CEDEFOP REFERNET FRANCE

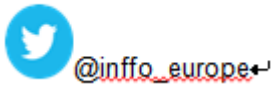
VOCATIONAL EDUCATION AND TRAINING FOR THE FUTURE OF WORK

FRANCE

CEDEFOP REFERNET THEMATIC PERSPECTIVES

Vocational education and training for the future of work: France

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



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The thematic perspectives series complements the general information on vocational education and training (VET) systems provided in 'VET in Europe database'. The themes presented in the series feature high on the European agenda.

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CHAPTER 1.

Introduction – Impact of digitalisation in France

The development of digital, automation and artificial intelligence (AI) technologies in work organisations has emerged as a major issue in French public debate.

France is ranked at the position in the European Digital Economy and Society Index (DESI) ([1]). Compared to other European countries, France appears particularly attractive for AI start-ups: it is ranked first for the continent and Paris first European city by the McKinsey Global Institute comparison ([2]).

However, the modernisation of the industrial sector is lagging; in 2015, there were twice fewer robots in French factories as in those of Italy, and five times fewer than in German factories ([3]).

Regarding the effects of digitalisation, automation and AI on the labour market, an increasing polarisation is expected with the impact concentrated around low-skilled and highly skilled jobs, at the relative expense of intermediate-skilled workers.

According to forecasts ([4])([5]), within the next 10 to 15 years:

- 10% of jobs (3 million) are at risk of automation and efforts to retrain and support them will have to be concentrated on them. This includes trades with a high content of manual and routine tasks (maintenance workers, personal assistance, labourers, ...),
- 50% of jobs (15 million) will see part of their tasks gradually automated,

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([1]) https://ec.europa.eu/digital-single-market/en/news/digital-economy-and-society-index-desi-2019

([2]) McKinsey Global Institute (2019). *Notes from the AI frontier - Tackling Europe's gap in digital and AI*. https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/Tackling%20Europes%20gap%20in%20digital%20and%20AI/MGI-Tackling-Europes-gap-in-digital-and-AI-Feb-2019-vF.ashx

([3]) Patrick Artus (2017). *Paper: Schumpeter and the robots, the case of France.* https://www.generationlibre.eu/wp-content/uploads/2017/11/2017-12-Schumpeter-et-les-robots-_-GenerationLibre.pdf

([4]) COE (2017). *Automation, digitisation and employment report, Vol. 1: the impacts on employment volume, structure and location.* http://www.coe.gouv.fr/Detail-Nouveaute.html%3Fid_article=1347.html

([5]) Cabinet Erdyn, Cabinet Katalyse, DGEFP, Conseil Régional Hauts-de-France, Medef Lille Métropole, Opcalia (2019). *Impact of AI on jobs and skills in Hauts-de-France: prospective study.* http://hauts-de-france.direccte.gouv.fr/sites/hauts-de-france.direccte.gouv.fr/IMG/pdf/synthese-etude-iahdf.pdf

- 40% of jobs (12 million) are in occupations that are expected to be little impacted by automation.

The strong employment growth expected in the digital trades, 3% of jobs in 2017 ([6]), could lead to a significant skills shortage. AI specific job offers have doubled between 2016 and 2017 ([7]). In this specific field, the need for skills will focus in particular on profiles of specialised engineers capable of intervening in the operational deployment of AI.

The low attractiveness of these professions to young people, as well as the lower proportion of women, are issues that need to be addressed.

Regarding required skills needs, the studies highlight the growing importance of cross-cutting skills, in particular creativity, for working in complementarity with AI. The acceleration in the obsolescence cycles of technical skills is also forecast.

To take up these challenges, a range of strategies, reforms and initiatives have been recently set up in IVET and CVET.

([6]) INSEE (2019). *Data scientists, community managers… and computer scientists: what are the digital professions?* https://www.insee.fr/fr/statistiques/4238635

([7]) https://corporate.apec.fr/home/nos-etudes/toutes-nos-etudes/lintelligence-artificielle--tend.html

CHAPTER 2.

VET policy strategies to adapt to digitalisation

Effectively taking up the challenges of the digital transition is a major aim and one of the foundations driving the public policies and reforms now being carried out in the field of IVET and CVET.

2.1. The national *AI for humanity* strategy

A national strategy dedicated to AI, "AI for humanity" was instituted in March 2018, with the ambition of positioning France at the forefront of global AI players. It is backed by a 1,5 billion euros in public funding for a five-year term plan. The strategy was presented in a report prepared by the MP and mathematician C. Villani ([8]), which sets out a series of recommended objectives and suggested measures.

Anticipating and tackling the impact of AI on work and employment is one of the cornerstones of the *AI for humanity* strategy. As regards the structure of the labour market, the aim is first to prevent polarisation of the market as a whole and increasing inequalities.

