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VOCATIONAL EDUCATION AND TRAINING FOR THE FUTURE OF WORK
NORWAY

Vocational education and training for the future of work: Norway

Policy strategies and initiatives to prepare vocational education and training systems for digitalisation and future of work technologies

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Contents

Foreword

This article on Digitalisation and the future of work is based on a common structure defined by Cedefop (European Centre for the Development of Vocational Training). The article was drafted by ReferNet Norway and has been validated by Gro Tjore, ReferNet national representative Norway. The content and the opinions expressed belong exclusively to the authors.

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Executive summary

This article is a synopsis of recent national policy development that aims to prepare Norway to meet the challenges of the future of work.

It focuses on policy strategies and national initiatives aimed at adjusting the national VET systems to the skill demands indicated by Industry 4.0 technologies, digitalisation and AI.

Norway has adopted white papers and a digitalisation strategy designed to meet the challenges of digitalisation and the fourth industrial revolution. A new national strategy is also being developed for artificial intelligence.

To keep up with a rapidly changing world of work, a VET education renewal process has been initiated, leading to the introduction of new VET programmes and updated curricula. The renewal will be introduced in 2020.

An Official Norwegian Committee on Skills Needs (*Kompetansebehovsutvalget*) has been established, for the purposes of better understanding the changes in skills needs.

Lastly, a newly adopted practice within the national VET system at higher education level (EQF5) is described. The practice focuses on Industry 4.0 with a view to promoting students' awareness of skill needs and learning in the various sectors and vocations.

CHAPTER 1.
Evidence of digitalisation in Norway

To respond to future challenges, Norway must be greener, smarter and more innovative in order to promote economic growth, employment and tax revenue.

A stable economic development and a weak krone are important elements in achieving new growth in business and industrial sectors exposed to competition. Report No 27 to the Storting (2016-17) *A greener, smarter and more innovative industry* plays a key role in economic policy planning and is intended to realise growth in existing and new businesses. Norway will also be promoted as an attractive nation for the localisation of industrial activities.

If we are to succeed with the reorganisation of the Norwegian economy, we must have an education and competence policy that facilitates these changes in skills demands. The Norwegian labour market and the Norwegian economy are in a transitional phase. A national committee was appointed in 2017 to find out what competence the Norwegian labour market will need going forward. The Official Norwegian Committee on Skill Needs is tasked with contributing to further research, and has mapped a great number of surveys, analyses and data sources relating to the field.

The level of competence in Norway is high, which forms the basis for a high level of productivity and means that a large proportion of the population are in employment. We must nevertheless reach a higher level of competence, particularly in light of a development showing higher competence requirements, and a reduction in employment opportunities for those who lack skills and education. The Official Norwegian Committee on Skill Needs was appointed by the Government in 2017 and comprises representatives of the social partners and a number of ministries, as well as analysts and researchers. In January 2018, the committee presented Norwegian Official Report (NOU) 2018: 2 *Fremtidige kompetansebehov I – kunnskapsgrunnlaget*. [Future competence needs I – the knowledge base] (in Norwegian only). In the report, the committee reviews the knowledge base relating to current and future competence needs in Norway.

Among other things, the projections indicate that in the years leading up to 2035, there may be a shortage of persons with vocational education and training (VET).

The Official Committee on Skill Needs' second report, submitted on 1 February 2019, further strengthens these projections in that the expected decline in labour immigration may lead to a greater shortage of labour with upper secondary vocational qualifications than previously assumed. The report also takes a more detailed look at national projections and identifies the occupational groups with a high probability of automation and those that are growing as a result of automation. One challenge that is particularly relevant to VET is the persistent

shortage of qualified labour in certain occupations, particularly in the health and care sector, primary and lower secondary teachers, ICT and skilled building and construction workers. The report also shows that there is a particularly high probability of automation in the occupational groups of clerks and shop assistants, and it sets out how the programme structure is being adapted to future skills needs.

The Government launched a VET Promotion Initiative (Yrkesfagløftet) in cooperation with school owners and the social partners, which aims to increase the number of young people who complete upper secondary education and thereby contribute to meeting the future need for qualified workers. A new vocational subject structure is set to be implemented in 2020 with a view to making the education programmes more relevant to professional practice.

The number of education programmes is being expanded from eight to ten, and four new programmes are being introduced from the school year 2020/2021.

One of the new programmes, ICT and media production, is intended to address the need for increased digital skills, and office and administrative skills is being replaced as a result of less demand for labour in this area.

More focus on tertiary vocational education is also an important priority, and, in autumn 2016, the Government issued Report No 9 to the Storting (2016-17) *Skilled workers for the future* on vocational colleges. This white paper established that vocational colleges are an important educational resource that must be strengthened and become more accessible and visible as an alternative course of education after upper secondary level. It includes measures intended to strengthen vocational colleges and make tertiary vocational education more attractive.

As a result of the follow-up of the white paper, everyone who wants to start studying at a public tertiary vocational college can send an application to the Norwegian Universities and Colleges Admission Service, a national system for admission to higher education. This is intended to help increase the visibility of tertiary vocational education and provide more efficient and predictable case processing for the applicants.

