate to specific elements of

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8) http://www.theaustralian.com.au/business/opinion/innovation-critical-to-boosting-productivity-in-tough-times/news-story/5860a36fb64279c1d5b9517469156df2

this research, in particular:

- expanding the National Innovation and Science Agenda to include the VET sector (Recommendation 16),

- adopting elements of the Canadian Applied Research and Innovation Services model to strengthen connections between VET providers and small-and-medium-sized enterprises (Recommendation 29).

NCVER is working with the Commonwealth Office of Innovation and Science Australia (NISA) in a consultative process around the Innovation, Science and Research System 2030 Strategy to ensure issues pertinent to VET are captured.

Recent research by NCVER (Beddie & Simon, 2017) also suggests there is an opportunity for the VET sector to be a contributor to the innovation system through an applied research agenda. In this context, applied research refers to research with a focus on solving real-world problems. Through its ties to industry, VET can play a role in translating this knowledge to the workforce. Registered training organisations (RTOs) do not need to start from scratch to be involved in the innovation agenda; they can build on their existing business models to develop innovation within industries. Other possibilities include capitalising on their infrastructure, expertise and community connections or hosting innovation hubs or enterprise incubators. Many practitioners already possess the skills relevant to applied research projects, but these need to be further developed, either by practising them or by undertaking professional development. The proposed VET applied research developmental framework can help to determine the additional skills needed.

[Figure 4] Australian Innovation System

Australian Innovation System

On average, every $1 invested in innovation returns $2 in sales

$30 billion
innovation investment → $60 billion
innovation sales

Innovation activity accounts for:

50% of economic growth in the **OECD**

R&D spending (billion)

$7b Basic research

$13b Applied research

$13b Experimental development

= **$33b** total spending = About the GDP of Estonia

Top barriers to innovation (all businesses)

1st — 18%
Access to additional funds

2nd — 16%
Lack of skilled persons

3rd — 13%
Cost of development or introduction/implementation

Average gross operating profit, by innovation status and degree of novelty

$0 $350,000 $700,000

■ Non-innovators   ■ New-to-business innovators
■ New-to-market innovators

Share of innovation-active businesses collaborating with:

37% Clients, customers or buyers

23% Competitors and other businesses from the same industry

7% Government agencies

5% Universities or other higher education institutions

Source: Source: ABS (2016) Innovation in Australian Business 2014–15, cat. no. 8158.0; OECD (2015) The OECD Innovation Strategy 2015, OECD Publishing; ABS (2016) Customised ABS data commissioned by the Department of Industry, Innovation and Science; ABS (2015) Research and Experimental Development, Business, 2013–14, cat no. 8104.0; ABS (2016) Government and Private Non-Profit Organisations, 2014–15; ABS (2016) Higher Education Organisations, 2014, cat no. 8111.0

Source: Australian Innovation System Report 2016, Australian Government Department of Industry, Innovation and Science, Office of the Chief Economist www.industry.gov.au/innovationreport

Snapshot: Australian House of Representatives Standing Committee on Employment Education and Training Inquiry: Innovation and creativity - workforce for the new economy

In May 2017, The House of Representatives Standing Committee on Employment, Education and Training delivered a report following their inquiry into matters ensuring Australia's tertiary education system—including universities and public/private providers of vocational education and training—can meet the needs of a future labour force focused on innovation and creativity.[9] The inquiry has particular regard to: the extent to which students are graduating with the skills needed for the jobs of today and of the future; matters relating to laws and regulations that may act as a barrier to education providers being able to offer qualifications that meet the needs of the new economy and fastest growing sectors; factors that discourage closer partnerships between industry - in particular small and medium enterprises, the research sector and education providers - including but not limited to: intellectual property, technology transfer, doctoral training practices, and rapid commercialisation; opportunities for generating increased economic activity, including further investment and jobs, through greater synergies among publicly funded research agencies, universities and other Australian research institutions with businesses and industry; including but not limited to: co-location, cluster formation and development of precincts between universities and industry; relationships between tertiary education entrepreneurship programs and public, private, and not-for-profit incubators and accelerators. The findings and recommendations can be found here: http://www.aph.gov.au/ Parliamentary_Business/Committees/House/Employment_Education_and_Traini ng/Innovationandcreativity/Report_-_Innovation_and_creativity

4.4.1. Australia's digital economy has stalled

The government had acknowledged the need for Australia to transition its economy, but research from Tufts University suggests we have stalled. While we have achieved a high level of progress towards becoming a digital economy in the past, we are at risk of falling behind. The research argues 'stall out' countries like Australia can only jumpstart their economies by redoubling on innovation and continuing to seek markets beyond domestic borders. It also says attracting highly talented young immigrants could help revive innovation (see Figure 5).

9) http://www.aph.gov.au/Parliamentary_Business/Committees/House/Employment_Education_and_Training/Innovationandcreativity/Report_-_Innovation_and_creativity

[Figure 5] Digital Evolution Index
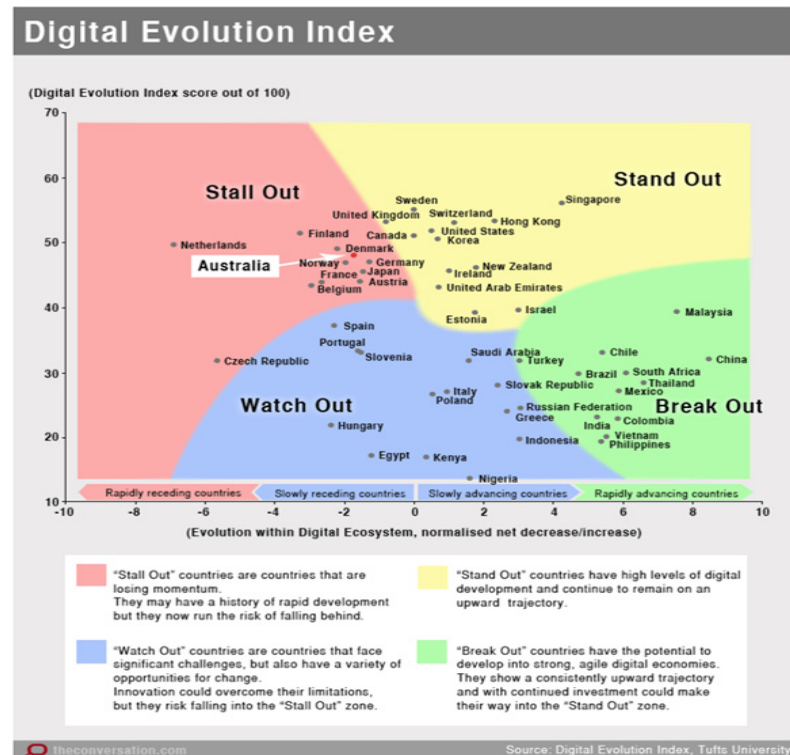
Source: Digital Evolution Index, Tufts University

A current research project funded by NCVER (Gekara et al., 2017) is aiming to identify the digital skills requirements for the broader Australian workforce and examine the capacity of the vocational education and training system and industry training packages to effectively meet the growing need for digital skills. As part of the project's outputs, the study will develop a replicable methodology for reviewing the alignment between skills needs and training capacity, as well as propose a digital skills framework to guide the development of adequate and appropriate digital skills for the emerging digital economy.

For the purpose of the study, digital skills were defined as a combination of a digital mindset (hardware, software, information, systems, security and innovation), knowledge (theoretical comprehension and understanding), competence (cognitive and practical know-how) and attitude (value and beliefs). The findings to date indicate (from Gekara et al. 2017):

- Of the 1,708 jobs searched, only 204 job vacancies across all of the selected occupations specifically mentioned digital skills. This poses important questions regarding employers' articulation of digital skills and how well they are explicitly stated rather than perhaps assumed. This is important considering that industry evidence suggests that occupations are changing as the economy enters a digital age, characterised by sophisticated efficiency and productivity-enhancing mechanical and digital technologies.

- Even in the job advertisements where digital skills were specifically mentioned, the level of expected application is largely vague and mostly basic. Employers used descriptions of expected performance like 'strong,' 'good,' 'sound,' 'solid' and 'basic.' This suggests that employers are not clearly articulating their specific skills needs.

- Additionally, employers seem to require a very basic level of skills - mostly basic computer operations and digital literacy. However, we identified some trends in terms of skill levels and digital tools across industries and occupations, and across position levels (for example, managers/professions and technical/trades).

- It is also evident that employers tend to conceptualise and articulate digital skills from a tools perspective. Instead of listing the skills they require, they simply describe the tools they would like prospective employees to be able to use and operate.

The digital skills training content analysis of the 11 training packages reveals a number of important findings:

- The VET system clearly contains a significant amount of digital training content, spread across different units of competence.

- However, a large number of these units of competence are elective rather than core to the qualifications of the respective occupations. While this provides greater flexibility for training providers, trainees and employers, it suggests that perhaps the training system is not according digital skills the same 'essential skills status' as would be expected, considering their growing importance.

- Digital training content in the training packages is expressed broadly and generically, with little reference to specific tools and systems. This is done deliberately, with the aim of making the package flexible and adaptable to the wide variety of workplace tools and systems used by different industries across the sectors.

- It also shows that the training is more geared towards developing skills at the lower skills end: that is, for the basic use of computer hardware and software in processing data and information from organisational databases, as well as for online internet and web sources. This is counter to growing industry evidence of an increasing need for higher-level skills in data analytics, cyber-security, social media and mobile-related digital skills.

The analysis also suggests that digital skills training content is available for all occupations across the sectors and at all levels. Interestingly, there appears to be more digital skills content in the lower-skills occupations: that is, in operational and non-supervisory than in higher-skills occupations such as managers. This is an indication that as digital skills become essential in all work settings, there is an assumption that people training for and entering higher-skill occupations already possess the necessary digital skills.

5. Conclusion

While Australian government policy related to apprenticeships is yet to specifically embrace strategies for Industry 4.0, there are a number of broader initiatives underway, as outlined in this paper. This includes for example a current and concerted focus on Higher Apprenticeships. There are also a number of other factors and challenges at play which cannot be ignored. A key concern for Australia is that, to date, the VET sector has largely being overlooked in the National Innovation and Science Agenda. Innovation has become an increasingly important concept for Australian businesses in enabling them to continue to compete in an international market, indeed the path to prosperity brought about by the 4th industrial revolution will be through innovation. The pivotal role of the VET sector – and apprenticeships – in this arena needs to be acknowledged and supported. There has also been a focus on Higher Education reform covering policy terrain impacting on universities, inadvertently impacting on the pool of apprentices. A significant challenge for Australia is the re-imagining of sectoral boundaries and perceptions between university and vocational pathways. With the deep connections between industry and employers, as well as the role of vocational training providers, Australian apprenticeships still have the potential to remain the lynchpin of the system.

Recommendations for Further Reading

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Chapter Ⅲ

Vocational and Professional
Education and Training
in Switzerland

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Vocational and Professional Education and Training in Switzerland

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Abstract

The Swiss VPET system 2017

The Swiss Vocational & Professional Education & Training system (VPET) enables young people to enter the labour market and ensures that there are enough skilled workers and managers in the future. It has a high labour market relevance and is an integral part of the education system. The VPET system is divided into two sectors: upper-secondary level VET and tertiary-level professional education. For Quality & Efficiency aspects consult "Paper."

1. The most popular form of upper-secondary level education and training

Two-thirds of all young people coming out of compulsory education in Switzerland enrol in vocational education and training (VET), which provides them with a solid foundation in a given occupation. There are around 230 occupations to choose from. The VET sector forms the basis for lifelong learning and opens up a wealth of job prospects.

