WORKING PAPER

Future of manufacturing

France: Policy developments on apprenticeship

Adaptation of national apprenticeship systems to advanced manufacturing

Author: Nicolas Farvaque and Djamel Messaoudi (ORSEU Lille)

Research managers: Massimiliano Mascherini and Sara Riso

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European Foundation for the Improvement of Living and Working Conditions

Telephone: (+353 1) 204 31 00

Email: information@eurofound.europa.eu

Web: www.eurofound.europa.eu

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Contact details

Donald Storrie (Project Manager) Donald.Storrie@eurofound.europa.eu

Alessandra Massaro (Project Administrator) Alessandra.Massaro@eurofound.europa.eu

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Introduction

Scope of the research

This country report is part of the study 'Policy developments and practices of apprenticeships in selected EU Member States and world competing regions' carried out in five EU (Denmark, Germany, France, Ireland and Italy) and two non-EU countries (Australia and the USA). This study is conducted in the frame of the Pilot Project 'The Future of Manufacturing', proposed by the European Parliament and delegated to Eurofound by the European Commission (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs).

One of the objectives of this study is to provide an analytical overview of apprenticeship systems in the selected countries and to review changes to the current systems following labour market shifts, changes in employment, career and mobility patterns and technological and structural change. Particular emphasis is placed on the impact of new technologies and the need for a high skilled and adaptable workforce in manufacturing and advanced manufacturing.

This research is carried out in response to the increasing interest in apprenticeships among policy makers to tackle skills mismatches but also to integrate young people into the labour market. The appeal of apprenticeships is also growing particularly in a context where new technologies are transforming work organisation and production processes across all sectors, particularly manufacturing.

The findings from this research will feed the policy discussions around the role of apprenticeships for the future of manufacturing and inform policy making in the context of current or planned reform of apprenticeship systems and the necessary links to be established between education/training and industrial policies.

Report structure

With a view to investigating country specific issues, the first section outlines the wider economic and labour market context in which the national apprenticeship system operates. The links between education/ training and industrial policies are also explored.

The second section describes the key features of the national apprenticeship system, including the regulatory framework, the governance structure, and the financing mechanisms and it provides some statistical data on apprenticeships and pinpoints the key challenges to the implementation and the development of the current apprenticeship system.

The focus of the third section is on the specific role of apprenticeships in relation to the advanced manufacturing industry in France. It examines the main requirements arising particularly from technological change in manufacturing and it explores recent reforms on apprenticeship systems together with the key drivers behind these policy changes. In doing so, it identifies success factors and barriers to the implementation and the development of apprenticeship systems.

This country report is based on a literature and document review, as well as five qualitative semi-standardised interviews with selected key actors and stakeholders, namely the Ministry of Labour, Vocational Eduation and Training and Social Dialogue, employer organisations and trade unions as well as VET providers in the manufacturing sector (see list of consulted stakeholders and experts in annex 2).

Key terms at a glance

Apprenticeship in France is a complex system based on two complementary pathways: the

'apprenticeship contract' (*contrat d'apprentissage*), corresponding to initial VET and the 'professionalization contract' (*contrat de professionnalisation*), corresponding to continuing VET. Both pathways fit the Cedefop definition of 'apprenticeship', and fall under the same generic label of '*alternance*' (alternation in English). The industrial sector makes extensive use of these two types of contracts. The French *alternance* system is highly institutionalised and heavily influenced by the public education system. In the industrial sector, however, employers play an important role in adapting curricula to their needs. For example, by creating, at branch level, specific professional qualifications that can be obtained through *alternance*.

There is no specific institutional or statistical definition of advanced manufacturing in France. The focus is therefore on digital technologies considered central to current industry developments, such as predictive analysis, Internet of things, advanced materials, numerical simulations and high frequency calculations. In this case, advanced manufacturing also includes current industrial projects grouped around the 'Industry of the future' flagship initiative (*Industrie du futur* as part of *Nouvelle France Industrielle* – New Industrial France – launched in 2015 by the government and the Ministry of economy).

An important and recent development in industrial sector apprenticeship programmes is the increasing popularity of 'higher apprenticeships'– namely, professional training courses for already highly qualified people. In the industrial sector, it is not uncommon to recruit *alternance* apprentices to work as engineers or as part of a doctoral thesis. This is viewed as a good point of entry and integration into the company.

Higher apprenticeships thus coexist alongside lower level learning. However, basic apprenticeship programmes are facing challenges of their own. Indeed it is crucial to adapt these lower-end industrial curricula to new digital technologies, while also preparing apprentices to have mobile careers, not limited to a job or profession, and therefore to have solid generic skills.

In order to do so, it is important to consider both the short term and a longer perspective. This is obviously a complex question since it requires that all stakeholders share a vision of what the manufacturing sector will need in terms of skills and expertise in the future. Currently the emphasis lies on expertise in digital skills, calculation, data processing, etc. However, 'meta-competence', including versatile skills (ability to intervene on several tasks) and integrated skills (data management; cognitive abilities of abstraction; representation and anticipation; ability to alternate phases of manual work with tasks that require more technical and cognitive skills), is also highly valued, as one can draw from a series of recent studies on apprenticeship in the French context (Assemblée Nationale, 2014; Brandt, 2015; Cahucet al, 2014; Castellazi et al, 2016; Conseil d'analyse économique, 2014).

The process of consultation between these stakeholders (State, regional government, employers and professional branches, training centres, etc.) has been improved by recent institutional reform. This includes the creation of a national coordination body - the National Council of Employment, Vocational Training and Orientation (*Conseil national de l'emploi, de la formation et de l'orientation professionnelle*, CNEFOP) and its regional counterparts (CREFOP) in the field of vocational training. At a regional level, there are initiatives – often spear-headed by local authorities and companies–which lead to industrial clusters putting apprenticeship at the centre of their skill development strategy.

Economic and labour market context

Economic and employment role of manufacturing and key trends

Since the 2008 crisis, average economic growth in France has not exceeded 0.5% per year. Manufacturing is the sector that has suffered the most. Industrial added value only increased by 0.3% on average (+ 0.5% in the EU). It now accounts for 11.4% of the country's total added value in 2015 compared with 16% on average in Europe (Eurostat, 2017).

The decline of industrial jobs has been considerable since 2008. More than 502,000 jobs were lost between 2008 and 2015. The industrial sector accounts for 12.2% of total employment in France in 2015, compared with 14.4% in 2008 (Eurostat, 2017).

Industrial employment in France has been declining since the 1980s. The two main factors in this trend are the automation of production and the outsourcing of certain industrial activities to the service sector. The branch of specialized, scientific and technical services[1] which benefited from this wave of outsourcing created 208,000 jobs between 2008 and 2015 (Eurostat), making it possible to offset almost half of industrial job losses. In this branch there are several occupational profiles that relate to advanced manufacturing technologies, for instance in engineering services or aeronautical technology consulting, in companies which work with industrial companies in the sector (for example Altran, Alten). This branch of specialised, scientific and technical services accounts for 5.6% of total employment. According to Eurostat, it employs 1.46 million workers in 2015, compared with the 3.2 million workers employed in the industrial sector (therefore high-tech jobs in services account for almost half of all industrial jobs–46%, a proportion much higher than in the EU–35%, or Germany–28%, for instance). This development of high-tech jobs in the service sector rather than the industrial sector, due to a process of outsourcing of certain functions from the latter to the former, is a specificity of the French model. This professional branch is dominated by management activities (for example lawyers, accountants), which account for 44% of jobs, followed by activities of architectural, research and development engineers which account for 39%, while advertising, market research and other specialized services account for 17% (according to INSEE Data[2]).
The activities of computer scientists fall under 'Computer programming, consultancy and related activities', a branch which employs 336,000 people in 2015, an increase of 36% since 2008 (INSEE Data).

Young people under the age of 25 are the most affected by the destruction of jobs. Since 2008, total employment has increased slightly (+ 1.3%), while youth employment has decreased by 11%. 262,000 jobs destroyed between 2008 and 2015 were jobs held by young people (Eurostat, 2017). This young population, which is more often employed on temporary contracts (*contrat à durée déterminée*, CDD), has become one of the main labour market adjustment instruments in times of crisis. Job creation in the specialised, scientific and technical services sector has benefited young people to a small extent. The share of young people in these high-skilled jobs remained stable between 2008 and 2015 (6.5% in 2008 and 6.4% in 2015).

[1] This branch includes specialised professional, scientific and technical activities, such as scientific research and development, architectural and engineering activities, technical testing and analysis, legal and accounting activities, etc. These activities require a high degree of training, and make specialised knowledge and skills available to users (Eurostat).

[2] See Labour Market Data at https://www.insee.fr/en/statistiques?debut=0&theme=22

Overview of industrial policy initiatives addressing advanced manufacturing

Since the 1980s, France has abandoned the industrial policy of so-called 'major works' carried out by a voluntarist state involving large public companies, public commissions and public research. This led to a 'deindustrialisation' of the French economy, with the loss of more than 2 million industrial jobs since 1980. It was not before the 2000s that a real change in policy occurred. Mostly built on public-private partnerships, its objective is to revive industrial innovation and to catch up in terms of high-tech productions (Gallois, 2012).

This new policy framework has been bolstered by the creation of competitiveness clusters, an Agency for industrial innovation and a public investment bank (Oséo). Since 2013, it has also been supplemented by a new strategic plan to develop the 'Industry of the future' (*Industrie du futur*)[3]. A plan which concretely manifests as an investment programme designed to modernise France's industrial fabric. It is co-financed by the State through tax cuts and the public investment bank Oséo. The Ministry of Economy has defined 34 innovative industrial plans at the sectoral level. The most relevant of them for advanced manufacturing concern innovative transport, digitalisation, robots, connected items, and health. One of the major goals of this new strategy is to accompany industrial companies in their digital transition, and to encourage the development of new innovative industrial sectors. According to an ex-ante assessment, around 480,000 new high-tech industrial jobs should be created within 10 years.[4]

This new policy is based on an approach that was strongly supported in the 2012 Gallois report, which has had an important impact[5]: industrial employment is declining because of poor industrial specialization. Indeed, industrial specialization is oriented towards the production of medium and low-level technology. The vast majority of highly skilled jobs are in services (75%) and not in industry (only 25%) according to Eurostat data.