To be able to seize the opportunities represented by digitalisation, society has a growing need for more specialised and better general ICT skills.

In August 2017, a comprehensive digitalisation strategy for basic education was launched, which maintains the balance between the different priority areas. This strategy is part of the Government's work on addressing and seizing the opportunities digitalisation offers.

This article is a synopsis of these policy developments responding to the advancement of digitalisation, 4.0 technologies and skills needs associated with the fourth industrial revolution.

CHAPTER 2.
VET policy strategies and initiatives

Norway is making ongoing local and national efforts to respond to the changes in society that result from digitalisation and Industry 4.0.

Globalisation, climate change, an ageing population, expected lower demand in the petroleum sector and technological development are changing Norwegian industry. New materials are being used, and processes are being changed, automated and digitalised. Norway has adopted a national policy dedicated to meeting the challenges of the fourth industrial/information age. Report No 27 to the Storting (2016-17) *A greener, smarter and more innovative industry* describes Norway's policy on addressing the opportunities and challenges Norwegian industry faces due to globalisation, climate challenges, the ageing population, lower expected long-term demand in the petroleum industry combined with technological developments that are changing Norwegian industry.

The white paper describes a reorganisation within a sustainable framework and the importance of access to capital. Other important elements include access to competence, research, innovation and technological development. This chapter will look in particular at the part of this white paper that deals with competence-related policy measures.

Norway has also adopted a digitalisation strategy intended to meet the need for more specialised and better general ICT skills in Norwegian society. On the one hand, society needs more ICT specialists and more people with multidisciplinary ICT skills. On the other hand, everybody needs general digital skills to enable us to use the services that have been developed, carry out work using ICT, make secure choices in our digital everyday lives and protect our privacy.

The labour market is dependent on the education system providing employees who are up-to-date and who have the necessary skills to practice their vocations.

The strategy is intersectoral and addresses different focus areas with a view to improving digital competence among the population. VET plays a major role in the digitalisation strategy and this chapter will look specifically at measures in this area.

2.1. The white paper 'A greener, smarter and more innovative industry'

A work force with good competence and skills will become even more essential to future value creation. Norway must have access to skilled labour in addition to continuously maintaining and developing employees' competence. The

Government will facilitate continuous innovation in education, research and industry and proposes a number of measures in Report No 27 to the Storting (2016-17) *A greener, smarter and more innovative industry*.

2.1.1. Continuous innovation in education

(a) the work on ensuring basic skills for all continues. Natural sciences and technical subjects are particularly prioritised, and emphasis is placed on life-long learning;

(b) the Government has recently issued a white paper on quality in higher education, cf. Report No 16 to the Storting (2016-17) *Quality culture in higher education*;

(c) a number of measures have been implemented to make tertiary vocational education more attractive, increase the number of students and academic communities, and make the sector more visible and its graduates more in demand in the labour market, see Report No 9 to the Storting (2016-17) *Skilled workers for the future* – Vocational college education;

(d) an Official Norwegian Committee on Skill Needs has been established to analyse and present future competence needs;

(e) an ICT strategy has been launched for basic education;

(f) a total of 146 schools are taking part in a pilot project with programming as an elective subject at lower secondary level up until the academic year 2018/19;

(g) a trade certificate at work scheme has been established in cooperation with the social partners;

(h) the requirement on the use of apprentices in public contracts will be followed up. This will help to increase recruitment to VET and develop competence for skilled workers and businesses;

(i) the Government has granted funding to a pilot project and supports the realisation of DigitalNorway/Toppindustrisenteret, which deals with the digitalisation of Norwegian business and industry;

(j) the current cluster policy to promote reorganisation in the business sector will be developed. The cluster programme is funded by the Government and is intended to create value through sustainable innovation;

(k) the Government has appointed a group, Digital21, which has launched a new strategy for the digitalisation of business and industry. The strategy recommends 64 measures divided into five different areas;

(l) the Government is establishing a forum for cooperation between the authorities, industry executives, knowledge communities and social partners, inspired in part by the German Industry 4.0 initiative. The purpose of the forum is to discuss challenges with a view to achieving greater digitalisation in industry, developing a common understanding of the roles and duties of different actors, and receiving input on further policy development.

2.2. The digitalisation strategy for basic education 2017-21

The majority of Norwegian pupils have good digital skills. At the same time, almost a quarter of Norwegian pupils in year nine have such poor digital skills that they will encounter problems at school and in the workplace. Although Norwegian pupils are major consumers of digital content, there are many important skills they do not learn through recreational use. There are challenges in the areas of digital judgement and security, and in subject-specific skills that require them to use ICT. The pupils also need knowledge and an understanding of the challenges that digital consumption on this scale creates – such as addiction, perceived pressure via social media and digital bullying. There is also reason to believe that Norwegian schools do not adequately equalise social differences, and that new digital dividing lines are being drawn up. Research shows that there are disparities, some of them great, between pupils' digital skills in Norwegian classrooms. Many pupils state that they have never used a computer in teaching activities, and many only use ICT a few times a week. There are therefore grounds to conclude that too many pupils do not receive the training they need with respect to using ICT, to achieve the purpose of their education.