2. Career prospects

Tertiary-level professional education builds from upper-secondary level vocational education and training (VET). It provides professionals with specific competences and prepares them for highly technical and managerial positions. There are around 400 federal examinations as well as 57 study programmes at colleges of higher education in 8 different professional fields. The Federal Vocational Baccalaureate (FVB) opens the way to Swiss universities of applied sciences (UAS). FVB holders who pass the University Aptitude Test (UAT) have the option of enrolling in a cantonal university or one of Switzerland's two federal institutes of technology (FIT).

3. Dual-track approach to learning

Most VET programmes are of the dual-track variety (i.e., part-time classroom instruction at a vocational school combined with a part-time apprenticeship at a host company). School-based VET programmes are generally offered by trade or commercial schools. Tertiary-level professional education also combines classroom instruction with work-based training, thereby ensuring a smooth transition from dual-track VET programmes.

4. Permeability

The Swiss VPET system is based on clearly defined education and training options as well as national qualifications procedures. Typically, VET and professional education are very flexible: learners may pursue more advanced education and training opportunities, switch from vocational/professional pathways to general education/ university pathways and later change the course of their working lives with relative ease. Continuing education and training (CET) options are also available at all levels.

5. Labour-market focus

Education and training are centred on acquisition of professional & core competences that are actually in demand as well as on occupations and professions for which there are existing job vacancies. **This direct link with the labour market** is the main reason why Switzerland has one of the lowest youth unemployment rates in Europe (3.4%). It also helps to integrate new trends such as digital transformation in the programmes of the VET-system.

6. Collective governance

The VPET system is collectively governed by the Confederation, the cantons and professional organisations. These three main partners work together to maintain a high level of quality within the VPET system. They also strive to ensure that there is an adequate supply of apprenticeship/traineeship positions and training options. This partnership and respective areas of responsibility are set forth in the Federal Vocational and Professional Education and Training Act (VPETA) and its corresponding ordinance.

1. The Swiss VPET system 2017

APPENDIX at the end: Answers to the KRIVET-questionnaire by Christian Kälin

Vocational education and training (VET) is provided at upper-secondary level. **Professional** education is provided at tertiary level. Both VET and professional education use clearly defined curricula and national qualification procedures. They are also characterised by a high degree of permeability: recognition of prior learning to keep track of prior education and training makes it much easier for learners to pursue further education and training opportunities, switch between vocational/professional pathways and general education/university pathways and change the course of their working lives. The Swiss VPET system offers a broad selection of available training options. Courses cater to different abilities and are geared to the needs of different age groups. A wealth of job-related continuing education and training (CET) courses can also be found at all levels.

[Figure 1] Swiss VPET system
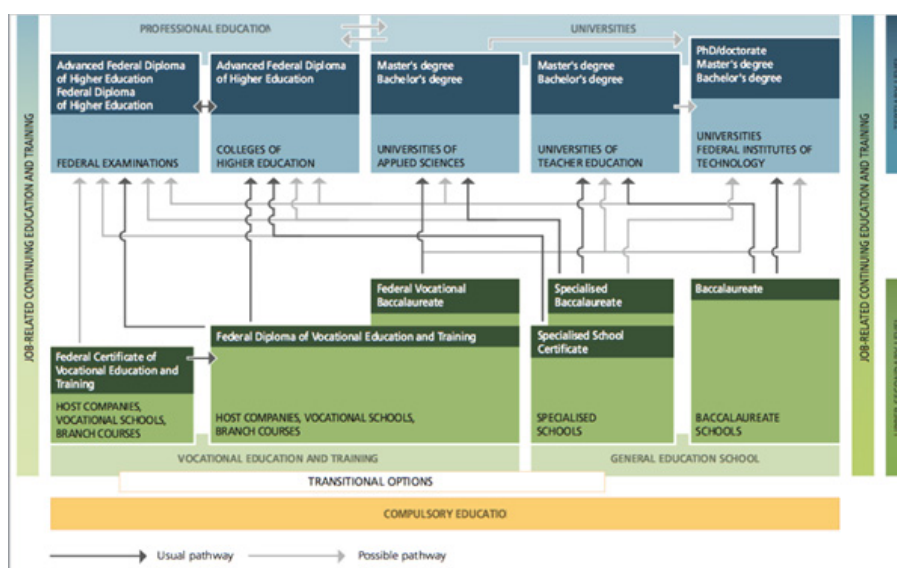
[Table 1] Completion rates for 2015

Upper-secondary level: vocational education and training (VET)	Total	Women	Men
Federal VET Diploma	63366	29030	34336
Federal VET Certificate	5917	2672	3245
Non-formal two-year apprenticeships	270	48	222
Federal Vocational Baccalaureate	13988	6493	7495
University Aptitude Test	773	318	455

Tertiary level: professional education	Total	Women	Men
Qualification awarded by colleges of higher education	8483	4071	4412
Advanced Federal Diploma of Higher Education	2707	668	2039
Federal Diploma of Higher Education	14835	5657	9178
Professional education not recognised by the Confederation	472	343	129

1.1. Upper-secondary level: VET

VET programmes provide learners with solid professional competences and pave the way for lifelong learning.

a. 3-year or 4-year VET programmes for the Federal VET Diploma

These VET programmes provide learners with the competences needed to work in a specific occupation and open access to tertiary-level professional education. Learners also have the option of preparing for the Federal Vocational Baccalaureate (FVB) either during their training or after graduation.

b. 2-year VET programmes for the Federal VET Certificate

These VET programmes provide young people with more practical skills to obtain a recognised qualification for a specific occupational profile. Graduates of a 2-year VET programme may enrol directly in a 3 or 4-year VET programme leading to the Federal VET Diploma.

c. Federal Vocational Baccalaureate (FVB)

Learners enrolled in a 3-year or 4-year VET programme for the Federal VET Diploma have the option of preparing for the Federal Vocational Baccalaureate (FVB). This preparatory course covers general education subjects and those who pass the FVB examination may enrol in a Swiss university of applied sciences (UAS) without having to take an entrance examination. Moreover, holders of the FVB can prepare for the University Aptitude Test (UAT), which opens the way for enrolment in a cantonal university or federal institute of technology.

d. Transitional options between lower and upper-secondary level

Transitional options are available to young people completing compulsory

education who have been unable to immediately transition to upper-secondary level. Such options include practical training and pre-apprenticeships and are generally designed to prepare young people for enrolment in VET programmes.

1.2. Tertiary level: professional education

Holders of the Federal VET Diploma or equivalent qualifications may specialise or deepen their expertise at tertiary level by pursuing a professional qualification. Preparation also includes acquisition of managerial skills. The professional education sector is designed to meet the needs of the labour market and builds on existing work experience.

a. Federal examinations (level 1)

This federal examination is intended for professionals who wish to improve their knowledge and skills and specialise in a given field after completing upper-secondary level vocational education and training (VET). Successful candidates are awarded the Federal Diploma of Higher Education, which is generally a prerequisite for admittance to the examination for the Advanced Federal Diploma of Higher Education.

b. Federal examinations (level 2)

This examination is generally for professionals who have acquired a great deal of expertise in their field and/or who intend to hold a managerial position in a company.

Successful candidates are awarded the Advanced Federal Diploma of Higher Education.

c. Study programmes at colleges of higher education

Study programmes at colleges of higher education are intended for professionals holding a Federal VET Diploma or equivalent qualifications, who wish to improve their

knowledge and skills and hold managerial positions. These degree programmes cover a broader and more general range of topics than those addressed in the two federal examinations described above. Successful candidates are awarded a federally recognised qualification.

d. Job-related continuing education and training (CET)

A wide range of job-related CET options (i.e., non-formal courses, seminars, etc.) can be found at all training levels and are part of lifelong learning.

2. One mission – three partners

The provision of VET and professional education is a mission collectively shouldered by the Confederation, the cantons and professional organisations. These three partners are jointly committed to the highest possible standard of quality within the Swiss VPET system. They also strive to ensure the availability of an adequate number of apprenticeships and training courses.

2.1. Confederation

a. State Secretariat for Education, Research and Innovation (SERI)

→ Concept 2030 (latest news announced during the presentation)

It is the federal government's specialised agency for national and international matters concerning education, research and innovation policy. SERI is responsible for regulating and co-funding the VET and professional education sectors.

b. Swiss Federal Institute for Vocational Education and Training (SFIVET)

Mainly provides basic and continuing training to teachers, trainers, instructors and examiners working at both upper-secondary level (VET sector) and tertiary level

(professional education sector). SFIVET is also involved in research, studies, pilot projects and the provision of services.

c. Strategic management and development

- Quality assurance and further development of the Swiss VPET system

- Comparability and transparency of courses throughout Switzerland

- Enactment of around 230 VET ordinances

- Recognition of regulations for around 400 federal examinations as well as 35 core syllabuses for study programmes at colleges of higher education

- Recognition of study programmes and continuing education and training at colleges of higher education

- Recognition of training courses for teachers, trainers, instructors and examiners within the VET and professional education sectors as well as training courses for vocational, educational and career guidance counsellors

- Recognition of foreign qualifications

- Payment of one-fourth of public sector expenditure for the VPET system

- Promotion of innovation and support for specific activities in the public interest

2.2. Professional organisations

a. Training content and apprenticeships

- Establishing the training content of VET programmes and study programmes at colleges of higher education

- Establishing national qualification procedures for VET programmes as well as for federal examinations for the Federal Diploma of Higher Education and the

Advanced Federal Diploma of Higher Education

- Creation of apprenticeship positions

- Imparting professional competences at tertiary level (professional education)

- Developing new training courses

- Organising branch courses

- Managing VPET funds

b. Vocational schools

Vocational schools provide classroom instruction for both dual-track (i.e., combined work and school) and school-based (i.e., full-time classroom instruction, no apprenticeship) VET programmes. They also prepare learners for the Federal Vocational Baccalaureate examination.

2.3. Cantons

a. Implementation and supervision

- Implementing the Federal Vocational and Professional Education and Training Act (VPETA)

- Supervising apprenticeships, vocational schools and colleges of higher education

- Providing vocational, educational and career guidance services

- Creating options that prepare young people for enrolment in VET programmes

- Issuing permits authorising host companies to take on apprentices and/or trainees

- Apprenticeship marketing

- Providing training to apprenticeship trainers in host companies

b. Swiss Conference of Cantonal Ministers of Education (EDK)

The cantons are generally responsible for education and training in Switzerland. National cooperation through EDK complements and reinforces cantonal authority over education.

c. 26 cantonal VPET offices

Responsible for implementing VET at cantonal level, VET offices coordinate their activities through the Swiss Conference of VET Offices (SBBK), a specialised conference of the Swiss Conference of Cantonal Ministers of Education (EDK).

d. Vocational, educational and career guidance services

Provide information and advice to both young people and adults.

e. Vocational schools

Vocational schools provide classroom instruction for both dual-track (i.e., combined work and school) and school-based (i.e., full-time classroom instruction, no apprenticeship) VET programmes. They also prepare learners for the Federal Vocational Baccalaureate examination.

2.4. Quality

The main purpose of having all three partners involved is to ensure high quality within the VPET system. The distribution of training content across two (or in some cases three) different learning locations – i.e., vocational schools, host companies and branch training centres – helps to improve the quality of upper-secondary level VET programmes. The responsibilities of each entity depend on the tasks assigned to each of the three main partners within the VPET system. In areas where responsibilities overlap, the entities collaborate on the specific situation and/or issue.

3. Learning locations

The trademark and strength of the Swiss VPET system is the direct correlation with the labour market. This is reflected in various learning locations.

3.1. Upper-secondary level: Vocational education and training (VET)

a. Apprenticeship training at host companies

With the dual-track approach, learners attend courses at vocational schools on a part-time basis. The remaining time is spent fulfilling an apprenticeship at a host company where they are provided with the practical know-how, knowledge and skills needed for their chosen occupation. Learners also actively take part in the host company's production processes. Host company networks; in some cases, host companies may wish to combine their strengths to offer one or more apprenticeships in a modular format.

b. Classroom instruction at vocational schools

Vocational schools provide classroom instruction. This consists of instruction in vocational subjects as well as subjects falling under the Language, Communication and Society (LCS) category. Classroom instruction is intended to develop technical, methodological and social skills of learners while imparting the theoretical and general principles needed to perform occupational tasks. Classroom instruction covers one or two days per week. Vocational schools also offer a preparatory course for the Federal Vocational Baccalaureate Examination.

c. Branch courses at branch training centres

Branch courses are meant to complement classroom instruction at vocational schools and apprenticeship training at host companies by providing learners with

essential practical skills. Branch courses often take place at third-party training centres run by the branches involved.