Over 64% of industrial jobs are located in medium- and low-tech sectors (+2 points since 2008) compared with less than 50% in Germany (-4 points). However, this mid-range or even low-end industry is in close contact with a high-tech industry that is highly competitive in the international market. It represents 10% of the added value of the manufacturing industry and 8% of manufacturing employment (see box for the statistical definition of high-tech jobs). However, despite gaining comparative advantages, this industry could not resist the crisis: more than 14% of jobs in this industry were destroyed, which is double the European average.

Table 1: Employment in high-tech sectors (manufacturing industry)

	2008		2015		Variation 2008-2015	
	Thousands	% total employment	Thousands	% total employment	%	% point
EU (28)	2,530.0	1.1	2,356.2	1.1	-6.9%	0.0

[3] New Industrial France - Building France's industrial future - https://www.economie.gouv.fr/nouvelle-france-industrielle/accueil

[4] See the website of the New Industrial France: https://www.economie.gouv.fr/nouvelle-france-industrielle/accueil

[5] L. Gallois, 2012, Report on the French competitiveness, report to the Prime Minister. At the time of the report, Louis Gallois was Commissary General for Investment. He was at the head of SNCF (national train company) and EADS.

Germany	605.6	1.6	649.6	1.6	7.3%	0.0
Austria	43.2	1.1	50.4	1,2	16.7%	0.1
France	306.9	1.2	262.5	1.0	-14.5%	-0.2
Italy	241.1	1.0	213.8	1.0	-11.3%	0.0
Ireland	60.6	2.9	60.9	3.0	0.5%	0.1

Source: Eurostat, High-tech statistics – employment, June 2016

Box 1: High-tech industry and knowledge-intensive services according NACE Rev. 2

High-tech industry includes the following sectors:

- Manufacture of basic pharmaceutical products and pharmaceutical preparations (21)
- Manufacture of computer, electronic and optical products (26)
- Manufacture of air and spacecraft and related machinery (30.3)

Source: Eurostat, available at http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries

High-tech knowledge-intensive services include the following sectors:

- Motion picture, video and television programme production, sound recording and music publishing activities (59)
- Programming and broadcasting activities (60)
- Telecommunications (61)
- Computer programming, consultancy and related activities (62)
- Information service activities (63)
- Scientific research and development (72)

Source: Eurostat, available at http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Knowledge-intensive_services_(KIS)

These job losses in the industrial manufacturing sector are partly offset by job creation in high-tech services (excluding finance, see box for definition). By integrating these services, the French high-tech sector is doing better than the EU average. Employment in these sectors grew by 6.1% between 2008 and 2015 (4.4% in the EU) against only 1.9% for the country's total employment (-1% in the EU). They account for 4% of total employment in 2015, which places France around the EU average (4%), like Germany. Trends in recent years in the high-tech sectors indicate a more favourable dynamic to services compared to industry.

France is therefore characterised by a higher concentration of high-technology jobs in the service sector than in the industry.

Table 2: Employment in high-tech sectors (manufacturing industry and services)

	2008		2015		Variation 2008-2015	
	Thousands	% total employment	Thousands	% total employment	%	% point
EU (28)	8,367.3	3.8	8,738.8	4.0	4.4%	0.2
Germany	1,591.4	4.1	1,627.7	4.1	2.3%	0.0
Austria	138.9	3.5	165.7	4.0	19.3%	0.5
France	998.6	3.9	1,059.2	4.0	6.1%	0.1
Italy	763.4	3.3	767.5	3.4	0.5%	0.1
Ireland	130.6	6.2	147.1	7.5	12.6%	1.3

Source: Eurostat, High-tech statistics – employment, June 2016

Live link: http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

Employment and training challenges linked to technological change and automation

Modern digital technologies represent major drivers of change, in terms of skills needs or requirements in the manufacturing sector. This report focuses on how new digital technologies such as predictive analysis, Internet of things, advanced materials, numerical simulations and high frequency calculations, are modifying the manufacturing process.

Current technological changes could have a major impact on the French industrial sector. According to studies carried out on the subject, 9% of jobs are 'automatable' and could therefore be destroyed, whereas 31% might be transformed instead (OECD, 2016). The impact of new technologies will be greater on the industrial sector than on that of services. According to a study by France Strategy (2016), 25% of industrial jobs in France are 'automatable', compared with 13% in the service sector.

The digital transformation of the economy will create a need for highly skilled jobs (OECD, 2015; Mokyr et al, 2015). According to a study on the evolution of jobs and qualification needs between 2012 and 2022 (France strategy - DARES, 2015), there will be 177,000 jobs created every year (1.8 million in ten years). More than 70% of these net creations will potentially be skilled jobs (managers, intermediate workers, skilled workers). However, the overwhelming majority of these new jobs will be created in the service sector, the industry accounting for only 2.5% of them.

According to these studies, three industrial families or groups of occupations will stand out with an estimated net creation of jobs between 2012 and 2022: the processing industry (+1%), industrial maintenance (+5%) and technical engineers (+16%). On top of these purely industrial professional families, employment needs for both computer scientists (+16%) and researchers (+18%) will be considerable (France strategy - DARES, 2015).

Young graduates may find job opportunities in several professions, notably engineers and technical industry executives, research staff, and especially computer engineers (France strategy - DARES, 2015).

Retirements also contribute to the considerable need for jobs. These waves of departures provide companies with the opportunity to rethink their business model in order to adapt to digital transformation. Each year, more than 6 million people retire, which represents 2.2% of total employment. In the industrial sector, these departures are estimated at nearly 100,000 people per year, or 2.6% of industrial employment (France strategy-DARES).

When the different effects on employment (technological transformation, demand effect and retirement effect) are all added up, employment needs are estimated to be just under 1 million in the industrial sector in the next 10 years and close to 8 million in the whole economy (France strategy - DARES, 2015).

However, stakeholders interviewed in the frame of this study as well as a number of studies on the cause of vacancies (Conseil orientation pour l'emploi, 2013; Gallois, 2012) indicate that initial training is often insufficient to meet rising demand**.** Indeed, several thousand industrial jobs go unfilled due to a lack of qualifications. In the digital sector, for example, a study by the European Commission (European Commission, 2014) estimates that there were 27,000 unfilled positions in France in 2012, representing 3% of total employment in digital industries. This rate could reach 8% in 2020, that is, 86 000 unfilled jobs, if the initial and vocational training system fails to adapt to the industrial sector's changing needs. In the rest of Europe, the vacancy rate (e-Skills Vacancies) is 3.7% in 2012 and could reach 10.3% by 2020 (European Commission, 2014). This study questions the French education and training system's ability to respond quantitatively and qualitatively to these evolving needs.

Overview of the apprenticeship system

Definition of apprenticeship

The Cedefop defines apprenticeship as

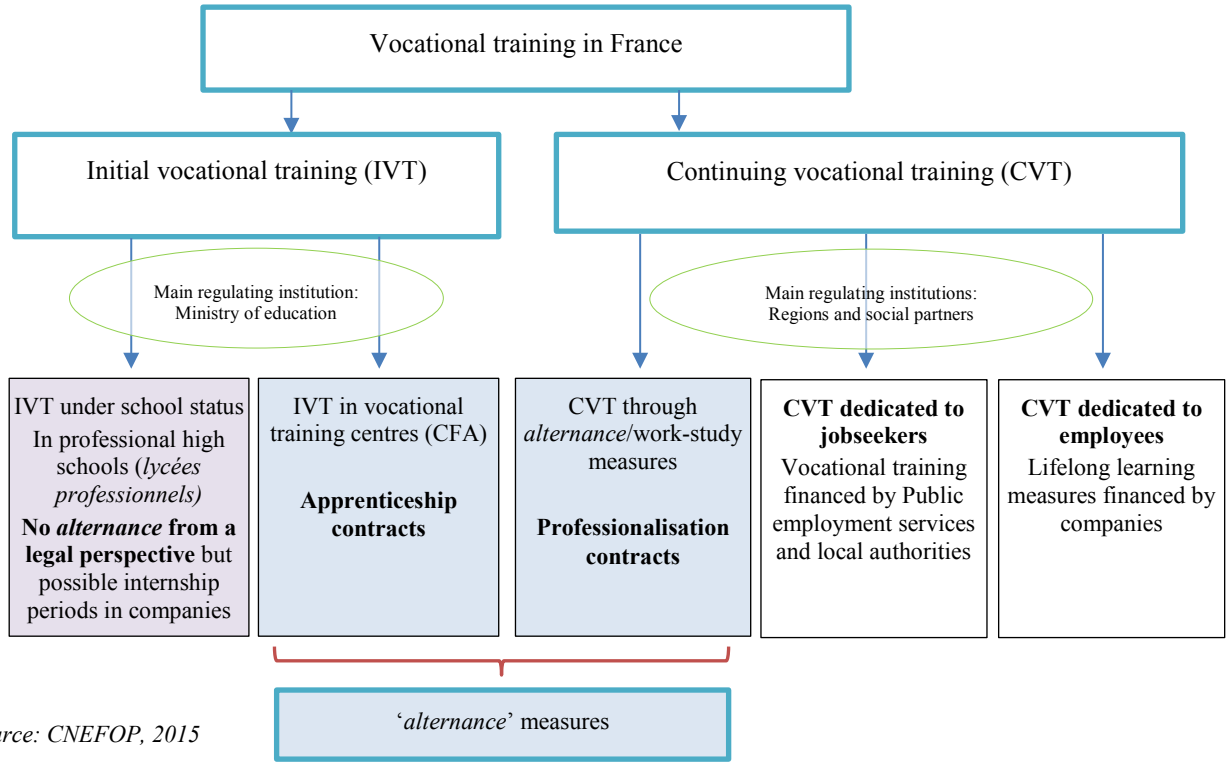
> *'systematic, long-term training alternating periods at the workplace and in an educational institution or training centre, which leads to a qualification. An apprentice is contractually linked to the employer and receives remuneration (wage). An employer assumes responsibility for the company-based part of the programme'.*
>
> (Cedefop, 2015)

Within this definition, apprenticeship corresponds in France to work-study training or the general principle of '*alternance*' in French (alternation or sandwich education). It is defined as a training course that *alternates* between theoretical training in an academic institution and practical training in a company or a public body.