To address these challenges, the Norwegian Government launched in June 2017 *Framtid, fornyelse og digitalisering – Digitaliseringsstrategi for grunnopplæringen* [Future, innovation and digitalisation – a digitalisation strategy for basic education 2017-21] (in Norwegian only).

The strategy intends to meet the need for more specialised and better general IT skills in Norwegian society. It sets out four key areas for initiating measures:
(a) The pupils' learning and the content of schooling;
(b) Competence;
(c) Infrastructure;
(d) Vocational education and training.

Vocational education and training is an important aspect of the digitalisation strategy, and digitalisation of the labour market affects several of the subject areas. Automation and robotisation, for example, will mean that skilled workers' competence must be adapted to new tasks and content in their everyday work, such as controlling, monitoring or remote controlling processes that are predominantly manual today. The green shift and technological development will create entirely new business areas for building, electronics, industry and transport and will also mean that the content of existing subjects will change.

A firm grasp of ICT will become more and more important for skilled workers in these areas. Skilled workers must familiarise themselves with and use different forms of digital tools for planning, organisation, coordination, communication, management and reporting.

Digitalisation encompasses all industries and nearly all subjects. It can be challenging for the education system to keep up with developments in the various industries. To do this, the education authorities must have a close and well-functioning collaboration with the professional field. The strategy therefore emphasises that updating the content of VET must take place in close cooperation with the vocational councils and social partners, since these are aware of the labour market's competence needs and are more in touch with developments in the industry. The strategy also states that the education authorities must work systematically to obtain knowledge about labour market needs, and recommends that a survey of skilled workers be conducted to provide better knowledge about how VET matches the labour market's needs.

Technological and digital competence is key to succeeding in a great many trades. The same is true of having access to up-to-date, technological and digital equipment. The public sector will not independently manage to have the most up-to-date equipment and technology, nor be constantly informed about the newest forms of organisation and production. A good cooperation between schools and local businesses is thereby necessary to keep abreast of the development in many trades and industries. Changes in the labour market will play a role in which trade and journeyman's certificates are sought after and which become less relevant. The changes that are set in motion are continuous, and arenas in which the education authorities and labour market can discuss the challenges this creates are a necessity. The strategy therefore encourages the use of established cooperation forums and bodies such as the National Council for Vocational Education and Training and the vocational councils to discuss how the education system can address the changes that follow from new technology.

Particularly good opportunities exist for developing digital learning resources for VET that simulate real situations in the various vocational practices. In this way, the learning resources can help to increase learning and knowledge of more trades and vocations than the schools and teachers have the resources for. ICT can be a valuable tool for documenting and logging the parts of the training that take place in an enterprise. In the labour market, ICT is well established as a documentation tool in many trades, and the strategy asks schools to consider the possibility of developing the solutions and technology already in use outside education.

VET also requires a different and more robust infrastructure that can incorporate such learning resources and enable digital cooperation with business and industry. There is a general need to raise awareness of technical use of ICT in education.

The competence of vocational teachers is a key aspect of the quality of VET. The strategy therefore emphasises that Norway must have vocational teacher education programmes that offer up-to-date and relevant competence, and that provide good and relevant opportunities for further education.

Many of the measures included in the vocational teacher promotion initiative will therefore also be important tools in a strategy for digitalisation in basic

education. There is also a wish to strengthen workplace incentives for participating in vocational teachers' skills development. It will be an advantage for the labour market if the teachers who will be teaching the apprentices and employees of the future are as up to date as possible about new technology, new production methods and other innovations in the subjects. These are skills that traditional providers of continuing and further education do not necessarily have, and that are best provided by the industries and enterprises. In 2017, 18 competence-raising pilots for vocational teachers were implemented on the basis of the vocational teacher promotion initiative. Five university and university college institutions are participating in a pilot project of combined continuing and further education for vocational teachers that teach programme subjects in the vocational programmes. The pilot project is being conducted in close cooperation with the school owners. There are a total of 18 courses broken down into three thematic areas:

(a) - teaching methods and vocational didactics;
(b) - pupil-related skills;
(c) - vocational skills – broad and in-depth.

Some of these were particularly aimed at giving the vocational teachers skills in ICT, e-learning and the use of new technology. The results of these pilot projects will be followed up, and consideration will be given to how the experience gained can best be continued and disseminated to facilitate more cooperation on continuing education with the labour market.

2.2.1. Measures that will be implemented in the strategy period (2017-21)

(a) development of new and more relevant continued and further education programmes for vocational teachers;
(b) continuation of professional development opportunities aimed at updating vocational teachers on new technology through the placement scheme and courses organised by the industry;
(c) work to ensure that VET is developed in close cooperation with school owners to meet the school's need for teaching competence;
(d) continue the pilot scheme with specialist teachers in VET. The specialist teacher scheme is designed to ensure that capable teachers encounter good professional development opportunities and thereby wish to continue in the teaching profession;
(e) contribute to recruiting and qualifying more vocational teachers through education and recruitment grants;
(f) develop a skilled worker survey that will contribute more knowledge on the extent to which VET is able to meet labour market needs;
(g) in cooperation with the professional field, ensure that VET is further developed to address the changes that follow from new technology.