3.2. Tertiary level: Professional education

a. Preparation for federal examinations

Preparation for federal examinations for the Federal Diploma of Higher Education and Advanced Federal Diploma of Higher Education takes place alongside one's usual working activities. Although there is no requirement to do so, candidates for federal examinations may enrol in part-time preparatory courses, which are offered by public and private providers in the evenings or on weekends.

b. Study programmes at colleges of higher education

Study programmes at colleges of higher education may be attended on either a full-time or part-time basis. Students enrolled in the full-time programme will complete a traineeship over the course of their studies. In order to enrol part-time, students must be employed at least 50% of a standard workweek. The aim is to apply what one learns in an actual working environment.

4. Vocational education and training

Vocational education and training provides young people with their first exposure to working life. It is the basis for lifelong learning and opens a wide range of career prospects.

4.1. Enrolment in upper-secondary level in 2014

[Figure 2] Enrolment in upper-secondary level in 2014
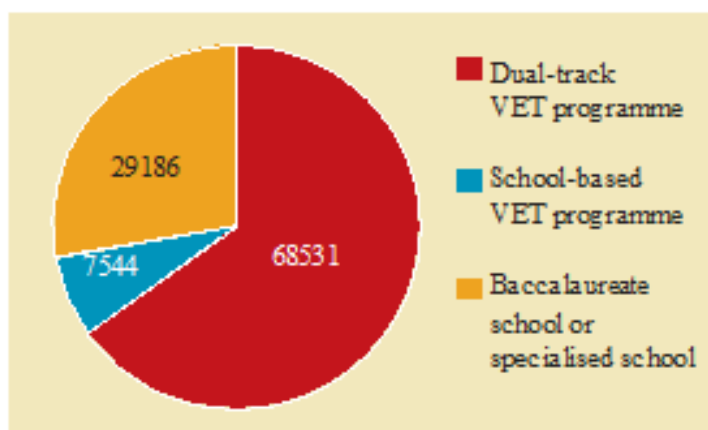
Around two-thirds of young people coming out of compulsory education in Switzerland enrol in an upper-secondary level VET programme. This proportion has remained constant for years. Dual-track VET programmes are by far the most prevalent form of vocational education and training. In the French and Italian-speaking regions of Switzerland, however, there is a marked preference for school-based VET programmes compared to the German-speaking region. In 2014, only 4.0% of all VET programmes from the German-speaking region were school-based, whereas in the French-speaking region, the proportions were at 24.4% and in the Italian-speaking region - 29.9%. The vast majority of pupils coming out of compulsory education, enrol in either a vocational school (VET sector) or in a baccalaureate school or a specialised school (general education sector). Many young people who were unable to transition directly to upper-secondary level opted for a transitional option, such as a 10th school year or a preparatory course for VET. Others continued on a motivational semester or spent time abroad to improve their language skills.

4.2. Apprenticeship market

There are two sides to the apprenticeship market: the supply side (host companies offering apprenticeship positions) and the demand side (young people looking for apprenticeship positions). The State plays a mediating role. It ensures the best possible general conditions for host companies, encourages the provision for apprenticeship positions and helps young people to choose an occupational-related company. Various factors influence supply and demand on the apprenticeship market. On the supply side are structural changes, economic fluctuations and the host company ratio (i.e., proportion of companies that are willing and able to train apprentices). On the demand side, demographic changes and the interests of young people have an impact on the apprenticeship market.

a. Structural changes
The supply of apprenticeship positions reflects the long-term needs of the labour market.

b. Economic fluctuations
Economic fluctuations affect the order book of host companies, and therefore, their ability to productively employ apprentices.

c. Host company ratio
Around 40% of the companies in Switzerland capable of offering apprenticeships actually do. Smaller companies in particular are either overly specialised or lack qualified apprenticeship trainers, which makes it more difficult for them to offer apprenticeships.

d. Interests of young people

The choice of occupation depends on the hopes, aspirations and aptitudes of learners as well as the availability of suitable apprenticeship positions. Career guidance services provide young people with information and advice.

e. Apprenticeship «Barometer»

The Apprenticeship «Barometer» is a survey conducted twice each year (once in April and again in August) to determine the current situation and short-term trends of the apprenticeship market. Representative surveys are conducted among companies and young people to identify and monitor key indicators of the current situation.

4.3. Focus on young people: Advice and support before and during training
Vocational information and counselling

Cantonal career guidance services work closely with schools to help young people choose an occupation and find a suitable apprenticeship.

a. List of apprenticeship positions

The list of apprenticeship positions enables young people to search all open apprenticeships by occupation and canton.

b. Transitional options

Transitional options are intended for young people who are not yet able to enrol in a VET programme for social or scholastic reasons or who have been unable to find an apprenticeship. In addition to courses aimed at improving scholastic, linguistic or other skills, young people attend a course to prepare them for enrolment in a VET programme. The acquired skills increase their chances of finding an apprenticeship.

c. Coaching and mentoring

Coaching and mentoring entail provisions for individual guidance to young people during the period of compulsory education. One of the aims is to help young people to improve occupational and social skills and optimise their CVs. The various projects and programmes are sponsored by both the cantons and private organisations.

d. VET Case Management

VET Case Management is intended to help young people, who are particularly at risk of dropping out of VET programmes. The aim is also to improve the efficiency and effectiveness of measures taken. VET Case Management is a structured process: a case manager coordinates institutional activities in accordance with an established plan so as to ensure that the young person receives adequate support.

e. Apprenticeship placement services

Apprenticeship placement services are available to young people in the fourth quarter of the last year of lower-secondary school. The aim is to further assist young people in their efforts to find an apprenticeship position.

f. Individual guidance

Individual guidance is for young people who encounter learning difficulties. They receive comprehensive support involving the host company, the vocational school, the branch training centre and social surroundings. Learners enrolled in two-year programmes are legally entitled to individual support and guidance. However, learners enrolled in three or four-year VET programmes may also make use of these services.

g. Focus on companies: creation of apprenticeship positions by host company networks

The creation of host company networks enables small-sized or specialised companies to pool their resources together as a network or with other companies. Instead of providing the full range of apprenticeship training as a single company, each partner provides a portion thereof.

h. Marketing of apprenticeship positions

Cantonal VPET offices are familiar with the conditions in the various regions. They maintain contact with local companies. Apprenticeship promoters contact companies directly to encourage them to create apprenticeship positions and become involved in training apprentices.

4.4. The ten most frequently chosen occupations

[Table 2] The ten most frequently chosen occupations

Occupations	Total
Commercial employee	14250
Retail clerk	5077
Health care worker	4147
Social care worker	3170
Electrician	2159
IT technician	1976
Cook	1750
Draughtsman	1630
Logistician	1618
Mechanical engineer	1568

In Switzerland, there are VET programmes for around 230 different occupations. The ten most popular occupations in 2015 account for over 50% of all newly signed apprenticeship contracts.

The choice of occupation and search for an available apprenticeship are important processes. Pupils begin this process during compulsory education when they are between the ages of 13-16. Over 70% of all young people who enrolled in a VET programme in 2016 managed to find an apprenticeship that matched their desired occupation. This proportion has remained constant over the years.

4.5. Creation of a VET programme – An example of cooperation between three main partners

In Switzerland, VET programmes are developed by the private sector, i.e., the professional organisations that represent the interests of economic branches. Every five years, the training content and structure of VET programmes are evaluated from an economic, technological, environmental and didactic standpoint and adapted accordingly.

a. A new occupation emerges

When a professional organisation wishes to introduce a VET programme for a new occupation, it works closely with the other main partners (i.e., the Confederation and the cantons). An important consideration for federal approval is that learners who graduate from a given VET programme will actually be able to find work. Development of a VET programme takes place in accordance with an established workflow.

b. First steps

Before work on the new VET programme can start, fundamental questions must first be answered: which professional organisation will sponsor the new VET programme;

has the occupational field been clarified; is there a need for the given occupation on the labour market and are there enough companies within the given branch that are willing to create apprenticeship positions and hire graduates afterwards? Once these questions have been answered, the professional organisation will contact the State Secretariat for Education, Research and Innovation (SERI) and schedule a planning meeting with all of the partners involved.

c. Competence profile and VET ordinance

The main documents in a given VET programme are the job profile, the overview of all professional competences and the statement of the level of difficulty of the given occupation. The VET ordinance includes legal aspects applying to apprenticeship training in dual-track VET programmes as well as the various requirements for practical training within school-based VET programmes.

d. Consultation and approval

SERI examines the VET ordinance and training plan for quality control purposes. After examination has been completed and any necessary adjustments have been made, SERI organises a consultation session with cantonal agencies, federal agencies and other interested parties. SERI will then take the results of this consultation into account and make whatever changes are needed to the VET ordinance and training plan. Any unresolved issues will be settled in an editing meeting of the various partners. SERI will then issue the VET ordinance and approve the training plan.

e. Implementation and subsequent modification

The committee for occupation development and quality that is responsible for the given occupation will then meet at least every five years to re-examine the VET ordinance and training plan in view of economic, technological, environmental and

didactic developments. Measures may then be taken on this basis to adapt the VET programme accordingly. The Swiss Federal Institute for Vocational Education and Training (SFIVET) has a federal mandate to provide support to the sponsoring professional organisation and the cantons.

5. Federal vocational baccalaureate

Issued as a complement to the Federal VET Diploma, the Federal Vocational Baccalaureate (FVB) entitles the holder to enrol in a Swiss university of applied sciences (UAS) without having to take an entrance examination. If an FVB holder also takes the University Aptitude Test (UAT), then enrolment in a cantonal university or one of Switzerland's two federal institutes of technology (FIT) is also possible.

5.1. Proportion of VET graduates who obtained an FVB

[Figure 3] Proportion of VET graduates who obtained an FVB
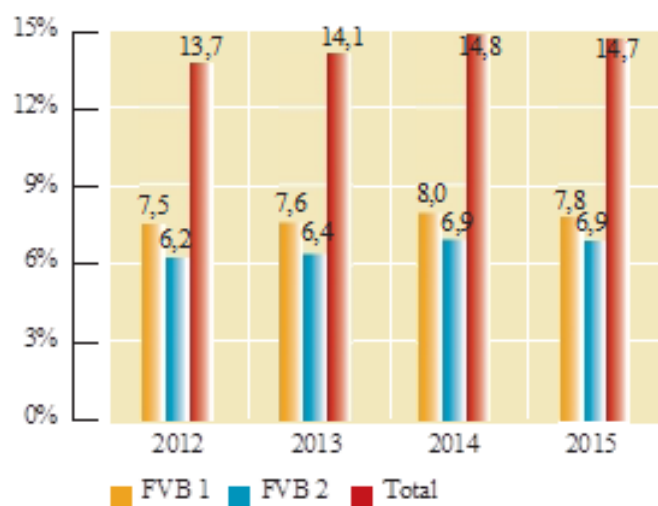
5.2. From federal vocational baccalaureate to a university of applied sciences

UAS offer a combination of theory and practical training at the tertiary level. Study programmes lead to a Bachelor's or a Master's degree. At the Bachelor's degree level, UAS impart general theory and research findings as well as the competences needed to work in a given occupation. At the Master's degree level, UAS provide students with in-depth, specialised knowledge, preparing them for a more advanced qualification in their field. Admission to UAS is generally open to holders of the FVB. The preparatory course for the FVB examination is generally taught by vocational schools. There are two options: either to take this preparatory course alongside the normal training regimen for the given VET programme (FVB 1) or to do so after completion of the VET programme (FVB 2). In recent years, the proportion of VET graduates who also obtain the FVB has been increasing steadily. The number of young people who take the preparatory course for the FVB examination after graduation (FVB 2) has risen at a faster rate than the number of young people who have chosen the FVB 1 option. The Confederation, the cantons and professional organisations are working closely together to consolidate the Federal Vocational Baccalaureate, particularly FVB 1.