This national therefore refers to *alternance* as being the notion the closest to the Cedefop meaning of 'apprenticeship', and to *alternants* as being the people following the *alternance* path.

As the figure below shows, *alternance* in the French model lies at the crossroads between initial and continuing vocational training.

Figure 1: Vocational training in France



Source: CNEFOP, 2015

More specifically, '*alternance'* or work-study training can include two different employment contracts: the apprenticeship contract (*contrat d'apprentissage*) and the professionalisation contract (*contrat de professionnalisation*). While professionalisation contracts fall under continuing training and are open to all, irrespective of age, apprenticeship contracts fall under initial training and are restricted to young people under 25, with recent exemptions up to 30. Both are employment contracts with specific conditions for the trainee and the employer. Overall, they are mainly used by young people. The term 'apprenticeship' generally refers to this principle of *alternance* or work-study contracts. However, from an institutional and legal point of view, it specifically refers to these apprenticeship contracts which are the only work-study pathway to exist in initial training.

An apprenticeship contract is a written contract of limited duration (*contrat à durée déterminée,* CDD) or of indefinite duration (*contrat à durée indeterminée,* CDI) between an employee and an employer. It allows the apprentice to undertake in-company training under the responsibility of an apprenticeship tutor in an apprenticeship training centre (*Centre de Formation d'Apprentis*, CFA) for 1 to 3 years. This employment contract is open to persons under the age of 26 who are preparing a diploma in vocational or technological education (or a certification recognized by the National Centre for Professional Certifications). All employers (private, associative or public) can hire an apprentice. They have to provide the apprentice with 400 hours of training per year, the rest of the apprentice's time being spent at school.

By contrast, the second road to *alternance*, namely 'professionalisation contracts', belongs to the field of continuing education and training. These contracts are not subject to an age limit, however most of the people who choose to follow this path are under 25. Their qualification level is higher than that of apprentices: 45% already have a 1-5-level qualification[6] against 33% of the apprentices (DARES, 2016d). Their share has almost doubled compared to 2008 (24%). However this increase in qualification levels is not linked to the extension of professionalisation contracts to people over 26, as older students tend to be less skilled on average. Four profiles are mainly represented: young high-school students (31%), young people in training programmes or subsidized contracts (21%), employees in vocational learning (14%), and jobseekers (31%), which represent a large majority of the over 26 year-olds. Companies in the service sector are the most likely to use professionalisation contracts: they represent 80% of the contracts, compared with 77% in 2008, whereas the industrial sector represented only 15% in 2015, compared with 12.5% in 2008 (DARES, 2016a).

Table 3 gives an overview of the main differences between the two types of *alternance* contracts.

Table 3: Summary of main differences between the two main 'alternance' pathways in France

	Apprenticeship contracts	**Professionalisation contracts**
VET Field	Initial vocational education and training	Continuing vocational education and training
Employment contract?	Yes	Yes
Duration of the contract	Between 12 and 36 months	Between 6 and 24 months
Gross monthly pay	Between 370€ and 1,154 €	Between 814€ and 1,480€

[6] The report refers to EQF throughout the document.

Minimum duration of training	400 hours per year	150 hours per year
Progressive duration according to level of diploma	20 to 25% of the duration of studies	15 to 25 % of the duration of contract
Characteristics of beneficiaries	Under the age of 26 who are preparing a diploma in vocational or technological education Experiment launched to extend up to 30 years (experimentation from 2017 to 2019)	Not subject to age restriction. Any person in continuing VET (employee, jobseeker, etc.) Mainly people under 25
Level of training prepared (EQF)	34% of apprentices prepare a diploma of level 5-8 and 66% below level 5	45% of people prepare a diploma of level 5-8 and 55% below level 5
Place of the training	Alternation between in-company training and training in an apprentice training centre (*Centre de Formation des Apprentis*, *CFA*)	Alternation between in-company training and in a training centre. These centres can be either public or private
Number of establishments providing the training	1,000 CFAs	66,300 vocational training establishments
Employers entitled to recruit	Any employer	Only private sector
Number of beneficiaries (2015)	283,000	186,000
Total spending (2015)	€5.6 billion	€1.1 billion

Source: Authors' own elaboration, based on DARES information

It is also important to mention that apprenticeship training has been extended to higher education since the early 1990s. Since then, higher apprenticeships are responsible for 68% of the increase in the number of apprentices. This is a noticeable trend that will be commented on later in the report.

Regulatory framework and institutional context

The professional certification system is regulated by the National Commission for Professional Certification (CNCP), created in 2002 by the French social modernization law (*loi de modernisation sociale du 17 janvier 2002*, n°2002-73). This commission can grant the recognition of the state to a diploma.

The apprenticeship training system has undergone major reforms in recent years. A central legal text is the 5 March 2014 law (*loi relative à la formation professionnelle, à l'emploi et à la démocratie sociale*, n° 2014-288) on vocational training, employment and social democracy. It is based on a 2013 national agreement between social partners on vocational training. This law has modified how the training system is funded. It has reinforced the role of OPCAs – the accredited

organisations collecting funds for training that are jointly managed by representatives of employers and employees (trade unions). There are around twenty OPCAs in total in France, covering large sectors (for instance, wood industry, automotive, bank-insurance). Vocational training in work-study programs (professionalisation contracts) falls within this framework of joint management. The OPCA must validate the professionalisation contract, ensuring that it complies with the employer's collective agreement or the branch agreement. OPCAs also have the role of monitoring the training content delivered by approved training organisations. They monitor the quality of these training courses and their adequacy with the objectives defined by the social partners of the concerned branches.

This reform has also put the topic of vocational training at the centre of social dialogue both at branch level and company level. It has simplified the environment of continuing vocational training, replacing the three pre-existing types of contracts with one, single option (i.e., the professionalisation contract). This law has also set the ambitious objective of training 500,000 apprentices each year by 2017. From an institutional point of view, it gives new powers and prerogatives to regional authorities, which are the main actors in the field of vocational training. This creates new instances of concertation at national and regional levels, between the state, local authorities and social partners.

Apprenticeship training is delivered by CFAs (apprenticeship training centres). CFAs do not have their own, separate legal identity and can be publicly or privately funded. This supervision of the learning centres determines how they are managed. The provision of apprenticeship training can take two forms: public management of the training offer and joint private management (social partners). Coordination of private and public provision must be ensured by local authorities (regions) which are the competent authority.

- **A public management model**: this includes CFAs created by public bodies such as the training sections in vocational high schools (*lycées professionnels*), or CFAs created by local authorities or chambers. The management of these training programmes is public insofar as the decision-maker is a public body. Training programmes are therefore defined by the regulating institution.
- **A joint model**: another type of CFA is one created directly by professional branches or by employers or a group of employers. These institutions are usually supervised by the training bodies of the professional branches or by employers' professional organisations. To take an example, in the industrial sector, the UIMM (*Union des Industries et des Métiers de la Métallurgie*, the main employers' confederation of industries) has created many CFAs offering a wide diversity of curricula. The management of these training centres is generally of a joint nature (by the social partners in the sector). The region and the state have a right to control these centres' training content, objectives, management and funding processes. These elements are defined within a regulatory framework between these centres, the region and/or the state.

In 2014, there were just over 1,000 apprenticeship training centres. Half are CFAs created by professional branches or employers and half are created by public bodies: 30% by educational institutions (high schools or universities), 18% by chambers and 2% by regions (Ministry of education, 2016a). In terms of the number of apprentices, we find the same distribution: 50% are in CFAs administered by the branches or employers and 50% in those administered by public bodies (19% CFAs managed by educational institutions and 30% CFAs managed by local chambers).

It should also be noted that the vast majority of higher education institutions (universities, engineering schools or business schools) also deliver apprenticeship diplomas. Following the reform of university degrees in 2002, the number of apprentices in higher education has increased

considerably. Today, they account for more than one third of apprentices in France, 32% of whom are preparing a diploma at level seven or eight (master, engineer or doctorate).

Financing the apprenticeship system

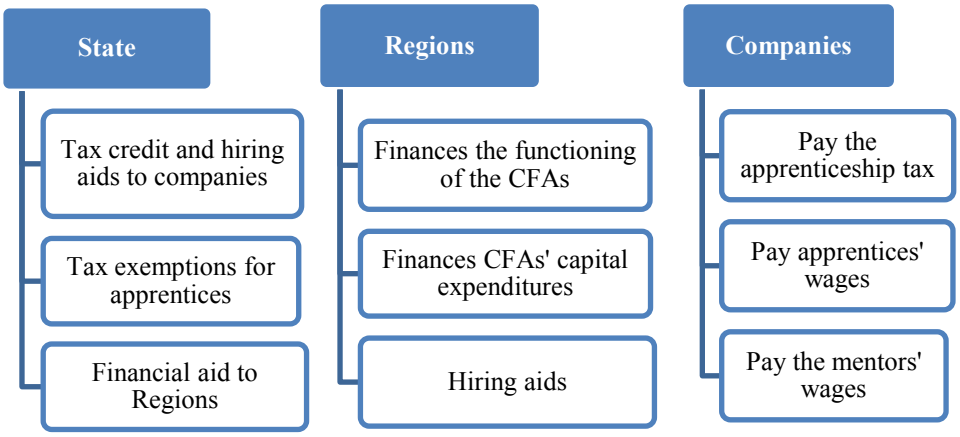
The financing of apprenticeship training includes the financing of the training centres and all subsidies or incentives for companies employing apprentices. This encompasses direct funding granted to training institutions and indirect funding granted to training beneficiaries and employers (for example through tax exemptions).

It involves three essential players – the state, the regions and the employers – among whom there are crossed financial flows. Employers pay an apprenticeship tax to collecting bodies. The state and the regions supplement this funding with grants to CFAs, employers and apprentices. Intermediary bodies intervene in these flows and in the distribution of funds (professional branches, collecting bodies, equalisation funds, etc.).

Apprenticeship training is also funded directly by the regions through the regional fund for apprenticeship and vocational training. This fund is co-financed by the state and the European Social Fund (ESF). Each region is free to allocate these funds between apprenticeship and vocational training for employees and jobseekers. The region is also free to use these funds to finance the functioning of CFAs or their capital expenditures.

Figure 2 gives an overview of the French system.