The strategy identifies four priority sectors facing major sectoral issues and challenges: health, environment, transport-mobility and defence-security.

In connection with VET, the strategy aims at strengthening research capacity with the development of a network of interdisciplinary AI institutes. It also sets the objective of tripling the number of people trained in AI within a 3-year period, with a priority on remedying the lack of high-level graduates (Masters, PhD). Another objective concerns the training of students in more technical AI professions. A target in terms of gender is also set for 40% of women in the digital sectors to be achieved by 2020.

At the level of the Ministry of Higher Education, Research and Innovation (MESRI), the *AI for humanity* strategy has been cast into a *national strategy for research on artificial intelligence* ([9]), presented in November 2018.

Within the State services, the "interministerial directorate for digital technology and the government information and communication system" (DINSIC) provides support for digital transformation ([10]).Through a call for

([8]) https://www.aiforhumanity.fr/pdfs/MissionVillani_Report_ENG-VF.pdf

([9]) http://www.enseignementsup-recherche.gouv.fr/cid136649/la-strategie-nationale-de-recherche-en-intelligence-artificielle.html

([10]) https://www.etalab.gouv.fr/wp-content/uploads/2018/11/Lab-IA-dossier_de_presse_-_2eme_comite_interministeriel_de_la_transformation_publique_-_29_octobre_2018.pdf

expressions of interest on AI, 6 projects from administrations wishing to develop the use of AI to improve their action were selected ([11]).

2.2. The reform of continuing vocational training and the apprenticeship system

Developing a skills-based society capable of meeting the challenges of the digital transition is one of the motivations for the systemic reform of the French system of continuing vocational training and apprenticeship, pursuant to the *law for the freedom to choose one's professional future* adopted in September 2018. The least qualified people are the priority targets, in order to protect them from skills obsolescence.

This reform entails a complete overhaul of the training system, by redefining its governance, funding and main schemes. Professional branches have an increased role to adapt qualifications as well as to develop apprenticeship training, all in accordance with the needs of companies.

The reform facilitates access to lifelong training for each individual, whatever his/her status, through a Personal Training Account *("Compte personnel de formation*, CPF"). The CPF is recorded in euros: EUR 500 (800 for the least qualified people) per year per person are credited, totalling EUR 5 000 (8 000) over a period of 10 years. It can be used thanks to a digital application that offers individuals direct access to their account, the eligible training courses by which to gain qualifications or sets of competences, and registration for training action.

One program aiming to train one million young people and one million job seekers, *plan d'investissement dans les compétences* (PIC) [skills investment plan], was launched in 2018 with a budget of 15 billion euros for 5 years. It deals with the challenges of the digital transition in each of its areas of action: training actions in digital professions, support for the development of forward-looking tools on employment and skills by the professional branches, and support for the modernisation and integration of new technologies by training organisations.

2.3. Ministry of National Education and Youth guidelines

The main strategic directions from the Ministry of National Education and Youth (MENJ) to place digital innovation at the heart of pedagogical and organisational transformations are summed up in the dossier *digital technology serving confidence in schools* ([12]), presented in 2018. A detailed and updated

([11]) https://www.modernisation.gouv.fr/sites/default/files/fichiers-attaches/207_-_dossier_de_presse_-_ami_ia.pdf

([12]) http://cache.media.education.gouv.fr/file/08_-_Aout/36/1/DP-LUDOVIA_987361.pdf

presentation of the strategy was communicated at the start of the 2019 school year ([13]). It details all of the objectives pursued and actions carried out, through 5 axes: the use of data, digital technology as a means of teaching, supporting and reinforcing teachers' skills, the development of pupils' digital skills, and the creation of new ties with school stakeholders and partners. AI's development as an innovation serving the efficiency of teaching in schools is addressed, anticipating various possible applications in the daily practices of teachers.

In June 2018, the Ministry of National Education and Youth (MENJ) also opened a structure dedicated to innovation called *110 bis* ([14]), which is a laboratory aimed at supporting project owners and a network flagship for the forty labs already active in the field of digital education.

2.4. Strategies developed by the Regions

The regional authorities deploy strategies and initiatives to develop ecosystems specialised in the area of AI and digital transition. These strategies focus on the development of specific training, collaborative projects and support for start-ups through multi-year plans ([15]).

The development of ecosystems specialised on Industry 4.0 is particularly dynamic in some regions ([16]).