5.3. University Aptitude Test

The University Aptitude Test (UAT), which may be taken by holders of the Federal Vocational Baccalaureate, enables one to enrol in any study programme at a Swiss university (i.e., cantonal universities and the two federal institutes of technology). The preparatory course for the UAT takes a year. This option has become increasingly popular in recent years.

6. Professional education

Holders of the Federal VET Diploma or equivalent qualifications may specialize or deepen their expertise at tertiary level by pursuing a professional qualification. Preparation also includes acquisition of managerial skills. The professional education sector is designed to meet the needs of the labour market and builds on existing work experience.

Swiss tertiary-level education is comprised of professional education, universities of applied sciences (UAS) and cantonal universities/federal institutes of technology (FIT). The professional education sector places great emphasis on the actual skills used in a given profession.

6.1. Transitions to professional education

Professional education imparts competences needed to handle challenging technical or managerial activities and provides the labour market with highly skilled workers. Admission to professional education is normally open to holders of a Federal VET Diploma or equivalent upper-secondary level qualifications. The proportion of holders of vocational qualifications who, after some years of work experience, decide to pursue professional qualifications has increased slightly in recent years. Most people obtain their professional qualification after having passed a federal examination. The federally regulated professional education sector accounted for over 90% of the qualifications awarded in Switzerland in 2015. In Switzerland, there are *federal examinations* at level 1 for around 220 different professions and at level 2 for around 170 different professions. Both levels combined, the ten most frequently taken examinations accounted for 40% of all federal examinations taken in 2015. In Switzerland, there are *study programmes* available at colleges of higher education for around 450 different occupations. The ten most frequently completed study

programmes accounted for over 60% of all study programmes completed in 2015.

6.2. The ten most frequently taken federal examinations (level 1) in 2015

[Table 3] The ten most frequently taken federal examinations (level 1) in 2015

All professions combined	Total
Human resources specialist	986
Police officer	838
Technical sales specialist	799
Marketing specialist	662
Training specialist	538
Finance and accountancy specialist	538
Social insurance specialist	440
Electrical safety specialist	362
Sales representative	328
Logistician	310

6.3. The ten most frequently taken federal examinations (level 2) in 2015

[Table 4] The ten most frequently taken federal examinations (level 2) in 2015[10]

All professions combined	Total
Company auditor	232
Electrician	198
Accounting and controlling expert Electrician	132
Fire protection expert	124
Einkaufsleiter	112
Sales manager	110
Master farmer	90
Real estate broker	77
IT specialist	74
Fiduciary	67

6.4. Top ten occupational fields chosen by adults in 2015

[Table 5] Top ten occupational fields chosen by adults in 2015

Occupational field	Total
Nursing	1713
Business administration	854
Social pedagogy	511
Machine manufacturing	420
Hotels, restaurants and catering Civil engineering	417
Business processes	397
Business informatics	330
Mechanical engineering and metalworking	318
Child care	288
Electricity and power	279

10) Einkaufsleiter = Purchasing Manager

6.5. Completed tertiary-level training by economic branch in 2015

[Figure 4] Completed tertiary-level training by economic branch in 2015

	Professional education	Professional education and higher education	Higher education
Industry	16.5	3.1	27.8
Transport, energy and water supply	17.7	2.4	17.0 23.1
Construction	20.8	0.6 4.2	
Trade, repairs	13.7	1.1	19.9 20.8
Hotel, restaurant and catering	8.2	2.2	15.4
Information and communication; art and entertainment	11.9	2.0	53.1
Financial services	22.7	5.4	39.8
Land and housing; services	12.4	3.3	31.6
Self-employed scientific and technical services	16.8	3.8	54.5
Health and social care	18.3	2.7	36.0
Public administration and education	11.2	2.6	63.1
Other	11.9	0.2	7.5

Holders of tertiary-level professional qualifications are more likely to work for small-sized companies on a contractual basis, whereas holders of higher education qualifications tend to work for larger-sized companies. In terms of employment position, there does not seem to be any significant difference between holders of professional qualifications and holders of higher education qualifications.

6.6. Income from employment by vocational/professional qualification

Professional education offers a good return on investment for qualification holders. Most students enrolling in preparatory courses for federal examinations or study programmes at colleges of higher education do so on a part-time basis while working and therefore already earn an income that increases once they obtain their tertiary-level professional qualification. Compared to holders of upper-secondary level vocational qualifications, holders of professional qualifications earn about one-third more.

6.7. Transition from professional education to a university of applied sciences

It is possible to transition from professional education to a Swiss university of applied sciences. Depending on the qualifications, holders of professional qualifications may be admitted to a Swiss UAS without having to take an entrance examination or after passing an admissions test.

7. Vocational qualifications for adults

In Switzerland, adults may also seek vocational qualifications. Adults may either attend the standard dual-track VET programme leading to issuance of a vocational qualification or obtain this qualification through direct admission to the final examination. A third option is to obtain their qualification through the validation of non-formal and informal learning (VNIL).

7.1. Number of vocational qualifications awarded to persons aged 24 and older in 2015

[Table 6] Number of vocational qualifications awarded to persons aged 24 and older in 2015

Age	25-29	30-39	40+	Total
Regular VET programme	2451	750	269	3470
Shortened VET programme	1173	479	350	2002
Direct access to final examination	574	889	775	2238
Validation of non-formal and informal learning	68	194	343	605
Total	4266	2312	1737	8315

7.2. Ten most frequently chosen fields for persons aged 24 and older seeking vocational qualifications in 2015

[Table 7] Ten most frequently chosen fields for persons aged 24 and older seeking vocational qualifications in 2015

Total occupations	Total
Nursing and obstetrics	1123
Social work and counselling	977
Business administration	940
Civil engineering	763
Wholesale and retail trade	733
Hotels, restaurants and catering	479
Housekeeping services	378
Mechanical engineering and metalworking	371
Plant cultivation and animal breeding	351
Electricity and power	248

7.3. Four established pathways to vocational qualifications

For adults, there are several ways to obtain a Federal VET Certificate or a Federal VET Diploma. The first two pathways to vocational qualifications consist of enrolment in a shortened or standard dual-track VET programme. The other two involve direct admission to the final examination or validation of non-formal and informal learning (VNIL).

7.4. Special conditions for adults with work experience

The shortened dual-track VET programme, direct admission to the final examination and VNIL were all developed specifically for adults who have already gained a certain level of work experience. Therefore, past knowledge and know-how can be taken into account. For direct admission to the final examination, the person must have at least five years of work experience. While direct admission to the final examination is possible for all occupations, the VNIL option is only available for a limited number of occupations.

7.5. Choice of pathway

Young adults tend to choose the first two options, enrolling either in a shortened or standard dual-track VET programme. Adults aged 25 and older tend to prefer preparation for direct admission to the final examination. VNIL is the preferred option for older adults.

8. Swiss VPET funding

The VPET sector is funded by the Confederation, the cantons and professional organisations, each to its own extent. Most of the costs of professional education and
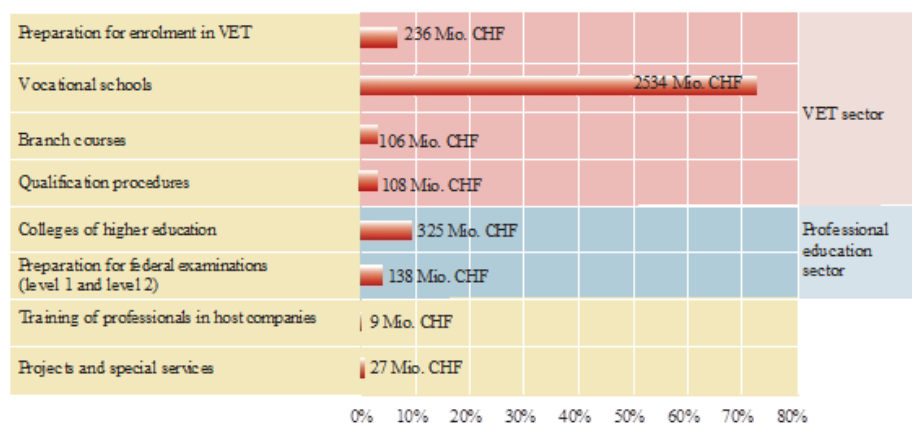
job-related CET programmes (continuing education and training) are borne by companies and private individuals.

8.1. Public sector

Public expenditure for Switzerland's VPET system stood at around CHF 3.5 billion in 2015. The cantons are responsible for implementing VPET. As such, they cover at least three-fourths of associated costs. The Confederation's share of public funding of the VPET system corresponds to one-fourth of the total costs. A total of 10% of federal funding will be used to promote VPET development projects as well as specific activities that serve the public interest, e.g., "Concept 2030."

8.2. Public expenditure for the VPET system in 2015

[Figure 5] Public expenditure for the VPET system in 2015

Preparation for enrolment in VET	236 Mio. CHF	VET sector
Vocational schools	2534 Mio. CHF	
Branch courses	106 Mio. CHF	
Qualification procedures	108 Mio. CHF	
Colleges of higher education	325 Mio. CHF	Professional education sector
Preparation for federal examinations (level 1 and level 2)	138 Mio. CHF	
Training of professionals in host companies	9 Mio. CHF	
Projects and special services	27 Mio. CHF	

0%　10%　20%　30%　40%　50%　60%　70%　80%

8.3. Private sector

Professional organisations provide both services and funding for the Swiss VPET system: they do the groundwork, run their own training centres and promote specific occupations (VET sector) and professions (professional education sector). For their part, companies help to fund the system by creating apprenticeship positions.

## 8.4. Funding of VET sector

Upper-secondary level vocational education and training (VET) is both publicly and privately funded. Public funding comes from the cantons, the Confederation and the communes. Private funding comes from host companies as well as professional organisations. In general, host companies stand to benefit from participating in VET programmes. According to a cost/benefit study conducted in 2009, gross costs of involvement in VET amounted to CHF 5.3 billion. This figure was outweighed by the productive output generated by apprentices, which amounted to CHF 5.8 billion.

8.5. VPET funds

All companies within a given economic branch are required to contribute to a corresponding VPET fund, which is used to cover the costs of activities within the VET sector and professional education sector (e.g., development of training programmes, organising courses and qualification procedures, promotion of specific occupations). The Confederation may declare some VPET funds to be of general interest and therefore mandatory for all companies within a given economic branch.

8.6. Cost/benefit ratio for Swiss companies involved in VET programmes (survey 2009)

[Figure 6] Cost/benefit ratio for Swiss companies involved in VET programmes (survey 2009)
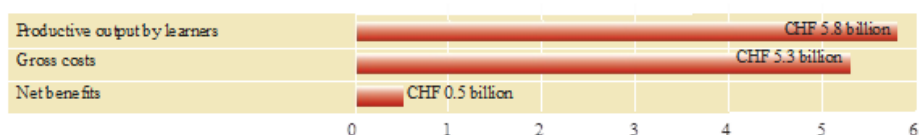

Efficiency

The consistent focus on the labour market allows VET programmes to be efficiently and effectively organised. One indication of this is the fact that the productive output of learners during their apprenticeships exceeds the gross costs of their training.