CHAPTER 3.
VET 4.0 initiatives and programmes

A number of changes have been made in the provision of VET over the past years to ensure a flexible course of education and adapt the content of the programmes to changes in society. Pilot schemes, such as the craft certificate at work scheme, and the possibility to switch from specialisation in general studies to vocational education, have become part of the structure of education offered.

To adapt the content of programmes to changes in society, the Norwegian Directorate for Education and Training has reviewed the structure of the vocational programmes offered and all curricula are in the process of being revised. This review took place in cooperation with the social partners. Emphasis was placed on three main principles:

(a) the principle of flexibility in education programmes – the pupils must be able to receive tuition and work experience in the vocation from as early as Vg1 (the first year of upper secondary school). Those who are unsure of their choice of education will be given a good basis for making the right decisions later on in their course of education;

(b) the principle of relevant competence – VET shall build on cooperation between the social partners in order to nurture competence that is needed and recognised in the labour market;

(c) the principle of a decentralised offer of education – the objective is to achieve a programme structure that, to the highest degree possible, allows people to take the education they wish regardless of their place of residence, financial situation and age.

As a result of the review, a new vocational education structure will be introduced in upper secondary education from autumn 2020 (EQF 4). This will be the biggest change to vocational education since the Knowledge Promotion Reform in 2006.

The background to these changes is that skilled workers represent a competence that society needs, and to sustain this, we must firstly have well-functioning recognised trades, and secondly, ensure that skilled workers are given a clear position in the division of labour. Report No 20 to the Storting (2012-13) *På rett vei – Kvalitet og mangfold i fellesskolen* [On the right path – Quality and diversity in comprehensive school] (in Norwegian only) showed that, to a great degree, VET leads to competence that is valued in the professional field. It was nonetheless pointed out that not all vocational education programmes work equally well when it comes to recruitment to recognised trades and connection to the labour market.

3.1. New programme structure for vocational education

The new structure of vocational education entails a renewal of the programmes themselves, and means that pupils will specialise earlier on and learn more about the trade they are going to work in. The structure will be introduced from autumn 2020 and consists of three main priorities:

3.1.1. Specialisation from the onset

With the current system, vocational education students do not start their specialisation until the second year. The industry's response to this is that the students do not acquire enough knowledge in the subject before becoming apprentices. The students spend too much time in their first year on subjects they do not need, because those training for very different trades must nonetheless take the same subjects. The new vocational education system will group the students who are training for more similar trades. The education will be better adapted to future work needs. More students will take a specialisation subjects from the onset and more specialisations will be offered in the second year.

3.1.2. New education programmes

The number of education programmes will increase from eight to ten in order to group students requiring subjects with a more similar content. The education programmes Design, arts and crafts and Service and transport will be replaced by four new programmes and the subject matter will be continued in these programmes. ICT, traditional crafts, hairdressing and sales will be enhanced in their respective study programmes to ensure they are better adapted to the skills needs of the labour market.

ICT and media production will be a brand new vocational education programme intended to enable pupils to understand how technology, communication and design influences and develops society, and it will prepare the pupils for a society and labour market in constant development by imparting information technology, communication and media production skills.

Recognised trades that have had few apprentices in recent years will be phased out. This includes large clock repairs, industrial sewing, sports facilities management, forging, tanning, industrial footwear and piano tuning and repair.

3.2. New curricula for vocational subjects

The purpose of renewing the subjects is to make children and young people better equipped to meet and find solutions to current and future challenges. They will develop relevant competence and good values and attitudes that will make a

difference for them in a society characterised by greater complexity, more diversity and rapid change.

The framework for basic skills has been renewed in relation to digital skills. Digital skills are understood as:

(a) using and understanding;
(b) finding and handling;
(c) producing and processing;
(d) communicating and cooperating;
(e) practising digital judgement.

The social sciences will be given special responsibility for teaching digital skills, especially in terms of source evaluation and critical reflection.

In autumn 2018, the curriculum groups started the work on developing the curricula for the vocational subjects. The objectives of the new curricula are that they should:

(a) address the content of the overriding part of the national curriculum;
(b) are a good tool for both schools and professional practice;
(c) are digitalised to become more user friendly;
(d) facilitate clear progress between the first, second and third year of upper secondary school (Vg1, Vg2 and Vg3);
(e) facilitate local adaptation and freedom of action;
(f) ensure a connection with the national curriculum for basic education;
(g) are forward-looking and relevant for pupils, apprentices and the needs of the labour market.

When the curriculum groups have submitted their proposals, all the curricula will be distributed for public consultation. After the consultation round, the curricula will be adopted and used from autumn 2020.

CHAPTER 4.
Using 4.0 intelligence for VET

The background for establishing the Official Norwegian Committee on Skill Needs was set out in Report No 44 to the Storting (2008-09) *Education strategy* and Report No 18 to the Storting (2012-13) *Long-term perspectives – knowledge provides opportunity*.

The purpose of the committee is to produce the best possible professional assessment of Norway's future competence needs as the basis for national and regional planning, and to inform both the individual's and professional field's strategic competence decisions.