Figure 1: Financing the apprenticeship system in France



Source: Authors' own elaboration

An apprentice's pay is defined by the Labour Code and depends on the apprentice's age and the year of the contract (between €370 and €1,154 per month). An experiment is being launched from January 2017 to 2019, which extends access to apprenticeship contracts to people ages 26 to 30. The young people concerned by this experiment enjoy the same status and the same rights as other apprentices between 21 and 25 years of age. Also, the financing modalities of apprenticeship for companies do not change.

Companies are subject to an 'apprenticeship tax' corresponding to 0.68% of the gross wage bill (they are also subject to a minimum rate of 1% to finance continuing vocational training). In companies with 250 or more employees which do not respect a legal quota of 4% of employees in *alternance*, that is, either under a professionalization contract or an apprenticeship contract,

whatever their age, the apprenticeship tax is increased by a rate comprised between 0.05% and 0.6% depending on the number of *alternants* in the company.

Funding is collected by a series of funding bodies, which can be of different types: a chamber of industry, an inter-professional body or sectoral body.

In return, the employer benefits from a series of financial and tax incentives. The main tax incentives are exemptions from social security contributions and a tax credit for all companies regardless of their size. They also benefit from public subsidies for the employment of an apprentice. A bonus of €1,000 per year per apprentice is allocated by the region to companies with less than 300 employees. Another bonus of €4,400 per year is granted by the state for very small companies.

Alongside funding from employers, come the contributions of the state, the regions and the public employment services (*Pôle Emploi*). These funds are intended to finance training organisations, remunerate trainees or give incentives to employers. They can take the shape of direct funding to training organisations or direct monetary or fiscal transfers to beneficiaries (employers and apprentices).

In total, national vocational training expenditure in 2014 represented €5.4 billion for apprenticeship contracts and €1.1 billion for professionalisation contract. The overall spending for '*alternance'* measures (apprenticeship contracts and professionalisation contracts) represented €6.5 billion, of which 38% comes from regions, 29% from employers and 28% from the state (DARES, 2017).

Within '*alternance*' measures, the will to develop apprenticeship training has resulted in an increase of expenses devoted to apprenticeship contracts. Apprenticeship training accounts for 72% of overall '*alternance'* expenditure in 2014 compared to 67% in 2008 (DARES, 2017).

Key actors involved and their governance role

From a general overview, the French system is characterised by a complex nexus of actors. The coexistence of two '*alternance'* pathways entails a large number of actors and institutions. Apprenticeship training in the initial vocational system is monitored by the regions, the state and employers. Vocational apprenticeship (professionalisation contracts) is monitored by social partners.

Employers participate in the financing of the vocational training system through their contributions. They – mostly the larger companies – negotiate internal training plans with employee representatives, in particular within the framework of a 3-year forecast for jobs and skills (mandatory for companies over 300 employees). For all companies, the law obliges the employer to consult employee representatives (works councils or staff delegates) about the company's vocational training guidelines at least once a year. The law gives employee representatives an important role in the development of in-company training. However, in reality, this role is insufficiently fulfilled due to the low quality of corporate dialogue in many companies.

Besides financial obligations, employers must also play a role in adapting existing curricula and developing vocational training for new jobs. This requires cooperation with training centres. However, this cooperation is severely underdeveloped in France seeing as elaborating and delivering diplomas has traditionally been the responsibility of the public authorities.

The state, through the Ministry of Labour, defines national policy in the field of vocational training, both in terms of objectives and financial means. It controls the pedagogical content (Ministry of Education) and defines the work contracts for different programmes (apprenticeship contract and professionalisation contract). It also has a role to play in funding the apprenticeship

system. Thus, the governance of '*alternance*' training in France is conducted by two ministerial tutors with different approaches, which might create coordination issues.

Regions are the competent authority in terms of vocational training for young people and adults seeking employment or vocational guidance. This authority is exercised within the framework of a 5-year regional vocational training plan, which is in turn complemented by a 7-year state/regions project contract that defines common objectives and target groups.

The region is responsible for organising and structuring apprenticeship training at the local level according to territorial specificities and economic needs. It validates the creation or extension of vocational training organisations in line with local needs and the state of local supply. For example, it determines the number of available apprenticeship training places on the basis of local objectives. It also has a direct role in terms of funding for training organisations, including CFAs. Whatever their status (public or private), the CFAs – which are in charge of providing apprenticeship training – are under the region's technical and financial supervision, in return for regional funding.

With regard to national and regional concertation bodies, vocational training policy is developed within a national consultative body on vocational training, employment and guidance (*CNEFOP, Conseil National de l'Emploi, de la Formation et de l'Orientation Professionnelle*), created by the 2014 law (Law on vocational training, employment and social democracy of 5 March 2014, n° 2014-288). It includes social partners representing both employers and employees, the regions and the state. This principle of multi-level concertation is called 'quadripartism'. The CNEFOP develops priorities within a three-year strategy. A similar consultative body exists to monitor policy at a regional level – the *CREFOP*. It is composed of the same representatives and has the power to allocate part of the funding for apprenticeship and beneficiary training. These concertation bodies make for a permanent arena of dialogue.

Social partners participate in the governance of the vocational training system at national level (CNEFOP), at regional level (CREFOP) and at interprofessional level through the organisations collecting funds for vocational training (OPCA). Their most visible role is that of channelling funding through branch or interprofessional agreements.

Concerning the adaptation and overhaul of apprenticeship system, the national education system plays a major role. Training programmes are adapted and new courses can be offered depending on the employers' training needs. Adaptation of apprenticeship provision is delegated to so-called professional advisory commissions or *Commissions Professionnelles Consultatives* (CPC). The national education system frequently revises training programmes based on the work of these commissions. They play a decisive role in adapting and changing the curricula and their content. These commissions can make proposals on the creation, modification or suppression of technological and vocational training programmes. The CPCs are managed by the Ministry of Education. There is currently a total of 14 CPCs covering several different sectors, among which the metal industry and the chemical industry, bio-industry and environment. Each CPC is composed of 40 members appointed by public authorities and employers' or employees' federations and unions.

The regions are the competent authority for the implementation of vocational training policy for young people and adults seeking employment or vocational guidance. Each region is in charge of structuring training supply according to business needs. It regulates the opening of CFAs as well as the number of places available for apprenticeship.

There are a few relations between the CPCs and the regions. The latter are sometimes present in the commissions CPCs through a representative but this is rare. The CPCs have a national perimeter. They are structured by major branches (for example metallurgy and transport). Their

opinions on the adaptation of diplomas are addressed mainly to the Ministries of Education and Employment and the social partners.

The region decides on the number of places available for each training section in CFAs. For example, it limits the number of training places for mechanics to *n* persons according to certain criteria on the business needs but also the supply (number of teachers available).

For their part, professional branches play the role of training deciders and potential *alternance* employers. Indeed, the main professional branches have their own CFAs and vocational training centres. For example, the UIMM has 110 training centres (CFAs). It employs and trains 40,000 *alternants* each year with 25,000 apprentices and 15,000 students in professionalisation contracts. Several industrial branches have settled a branch agreement to develop dual training. In most cases, these agreements provide for quantified hiring targets.

Major statistical data and trends

Expenditure on work-study programs (*alternance* measures) increased by 4.5% between 2008 and 2014 (DARES, 2017) in line with the increase in the number of people in such programmes. The overall number of *alternance* contracts increased by 8% between 2009 and 2015. Within these *alternance* contracts, apprenticeship contracts decreased by 4% and professionalization contracts increased by 34% (Table 4).

Table 4: Number of apprenticeship and professionalisation contracts (in thousands), 2009-2015

	2009	2010	2011	2012	2013	2014	2015	Change 2009-2015
Apprenticeship contracts	296	296	304	314	290	280	284	-4,2%
Public sector	8	8	9	10	9	9	11	43,2%
Private sector	288	288	295	304	281	271	272	-5,4%
Professionalisation contracts	139	153	172	179	173	176	186	34,0%
Total	434	449	477	493	463	456	469	8,0%

Source: DARES, 2016c; 2016d

Overall, apprenticeship training incurs higher costs than professionalisation contracts. Indeed, in purely quantitative terms, apprenticeship accounts for 60% of *alternance* contracts versus 40% for professionalization. Not only is that, but the duration of apprenticeship training (400 hours/year on average) 5 times higher than that of professionalization contracts (70 hours/year on average). Furthermore, funding has recently been redirected towards higher qualifications and longer apprenticeship programmes, which are more expensive (National Council for Vocational Training and Guidance, 2015). The fact that apprenticeship spending has risen significantly (+ 13% between 2008 and 2014), while the expenditure on professionalization contracts has fallen sharply (-23%), fits in with the prioritisation of apprenticeships that was decided at national level in 2008.

Over the last decade, there has been a significant change in the profile of apprentices, that is, young people in initial vocational training who are following work-study programmes in an apprenticeship training centre (CFA) and have an employment contract with an employer. Apprentices tend to be older, more qualified, and returning to apprenticeship for a shorter period while aiming for a higher diploma.

One of the main changes is the influx of increasingly qualified apprentices. According to data on the characteristics of the *alternates* (DARES, 2016c and DARES, 2016d), the share of *baccalauréat* holders (level 4 according to EQF) or graduates (level 5 and above according to EQF) increased from 27.4% in 2008 to 45.3% in 2015. One third of apprentices have already received higher education (*bac +2*–level 5 according to EQF–or higher), compared to only 20% in 2008. This paradigm shift can be explained by employers seeking more highly qualified apprentices, and the fact that apprenticeship is gaining in terms of prestige and reputation. It is now situated in between general education (excellence pathway for strong pupils) and vocational lycées (for weaker pupils). In 2015, 37% of apprentices were aged 20 or over, compared with 26% in 2008 (DARES, 2016c).

The levels of qualification of qualifications of the diplomas prepared are also higher: 42% of apprentices in 2008 were preparing a qualification higher than the EQF level 4 (higher than the *baccalauréat*) of which 21% a qualification 1 to 5. By 2015, these rates had increased significantly: more than half (55%) prepared a diploma above level 4, of which 34% is a diploma from level 1 to 5 (DARES, 2016c). Indeed, apprenticeship is increasingly being used by previously qualified young people to achieve a higher degree of qualification or a specialized diploma.