8.7. Costs and benefits by duration of training, in CHF

[Figure 7] Costs and benefits by duration of training, in CHF
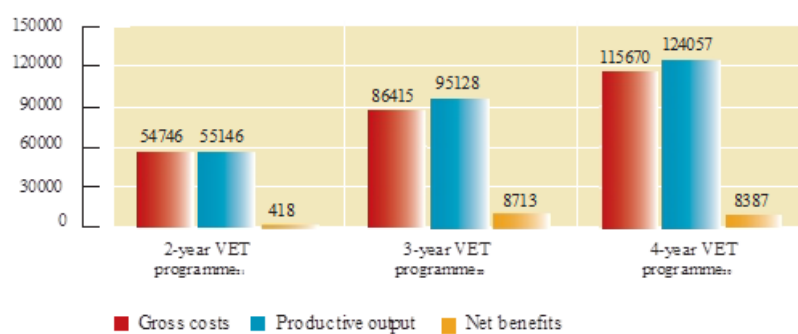
8.8. Funding of professional education sector

Unlike the upper-secondary level VET sector, the tertiary-level professional education sector relies much more heavily on funding from students and employers. Federal examinations in particular and the corresponding preparatory courses are mostly paid for by the private sector. Nevertheless, the public sector contributes substantial funding. In 2015, public expenditure for professional education and job-related continuing education and training (CET) exceeded CHF 460 million.

8.9. Sources of funding for level 1 and level 2 federal examinations in 2010

[Figure 8] Sources of funding for level 1 and level 2 federal examinations in 2010
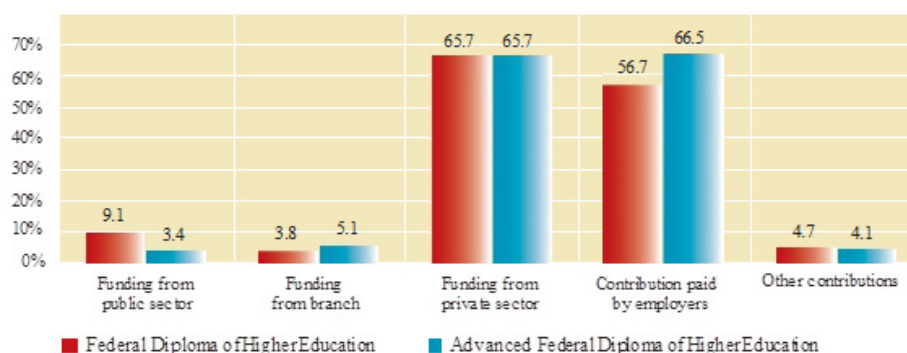
8.10. Federal examinations

60%-80% of the costs of conducting federal examinations is paid for by the Confederation. In 2015, this amounted to around CHF 30 million. Most individuals who attend preparatory courses for federal examinations do so on a part-time basis while remaining in employment. These preparatory courses are not regulated by the state and are only partially funded by the public sector. According to a study conducted in

2010, most of the associated costs are paid for by the private sector (i.e., employers, students). The amount contributed by employers is agreed upon on a case-by-case basis in discussions with their employees.

a. Federal examinations (level 1)

This federal examination is intended for professionals who wish to improve their knowledge and skills and specialise in a given field after completing upper-secondary level vocational education and training (VET). Successful candidates are awarded the Federal Diploma of Higher Education, which is generally a prerequisite for admittance to the examination for the Advanced Federal Diploma of Higher Education.

b. Federal examinations (level 2)

This examination is generally for professionals who have acquired a great deal of expertise in their field and/or who intend to hold a managerial position in a company. Successful candidates are awarded the Advanced Federal Diploma of Higher Education.

9. VPET at international level

The internationalisation of education and labour poses challenges for the Swiss system of vocational and professional education and training (VPET). Switzerland has therefore taken active steps at multiple levels to address this evolving business/ educational reality. With the aim of further strengthening the position of Swiss dual-track VET programmes, the State Secretariat for Education, Research and Innovation (SERI) is taking corresponding measures in coordination with the cantons and professional organisations.

9.1. International cooperation in vocational education and training (IC-VPET)

The main thrust of the strategy for international cooperation in vocational and professional education and training (IC-VPET) is to support the following: international recognition of vocational and professional qualifications, transfer of expertise, maintaining the high quality of the Swiss VPET system within an international context and encouraging the international mobility of those who are active within the VPET system. In addition to these objectives, the strategy also establishes priorities, measures and criteria for IC-VPET.

a. Transfer of expertise

The Swiss VPET system has generated international interest. Switzerland receives foreign delegations, shares its expertise with interested countries in accordance with the IC-VPET strategy and works closely with countries that also have strong dual-track VET systems. Projects and measures pursued by Swiss partners in the area of international cooperation in vocational education and training (IC-VET) qualify for subsidiary support from the State Secretariat for Education, Research and Innovation (SERI). Scheduled to take place in Winterthur from 6-8 June 2018, the 3rd International Congress on Vocational and Professional Education and Training will serve as a platform for open dialogue and the exchange of good practices between IC-VPET participants.

b. EU education programmes

Switzerland indirectly takes part in EU education and youth programmes (Erasmus+). Among others, this includes funding for mobility and cooperation activities in the area of VPET.

c. National Qualifications Framework (NQF VPET)

The Swiss National Qualifications Framework for Vocational and Professional Qualifications (NQF VPET) makes it easier to compare and appreciate the value of Swiss vocational and professional qualifications at the international level. In the future, all vocational and professional qualifications will be assigned to a level within the NQF VPET. In addition, each VET qualification will be accompanied by a corresponding certificate supplement and each professional education qualification with a corresponding diploma supplement. These documents explain the competences acquired by the qualification holder and will be available in Swiss national languages and English.

d. Recognition of foreign vocational and professional qualifications

SERI recognises foreign upper-secondary level vocational and tertiary-level professional qualifications. Recognition makes it easier for holders of foreign qualifications to work in occupations or professions that are regulated in Switzerland, thereby facilitating integration on the Swiss labour market. In most cases, recognition is based on a comparative analysis of the content and structure of training in the country where the foreign qualification was issued. This is done to determine whether the foreign qualification is equivalent to a Swiss one. Any significant discrepancies can be overcome by means of compensatory measures. SERI works closely with Swiss professional organisations and training institutions, which helps to ensure a high level of acceptance of recognition (decisions) of qualifications.

e. Pursuing international cooperation in VET through international organisations

Cooperation with international organisations, such as the OECD or the EU, fosters an understanding of VET at the international level. The State Secretariat for Education, Research and Innovation (SERI) represents Switzerland in various European bodies in

matters pertaining to VET. This has enabled Switzerland to present its positions and exchange good practices. This cooperation has led to international VET projects.

f. SwissSkills, EuroSkills and WorldSkills competitions

Each year, numerous trade associations choose who among their professionals will represent them at the SwissSkills competition, which also serves as the selection process for those who will represent Switzerland at EuroSkills and WorldSkills competitions.

9.2. Key figures for international VET activities

[Table 8] Exchange and mobility within the VET sector

Budget for Swiss participation in EU-sponsored traineeships abroad (Leonardo da Vinci)[23]	4,5 Mio. CHF
Number of young people doing traineeships abroad in 2015	946
Outgoing	856
Incoming	90
NQF VPET	
Vocational and professional qualifications to be assigned by 2017	730
Recognition of foreign qualifications	
Number of qualifications processed in 2015	5200
Qualifications from EU/EFTA member states	4300
Qualifications from non-EU/EFTA member states	900
Foreign delegations	
Number of foreign delegations received in 2015	32
Swiss performance at last four WorldSkills competitions	
São Paulo 2015	4th place
Leipzig 2013	2nd place
London 2011	3rd place
Calgary 2009	2nd place
Anzahl vertretene Nationen am Internationalen Berufsbildungskongress	
2016	76
2014	70

[23] In relation to transitional measures for Erasmus+ in 2016 (based on Federal Council proposal for compensatory budget to cover period 2015/16).

Translation figure above: Anzahl vertretene Nationen am internationalen Berufsbildungskongress = Number of represented nations at the VET-Congress.

10. VPET research

The Swiss VPET system is an important asset for the Swiss economy and strengthens its international competitiveness. Subsequent development and adaptation of the VPET system to new challenges requires knowledge, which can be gained through VPET research.

10.1. Legal mandate

The Federal Vocational and Professional Education and Training Act (VPETA) states that the Confederation must contribute to the development of the Swiss VPET system through VPET research, among other things. Quality and independence must be assured through qualified research institutes.

10.2. Objectives

The Confederation will continue to support VPET research until a lasting infrastructure is in place that conducts research to an internationally recognised standard. VPET research findings should enable continuous development of the Swiss VPET system. In addition, research findings should produce the knowledge needed to manage Swiss VPET policy. Together with funding of projects aimed at developing the VPET system and support for special services, federal VPET research constitutes a viable means of ensuring innovation within the VPET system (e.g., "Concept 2030").

10.3. Support instruments

The support programme sponsored by the State Secretariat for Education, Research and Innovation (SERI) is comprised of two support instruments: «Leading Houses» and «Individual projects». Both of these instruments complement one another. The

Leading House instrument pursues long-term objectives with the aim of establishing new research constructs. Leading Houses focus on clearly defined, relevant research themes. In their respective areas, each Leading House acts as a competence centre. In contrast, individual projects pursue shorter-term objectives and generally last for a period of up to four years. With these two instruments, it is possible to conduct both fundamental and applied research in support of the VPET system.

[Appendix]

Industry 4.0 – Apprenticeship Switzerland: <u>Answers to the KRIVET-questionnaire</u>

Christian Kaelin, Strategy Consultant, Switzerland, 8 August 2017

1. The change of apprenticeship governance and delivery according to the change of future industry

1.1. The change of government policy related to apprenticeships

The government policy related to apprenticeships has to focus on the following strategies:

- Provision of stable framework (infrastructure and legal)

- Delivery of quick and professional government services (Public Management 4.0)

- Vertical and horizontal permeability within the education system (Master-Bachelor System, Continuous training System, Relevance of Universities of Applied Sciences for Industry)

- Adaptation of the public school system to new developments (IT, globalization, diversity, etc.)

- Access to dual VET for young migrants (e.g., preparatory year with local language and math)

- Provision of a professional orientation system with consultants knowing the needs of the industries

1.2. Role modification of main stakeholders for future training (government, industrial organizations, enterprises, training organizations, VET schools).

- Government: bring together the main stakeholders to review and adapt the curriculas. Creating clusters within a group of professions.

- Industrial organizations: Developing professions according to the needs of their members. Maintaining and updating the training centres for their specific sector (technology, learning methods).

- Enterprises: Developing the soft skills of the young apprentices to prepare them for group work in teams with senior staff.

- Training organizations: Adapting the training centres to new technologies and applying modern teamwork and project management know how.

- VET schools: Maintaining and updating the schools for the students and their new abilities. Blended learning methodologies and group work with IT systems. Cooperation between teachers and relating subjects (e.g., mathematics, IT and economics for group work).

2. How does Switzerland integrate future prospective occupations (sectors) into apprenticeships?

Industries and their organizations suggest new professions to the federal department of economic affairs, education and research. Working groups with representatives of industry, chambers and schools develop new curricula and run pilot projects.

2.1. Which competencies are required? Which occupations are revised and newly developed?

Core-competences such as soft skills, interpersonal competencies and IT skills are more and more important.

New developments in industries are transformed into existing professions.

E.g., Motor vehicle maintenance: a lot of testing with IT tools is required. So, core-competences, such as analytical know how and skills in communication, are required. In the past, it was a 'fix-it' approach.

New professions are developed, tested, adapted and integrated.

Clusters of existing professions share their know-how to provide initial training for the apprentices / gleam courses in the first months or in the first year to acquire knowledge in technology and IT tools and interaction in teams.

2.2. How are training methods different in future prospective occupations?

Training methods depend on the needs of the relevant industry and the type of delivery. Service oriented professions focus more on core-competences in behaviour and communication skills: technological professions, more on IT and core-competence group work abilities. In Switzerland, the focus is on quality delivery to reach the best standards.