The committee will use a wide range of methodological approaches and stimulate the development of new knowledge bases. It will facilitate and stimulate open dialogue and debate about society's competence needs with different interest groups and society at large. The committee has used national and international references in addition to projection methods when developing its first report. The demand for labour is calculated using the empirical macro model MODAG, using figures and categorisations from national accounts. Provision of different types of labour is simulated for the future on the basis of register data using the model MOSART, which is a dynamic microsimulation method.

4.1. NOU 2018:2 - Future competence needs I – The knowledge base

We must anticipate major changes in competence needs going forward. Some will result from demographic changes, digitalisation, innovation and other development characteristics that have already taken place, but where we have so far only seen a limited part of the overall impact. Other changes will come as a result of future technological, organisational or other types of innovation, the scope of which is even more difficult to estimate.

The report reaches certain conclusions about topics considered in the knowledge base. In this article, we have concentrated on conclusions relating to digitalisation and automation.

4.1.1. Digitalisation and automation changing competence needs

Digitalisation means that work and services will be changed. Changes in work will take place across the workers' levels of education and will lead to the content of the various vocations changing and being subject to different competence requirements, but not necessarily to jobs disappearing. Digitalisation is expected to entail major changes in competence needs going forward. As tasks become

more and more complex and digitalisation encompasses even more jobs and tasks, interdisciplinary cooperation, and social and emotional competence will likely become more important.

Technological development, largely triggered by increased digitalisation, means that reorganisation needs will likely be greater than before. Digitalisation and automation will permeate the labour market to a greater extent and lead to a change in the work being carried out in all vocations across the workers' levels of education.

A number of studies have examined how exposed different professions are to automation based on an analysis of the degree to which tasks can be automated. These studies emphasise that there are bottlenecks that hinder the degree of automation for reasons relating to core tasks that require coordination and quick movements, creativity or social intelligence. Professional groups with a low estimated probability of automation include specialists in education, psychologists, specialist nurses, engineers in the chemistry field, clerics and primary and lower secondary school teachers. Professions with a high probability of automation include telephone and internet salespersons, accountants, shop assistants and clerks.

A new analysis of OECD countries indicates that a lower percentage of jobs in Norway are exposed to automation than in other countries. The study also found a higher rate of unemployment in vocations with a high risk of automation.

The digital shift will require greater competence in both managers and employees. Digitalisation can create entirely new jobs, such as application programmers and can also produce more new duties and challenges in existing professions, such as legal advisers, the police and security authorities. These professions work on issues relating to data protection, ethical issues and surveillance. One example is the question of who is liable in the event of an accident caused by a self-driving car.

4.2. NOU 2019:2 - Future competence needs II – Challenges for the skills policy

The Official Committee on Skill Needs' second report takes a more detailed look at national projections and identifies the occupational groups with a high risk of automation and those that are growing as a result. The report also shows that an expected decline in labour immigration can lead to the shortage of labour with upper secondary VET being greater than previously expected.

4.2.1. Changes in the occupational structure in Norway

A persistent shortage of qualified labour in certain occupations, particularly in the health and care sector, primary and lower secondary teachers, ICT and skilled building and construction workers.

Declining availability of certain types of skilled labour hinders value creation and employment, and this hits some regions harder than others. A persistent shortage of qualified labour will restrict business development and the provision of public services. The common denominator for these occupations is that they require formal vocational qualifications or a high degree of specialisation, which means that other types of labour cannot easily fill the gaps. The reasons for this shortage are varied and complex. One of the most important reasons is that there are too few study places, but weak recruitment, low completion rates and a mismatch between education and labour market needs are also significant. In addition, some people choose to take other types of jobs after completing their education.

The shortage of ICT labour was more than twice as high as registered unemployment in 2018. The estimated shortage of ICT labour has risen sharply from 2016 to 2018, while registered unemployment in the ICT profession has fallen. The statistics thus show a significant and increasing shortage of ICT labour, which reflects a strong increase in demand for ICT labour in recent years.

The strong increase in demand for ICT labour over the past few years is an important explanation for the significant shortage of ICT labour. At the same time, many ICT candidates who have completed their studies struggle to find relevant jobs, which could indicate a mismatch between employers' needs and the unemployed candidates' qualifications. Employers state that they prefer candidates with relevant work experience, rather than fresh graduates. A regional mismatch in the labour market also contributes to the shortage of ICT labour, as we see substantial unemployment among ICT candidates who do not live in Oslo.

If the shortage of ICT labour is to be reduced in the time ahead, it will be necessary to improve ICT candidates' transition to work. This suggests that closer ties are needed between educational institutions and the business sector, and that the quality and relevance of the programmes should be improved. The candidates should gain more skills through their education that employers need, and employers should take greater responsibility for training graduates in line with the enterprises' specific needs. In step with the increase in the number of study places in this field, more ICT specialists will also become available in the labour market in the time ahead, which will also help to reduce the considerable shortage of labour in this occupation.

4.2.1.1. *Occupational groups with a particularly high risk of automation*

Shop assistants and clerks were two of the occupational groups in Norway that saw the biggest decrease in the number of employees in the period 2005 to 2013 and had the highest probability of automation, measured by the number of wage earners.