([13]) https://www.education.gouv.fr/cid133192/le-numerique-au-service-de-l-ecole-de-la-confiance.html&xtmc=profan&xtnp=1&xtcr=1

([14]) http://www.education.gouv.fr/110bislab/pid37871/bienvenue-au-110-bis-le-lab-d-innovation-de-l-education-nationale.html

([15]) e.g.: "Plan AI 2021 " in Ile-de-France launched in October 2018, https://www.iledefrance.fr/presse/la-region-ile-de-france-presente-plan-regional-l-intelligence-artificielle-ia-2021-les, Plan launched in région Grand Est in June 2019, http://regions-france.org/actualites/en-direct-des-regions/presentation-du-plan-intelligence-artificielle/

([16]) e.g.: regions Auvergne Rhône-Alpes, Pays de la Loire, Occitanie. As mentioned in the report: Cabinet Erdyn, Cabinet Katalyse, DGEFP, Conseil Régional Hauts-de-France, Medef Lille Métropole, Opcalia (2019). *Impact of AI on jobs and skills in Hauts-de-France: prospective study.* http://hauts-de-france.direccte.gouv.fr/sites/hauts-de-france.direccte.gouv.fr/IMG/pdf/synthese-etude-iahdf.pdf

CHAPTER 3.

VET 4.0 initiatives and programs

3.1. Initiatives in the field of education and initial vocational training

3.1.1. The PIX platform

In order to assess and certify the level of digital skills of secondary students, university students as well as workers, a free online platform PIX ([17]) was developed on the impetus of the Ministry of National Education and Youth (MENJ). It was initially developed as a State start-up before being established as a Public Interest Grouping.

Based on the DigComp 2 European skills reference framework, PIX offers all users the chance to accurately determine their level of proficiency in 16 different areas of competency. The PIX qualification is recorded on the National Register of Vocational Certifications.

The assessment tests are based on action: challenges, practical cases and immersive environments in which individuals can hone their digital competencies while testing themselves on a fun interface that stimulates the desire to learn. For each of the questions asked, a selection of teaching resources (tutorials, fact sheets, online courses) is provided so that users can embark on a dynamic progress. Thanks to an adaptive algorithm, the difficulty of the tests is adjusted to the user's level. Each user therefore benefits from a personalised experience.

Since the launch of the PIX platform in November 2016, 300,000 accounts have been created and 50,000 certifications issued ([18]).

3.1.2. The ProFan programme

The Ministry of National Education and Youth's ProFAN programme tests out new teaching and training methods within the vocational pathway, to encourage the development of new competences required by the digitisation of professions ([19]).

Its objectives are to identify new competences associated with the professions and activities that have emerged with the development of digital technology, and to test and qualify new contexts of learning and teaching

([17]) https://pix.fr/

([18]) https://pix-site.cdn.prismic.io/pix-site/8111d394-079e-445c-9c57-979d7f16f1b8_06102019_Dossier-presse.pdf

([19]) http://www.education.gouv.fr/pid285/bulletin_officiel.html?cid_bo=108403

intended to promote the acquisition of these competences. The target competences combine technical competences with cross-cutting ones.

One of the programme's innovative aspects lies in it bringing together, in a shared protocol, field players and high-level researchers from France and Switzerland, from the disciplines of cognitive sciences, behaviour, economics, ergonomics and education.

National in scale, this experiment involves 110 vocational high schools with a thousand teachers, 10,000 vocational baccalaureate students and seven laboratories with around thirty researchers and doctoral students.

It covers three professional sectors: the electricity professions and its connected environments, support and care and personal services, and commerce. The programme runs since September 2016 and until September 2020. A scientific colloquium organized in October 2019 presented the first results of the project and the experiments carried out ([20]).

3.1.3. Training for specialised teachers

A *certificat d'aptitude au professorat du second degré* (CAPES) [certificate of aptitude for secondary education teachers] specific to those specialising in *digital and computer sciences* has been instituted, the first test session of which has been scheduled to take place in 2020.

In implementing this specific training programme, the aim is to enable teachers to deliver high-quality, stringent training in step with the latest technological developments, in connection with the introduction of a new specialised *digital and IT sciences* course in the middle year of secondary school.

3.2. Training programmes supported by the skills investment plan

The skills investment plan (PIC, cf 1.2) is structured around thrusts for action, all incorporating the issue of work digitalisation and the 4.0 revolution.

One thrust is dedicated to financing new training and support pathways in sustainable employment. Under this thrust, a so-called *KNUM* national programme enabling training for 10 000 people in digital professions was launched in 2018 ([21]). The KNUM programme is aimed at addressing the growth of the digital sector and its struggles to recruit. It is geared at job seekers, young people and in particular school drop-outs, and provides a special digital professions grant for all businesses wishing to train a candidate. 347 new training

([20]) https://www.education.gouv.fr/cid146053/participation-de-jean-michel-blanquer-au-1er-colloque-scientifique-de-l-action-profan.html

([21]) https://travail-emploi.gouv.fr/IMG/pdf/10knum_10000_formations_au_numerique.pdf

courses have been awarded the “grande école du numérique” label, which stands for a set of quality, innovation and inclusion criteria ([22]).