3. Limitations and strategies of reacting to change

3.1. Are there demands from enterprises in future prospective sectors to introduce apprenticeships?

Yes, the industries need young people with state-of-the-art practical skills. They are ready for work with competitive prices. Diverse teams (age, professional background,

cultural experiences) deliver better quality and are open for improvements and change.

3.2. Is long-term (2-3 years) apprenticeship able to follow rapid technological change?

Yes, the industries and the VET schools are able to integrate technological change in their training methods. Apprentices contribute with practical state-of-the-art examples from their employers. It's a continuous review and exchange of ideas and methods.

Chapter Ⅳ

Including "Industry 4.0"
in the Spanish VET programmes

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Including "Industry 4.0"
in the Spanish VET Programmes

Mr. Julio Mariano Carballo Fernández

Ministry of Education, Culture and Sport; Euroguidance

Abstract

Including Industry 4.0 contents in the VET Programmes is a priority of all the countries. In Spain, the entity responsible for designing VET Programmes is the Ministry of Education, Culture and Sport.

Spain is a much decentralized country, with a National Government and 17 autonomous regions with competences in education. That means there are different competences at the National and Regional levels.

At the National level, the Ministry is responsible for the 'design' of diplomas, including the number and type of subjects, hours of duration of each subject, academic years, and minimum of contents for each diploma and subject included. These minimum contents should be developed/acquired, at least, within 55% of the total hours required for programme. The autonomous regions can complete the remaining 45% with contents adapted to the regional particularities.

The design of each diploma is based in the occupational standards elaborated by the National Qualifications Institute. It is a complex process that try to guarantee the best possible marriage between training and requirements of the professional sectors. However, this process may be too slow to quickly update training programmes to

respond to changes in the production processes.

The only way that allows for the permanent updating of the contents to the ever-changing production processes, including Industry 4.0, is to establish a methodology on three levels: national, regional, and local (school). The latter pushes the responsibility to teachers for doing real time updating when there are significant and relevant changes to be incorporated, but always under the framework established by the National and Regional Authorities.

This system requires close cooperation among authorities, teachers, companies, and other stakeholders; it also requires a very strong system of permanent training of teachers and trainers.

This paper is a brief explanation of the proposal for a new model of updating programmes to ensure that we can adjust to the needs of the work economy.

1. Introduction and context

According to our National Constitution, Spain is hereby established as a social and democratic state, subject to the rule of law, which advocates as its highest values - legal order, liberty, justice, equality and political pluralism. National sovereignty is vested in the Spanish people, from whom emanate the powers of the state. The political form of the Spanish state is that of a parliamentary monarchy.

The Constitution is based on the **indissoluble unity of the Spanish nation**, the common and indivisible country of all Spaniards, but it also **recognizes and guarantees the right to autonomy of the comprised nationalities and regions** and the solidarity amongst them.

The Article 27. 1. recognizes that **everyone has the right to education** and thereby guarantees the independence/**freedom of teaching. Education shall strive to the full development of the human character and elementary education is compulsory and free.**

The Article 149. 1. states that The State **holds exclusive competence/authority in the regulation of the conditions pertaining to the obtaining, issuing and standardization of academic degrees, and professional qualifications.** Furthermore, Article 27 of the Constitution seeks to guarantee the fulfilment of these obligations by the public authorities in this arena.

Total **population of Spain is 46,528,996**: 45% men, 46% women. We have a **moderate foreign population** of about 9% (see Figure 1). **35.73% of the population has an educational level that prepares them for a specific professional sector.**
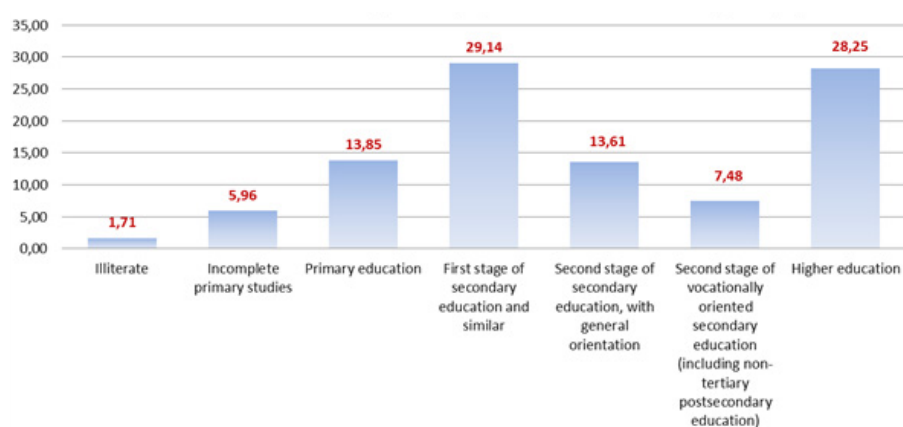
[Figure 1] Total population of Spain 2017

## Population 2017 - Spain - Total 46.528.996
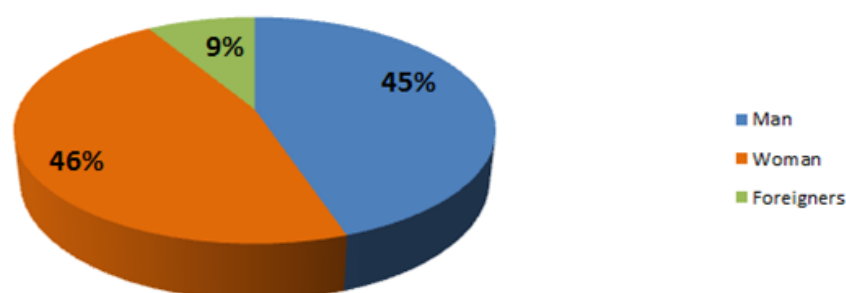
The portion of **the population that only has compulsory education level** (or less) reach 50.66%. This is important in order to design study programmes and, specifically, VET and University programmes (see Figure 2).

[Figure 2] Educational level of the Spanish population older than 16 years (%)

Spain is now **a decentralized state with a national government and 17 autonomous regions**. That means there are divisions of responsibilities in developing the VET Programmes as regions have varied educational situations. **The early school leaving rate is very high at national level, (nearly 19% in 2017)**, but with strong differences among regions.

[Figure 3] National and regional early school leaving rates in Spain
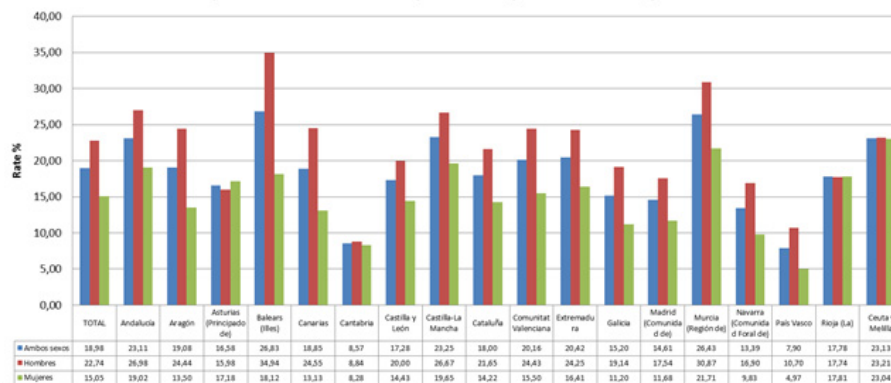
In the recent past, Spain reduced notably the early school leaving rate; the goal is to have a 15% rate by the year 2020. One of the tools for this reduction of the early school leaving has been the new VET System.

Spain has **two different VET Systems**:

- The first is the **Vocational Education and Training System**, handled by the Educational System. This is targeted, mainly, for young people; students that are finishing compulsory education, or students that are finishing post compulsory secondary education in general programmes (bachillerato).

- The second is the **Vocational Training System for Employment**. This system is under the responsibility of the Ministry of Employment; it targets, mainly, adult job-seekers or people that want to acquire new skills and competences.

Both systems are connected through the National Qualifications System, which allows for reciprocal validation through the certifications obtained in either system.

2. Levels in the Spanish VET System and actual situation

The Educational System has three levels for VET studies (see Figure 4):

- **Basic level**: the lowest level, targeted for those students in the two last years of secondary compulsory education. Based on teachers' assessment, Basic VET may be the best alternative for certain students trying to obtain better results (reflective of their personal skills).

The conditions are to have finished, at least, the second year of compulsory secondary education, and being, at minimum, 15 years old.

- **Intermediate level**: this level prepares the students for a professional profile. For accessing this level, it is necessary to have finished the secondary compulsory education.

- **High level**: this level is a part of the Spanish higher education system. It prepares students for a high qualified professional profile.

All the programmes, in the three levels, have two years of duration (2,000 hours equivalent), and a compulsory period of practice at a company for, at least, 440 hours (20% of the total curricula).

There is a pathway through the three levels; at the end of each level, students can

transit to the next level directly.

With the high level VET, students can go directly to the University Grade Studies, in some cases, validation of some ECTS credits. In effect, the VET System is a real alternative pathway for students to reach the maximum level of qualification in Spain.

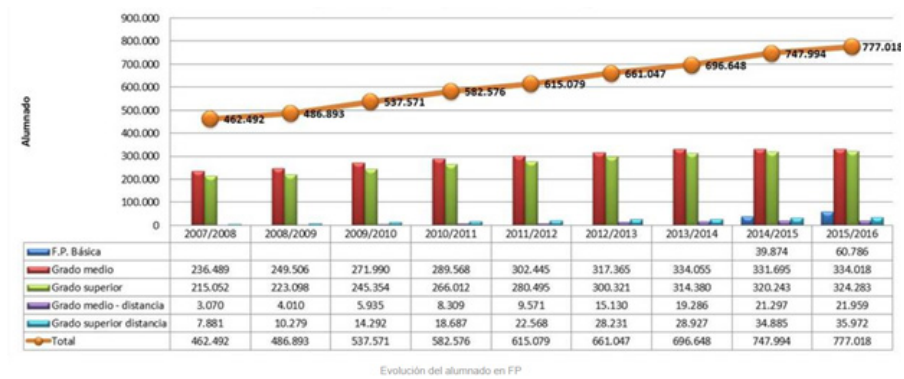[Figure 4] Levels in the Spanish VET system
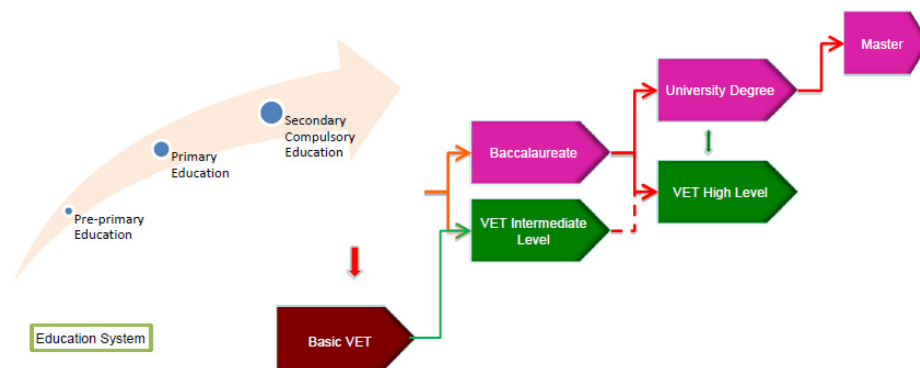
Currently, Spain has a total of 161 VET diplomas, belonging to the following 26 professional families:

- Agriculture (AGA)
- Maritime Industry & Fisheries (MAP)
- Food Industry (INA)
- Chemistry (QUI)
- Personal Image (IMP)
- Health (SAN)
- Security & Environment (SEA)
- Mechanical Manufacturing (FME)

- Electricity & Electronics (ELE)

- Energy & Water (ENA)

- Installation & Maintenance (IMA)

- Extraction Industry (IEX)

- Transport & Maintenance of Motor Vehicles (TMV)

- Construction & Civil Work (EOC)

- Glass & Ceramics (VIC)

- Wood, Furniture & Cork (MAM)

- Textiles, Manufactures, Leather & Fur (TCP)

- Graphic Arts (ARG)

- Image & Sound (IMS)

- Computing & Communications (IFC)

- Administration & Management (ADG)

- Trade & Marketing (COM)

- Sociocultural & Community Services (SSC)

- Hotel Industry & Tourism (HOT)

- Physical & Sporting Activities (AFD)

- Arts & Craftwork (ART)

The number of students in VET programmes has been increasing in the past decade. Presently, we have a total of 798,370 students in the three levels (see Figures 5 and 6).