Industry accounts for 22% of apprentices, of which nearly 90% are young men.

Table 5: Distribution of apprentices by sector of activity (%), 2009-2015

	Apprenticeship	2009	2010	2011	2012	2013	2014	2015	Change 2009-2015
	Agriculture, forestry, fishing	2.4	2.7	2.8	3.0	2.9	3.3	3.5	1.1
	Industry	20.1	20.5	20.7	21.2	22.1	22.1	22.1	2
	Construction	21.8	21.4	20.4	19.7	18.7	16.9	15.9	-5.9
Services	**Wholesale and retail trade and repair of motor vehicles and motorcycles**	20.4	20.3	19.2	18.8	18.8	19.2	20.1	-0.3
	Hotels and restaurants	11.6	11.3	11.6	11.5	11.6	11.9	11.9	0.3
	Professional, scientific and technical activities	6.7	6.9	7.3	7.7	7.8	8.1	8.0	1.3
	Hairdressing and other beauty treatment	6.1	6.4	5.7	5.8	5.8	5.4	5.7	-0.4
	Other service activities	10.8	10.4	12.4	12.3	12.3	13.2	12.7	1.9

Source: DARES, 2016c

Regarding apprenticeship in the industrial sector, the most popular training specialisations are agro-food processing (18%), mechanics, electronics and electricity (18%) and civil engineering (14%). The sector of so-called basic industrial technologies (design, automation, robotics and industrial computing) represents only 3.3% of registered apprentices. Regarding the companies where apprentices carry out their *alternance* training, just over 58% of apprentices were trained in companies in the service sector in 2015 (56% in 2008). The industrial sector is the second most popular destination for apprentices, with 22% in 2015 (20% in 2008), followed by construction where the number of apprentices is declining (16% in 2015 compared to 22% in 2008) (DARES, 2016c).

Small companies remain the main recruiters of apprentices: 74% of apprentices were employed by companies with fewer than 50 employees in 2015 and 56% in companies with fewer than 10 employees (DARES, 2016 c). These proportions were somewhat higher in 2008 (78% and 58% respectively). However, the proportion of companies with more than 250 employees is steadily increasing. They employed 18% of apprentices in 2015 compared to 13% in 2008. This improvement is explained by a 'bonus-malus' incentive system created in 2012 to encourage companies with more than 250 employees to exceed a quota of 4% of employees in work-study programmes in their workforce. Companies are thus encouraged to hire apprentices or people in professionalisation contracts. A large percentage of companies have therefore chosen to support professionalisation contracts which are more flexible than the apprenticeship contracts.

Key challenges

In terms of supply and demand related challenges, we must first consider the development of apprenticeship programmes suited to under-qualified young people. In the past few years, the *alternance* training system has attracted more young people with previous qualifications than unskilled young people. By selecting only the strongest academic profiles, employers are restricting unskilled pupils' access to workplace training opportunities.

Another challenge lies in reducing apprenticeship's high failure rate. Every year, more than 25% of apprenticeship contracts are broken before the end of the training period (DARES, 2016 b) and the failure rate is increasing in low-skilled training programmes. There are several reasons for this: training content not being fully adapted to employers' needs; difficult working conditions (Céreq, 2010; DARES, 2017); young apprentices being unsure of their chosen career path. These problems are mainly salient in educational institutions which do not belong to specific industrial branches or are not in step with the reality of the business world. Some companies also view recruiting apprentices as a constraint imposed by the law rather than an investment in qualification.

Regarding challenges related to the new labour market and skills needs, the content of apprenticeship curricula is often based on official job and qualification nomenclatures. However, the mutation of work in connection with digitisation is rapidly making these nomenclatures obsolete. Economic developments are being integrated into vocational training curricula with partial success and often with some delay. The nomenclature of professional activities (*Répertoire Opérationnel des Métiers et des Emplois, ROME*), which is used by many actors such as the Ministry of Education and the Public employment service, is too large, and does not distinguish between new jobs or activities and those that are undergoing a transformation. This makes it difficult to adapt certifications and training programmes to the needs of both employers and regions.

Professional branches are sometimes more successful in adapting training programmes to their needs. The pedagogical content of *alternance* courses is under the control of the Ministry of

Education. The accreditation of a training course has to follow a normative and cumbersome administrative process. As a result, employers have very little room to change the content of national diplomas (Conseil d'analyse économique, 2014). However, they have the possibility to create branch-level qualifications, or CQPs (for Certificates of Professional Qualification). These qualifications can be delivered through initial or continuing vocational training. Regarding IVET, they can be delivered through professionalisation contracts. They can also be delivered through apprenticeship contracts, but only if the diploma has been officially registered with the national registry (*Répertoire National des Certifications Professionnelles*, RNCP). Since they are designed to respond to qualification needs, these branch-level vocational diplomas are widely used across many different industries. However, as a direct result of their adequacy, they are closely associated with one particular sector and cannot be easily transferred to another.

There are other challenges as well, the first of which lies in structuring supply at a local level. In some regions, the training supply is too scattered and the content of the offers is poorly coordinated. This is illustrated by training offers (different educational institutions either in the field of *alternance* or not) being in direct competition with each other on the same territory while demand is low, or the fact that young people are still being trained in declining professions.

Regions now have to play the role of supply coordinator at the level of their territory. They are sometimes unprepared to exercise this role, and as a result, significant needs remain unsatisfied by the training programmes offered at local level.

Sometimes young people also get oriented towards disciplines suffering from a lack of jobs, whereas employers and branches fail to sufficiently anticipate the need for new skills. As a result, the training offer can be out of step with employers' needs while apprentices are trained in declining trades.

The second major challenge remains a cultural one. There are professions, such as craftsmanship, where apprenticeship is strongly tied to the culture of transmitting knowledge. But this is not the case for all occupations or for all small businesses. Today, SMEs welcome more than 70% of apprentices and 45% of professionalisation contracts (DARES, 2016c; DARES 2016d). However, these companies sometimes lack the human resources to accompany and mentor young apprentices or young students in vocational training. The lack of recognition of tutoring within company structure is one of the main causes of this (IGAS, 2014).

Moreover, the coercive approach (obligation by law) has been known to have perverse effects, that is, companies hiring *alternance* trainees to fulfil legal quotas and failing to adequately accompany these trainees throughout their professionalisation or apprenticeship contracts.

The final, overall challenge is certainly to simplify the *alternance* system, which is very complex and seems opaque, with regard to its financing and its operation in particular. This primarily penalizes young people in *alternance* training (apprenticeship or professionalisation contracts) and employers, as they lack knowledge about their rights and duties when they engage in a work-study contract. This knowledge gap does not encourage companies to hire *alternance* trainees.

Apprenticeship policy and practice in the manufacturing sector

Apprenticeship in the manufacturing sector

According to the interviewed UIMM representative, manufacturing or so-called 'technological industries' represents 42,000 companies and 1.5 million jobs in France. They comprise various industries, including aeronautics, space, defence, automobile, energy, electrical, electronic, digital and computer equipment, railway, mechanical, metallurgy, and shipbuilding.

Apprenticeships in particular and vocational training in general are of central importance to the industrial sector. As the following data indicate, the industrial sector relies on vocational training and *alternance* measures to integrate young people into its workforce to a much higher degree than the service sector for example. However, the industrial sector's lack of attractiveness may result in important competence gaps. The interviewed CNEFOP representative emphasised that certain sectors, such as the textile or luxury goods industry, are subject to important technological transformation and lose their know-how due to lack of apprenticeship centres. This competence gap makes it difficult to take advantage of innovative industrial processes that are currently emerging in France. This example underlines how important vocational training is to the competitiveness of certain industries.

Size and relevance as compared to other VET pathways

Industrial companies accounted for 19.4% of the number of *alternants* (including people on professionalisation or apprenticeship contracts) hired in 2015 (DARES, 2016 c and 2016d) and 21.1% of the number of apprentices (apprenticeship contracts, see Table 5). This proportion of alternants in industry is slightly higher than in 2008 (17.6%). The industrial sector is the second biggest recruiter after the commercial sector. Some 91,000 *alternants* were hired in in 2015, which represents 3% of total employment in the industrial sector. This ratio is higher than the average for other branches of the economy (2%).

The vast majority of *alternants* in the industrial sector are hired through an apprenticeship contract (69%, around 63,000 individuals). However, the professionalisation contract, which offers a more flexible framework for employers (in particular a shorter training period), has become increasingly popular over the past few years, rising from 22% in 2009 to 31% in 2015 (DARES, 2016c and 2016d).

Despite the economic crisis, the number of apprentices in the industrial sector has continued to increase. This is due to several factors, the first one being the 2012 law imposing a quota of *alternants* in companies and creating a 'bonus/malus' incentive system. There is also better recognition of the positive role of apprenticeship in preparing the workforce of tomorrow in a rapidly changing industrial context. Apprenticeship has come to be recognised as a more effective pathway to steady employment for young people. Companies that use apprenticeships in the industrial sector tend to recruit apprentices very regularly as a permanent HR practice (Assemblée Nationale des Chambres de Commerce et d'Industrie, 2013).

The industrial sector thus favours apprenticeship when it comes to meeting the structural needs of its activity. Apprenticeship contracts are based on long, specialised training courses in CFAs that give future employees a solid grounding in basic skills. Moreover, most industrial branches have created their own CFAs in order to adapt the training offer to their needs.

By contrast, professionalisation contracts are increasingly being used to recruit skilled workers for more qualified positions. They rely on shorter duration and they are therefore considered more appropriate for recruiting specific profiles. A typical example would be that of an engineer hired under a professionalisation contract in order to be rapidly trained to occupy a specific position.

Occupational profiles and apprenticeship courses

The general data from the Ministry of Education indicates that apprentices in industrial occupations tend, on average, to prepare for lower-level diplomas than in other sectors. We can posit from the following data (see Table 6) that only certain specific apprenticeship schemes touch upon advanced manufacturing technologies. These schemes fall under so-called 'multi-technological specialties of production' and encompass high-technology curricula. These specialisations include product design, automation, robotics and industrial computing. One-quarter of apprentices (26%) in the industrial sector prepare an EQF level 5-8 diploma whereas almost half prepare an EQF level 3 diploma (Ministry of Education, 2016a). The EQF level 8 (that is post-Master, PhD levels) represented 10% of industrial apprentices in 2015, against 5% in 2010 (Ministry of Education, 2016a). This figure of 26% of apprentices in industry preparing a higher diploma can be compared to that of 50% in the services sector. Higher apprenticeship is more prevalent in the tertiary sector. However, its growing importance in the industrial sector seems to be a very peculiarity of the French system, which should be put in comparison with other countries.