Some innovative projects selected in 2019 are presented in Chapter 5.

3.3. Initiatives developed by the social partners

3.3.1. French Coalition for digital skills

Launched in 2017 at the initiative of the European Commission, the French Coalition for Digital skills is coordinated by MEDEF, the employers' union. The coalition aims to develop a digital strategy for skills and jobs. Among the actions carried out in 2019, it has developed practical tools to compensate for the lack of attractiveness of digital jobs to young people and in particular girls ([23]).

3.3.2. A qualification dedicated to basic digital skills

A new qualification called “CléA numérique” has been registered in September 2018; as an inter-professional certificate attesting to proficiency in basic digital skills ([24]). Cléa numérique targets jobseekers as well as employees, to enable them to develop a set of digital skills and have them recognised through a qualification.

The scheme combines an initial evaluation of one individual’s skills needs, access to a tailored training pathway, and a final evaluation leading to acquire the qualification. It is eligible for CPF funding (cf 1.2).

3.4. A specialised training provision on AI developed by public and private service providers

AI-based initial and continuing training provision is developed on the impetus of training providers.

([22]) https://www.grandeecolenumerique.fr/wp-content/uploads/2018/12/GEN_Appel_a_labellisation_2018_.pdf

([23]) French Coalition for Digital skills (2019). *Young and digital, the paradox! How can we make digital jobs more attractive?* https://www.medef.com//uploads/media/node/0006/68/10614-rapport-laquo-jeunes-et-numerique-le-paradoxe-raquo-.pdf

([24]) https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000037382019&dateTexte=&categorieLien=id

There exist many initiatives in this area, most often degree programmes in which AI is but one component. Those exclusively referring to AI are rarer, with 35 specialised Masters ([25]).

Training centres dedicated to VET in AI have opened, with the support of some of the major players in the IT or e-learning sector ([26]).

([25]) https://minefi.hosting.augure.com/Augure_Minefi/r/ContenuEnLigne/Download?id=0B24A9E8-CBA3-4F4C-8379-78D20E88ACF2&filename=1314-%20IA%20DP.pdf

([26]) e.g.: an AI school opened in Occitanie, thanks to a partnership between the Region and Microsoft. https://www.laregion.fr/La-1re-ecole-d-intelligence-artificielle-en-region-ouvre-en

CHAPTER 4.

Using 4.0 intelligence for VET

4.1. Innovations supported by the Skills investment plan

One thrust of the skills investment plan (PIC, cf 1.2) is dedicated to the use of data and the development of labour market and skills information in order to refine the training provision and better guide individuals. This includes project financing to develop advanced data analysis systems in real time by expanding statistical sources, with the construction of shared tools, particularly digital, to identify businesses' competence requirements ([27]).

Another thrust aims at supporting to the transformation of training providers and innovation in educational approaches.

4.2. The development of new guidance and information tools

4.2.1. Innovative tools of the public employment service

The public employment office, Pôle emploi, has created an internal structure, *le lab*, dedicated to developing innovative services for its advisers, registered job seekers, recruitment firms and partners ([28]). The structure operates like an internal start-up and uses a project development methodology in agile mode that involves end users as well as upstream to test and design digital service prototypes.

A service dubbed *my professional potential* ([29]) has thus been developed, combining competences related to a person's profile with those most sought on the job market, suggesting career development paths, and thus encouraging professional mobility. It aims to allow for the co-construction of the professional project by the job seeker and adviser based on hypotheses developed from data analysis.

The expert system provides an ability to analyse extremely large quantities of data, including 5 million job offers, as well as modelled successful pathways

([27]) https://travail-emploi.gouv.fr/grands-dossiers/plan-d-investissement-competences/article/axe-1-mieux-analyser-les-besoins-de-competences-pour-mieux-orienter-les

([28]) https://www.lelab.pole-emploi.fr/

([29]) https://www.pole-emploi.fr/candidat/boostez-vos-competences-avec-mon-potentiel-professionnel--@/article.jspz?id=640286

built from actual professional reintegration or return-to-employment trajectories observed in beneficiaries.

The development of new services using AI is targeted with the financial support of a fund of 20 million for 3 years ([30]).

4.2.2. Innovative information tools on training and jobs

4.2.2.1. *At the regional level*

A variety of Carif-Oref ([31]), regional structures in charge of providing information about training and foresight on jobs and competences, have developed innovative information tools for the general public, premised on the use of large labour market data sets connected up with those relating to available training: the online tool Cléor, *keys for regional development and orientation*, for instance, has been deployed in five regions ([32]). For this purpose, it mines and aggregates a variety of data: corporate social declarations, Pôle Emploi's job offers and surveys on labour requirements, the interregional database on available training, results of surveys carried out by the Ministry of National Education and Youth (MENJ) concerning professional integration, etc.