[Figure 5] Growing number of students in VET programmes in the past years

	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016
F.P. Básica								39.874	60.786
Grado medio	236.489	249.506	271.990	289.568	302.445	317.365	334.055	331.695	334.018
Grado superior	215.052	223.098	245.354	266.012	280.495	300.321	314.380	320.243	324.283
Grado medio - distancia	3.070	4.010	5.935	8.309	9.571	15.130	19.286	21.297	21.959
Grado superior distancia	7.881	10.279	14.292	18.687	22.568	28.231	28.927	34.885	35.972
Total	462.492	486.893	537.571	582.576	615.079	661.047	696.648	747.994	777.018

Evolución del alumnado en FP

[Figure 6] Number of students in VET programmes in Spain 2016/17

	Basic Level	Intermediate Level	High Level
Number of students	69,283	348,512	380,575
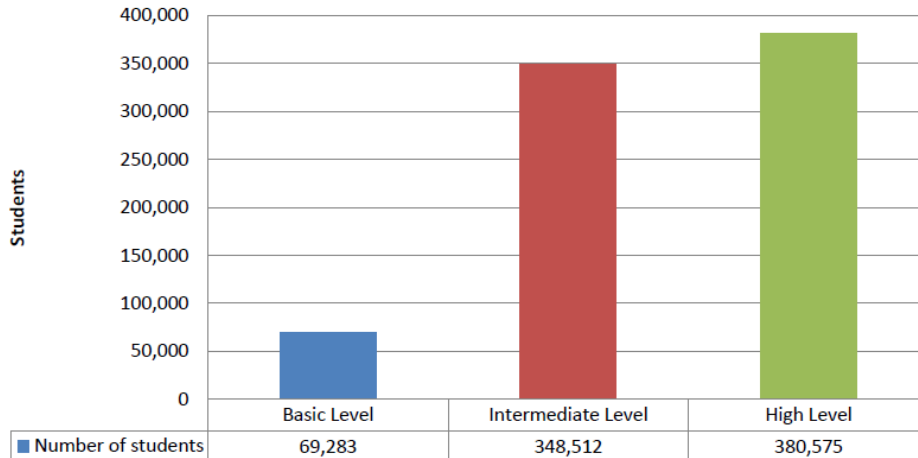
3. The change of apprenticeship governance and delivery according to the change of future industry

3.1. The change of government policy related to apprenticeships

DUAL VET Programmes is **a relatively new modality of VET** (since 2012); it is made in an alternating system of schooling and work - between a school and company. **The system is under a provisional regulation,** based on the experiences since 2012, and subsequently, **the Ministry is preparing a definitive framework for DUAL VET programmes in Spain**.

The different modalities previously developed have been created under the initiative of the autonomous governments, while respecting the general regulation of the National Authorities (Royal Decree 2012).

Effective in 2012, the Spanish Government - taking into account the fast evolution of the production processes, the globalization of labour market, and the need for close cooperation between companies and training systems - initiated a new regulation for the VET. Inclusive of a new DUAL System with **two different modalities**, the first regulation mandated DUAL VET programmes from the Vocational Training for Labour, and the second, DUAL VET programs from the Educational Sector.

This second modality shall be the focus of this paper.

The development of vocational training projects from the Educational Sector has the following purposes:

- **Increase** the number of persons obtaining a post-secondary education diploma through vocational education and training.

- **Obtain** a greater motivation in the students that diminishes the early school leaving.

- **Facilitate** labor insertion as a result of greater contact with companies.

- **Increase** the linkage and co-responsibility of the business community with vocational training.

- **Strengthen** the relationship of the professional formation with the companies of the sector and to favor the transfer of knowledge.

- **Obtain** qualitative and quantitative data that allow decision-making in relation to the improvement of the quality of vocational training.

The projects are developed **in collaboration with schools and companies**. The agreement signed with the collaborating company specify that programming for each of the professional modules (a module is one of the diploma subjects) includes: the activities to be carried out at the center and company, the duration of the activities. and the criteria for their evaluation and qualification. **Programming will allow the acquisition of established learning outcomes for each diploma that are established in the curricula.**

A minimum of 33% of training hours prescribed, with participation of the company, will be established. This percentage may be extended **to 85%,** depending on the characteristics of each professional module and the participating company.

The duration of the training for diploma acquisition **may be extended from two to three years**.

The student must take the necessary training in advance to guarantee the development of training in the company with safety and efficiency.

The training activity in the company and in the educational center will be coordinated through, at least, monthly control meetings in which each student will be monitored. To this end, tutorials will be established.

The **evaluation** of the students **will be the responsibility of the teachers of the professional modules at the ascription centers**, taking into account the contributions of the trainers of the company and the result of the activities developed in the same.

The dual vocational training project must be authorized by the corresponding Educational Administration and formalized through an agreement with the collaborating company under the conditions established by the educational authorities. The agreement shall include, at a minimum, the following aspects:

- The training program

- The number of participants

- The scholarship scheme

- The day and hours in the center and company

- The conditions that companies, students, teachers and tutors must meet

- Insurance necessary for students and teachers to cover the training

Where the scope of application of the dual vocational training project submitted by an undertaking affects more than one Autonomous Community, its authorization shall be the responsibility of the Ministry of Education, Culture and Sport.

Students may be awarded scholarships by companies, institutions, foundations, etc., and/or by Administrations, in the manner determined for each project.

The new legal conditions of the Educational System, initiated in 2013, oblige the Ministry of Education to make a specific regulation for DUAL VET programmes. Currently, we are working on this issue, bearing in mind, the experience, strengths and weaknesses of the projects operating in the 5 last years in the Autonomous Regions.

In 2017, the data of schools, companies and students involved in DUAL VET programmes are detailed in the following chart (see Figure 7).
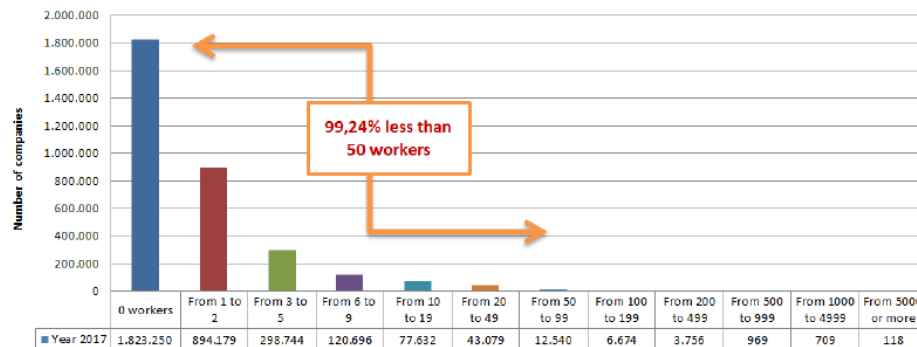
[Figure 7] DUAL VET programmes by region 2017

Autonomous Region	Schools	Companies	Students
Andalucía	120	1807	2989
Aragón	42	177	222
Asturias	69	38	269
Canarias	12	136	470
Cantabria	14	33	139
Castilla la Mancha	70	427	2370
Castilla y León	18	122	303
Cataluña	138	1050	5040
Comunidad Valenciana	143	1593	1987
Euskadi	85	790	1269
Extremadura	8	12	229
Galicia	21	93	502
Illes Baleares	10	334	252
La Rioja	5	103	131
Madrid	43	925	3970
Murcia	21	166	422
Navarra	13	260	586
TOTAL SPAIN	832	8066	21150

3.2. The change of roles of main stakeholders for future training (government, industrial organizations, enterprises, training organizations, VET schools)

Involving stakeholders in DUAL VET programmes, mainly companies, is crucial for the success of this training modality, but **in Spain, we have a structure of enterprises based on small and medium-sized businesses - 99.24% have less than 50 workers**. This structure adds **difficulties** to the implementation of a Dual Vocational Training system (see Figure 8).

[Figure 8] Companies in Spain by number of workers 2017

	0 workers	From 1 to 2	From 3 to 5	From 6 to 9	From 10 to 19	From 20 to 49	From 50 to 99	From 100 to 199	From 200 to 499	From 500 to 999	From 1000 to 4999	From 5000 or more
Year 2017	1.823.250	894.179	298.744	120.696	77.632	43.079	12.540	6.674	3.756	969	709	118

It is problematic at best **to request a company with less than 5 workers to collaborate in the Dual VET Programmes**. Therefore, it is imperative **to create an atmosphere whereby these programmes can be attractive, simple, and open, if we want to have success**.

As previously stated, the Ministry is currently working on a new regulation that allows **easier implementation to engage in Dual VET programmes for enterprises and schools**. In this process, the Ministry has **active collaboration with the representatives of different professional sectors, trade unions, and other stakeholders, e.g., the Chamber of Commerce**.

As a complementary measure, the Ministry encourages autonomous communities through **a special funding line**.

Since 2012, the regulation allowed the autonomous regions to develop their own modalities of DUAL VET, under the general framework of the national regulations. This has been an **extraordinary experience, and we have learned from the results of the different modalities**.

The Autonomous regions have **analyzed for each diploma: what learning outcomes was possible at the companies, what learning outcomes was needed to be developed at the schools, and what learning outcomes can be obtained in a mixed school-company activity**. Upon this basis, **they have designed different models**, alternating the experiences at the company with the experiences at the school. The results were very different.

In the projects, one can observe, for example:

- Some hours at the school and some hours at the company every day

- Some days at the school and some days at the company every week

- Some weeks at the school and some weeks at the company every month

- Some months at the school and some months at the company every academic year

- And last, one academic year at the school, and one or two academic years at the company

Even for the same group of students, some students resulted with different schedules. As one can see, there are **many possibilities for easy application, for schools and companies, the organization/implementation of DUAL VET Programmes**.

As one of the conclusions to this paper, we can say that, main challenges for success in Dual VET Programmes are:

- Permanent teacher training

- Simplified and attractive DUAL VET system for the companies

- Better guidance and information about DUAL VET Programmes

- Increase the number of students in DUAL VET Programmes to 200,000 by the year 2020.

4. How does Spain integrate future prospective occupations (sectors) into apprenticeships?

4.1. Which competencies are required? Which occupations are revised and newly developed?

In order to determine which competencies are required and which occupations are revised and newly developed, Spain has an institution, the National Qualifications Institute, with the mission to devise **the first analysis of the labour market evolution**.

The National Institute of Qualifications (here-in-after INCUAL) was created by Royal Decree 375/1999 on 5 March 1999. It is **the technical instrument, endowed with capacity and independence, which supports the Spanish General Council of Vocational Education and Training**, in order to attain the objectives of the National System for Qualifications and Vocational Education and Training (known in Spanish as SNCFP).

The Organic Act 5/2002 of 19 June 2002 on Qualifications and Vocational Education and Training confers on the INCUAL the responsibility **for defining, creating and updating the National Catalogue of Professional Qualifications and the corresponding Modular Catalogue of Vocational Education and Training. Both will be the basis for designing VET Diplomas (under the responsibility, in this case, of the Directorate General for Vocational Education and Training)**.

The governing body of the INCUAL is the General Council of Vocational Education and Training, though INCUAL is placed under the control of the General Directorate for VET.