These lower levels of qualification in industrial apprenticeships are explained by the predominance of manual occupations and jobs in the automotive, agro-food, mechanical and electrical sectors, amongst others. Moreover, in certain industrial activities, starting a career at entry level is a non-negotiable condition of mastering basic skills and subsequently evolving towards high-tech jobs. But industrial companies are becoming increasingly demanding in terms of training requirements (IGAS, 2014). The share of high-qualification training has therefore increased in recent years, especially for mechanical and electrical jobs, which account for half of all industrial apprentices.

Table 6 is based on the typical categories used by the national education system to classify technical diplomas by specialisation. This classification may sometimes appear opaque or abstract, as it assembles different occupations and concrete qualifications into large categories. The table reproduced in annex 3 gives further information about the training courses and curricula that are included here.

Table 6: Evolution in the number of apprentices in the industrial sector

	Apprenticeship contracts		
	2009	**2015**	**Variation**
Manufacturing Production	154,663	153,092	-1%
Multi-technological specialties of production	11,938	13,496	13%
Flexible materials	1,136	1,027	-10%
Mechanical, electrical, electronic	76,438	63,153	-17%
Processing (agro-food)	65,151	75,416	16%

Source : Ministère de l'éducation nationale (Ministry of Education), 2016a

Apprenticeship training in industrial trades is very diverse. Generally, training is classified in four disciplines: multi-technological specialties of production (high technology); processing (agro-food); flexible materials; and mechanical, electrical and electronic. The first category is distinguished by a very high level of qualification. Almost all apprentices in this specialisation (a

total of 13,500 apprentices, representing only 3.3% of all apprentices) prepare a diploma of EQF level 5 or higher. 44% of them are following a PhD curriculum for instance (Ministry of Education, 2016a). This illustrates a developing trend towards higher apprenticeships in certain high-technology fields. However, this trend has to be put into perspective since it only concerns a very limited number of apprentices.

Strengths and weaknesses of the system

Attractiveness of apprenticeship

Dual training or *alternance* in the industrial sector is attractive for several reasons:

- The duration of the training courses is in general longer, which implies more solid pedagogical support to master the basic knowledge for the job at hand. Companies complete the training of *alternants* with on-the-job training. This system makes it possible to prepare future employees to take up jobs by adapting their skills to the evolution of the profession.
- For young people, dual training is the best way to enter the labour market. In 2015, between 69% and 75% of *alternants* in industrial vocations (depending on the specific curriculum followed) found work within 6 months of graduating. Among apprentices who have found a job after their training, more than one in two works in the company where they have been trained (Ministry of Education, 2016b). The employment rate of *alternants* increases to somewhere between 80 and 90% when the achieved diploma is of EQF level 5 or higher. These results are much better than those of the school pathway, since the employment rate of young people leaving vocational *lycées* is only 48% on average (Ministry of Education, 2016b).

However, there has been a decline in the employment rate since 2012 due to a depressed labour market. The overall employment rate for apprentices (whatever the nature of diploma prepared) was 62% in 2015. Some industrial sectors have an employment rate higher than average. This is the case for industrial technologies that allow 75% of apprentices to enter the workforce (Ministry of Education, 2016a).

Industrial apprenticeships suffer from an image problem, craftsmanship especially. Vocational education is culturally less valued than general education in France. According to the 2015 apprenticeship data (Ministry of Education, 2016a), the attractiveness of these jobs is particularly low among young girls who represent less than 10% of apprentices in these sectors. The number of apprentices in industrial companies has slightly increased in recent times and amounted to 22% of all apprentices enrolled in 2015. However, the high-tech manufacturing sector represents only a marginal share (which can be estimated at 3% of apprentices), which is largely below the challenge posed by the digital transformation of production. Although the high-tech sector is attracting more and more apprentices, their numbers remain low (less than 14,000 in 2015).

However, this devalued image of apprenticeship is slowly beginning to change thanks to the development of higher apprenticeship (apprenticeship leading to a higher education diploma) and access to higher qualification through the *alternance* route. The *alternance* system is no longer restricted to young people having left school early, but appeals more and more to apprentices who are older and more qualified. This trend was detected a decade ago (Abriac, 2009), but collected data on the profiles of *alternants* has shown a marked acceleration of the phenomenon in recent years (Ministry of Education, 2016a; DARES, 2016 c and 2016d).

Matching of supply and demand

The overwhelming majority of *alternance* qualifictions are national diplomas. The share of qualifications registered in the RNCP increased from 52% in 2009 to 59% in 2014, whereas

diplomas certified by professional branches represented 41% in 2014 against 48% in 2009 (DARES, 2016 c and 2016d).

This trend is even more pronounced in the industrial sector. The proportion of diplomas certified by professional branches dipped to 46% in 2014 in the metal-working industry compared to 58% in 2009. In mechanics, electronics and electricity branches certified only 43% of diplomas in 2014 compared to 64% in 2009 (DARES, 2015; DARES, 2010).

Traditionally, apprenticeship prepares for EQF qualification level 3 and 4. This is particularly the case in the industrial sector. Over the last few years, under the pressure of business demands, graduates are being recruited on more qualified profiles which are converging towards EQF Level 5 and even higher. According to a report by the Inspector-General of National Education (2013), this can be attributed to several factors, most notably increasing requirements specifically in mutating industrial jobs.

As described previously, at regional level, training is lacking in terms of supply: there are not enough places or training programmes locally. As shown in a study by the Ministry of Economy, Industry and Digital Economy (Castellazzi et al, 2016), technological university degrees accessible through apprenticeship have to contend with a large supply gap. Demand exceeds supply, particularly in computer, multimedia and Internet-related curricula.

Another problem lies in geographical mobility. The *alternant*'s place of residence can sometimes be far away from the training establishment. This discourages young people in rural areas from taking this learning pathway.

Quality of apprenticeship programmes

Raising the level of training is an opportunity for the industrial sector. In high-tech sectors, companies can now better rely on the *alternance* system (apprenticeship and especially professionalisation contracts). This increase in qualifications attracts more diverse profiles than in the past.

However, an OECD report (Brandt, 2015) identified some limitations in apprenticeship training. There is:

- a need to improve the quality of teaching, particularly with regard to the basic knowledge of the 1st level of training (mathematics and languages). In this domain, apprenticeship training suffers from an imbalance of quality compared to secondary education. Moreover, the over-representation of pupils with academic difficulties in CFAs should be counterbalanced by better individual accompaniment and specific 1st level training programmes.
- a lack of training and certification for apprenticeship tutors in companies. Social partners should define an attractive status for tutors.
- a lack of professional staff coming from the industry in apprenticeship centres. Attracting teachers with professional experience and cutting-edge technological knowledge can improve the quality of vocational training and better articulate theoretical and practical training. The evolution of teachers' skills is also at stake. Indeed, their initial training is often not in line with the new technologies used by companies. A recent report quoted the CEO of a company specialised in composite materials, who said: '*some technologies are so advanced that the aeronautics industry takes time to appropriate them. Training, on the other hand, does not evolve at the same rate. ... Teachers were trained more than twenty years ago, on composites that are no longer used. Hence the important gap between education and business needs*.' (Bidet-Mayer, Toubal, 2014).

Capacity to adjust and modernise

As mentioned previously, consultation regarding training content exists at the regional level. This has been reinforced by the 2014 law (Law on vocational training, employment and social democracy of 5 March 2014, n° 2014-288). The underlying principle is that of 'quadripartism', that is, consultation between the state, the region and social partners, which gives everyone involved, professional branches especially, the possibility to influence the content and the quality of apprenticeship training. The dynamism of these bodies varies from region to region. However some regions are models of virtuous co-operation in adapting and modernising apprenticeship training according to economic and social needs.

Two types of regional good practice can be listed (National Assembly, 2014). The first type concerns improving the flow of information regarding available training and the skills needs expressed by employers (for example the creation of regional information databases in the Hauts-de-France, Auvergne-Rhône-Alpes and Nouvelle Aquitaine regions)[7]. The second type consists in the creation of mechanisms to adapt existing training programmes to the professional branches' needs. One of these mechanisms is the creation of professions and qualifications campuses, which represent a very interesting case of good practice (see below for concrete examples). These campuses include educational institutions (secondary and higher education, initial or continuing education) and companies belonging to an 'excellence' branch at regional or national level. A large number of these campuses concern the manufacturing sector.

The dual training system benefits from large financial resources to modernise apprenticeship training programmes. Moreover, the offer is structured by large national networks capable of offering training adapted to the technological change occurring in the industrial sector. Because of their size, they can depreciate the cost of setting up new training activities. These include, for instance, the AFPA (*Agence Nationale pour la Formation Professionnelle des Adultes*) or other public actors.

The training centres run by professional branches offer many specialised training programmes, spanning a wide industrial field. This is the case of the vocational training network of the Confederation of Industries (UIMM), which is composed of 110 training sites and encompasses most new technologies[8].

Cooperation and involvement of relevant stakeholders

Despite the existence of both national and regional bodies, cooperation on apprenticeship training programmes is often difficult. This is notably the case for negotiations regarding the content of training curricula and the elaboration of training programmes. Competition between apprenticeship training centres and vocational high schools (*lycées professionnels*) is a direct consequence of this lack of cooperation. Competition arises because both systems are trying to attract a maximum of students in order to maintain the activity of their establishments and thus the employment of their teachers. Sometimes the same specialised training is offered in both systems (professional high school, apprenticeship in CFA) on the same territory even when demand is insufficient or in decline. In many regions, concerted action on the vocational education map is rife with tension, especially when it comes to rationalizing the training offer. Another area under development is that of cooperation between teachers in CFAs and company

[7] Regional information databases: Auvergne-Rhône-Alpes (http://www.rhonealpes-orientation.org/offre-formation/public/index.php#ancreForm); Hauts-de-France (http://www.c2rp.fr/formations); Aquitaine (https://www.aquitaine-cap-metiers.fr/web/guest).