Another example is the development of a digital platform listing the entire higher education offer in the Brittany region, which will incorporate an engine using AI for personalised content[33].

4.2.2.2. *At the level of the professional branches*

Professional sector observatories have also developed tools that provide real-time information on trends on the job market, competences and qualifications researched by the employers. For instance, the observatoire des métiers du numérique, de l'ingénierie, des études et conseil et de l'événement (OPIIEC) [observatory of occupations in the fields of digital, engineering, counselling and events] developed an online platform with updated data on job market trends in the sector, the dynamics of professions, shifts in the profiles sought and trends in training ([34]). Here too, an effort has been made to improve the data ergonomics

([30]) https://www.archimag.com/demat-cloud/2019/09/06/transformation-action-publique-pole-emploi-dope-ia

([31]) The Carif-Oref (Centre animation ressources d'information sur la formation - Observatoire régional emploi formation), partnership structures supported by the French State and Regions, are in charge of informing professionals and the general public about available training, and producing forward-looking studies on trends in jobs, qualifications and competences in the territories. http://reseau.intercariforef.org/

([32]) e.g. region Auvergne–Rhône–Alpes: https://www.cleor-auvergnerhonealpes.fr/

([33]) https://www.univ-rennes1.fr/actualites/orientation-luniversite-de-rennes-1-et-ses-partenaires-selectionnes-avec-brio

([34]) http://observatoire-metiers.opiiec.fr/

and layout to produce a set of aggregated and updated data that is accessible and clear to the general public ([35]).

4.2.2.3. *Developed by start-ups*

Innovative guidance services are developed by private start-ups, which are distinctive in that they mine analysis of big data on actual pathways e.g. those of alumni from an institute of higher learning, or data from professional social networks such as LinkedIn and Viadeo.

For instance, one start-up ([36]) working in collaboration with the Onisep ([37]) has produced a mapping based on 750 Onisep job descriptions and data about the career paths of alumni across selected territories. Research on the possible training pathways and their opportunities is refined based on actual experiences. The geolocation covers both diplomas and businesses and contact with real people is offered.

Another example is a start-up ([38]) that has developed guidance services using AI, in partnership with higher education institutions. A professional exploration project on more than 100 million experiences has been carried out, bringing together around 20 000 jobs.

([35]) e.g. digital sector: http://observatoire-metiers.opiiec.fr/numerique/2018/tous-les-themes/tous-les-indicateurs

([36]) Human roads: www.humanroads.com

([37]) A public publisher, Onisep produces and disseminates information on training and jobs.

([38]) Studizz: www.studizz.fr

CHAPTER 5.

VET 4.0 learning practices

This chapter does not aim to cover the digitisation of training in the broad sense. The paragraphs below focus instead on some examples of innovative practices.

5.1. The growth of EdTech

The term EdTech refers to the ecosystem of players specialised in digital innovation, and its application in the field of education and training and brings together a variety of actors, both public and private, such as research organisations, training organisations, IT providers, etc. The French EdTech observatory lists 387 specialised players ([39]).

A vast range of initiatives and innovations are driven by the economic players that transform training practices. The Fédération de la formation professionnelle [Federation of Vocational Training, employers' union of training providers] has developed a project to raise awareness and support managers of training companies in the digitalisation of their activity ([40]).

5.2. Using immersive tools and virtual reality for guidance or training

Various new tools and projects are developed around the use of immersive exploration to learn about new professions.

The profession explorer ([41]), produced by a private publisher, offers a video information platform to facilitate career guidance and is now developing a new form of 360-degree video ([42]). In the first immersive video, users are introduced to operating room professions, experiencing those professional realities in total immersion mode ([43]).

The start-up *Come In-VR* ([44]), which specialises in developing learning software for machine or vehicle driving simulators, has developed a virtual reality

([39]) http://www.observatoire-edtech.com/

([40]) Project "digital training for employability and competitiveness": www.pia-ffp.org

([41]) https://www.explorateurdemetiers.tv/actualites

([42]) https://vimeo.com/302211893

([43]) http://www.citedesmetiers-valdemarne.fr/wp-content/uploads/2018/11/communique-de-presse-explorateur-de-metiers-cite-des-metiers-94-21-11-2018.pdf

([44]) https://www.come-in-vr.com/

forklift driver simulator ([45]). Through immersive training, the aim is to better professionalise future drivers of lifting equipment and reduce the number of workplace accidents that occur in their line of work.