These occupations have been clearly affected in different ways by digitalisation. In the years 2009 to 2013 alone, the number of clerks declined by

more than 6,000 people according to the register-based statistics for wage earners in the private sector. Information is not available about which tasks have been cut, but examples could include more use of electronic solutions for handling invoices and general accounting and reporting tasks.

Salespersons (wholesale) is one of the occupations that has seen the biggest decrease in the period 2005 to 2013. This strong decline has largely been seen among employees with lower secondary or upper secondary level education. Much of this decline is due to the increased digitalisation of tasks. The fact that the decline has been less pronounced among those with higher education could be due to it being more difficult to automate their tasks. It is more difficult to automate assessments and negotiations in the sales process, which are tasks that require greater expertise. The actual decline in salespersons (wholesale) is thus probably greater than the figures suggest.

There was very little growth in the number of shop assistants in the latter part of the period, 2009 to 2013. This breaks a long-term trend, where a growing population and higher disposable income per household have previously led to increased growth in this occupation. The changing trend can be explained by the transition to bigger shops that require fewer employees for each krone in turnover, but the number of shops has also declined in recent years. Online retail has increased, however, but employees who work in this industry are not coded as shop assistants.

4.2.1.2. *Changes in the structure of vocational programmes as a result of automation*

Recognised trades at upper secondary level target these occupations. However, the programme structure in upper secondary education is changing, and a new structure for vocational upper secondary education programmes will be introduced in autumn 2020. Office and administrative skills will be replaced and the ICT subject will be highlighted in a separate study programme that will offer earlier specialisation and be better adapted to the labour market's needs.

CHAPTER 5.
VET 4.0 learning practises

Tertiary vocational education in Norway is a publicly approved profession-oriented education at upper secondary level. Vocational colleges in Norway are rated at level five in the national qualification framework. The education provides competence that can be used in professional practice without further training measures and is a fully equivalent alternative to university and university college education. The education lasts from between one semester to two academic years.

Report No 9 to the Storting (2016-17) S*killed workers for the future – vocational college education*, issued in 2016, set out a number of measures intended to improve vocational colleges. The unique nature of vocational colleges allows them to quickly adapt to labour market competence needs. Several vocational colleges are already adapting their programmes to meet the requirements that follow in the wake of Industry 4.0. Innlandet Vocational College has adapted one of its education programmes to the latest industry developments, and this will be described in the following section.

5.1. Robotisation of learning arenas – Operationalising Industry 4.0

In autumn 2016, Innlandet Vocational College introduced a new programme option to improve the quality of its education programmes. Industry 4.0 encompasses new business models, automation and digitalisation of traditional industries and is reflected in more efficient use of resources, intelligent processes and more advanced communication between humans and machines.

Innlandet Vocational College is making efforts to ensure that the students are capable of adjusting to this development. The programme was developed in close collaboration with business and industry in the region.

It encourages up-to-date and profession-oriented tertiary vocational education and has led to the college upgrading its technical programmes. The following measures have been initiated since start-up in 2016:

(a) the use of industrial CNC robots for students of the technical and industrial production programme (TIP) and electronics programmes (elpower and automation);

(b) more and further developed use of 3D modelling with Revit, Autodesk Inventor, Additive Manufacturing (e.g. 3D printing) for students taking the following programmes: Climate, energy and environmental engineering, building, construction and building information modelling (BIM), TIP, and the electronics programmes.;

(c) the use of drones in land surveying with a combination of virtual reality (VR) and augmented reality (AR);

(d) the use of VR/AR in BIM;

(e) digitalisation of education with video and streaming of lectures;

(f) the use of cloud solutions in laboratory exercises (the students operate the laboratories at school from their current location);

(g) broad, conscious and future-oriented use of cloud solutions in co-writing, collaborations, file sharing and data transfer;

(h) centralised and efficient use of Citrix solutions for students and teachers. In practice, this means that the students can use all necessary software, regardless of their location, through a central server managed by the school. The solutions also mean a significant reduction in computer costs for the students and a higher level of security in digital solutions.

The measures that have been implemented contribute to revitalising the teaching and provide a more modern educational content. They create variety in the teaching, and the students report that the methods have increased their motivation and enthusiasm for their studies.

Local curricula and content have also been amended. The programme descriptions now place more emphasis on the students raising their competence through different forms of digital support methods in their work.

Developing remote controlled digital laboratory exercises, where the students can take part in laboratory work from almost any location, has a positive effect on the programme. This is done by installing cameras and instrumentation in several of the laboratories. The college has also established remote monitoring and remote control possibilities so that, on agreement, the students can log in from their location and both observe and operate various functions. This helps to improve knowledge, skills and competence and increases the learning outcomes.

Innlandet Vocational College has developed a learning scheme for the use of VR technology that students taking the BIM and TIP programmes can use. In time, this will also be used in the college's other programmes. VR is increasingly used in working life and it is important to keep the students up-to-date on its use. The students' learning outcomes increase significantly when they can use this technology to control what they have designed and modelled.

The programme was established on the basis of labour market demands for a future-oriented vocational college education. Innlandet Vocational College works with local businesses, upper secondary education institutions in Oppland county, the Norwegian University of Life Sciences (NTNU), the vocational training office for industry and technology, and the industrial cluster in Raufoss.