[8] For more information is the web site of UIMM's training centre: http://www.les-industries-technologiques.fr/

mentors. This form of cooperation is underdeveloped in France compared to other countries (OECD, 2013).

Key requirements arising from technological and other changes in manufacturing

In the past twenty years, the industrial sector and industrial jobs have undergone profound changes. Even the most traditional trades, such as the textile or steel industry, have evolved. Certain trades and activities have disappeared under the effect of international competition, but most of them have done so because of automation. The professions that have resisted tend to evolve towards greater technicality and innovation. New industrial jobs are appearing under the influence of automation, digitisation and big data. The industry of the future creates increasingly demanding skills requirements. This requires an extensive rethinking of the vocational training system and apprenticeship.

Adjusting contents/curricula

The multiplicity of political actors involved in the governance of the French apprenticeship system makes it difficult to reach a strategic agreement on work-study training with common subjects. This difficulty manifests itself in making training contents evolve.

Regarding the content of 'school-based' vocational training provided by technical high schools (*lycées professionnels*), the Ministry of Education remains the main actor.

In the field of apprenticeship programmes, that is in initial vocational training, there is more concertation between different actors. A large majority of apprenticeships lead to a qualification recognised or validated by the state, hence its important regulatory role. The national education system has inspectorates that control the CFAs. However, these centres are funded by the 'apprenticeship tax' that is paid by employers. Therefore, employers and social partners have some influence at least in the structuring of the training supply, including the opening of new centres, the creation or adaptation of new training, and the accreditation of training centres.

The field of continuing vocational training is much more open and competitive. In this field, branches have progressively developed their own qualifications called CQPs (*Certificats de Qualification Professionnelle*) that can be recorded or not in the national repertoire of qualifications. The regulation here is the result of concertation between several actors.

Making training contents evolve is a crucial challenge today. The Ministry of Education has a leading role in the definition and classification of apprenticeship programmes. This work is based on the proposals made by 'professional advisory commissions' or *Commissions Professionnelles Consultatives* (CPC) in 14 sectors.

According to the interviewed UIMM representative, adjusting the reference system is a cumbersome and lengthy procedure (two to three years to change the content of a curriculum). However as noted by the CNEFOP representative, the curricula changing every year or so would lead to a general lack of credibility.

According to expert interviews carried out in the context of this study, there is in general no disagreement between these different actors in terms of opening a new training programme. Yet, there is often strong opposition when it comes to closing a training programme that is no longer adapted to the reality of the labour market. Despite the existence of several bodies designed to govern the *alternance* system, the development of a common strategy adapted to regional economic realities is often subject to political or corporatist tensions.

Another issue is that the map of vocational training is often defined according to the number of teachers and their specialisation rather than employers' needs (Bidet-Mayer and Toubal, 2016).

Among social partners, some (employers' organisations in particular) call for more direct participation in the preparation of curricula instead their current advisory role.

In general, the content of apprenticeship curricula is revised once every five years, but this schedule can be more flexible in case of sudden needs. The main difficulty here lies in the capacity to anticipate change and to translate it into operational tools.

The interviewed UIMM representative highlighted different elements of flexibility at their disposal in order to circumvent difficulties:

- the CQP allowing to create or rapidly adapt training according to the evolution of a profession. The branches have more freedom in the creation and adaptation of a CQP. The UIMM has launched several CQPs in the industry of the future, for instance in the digital sector or robotic and technological systems.[9] But these certificates are very often closely linked to one specific sector and not easily transferable to another.
- the training pedagogy which enriches basic knowledge with new skills adapted to employers' needs. The CFAs that belong to the UIMM network (in the metal industry) comply with the national diploma reference system, but they complement this framework with specialised and cross-functional knowledge (project-based and multilevel learning).

Although most branches try to anticipate change and rely on internal, joint observatories of jobs and skills, it is quite complex to efficiently fulfil the steps mentioned previously. But there have been many improvements to this process. The national council of industry (*Conseil National de l'Industrie,* CNI) recommends the development of a 'shared' anticipation at the intersectoral/interbranch level, emphasising the need to develop a more transversal approach vis-a-vis training instead of a specific need approach. An experiment is being led in the digital industry to develop more transversal training.

New occupations

The 'Industry of the future' initiative regroups both emerging industrial activities (such as the digital industry, biotechnology) and traditional industries that are in a process of transformation and modernisation. New industrial jobs can be created in these sectors.

On the basis of the interviews conducted in the frame of this study, there are at least two new industrial areas and occupations that are developing. The first is so-called 'additive' manufacturing (3D printing). Jobs are being created in connection with this technology (use of 3D printers, printing materials, design of printed products, etc.). However, the training offer appears to be poorly developed and does not cover all of the employers' needs. This new technology, like all disruptive technologies, requires adapting educational content throughout the education system and especially in continuing education (CCI Paris Ile de France, 2017). If major engineering schools are doing well, the vocational training programmes are lagging behind. For the interviewed AFPA representative, '*the apprenticeship and continuing training apparatus is not currently ready to meet the skill needs of the industry of the future'*. According to him, lack of flexibility and responsiveness is the cause.

The second developing sector is that of the design, manufacture and maintenance of industrial automation systems[10]. These are generally engineering jobs, for which training is increasingly

[9] For example digital modeler of mechanical products or systems, machining technician on CNC machine tools, integration manager in industrial robotics, automated production systems operator, and automated production systems pilot.

[10] Most of the training in these areas of high technology is provided by the training organisations of the UIMM: https://formation.les-industries-technologiques.fr/

being carried out in apprenticeship training centres (CFAs) or in the apprenticeship sections of universities, engineering schools and technological institutes. Indeed, having a practical in-company component is vital to properly train applicants in this field. Predictive maintenance is one of the most in demand jobs. It consists in predicting the technical malfunctions of equipment and industrial automation by analysing the machines' technical data. This occupation requires both numerical (data analysis) and technical skills.

Developing higher apprenticeships

Apprenticeship was extended to higher education in the 1990s. This trend has caused a major change in the profile of apprentices in recent years, especially in the manufacturing sector. This extension of the apprenticeship system to higher education also makes for an opportunity to bring university and workplace closer together, thereby facilitating the students' professional integration.

The 'universitarisation' of apprenticeship has also caused the specialised industrial sector to start using the *alternance* system, especially for the higher diploma levels (bachelor, master). As already mentioned in the report, the development of higher apprenticeships is a positive element insofar as it boosts the attractiveness of apprenticeship training.

Higher apprenticeships are valued because they provide companies with a mix of apprentices. Some companies try to build crossed curricula between engineering training and other initial and continuing training. This makes it possible to train employees with cross-functional technical skills and develops a collaborative working culture between employees from different professional backgrounds. This type of crossed curriculum requires the creation of new courses and innovative pedagogical formats. This is the case of CESI (*ecole supérieure des métiers*), a network of several private training centres resorting to *alternance* courses (either through apprenticeship or professionalisation contracts). It trains engineers using the 'active learning by project' method. This consists of complementing technical and fundamental skills (hard skills) with transversal skills (soft skills, including ability to work in a team, ability to innovate, entrepreneurial spirit, management and management in project mode).
The UIMM for its part is experimenting with this new pedagogy of learning by project, and plans to extend it to all of its training centres. The idea is to have apprentices from different industrial specialties work on the same project–the manufacture and marketing of a product, for example. The aim is to train an engineer or technician capable of understanding all the phases of the production of a product from its conception to its commercialization, through manufacturing and marketing.

Establishing links to continuing learning

Continuing education has been built independently from initial training, which explains the discrepancy observed today between the educational and production sectors. The French system is marked by the importance of the diploma as a means of identifying qualifications and skills, and the weight of initial training in an individual's professional trajectory remains decisive.

France is characterised by a clear break between the education system and the labour market. The vocational training system is considered to be particularly compartmentalised with, on the one hand, diploma-oriented training which depends on the state and, on the other, continuing professional training, depending on social partners and professional branches. The French model is characterised by a diversity of actors, tools and devices. This multiplicity leads to a lack of articulation between initial and continuing training and, above all, makes the concept of lifelong training difficult. It may be argued that the French system has been completely built around the central pillar of the national education system and the diplomas it provides, which leads to the

undervaluing of knowledge produced in companies– a vital complement to the academic teachings of initial formation (Bidet-Mayer and Toubal, 2014).

The industry of the future will require greater versatility in professional industrial profiles, as well a different mix of expertise, in particular the integration of cognitive and technical skills. This in turn should lead to a new approach to apprenticeship and work-study programmes.

According to a recent report, the industry of the future requires fundamental knowledge but also technical knowledge that can no longer be taught solely at school before the beginning of an individual's career (Bidet-Mayer and Toubal, 2016). This knowledge should be acquired through vocational experience. The authors argue for a form of 'permanent apprenticeship' which could become the norm in vocational training in the industry of the future.
In this perspective, according to the director of Renault-Douai automobile manufacturing plant (as quoted by Bidet-Mayer and Toubal, 2016), the typical profile of a worker-technician in the industry of the future will be an employee with versatile (ability to intervene on several tasks) and integrated skills (ability to alternate phases of manual work with tasks that require more technical and cognitive skills). The skills needed in the upstream phase of production mostly consist of controlling and programming automated equipment (robot machines, etc.). This requires knowledge of data management, cognitive abilities of abstraction, representation and anticipation. A production operator in the industry of the future will no longer be a 'Taylorian worker' but a 'cognitive worker' (Colletis and Paulré, 2008). The considerable decrease of unskilled employment in the industrial sector in favour of skilled employment has been ongoing over several years. From 2011 to 2015, the share of skilled workers has increased by 4.8 points to 42.3%, while unskilled labour has fallen by 2.2 points to 6.9% (Eurostat database, 2017) [11].

Advanced manufacturing: mapping reform processes and adjustments

Numerous reforms have taken place since the introduction of the continuing education system in 1971, but they have not succeeded in rebalancing the system, which is still dominated by initial training. The law on vocational training, employment and social democracy of 5 March 2014 (*loi relative à la formation professionnelle, à l'emploi et à la démocratie sociale* du 5 mars 2014, n° 2014-288) was presented by the government as a long-term reform that recasts vocational training for the next forty years.