5.2.1. Promoting and training to Industry 4.0

The *extraordinary factory* event was held in November 2018 in Paris, with the aim of showing the technological sophistication of Industry 4.0 and the appeal of its new professions ([46]). Visitors were introduced to the technological innovations now transforming industrial processes: sensors, Internet of Things, AI, 5G, 3D printing, robots, augmented and virtual reality.

Aimed at changing the way people, and particularly the younger generations, see the industrial sector, it was organised under the aegis of the Foundation for Action against Exclusion (Fondation Agir Contre l'Exclusion, FACE).

The technological platform "*Factory of the Future*" of the Apprentices training centre for industry of Brittany, inaugurated in November 2019, will enable the training of alternating students and employees in the new technologies used by industry and metallurgy ([47]).

([45]) https://www.come-in-vr.com/wp-content/uploads/2018/11/Pr%C3%A9sentation-FL1-CAT-3.V1.pdf

([46]) https://www.usineextraordinaire.com/

([47]) https://www.centre-inffo.fr/site-centre-inffo/actualites-centre-inffo/le-quotidien-de-la-formation/articles-2019/lusine-du-futur-de-bretagne-un-outil-appele-a-etre-partage-par-un-maximum-dentreprises

CHAPTER 6.

Adapting to AI and automation

6.1. Rolling out of the national strategy « AI for humanity »

6.1.1. Development of a research network

Four Interdisciplinary Institutes of Artificial Intelligence (3IAs) have been selected by the Ministry of Higher Education, Research and Innovation (MESRI) and labelled for an initial period of four years. They will receive funding to conduct their research, training and innovation programme ([48]).

6.1.2. Deployment of the economic strand

The Ministry of Economy and Finance presented in July 2019 the deployment of the economic strand of the strategy ([49]). The priority areas of work relate to the development and structuring of a French AI supply; the dissemination of AI accessible to all businesses in the economy; and the development of a French and European data economy.

A mapping of innovative firms in the field of AI has identified 550 French start-ups. A manifesto has been signed with 8 French industrial groups of global dimensions, to establish a common diagnosis and an action plan coordinated with the French AI ecosystem.

([48]) https://www.enseignementsup-recherche.gouv.fr/cid141320/lancement-de-4-instituts-interdisciplinaires-d-ia-3ia-et-ouverture-de-deux-appels-a-projets-complementaires.html

([49]) Ministry of Economy and Finance (2019). Press kit "*AI at the service of companies - National strategy for AI*". https://minefi.hosting.augure.com/Augure_Minefi/r/ContenuEnLigne/Download?id=0B24A9E8-CBA3-4F4C-8379-78D20E88ACF2&filename=1314-%20IA%20DP.pdf

6.2. Policy initiatives and programs developed by the Ministry of National Education and Youth and by the Ministry of Higher Education, Research and Innovation

Artificial intelligence is a promising instrument for learning. France is thus fully mobilized to give more room to digital innovation at the service of pedagogy.

AI for the acquisition of basic skills

- An innovation partnership for AI was launched in 2018, specifically concerning fundamental learning in French and mathematics from CP to CE2.
- The State is investing as part of the Future Investment Plan in the support of innovative educational projects using digital technology in schools in rural areas.

AI at the service of the transformation of Higher Education

- Calls for projects for the development of experimental digital universities (DUNE), funded by the IAP, aim to initiate a massive and multidimensional digital transformation of higher education and research curricula.
- Calls for projects to support new university courses (CNU), financed by IAP, aim to diversify and decompartmentalise training within the first grade.

AI, Research and Investment

- The Ministry of National Education and Youth has set up a working group dedicated to the subject of artificial intelligence as part of the work of the Scientific Council for National Education, which will make recommendations on the subject.

AI for the professional development of teachers

- The M@gistère system offers nearly 400 training courses and trains more than 250,000 teachers every year.
- In 2019, e-skills certification will become mandatory in master's programs in teaching, education and training.
- A new "digital and IT" recruitment competition will lead to the first recruitments in 2020. An aggregation will be created in the coming years.

Artificial intelligence and ethics

- On October 21, 2019, the Minister of National Education and Youth (MENJ) set up a committee of ethics and expertise in educational data, whose principle is to "better protect for better value".
- The Ministry of Higher Education, Innovation and Research (MESRI) is committed to doubling the number of students trained in AI, particularly at the doctoral level, and to developing training in ethics related to digital technology.

6.3. Making the National Qualifications Framework more flexible

In September 2019 the agency France competences, in charge of the National Qualification Framework, drew up a list of emerging or fast-changing professions, some of which concern AI, for which the procedure for registering a vocational qualification will be simplified ([50]).

6.4. The development of diagnostic and prospective studies

A study titled *AI and work* had been published by the organisation France Stratégie ([51]) in March 2018, to analyse the challenges posed by the transformation in three sectors, transport, banking and health, and outline scenarios for the transformation of labour.