The industrial cluster has signalled a need for adaptation to the industrial structures of the future and depends on access to vocational college engineers who can handle and operate automated and advanced processes. The collaboration has ensured support, motivation and enthusiasm for the programme.

In the continuation of this work, a mini-learning factory will be established in various subject areas. The main goals are to ensure greater innovation and learning outcomes, and the development of green industry. The schools and core businesses in the industrial cluster and local SMBs are involved in the initiative.

Upper secondary school pupils, vocational college students and NTNU will work together to develop the concept 'experts in a team' and will explore real issues raised by industrial enterprises. In this way, the students' learning methods will be developed and there will be more focus on increased rationalisation through digitalisation and robotisation. A long-term effect will be that the labour market will have quick access to competent workers with documented qualifications in programming and process management.

Innlandet Vocational College has established academic councils for all its programmes. These comprise industry representatives, teachers and heads of departments. The councils convene once or twice a year and discuss labour market needs in relation to programme content.

The college has also established close contact with the Manufacturing Technology Norwegian Catapult Centre (MTNC) through participation at steering committee level and work process level. All the teachers' employment contracts include an agreement on contact with the industry in their respective fields.

The college uses available statistics and information from a number of different sources to stay abreast of labour market needs in both the public and private sector.

Examples of such sources are the Confederation of Norwegian Enterprise's (NHO) competence barometer, the Norwegian Labour and Welfare Administration's (NAV) publications on labour needs, and the Norwegian Association of Local and Regional Authorities' (KS) statistics on labour needs in the public sector. Information from these sources is used to make strategic decisions when designing the college's study programmes.

The programme will have great transfer value to, for example, health and social care programmes. The digital competence of employees and welfare technology solutions can give patients a greater sense of freedom, security and, in general, better services for patients and next of kin, as well as more efficient use of resources in the municipal health and social care services.

To increase efficiency in the health services, it is important to establish standards, and better and more modern cloud-based solutions. With a greater percentage of elderly persons and more patients with complex diagnoses, employees must work smarter and use new technology. It is therefore essential that the health and social care programmes also utilise this technology in their teaching methods.

The programme can also be transferred to agricultural programmes. Surveillance and remote controlled operation of processes and activities are already used in agriculture. Examples of this are the use of GPS in relation to farm animals, drones during spraying, robotised milking of cows and self-driving

agricultural robots that can carry out high-precision farm work. Fertiliser and pesticide application can also be optimised using precision technology.

No study programmes or subject areas can avoid digitalisation, innovation and Industry 4.0 altogether. Interdisciplinary cooperation between the different programme options and utilising the opportunities brought about by synergy effects are essential to students, teachers and the labour market going forward.

CHAPTER 6.
Adapting to AI and automation

6.1. Strategy for artificial intelligence

The transition to the fourth industrial revolution will bring bigger and more far-reaching changes in society at large as well as in the labour market than ever seen before. New technology can replace tasks that were previously considered difficult to automate. The availability of huge quantities of data, artificial intelligence and powerful processors enable the technology to be used in new areas and will lead to changes of an unprecedented scale.

Artificial intelligence is a technology that can have huge significance for societal development, and that gives us brand new tools with which to address challenges facing society, improve public services and contribute to greater value creation in the business sector. However, the technology also presents challenges, particularly with respect to ethics and data protection. A national strategy for artificial intelligence is currently being drawn up to respond to these needs. The strategy is scheduled for completion in 2019.

Relevant topics in the forthcoming national strategy for artificial intelligence will be:

(a) how Norway can develop artificial intelligence expertise by facilitating education, research and innovation;

(b) how Norway can start using artificial intelligence, through, among other things, digital skills, adapting to changes in the labour market and using artificial intelligence in the public sector;

(c) how Norway can exploit the commercial potential of artificial intelligence;

(d) the strategy will also consider technologies that enable artificial intelligence, such as broadband and 5G, High Performance Computing (HPC), etc.

(e) artificial intelligence raises a range of issues linked to ethics and data protection. A national strategy will naturally deal with such challenges.

6.2. NOU 2019:12 - Learnability: lifelong learning for reskilling and competitiveness

On 4 June 2019, a national committee on continuing and further education delivered the new green paper Learnability: Lifelong learning for reskilling and competitiveness. NOU (Norwegian Official Report) 2019: 12. The green paper proposes how we can facilitate lifelong learning and ensure that continuing and

further education is flexible and possible in practice for employees. The committee has assessed how changes in society and the labour market will affect the need for lifelong learning. The committee has also assessed whether the education system is capable of meeting these needs, whether the framework conditions for investing in new skills is sufficient and whether the policy instruments as a whole are adapted to the needs of the future. The report contains the committee's proposals for what should characterise a system for lifelong learning, and how a system can be established by changing existing policy instruments and supplementing them with new instruments.

The committee proposes a range of measures:

1. Strengthening the range of education and training programmes defined on the basis of the labour market's needs.
2. Improving the quality of the programmes on offer.
3. Extending access to education and training to more people.
4. Increasing regional responsibility for coordination and mobilisation.