The main objectives of the INCUAL are:

- **To observe qualifications** (as occupational standards) and their evolution
- **To determine qualifications to be designed or updated**

The main functions related to these objectives are:

- **To establish criteria for the requirements and characteristics due to be met by professional qualifications** in order to be incorporated into the National System for Professional Qualifications

- To establish **a basic methodology to identify professional competences and to define a model to be adopted by professional qualifications** in order to be incorporated into the National System for Professional Qualifications

- To propose a system for the professional accreditation and recognition

- To establish **a procedure to involve regional institutions of qualifications as well as other social agents in the definition of the National Catalogue of Professional Qualifications** and in the update of sectoral demands

- To establish criteria about **basic methods to be observed in the assessment of competences** and to establish criteria for the procedure to award accreditations by competent authorities

- To propose procedures for the establishment of modalities for the accreditation of professional competences from the National System for Professional Qualifications as well as their update

- To develop, as a basic instrument serving the General Council of Vocational Education and Training, essentially technical activities of vocational education and training both in Spain and the European Community, such as studies, reports, comparative analysis, information collection, bibliographies and scientific seminars

- **To facilitate the functional interrelations between training activities of the different subsystems** of Vocational Education and Training (and the diplomas and certificates they generate) and professional classifications systems created by collective bargaining

**For the designing of the VET programmes, we have developed two phases:**

- The first phase is **the observation of the characteristics of the production processes**. For that, we have comprised **expert groups from the enterprises** that analyze the skills needed for each professional profile working in a production chain or services provision. This analysis is made under the coordination of the National Qualifications Institute.

- In the second phase, depending on the skills needed and the competences to develop are already determined, the General Directorate for VET (Ministry of Education, Culture and Sport), with an expert group of teachers and professionals of each sector, **design the study programme**.

This system **allows a backdrop whereby any fine-tuning or adjustments can be made between training and needs of the job/company**.

Presently, we have updated **161 VET diplomas that include more than 660 professional qualifications (occupational standards)**.

All qualifications are revised continuously for possible updating needs every 5 years, at the minimum (see Figure 9).

[Figure 9] VET and DUAL VET
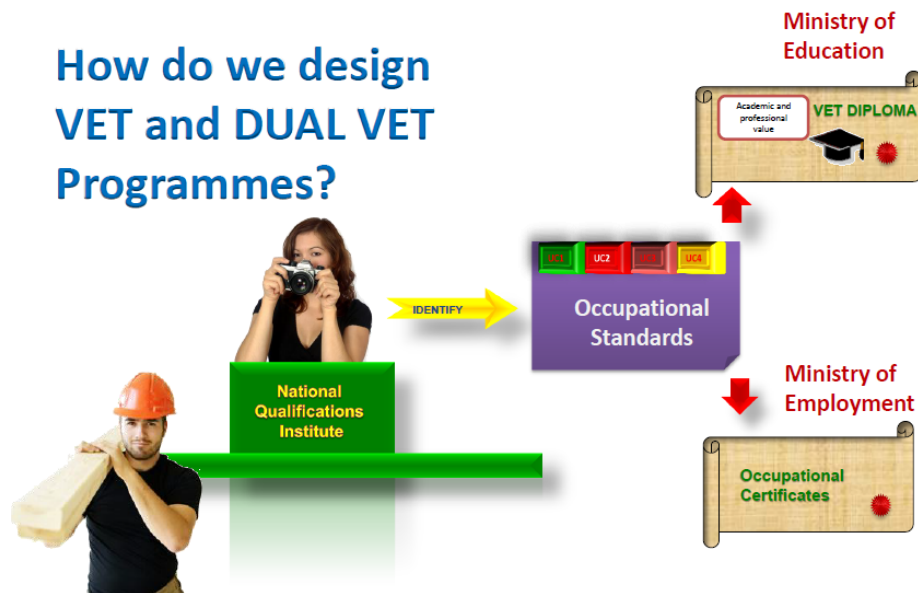
4.2. How are training methods different in future prospective occupations?

The system, as described before, may be too slow to respond to updates in the training programmes, especially if all parts of the programmes are determined by the national and the autonomous regional governments of Spain.

Therefore, **the final conception of the programmes must be the responsibility of teachers**.

Thus, we have three levels of curricular development (see Figure 10).

- **The first corresponds to the National Authorities** - Ministry of Education, Culture, and Sports - which oversees the general design and content of each diploma.

- **The second corresponds to the autonomous regions**, which adapt the general curricula to the particularities of their geographic region and culture.

- The third corresponds to the teachers, whereby they **update in real time the contents of the needs and skills of each professional profile**. This third level **allows for the permanent updating** of the programmes. This method requires a parallel system for updating the teacher's knowledge, skills, and competences in the professional sector they are teaching.

[Figure 10] Three levels of curricula development
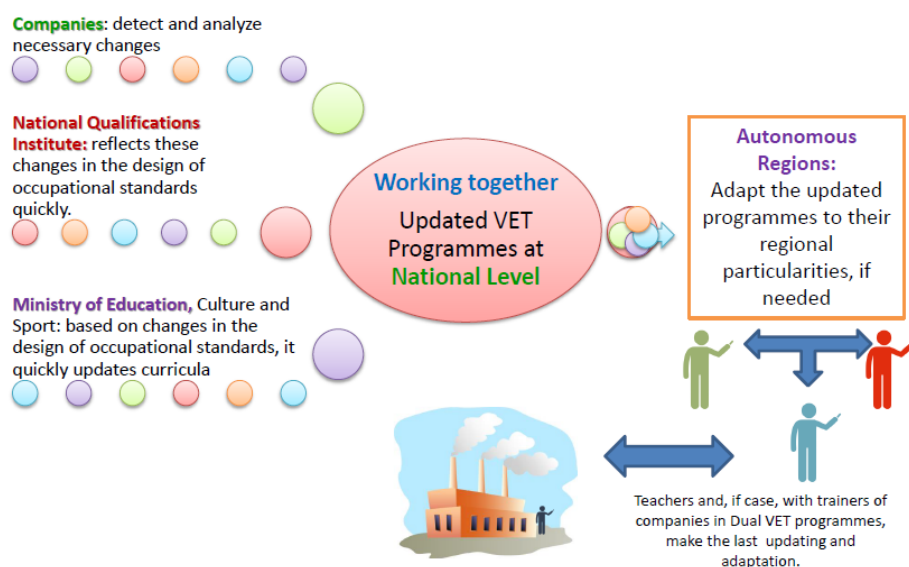
- The National Qualifications Institute, with the companies and experts, has the responsibility to detect the changes in the activities of the production sectors. Analyze these changes and reflect it in the occupational standards.

- The Ministry of Education includes the changes in the VET programmes.

- The Autonomous Regions complete and adapt programmes to their particularities, if needed.

- Finally, **teachers create a classroom programme, incorporating all the existing and new elements that are considered necessary, but due to novelty, are not included in the official programmes**.

In this model, it is **especially important for knowledge transfer to seamlessly exist between companies and schools**.

It is very important that adequate permanent training of the teachers regarding Industry 4.0, public administration, and companies be executed.

To allow for teachers to adapt and update programmes in real time, it is necessary that the curricula established at the national and regional level be devised in a very open and general terms. For example:

If a programme has a learning outcome pertaining to the skill of «manage the data transmission protocol», it may be written as:

The student manages correctly the XML data transmission protocol.
Or
The student manages correctly the adequate transmission protocol for the activity involved.

The first writing mode is only available for an XML protocol; the second is available for all the other protocols (existing today or in the future).

The former does not allow the teacher to teach other protocols, the latter allows the teacher to teach the most appropriate protocols for each case.

What contents need to be incorporated or enhanced in the VET programmes, especially relating to the adaptation of Industry 4.0?

The main contents, albeit not the only ones, are related to: **simulation, additive manufacturing, horizontal and vertical integration systems, cybersecurity, augmented reality, cloud computing, autonomous robots, industrial internet of things, and last but not least, big data analysis** - adapted to the **particularities of each production sector or services providers**.

These contents respond to the national objectives for Industry 4.0:

- Increase industrial added value
- Increase the added value of employment
- Foster an industrial model for the future
- Foster emerging sectors
- Develop competitive levers
- Improve exports

5. Limitations and strategies of reacting to change

5.1. Are there demands from enterprises in future prospective sectors to introduce apprenticeships?

The dialogue between public administration and enterprises has resulted in the progressive involvement of enterprises, not only **in the design** of the VET programmes, but also **in the training offers** - compulsory practice period for all VET Diplomas and new DUAL VET Programmes. However, **a better effort is required to clarify, simplify and make attractive the collaboration among the enterprises, schools, and other stakeholders**. The National VET Council - with the participation of all the public administrations: Education and Labour at national and regional levels, trade unions,

chambers of commerce, and representatives of the professional sectors - is an extraordinary tool in achieving a quality national VET System, ready for the challenges of the future.

5.2. Is long-term (2-3 years) apprenticeship able to follow rapid technological change?

We have no doubts about the qualification of future professionals to face technological changes and challenges.

Enhanced DUAL VET programmes, with the collaboration of enterprises, are the pillars of success. This only may be guaranteed with close cooperation among administrations, schools, teachers, companies, and all the actors of the labour market and VET Community (see Figure 11).

[Figure 11] Cooperation system
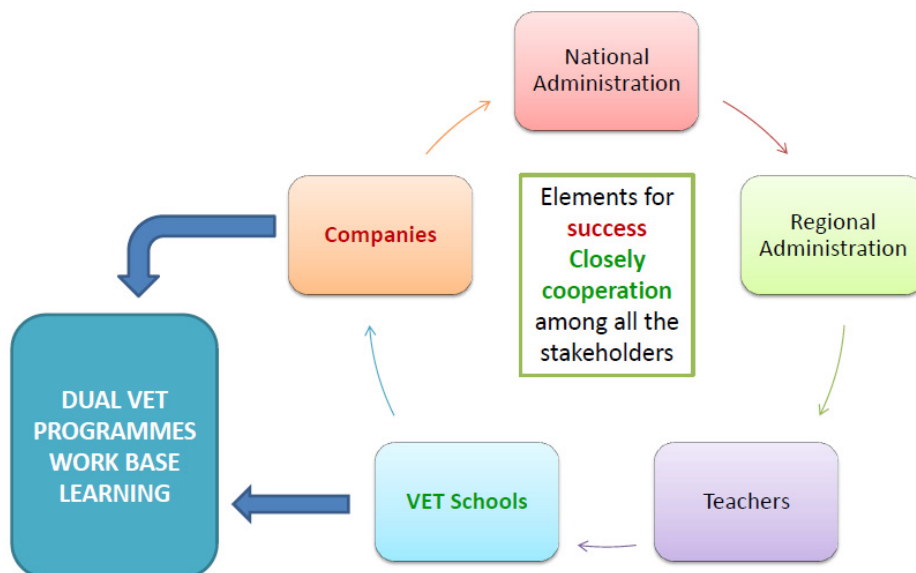
6. Conclusion

To guarantee the permanent and fast updating of the VET Programmes to the changes and challenges of the new production processes is crucial to maintaining the competitiveness of our economic system in a globalized labour market. Nevertheless, this only can be accomplished through close cooperation among all the administrations, enterprises and stakeholders.

For this purpose, DUAL VET programme is an essential tool. Nonetheless, we can only have success if we are capable of creating DUAL VET programmes attractive for schools and companies, and concurrently, easy to implement. Given that, having an open framework and sufficient autonomy for schools and teachers in the implementation of these programmes are extraordinarily important.

A complementary issue is information and guidance. Both are fundamental elements for improving DUAL VET programmes. Students that are finishing educational levels need to have all the necessary tools when making an adequate decision about their future.

Some elements of the equation are:

Lifelong Learning + Lifelong guidance + Enterprises' participation and responsibility + Adequate Public Administration VET policies + Stakeholders' participation = competitive workers force = successful and equilibratory social and economic system.