Multiple studies continued to be published in 2019 to refine the understanding of the effects of AI on employment, skills and qualifications requirements ([52]).

The transformation of public action and administrations is the subject of projects and prospective studies undertaken at an interministerial level ([53]).

A survey identifying the sectors most affected by AI in France has been developed by the Pôle interministériel de Prospective et d'Anticipation des Mutations économiques (Pipame) [Interministerial Centre for Foresight and Anticipation of Economic Change]: health, transport and logistics, industry, energy and the environment, commerce, financial services, security of goods and people ([54]). Its prospective work also concerns specific sectors of activity, in conjunction with economic players ([55]).

([50]) https://www.francecompetences.fr/Metiers-emergents-ou-en-forte-evolution-publication-des-premiers-metiers.html

([51]) France Stratégie is an organisation dedicated to conducting studies and foresight, and assessing public policies and proposals, placed under the authority of the Prime Minister.

([52]) e.g.: Sénat (2019). *Information report about robotization and service jobs* http://www.senat.fr/notice-rapport/2019/r19-162-notice.html
Sénat (2019). *Information report on the European strategy for AI* http://www.senat.fr/rap/r18-279/r18-279.html

([53]) Interministerial Directorate of Public Transformation (2018). *Digital transformation: let's design the public jobs of tomorrow!* https://www.modernisation.gouv.fr/etudes-et-referentiels/numerique-et-transformation-des-metiers-publics-quelles-perspectives-0
Interministerial Directorate of Public Transformation (2019). Volume 2: *zoom on 10 new professions* https://www.modernisation.gouv.fr/etudes-et-referentiels/transformation-numerique-des-metiers

([54]) Interministerial Centre for Foresight and Anticipation of Economic Change (PIPAME) (2019). *Artificial Intelligence: state of the art and prospects for France: final report.*

Observatories of professional branches have also developed prospective studies, for example in the professional branch of IT, to anticipate all the necessary resources (employment, skills, training) for the development of AI ([56]).

At the regional level, an experimental study has been conducted in the Haut-de-France region concerning the challenges of AI on skills within the territory, within the framework of an agreement "Accord -cadre national d'Engagement de Développement de l'Emploi et des Compétences (EDEC) [Commitment to the development of employment and skills] between the State, the region, and regional social partners (the employers' union MEDEF and the approved joint collecting body OPCALIA). It provides many highly detailed data and analysis, some of them also relevant at the national level ([57]).

6.5. Projects developed under the Skills Investment Plan and regional skills investment plans

A platform, opened on the website of the Ministry of Labour, pools the innovations, experiments and disruptive projects selected as part of the Skills Investment Plan ([58]).

About half of the total plan budget is dedicated to its regional implementation. The skills investment plan is tailored to each region through "*Pactes Régionaux d'Investissement dans les compétences*" (PRIC) [Regional pacts for investment in skills] signed by the State and the Regional authorities concerned.

Among the projects selected as part of the Regional Skills Investment Plans for 2019 (see above), six deal with the use of job data and AI to develop regional job-skills forecasting, create open data tools shared between players in the

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https://www.entreprises.gouv.fr/etudes-et-statistiques/intelligence-artificielle-etat-de-art-et-perspectives-pour-la-france

([55]) e.g. for water, health industries and technology, electronics, chemicals and paper - cardboard. https://www.entreprises.gouv.fr/etudes-et-statistiques

([56]) OPIIEC (2019). *Study: training and skills on artificial intelligence in France*. https://www.fafiec.fr/l-observatoire-opiiec/etudes-sectorielles/metiers-du-numerique/85-l-observatoire-opiiec/etudes-transversales/687-etude-formations-et-competences-sur-l-intelligence-artificielle-en-france.html

([57]) Cabinet Erdyn, Cabinet Katalyse, DGEFP, Conseil Régional Hauts-de-France, Medef Lille Métropole, Opcalia (2019). *Impact of AI on jobs and skills in Hauts-de-France: prospective study.* http://hauts-de-france.direccte.gouv.fr/sites/hauts-de-france.direccte.gouv.fr/IMG/pdf/synthese-etude-iahdf.pdf

([58]) https://travail-emploi.gouv.fr/grands-dossiers/plan-d-investissement-dans-les-competences/inspiraction#Accedez-a-des-innovations-inspirantes-pour-la-formation-professionnelle

economic world and the employment-training ones and refine the training offer for jobseekers ([59]).

Other projects are dedicated to develop the use of augmented reality and virtual reality in training. For instance, in Ile-de-France, a « FabLab for trades and qualifications » will be deployed in 2020 to supplement trade information with virtual reality tools, providing an immersive experience at the heart of each professional sector.