6.2.1. NOK 35 million to flexible further education programmes in digital skills

In 2019, NOK 35 million was allocated to 16 different cooperation projects between university colleges, universities, tertiary vocational colleges, enterprises and the business sector to develop new further education programmes that will help business and industry to take advantage of the opportunities presented by digitalisation.

The 16 projects comprise enterprises across Norway that need a top-up in digital skills. As a result of technological developments, the number of jobs that require little or no formal qualifications is decreasing, at the same time as these developments mean that highly qualified employees need to regularly top up their skills.

The further education programmes in digital skills are being developed through collaborations between tertiary vocational colleges, universities and university colleges, and local businesses that need to top up their skills. Inland Norway University of Applied Sciences will develop, among other things, an open online course in Virtual Reality and AI for the business sector in Norway, and the University of Agder and the NCE (Norwegian Centre of Expertise) iKuben will develop courses in Industrial digitalisation and AI.

It will be possible to combine this flexible further education with working almost full-time, and it will be organised in such a way as to give as many people as possible the opportunity to take such education.

Flexible further education programmes in digital skills are a policy instrument in the Government's lifelong learning skills reform. The goal of the new skills reform is for no one to be excluded from the labour market because of a lack of skills. The goal is:

- Better access to flexible further education for enterprises that need skills to digitalise their activities
- Better access to flexible and job-relevant further education in digital skills for individuals
- Increased cooperation between educational institutions and the business sector on developing further education

6.2.2. Flexible continuing education to develop competence-raising options in the industries particularly at risk of digitalisation, automation and other forms of reorganisation.

NOK 30 million was also allocated over the national budget for 2019 to industries at risk of digitalisation and automation or other types of reorganisation. Flexible continuing education will be organised such that the state pays for the development, while enterprises must invest operating resources, and individuals must invest their own time. The scheme will initially focus on vocational education and training in the municipal health and care sector and industry and the construction industry.

6.2.3. Continuation of trials based on modules at lower secondary level and in vocational education and training.

NOK 36.3 million was also allocated over the national budget for 2019 for the continuation of trials based on modules at primary and lower secondary level and in vocational education and training. This trial scheme tests the opportunities for more people to complete a craft certificate or other education in combination with work.

CHAPTER 7.
Conclusion – Main challenges and outlook

Vocational education is a top priority in national policy, which is reflected in the white papers, strategies and measures described in this article.

Access to up-to-date, technological and digital equipment in education is essential to ensuring that workers are educated to meet the challenges of the future. A good cooperation between schools and local business will be necessary in order to have up-to-date and relevant technological equipment in education.

The Official Norwegian Committee on Skill Needs indicates that in the years leading up to 2035, there may be a shortage of persons with vocational education and training (VET) and that an expected decline in labour immigration could increase the shortage of labour with upper secondary VET to a greater extent than previously estimated. One challenge that is particularly relevant to vocational education and training is the persistent shortage of qualified labour in certain occupations, particularly in the health and care sector, primary and lower secondary teachers, ICT and skilled building and construction workers. The report also shows that the occupational groups clerks and shop assistants are expected to be at particular risk of automation.

These projections are intended to produce the best possible professional assessment of Norway's future competence needs as a basis for national and regional planning, and to inform both the individual's and labour market's strategic competence decisions.

A new vocational subject structure is set to be implemented in 2020 with a view to making the education programmes more relevant to professional practice and meeting the future need for qualified workers.

The number of education programmes is being expanded from eight to ten, and four new programmes are being introduced from the school year 2020/21.

One of the new programmes, ICT and media production, is intended to address the need for increased digital skills, and office and administrative skills is being replaced as a result of less demand for labour in this area.

Previous reviews have pointed out that not all vocational education programmes have worked as well when it comes to recruitment to recognised trades and connection to the labour market. The new programme structure has therefore incorporated a greater focus on early specialisation and the programmes are adapted to labour market needs.

Projections also show that there will be a great need for more vocational teachers in the years to come. It is a challenge in this respect that schools must directly compete with the salary level of the private sector to recruit and hold on to vocational teachers. In addition, the education sector must often recruit teachers from industries with shortages in the labour force. The Government has therefore

introduced a separate recruitment grant for skilled workers and others with a relevant education who wish to become vocational teachers.

Projections also indicate that those who have only completed primary and lower secondary school, or a foundation course at upper secondary level, will find it more difficult to find work.

They also show that, towards 2030, there will be an increased demand for people with a craft certificate from upper secondary school. Developing vocational subjects, raising completion rates, facilitating flexible courses of education and adapting vocational subjects to labour market needs will be essential factors in meeting future needs. This article covers some of the measures that have been implemented and that are linked to digitalisation and Industry 4.0.

Abbreviations and acronyms

AR	Augmented reality
BIM	Building information modelling
KS	Norwegian association of local and regional authorities
MTNC	Manufacturing technology Norwegian catapult centre
NAV	Norwegian labour and welfare administration
NHO	Confederation of Norwegian enterprises
NOU	Norwegian official report
NTNU	Norwegian university of life sciences
TIP	Industrial production programme
VET	Vocational education and training
VR	Virtual reality

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