Projects also include the development of additional training modules dedicated to skills related to ecological and digital transitions. The fight against the « illectronism » with the acquisition of basic digital skills is also carried out.

([59]) Ministry of Labour (2019). *Transversal thematic reading of the Regional Skills Investment Pacts*. https://travail-emploi.gouv.fr/IMG/pdf/lecture_transversale_thematique_des_pactes.pdf

e.g. in region Grand Est: the "Data Platform" project to develop the skills approach https://travail-emploi.gouv.fr/IMG/pdf/ge_fiches_actions_remarquables_plateforme-data.pdf

CHAPTER 7.

Conclusions – Main challenges and outlook

7.1. Challenges in addressing skills needs

7.1.1. Expanding the pool of AI specialists and engineers

Meeting the training needs related to digitisation and AI requires a "scaling up", going beyond high-level researchers. France needs a broader pool of specialised engineers and computer scientists. A fundamental point concerns the broadening of the teaching of probabilistic techniques used in AI. In order to accelerate their dissemination, it is suggested that MOOCs be rapidly developed to create a French-language reference corpus on AI ([60]).

7.1.2. Developing cognitive and softs skills

In order for active workers to show the agile adaptability needed with respect to rapidly changing job content, reports concur on the need to prioritise cognitive and soft skills, such as critical thinking, creativity, communication and collaboration.

7.1.3. Addressing the basic digital skills gap

In 2019, 17 per cent of the population was electronically illiterate, 38 per cent lacked basic skills and 15 per cent of people aged 15 years and older had not used the Internet during the year ([61]).

The digital revolution increases the risk of digital dropout for the least qualified and most vulnerable people and efforts to target these groups will have to be continued and strengthened.

7.2. Challenges to work organisation

As concerns changes in work organisation within businesses, AI offers a set of opportunities, mainly productivity gains, but also leads to risks resulting from neo-

([60]) Interministerial Centre for Foresight and Anticipation of Economic Change (PIPAME) (2019). *Artificial Intelligence: state of the art and prospects for France: final report.* https://www.entreprises.gouv.fr/files/files/directions_services/etudes-et-statistiques/prospective/Intelligence_artificielle/2019-02-intelligence-artificielle-etat-de-l-art-et-perspectives.pdf

([61]) https://www.insee.fr/fr/statistiques/4241397?pk_campaign=avis-parution

Taylorian and post-Taylorian practices, potentially bringing about a deterioration in work situations and cooperation bonds ([62]).

As to human/machine complementarity, the “AI for humanity” strategy recommends giving priority to those forms of complementarity that enable the development of strictly human capabilities (creativity, manual dexterity, ...), and avoiding those likely to generate work-related distress (being subject to the orders of an AI, loss of control over processes, delegation of decisions to the machine) ([63]).

7.3. Challenges in funding CVET

As to financing for vocational training, the Villani Report raises an issue specific to the digital sector, namely the transformation of value chains caused by the development of AI, which leads to a decorrelation between those who capture added value and those who finance CVET (when financing is based on payroll). How can we ensure that those who capture added value can participate in financing the development of individual competences, which they have sometimes helped to make obsolete?

Meeting this challenge would require international negotiations, within a multilateral framework: ‘New ways of financing vocational training could be determined by negotiation, at the global level’ ([64]).

([62]) COE, Employment advisory council (2017). *Automation, digitalisation and employment – Vol. 3, the impact on work*. https://www.ladocumentationfrancaise.fr/docfra/rapport_telechargement/var/storage/rapports-publics/184000022.pdf

([63]) https://www.aiforhumanity.fr/pdfs/MissionVillani_Report_ENG-VF.pdf

([64]) *Ibid*

Abbreviations and acronyms

AI	Artificial intelligence
APEC	Agence pour l'emploi des cadres [agency for the employment of managers]
CAPES	Certificat d'aptitude au professorat du second degré [certificate of aptitude for secondary education teachers]
CEP	Conseil en evolution professionnelle [career development counselling]
COE	Employment advisory council
CPF	Compte personnel de formation [personal training account
DINSIC	Interministerial directorate for digital technology and the government information and communication system
OPCO	Opérateurs de compétences [competence operators]
OPIIEC	Observatoire des métiers du numérique, de l'ingénierie, des études et conseil et de l'événement [observatory of occupations in the fields of digital, engineering, counselling and events]
PIC	Plan d'investissement dans les compétences [skills investment programme]
PRIC	Pacte régional d'investissement dans les compétences [skills investment regional plan]
RNCP	Commission nationale de la certification professionnelle [National register of vocational certifications]
SGMAP	Secretariat general for the modernisation of public action
VET	Vocational education and training

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