In parallel, since the early 1990s, several plans to develop the apprenticeship system have succeeded. As early as 1993, the very ambitious and voluntarist Quinquennial Act (*loi quinquennale relative au travail, à l'emploi et à la formation professionnelle* du 20 décembre 1993, n° 93-1313) on employment and vocational training set a target of 500,000 apprenticeships by 2000. This target was never achieved but it was reaffirmed in 2005 and it still features in the national pact for growth, competitiveness and employment of 5 November 2012 (*pacte national pour la croissance, la compétitivité et l'emploi*), with the target date pushed back to 2017 (Lopez and Sulzer, 2016).

In 2015, new measures were introduced to encourage companies – the smallest in particular, through an additional hiring aid making the cost of an apprentice close to zero – to develop apprenticeships, so as to reach this quantitative target.

Adjustments linked to industrial policy initiatives targeting advanced manufacturing

France's main industrial policy is the 'Industry of the future' plan, launched in 2013. This plan has so far seen the creation of several industrial clusters, such as the 'Jules Verne Manufacturing

[11] Employment data by European socio-economic group (lfsa_esegg).

Valley' in the Pays-de-la-Loire region. Developed by public and local authorities, this cluster gathers industries together to form a so called 'competitiveness pole' (*pôle de compétitivité*), which includes a training centre. Apprenticeship therefore has a major role to play. Within this cluster, the Institute for Technological Research Jules Verne carried out an experiment (still on-going) which involved apprentices from different backgrounds and qualification levels (engineers, graduate students, bac pro and CAP) working on the same project (intra-level training). The aim was to build bridges between different diplomas and find common modules (Agera, 2015). This institute is dedicated to the industry of the future and provides training in several specialised fields, for example robotics, augmented reality, simulation and modelisation, composite processes and metal processing. This manufacturing academy has multiple objectives, such as implementing new training methods by using technological facilities, proposing a large selection of apprenticeship training ranging from professional bachelor to engineering degree, offering in-house training, continuing education and vocational training, and motivating young people to come work in manufacturing industries.

Sector- and company-specific initiatives

More and more industrial companies are aware of the need to adapt the qualifications of their employees to the digital transformation of their production. This is the case of hydraulic machine manufacturing company Poclain, which has launched a 'Skill In' programme to identify the company's key jobs and define an updated skills repository. A systematic evaluation of each employee's skills is then carried out allowing the company to elaborate and propose individualised training courses.

Other companies have set up internal training centres or even mini-training centres within production units (factories). This is the case of the French subsidiary of German company Festo, specialised in automation systems, which has set up mini-training centres (or learning factories) whose objective is to offer continuing education courses. More precisely, these are training courses geared towards helping employees adapt to the transformations the company is undergoing. These courses are short (less than two hours) but more regular, and their content is defined according to the each factory's specific needs.

Another more frequent example concerns cooperation between one or more companies and a training centre to develop tailor-made training. This is the case of Safran, a large company specializing in aeronautical equipment, which recently created a subsidiary to manufacture parts in composite materials (Bidet-Mayer and Toubal, 2016). This technology is new and no training existed in the field. Safran then partnered with an apprenticeship training centre to create a qualification programme specifically for aerospace professions (mixing aeronautics and composite materials) to train 450 employees in three years.

Innovation

One recommendation that has not as of yet been translated into practice is that of the National Council of Industry (CNI) to improve the relationship between schools (especially secondary schools) and businesses in order to increase the visibility of *alternance* training (CNI, 2017). To improve its attractiveness, the CNI proposes to build a pool of apprentices shared between large companies and SMEs. This pool would also make it possible to build diversified training paths and bridges between industrial trades. It would rely on more general curricula and it therefore involves a 180-degree turn since companies and professional branches often privilege very specific training and non-transferable qualifications. This general/specific qualification debate is an old one in education and labour economics. By favouring more general training, companies would accept that the skills and qualifications of tomorrow should be grounded in a common foundation, making them transferable to different fields or branches. This would in turn lead to

simplified curricula and make it easier for young people to enrol in apprenticeship or vocational learning, since their careers would not be inextricably tied to a single job. This might also help to improve the image of apprenticeship training. Today only certain interprofessional certificates (interprofessional CQPs) lean in this direction.

To improve relations and enhance links between schools and companies, the CNI proposes to decompartmentalise initial training and vocational training. One way forward would be the generalisation of the 'factory-school' concept, which is an innovative pedagogical approach consisting in training pupils directly on equipment, software and industrial components used by companies. This concept, which has existed for a long time, is developing recently with the emergence of the industry of the future. Several factory-schools are being set up in France, including the AIP-Prémica (a national network of technical training platforms) or the manufacturing academy in Nantes, which will be managed by the Institute for Technological Research Jules Verne.

The previously mentioned professions and qualifications campuses, which were created during the extensive educational reform of 2013 may be the most interesting case of innovative practice so far. There are currently 77 campuses which allow companies to play their role in the development of training programmes adapted to their professions. They include several academic institutions (secondary and higher education, initial or continuing education, apprenticeship training centres) and companies. The *Plasti Campus* in Oyonnax-Bellignat in the so-called *Plastics Vallée* (highest concentration of plastic manufacturing companies in Europe, located in the departments of Ain and Jura) is a salient example. It is an integral part of the Plastipolis competitiveness cluster. There are 200 companies participating in this campus which contributes to giving apprenticeship much better visibility in this sector.

Another example is the digital images and creative Industries campus (*Campus Image Numérique et Industries Créatives*) of the Hauts-de-France region, which includes more than 70 companies, vocational *lycées*, an apprenticeship training centre (CFA), universities and engineering schools. Close cooperation between member companies and academic institutions makes joint development of training course content possible. It allows teachers to keep up to date with the new technologies used by these companies. Some companies even accept to provide teachers with specialised technical equipment in order to adapt their pedagogy accordingly.

In total these campus encompass 11 dynamic and job-creating sectors. These include food and agri-food; chemistry and biotechnology; creation, design, audio-visual; infrastructure, building, eco-building; materials, innovative materials; mobility, aeronautics, land and sea transport; digital, telecommunications; business services, logistics; innovative systems, mechatronics; tourism, well-being, gastronomy; energy transition, eco-industry.

The industrial professions' lack of attractiveness is undoubtedly one of the weaknesses of the French apprenticeship system, although the development of the industry of the future and higher learning have greatly contributed to the improvement of the image of industrial occupations in recent years. To improve their attractiveness, the UIMM periodically organises an operation called 'in-company classes' which involves inviting a class of high school students and their teachers for a weekly immersion in an industrial working environment. The goal is to allow them to discover the broad spectrum of professions that exist within the industry and encourage them to embark on an industrial training programme after college (*collège*).

Commentary and conclusion

Developing apprenticeship in the industrial sector is not a new idea, and it has been the subject of intense planning for decades now. The German, Austrian or Swiss dual models are often praised in public debate. Industrial jobs and apprenticeship training do not have a good image in France. These professions are associated with 'getting one's hands dirty', although they are now evolving towards more cognitive and integrated tasks. Vocational training in general, and apprenticeships more specifically, remain undervalued among students and parents, even though they lead to rapid integration into the workforce, but this general opinion is certainly changing as the image of apprenticeships has improved in recent years, thanks to new occupations linked to the industry of the future. Apprenticeship is increasingly attracting more qualified people. One reason for this improvement is the development of higher apprenticeships, which is one of the major changes in recent years. Furthermore, the promotion of the 'Industry of the future'- which is a term used extensively by the government and social partners, in particular by the employers' federation of metalworkers - is a major factor of attractiveness. The employers' federation develops new ways of promoting these jobs among young people, using more 'interactive' approaches (for example by presenting 3D printers).

From an institutional point of view, the system is very complex. This report has mainly focused on the apprenticeship pathway but another pathway exists alongside it – the professionalisation contract. Both are included in the *alternance* system, which relies on in-company practical training, but operate within different frameworks. Since the 2014 reform of vocational training, new advisory bodies such as CNEFOP have developed and seem to be in line with the most important issues at stake, in particular making training content and methods evolve. However this is a long process and industrial companies will often question the lack of reactivity or flexibility of the national education system. Industrial branches can resort to their own system of qualifications (which is however generally linked to the national education standards), namely the CQPs. These vocational certificates, either in initial or continuing education, are a strong element of reactivity. Some employers' federations, such as the UIMM in engineering, are very proactive in developing new content, new training centres and new learning pedagogies in line with the industry's changing needs. New skills needs are emerging and are required by companies, in terms of performing more integrated and complex tasks, including cognitive assets. Another idea is to develop intersectoral content or at least a common basis, in order to help people change occupations more easily. A view shared by several actors who have been interviewed in the context of this study, is that young people cannot be trained in one single job and that they need general, transferable knowledge, rather than a specific qualification.

In terms of the impact that changing technology and industrial production have on skills needs in the French industrial sector, there is a common concern that skills and competence needs are growing and that this increase represents a major and durable transformation. It is observed a rise in the level of qualification and the level of diplomas prepared by alternates.

New methods of learning such as open and distance learning are being integrated but are still limited for the moment. New vocational curricula are being opened by professional branches (in the form of their own CQP) to meet the industry's short term needs. In a long-term perspective, branches are trying to cooperate to create intersectoral diplomas, which would be more generic and more adapted to transversal skill needs, such as versatile skills and integrated skills. Of course, in their specific content, curricula are in perpetual adaptation to new industrial processes. A key question is to prepare apprentices to use the latest generation of tools (robots in particular). Although these different elements, occupational profiles, and curricula are affected by the changes in the industrial sector, there is some inertia, as diplomas under the scope of national education cannot change every year.

Nevertheless, an important weakness in the system is the training and skill adaptation of the teachers themselves, since their initial training is sometimes not adjusted to new practices or technologies. It is important to reinforce the links between companies and teachers.

Despite offering quality higher education[12], the French system remains insufficient to satisfy all skill requirements. The weak point of the French model is the provision of training in secondary education and its system of vocational training. In both these areas, France is lagging behind other countries according to a report for the ministers of labour, education and industry (Castellazzi et al, 2016), in particular in relation to the skills needs of new emerging industrial sectors. According to this report, France has a diversified but too scattered offer regarding apprenticeship training in the field of digital initiatives. One of the issues identified is that of making these training programmes more visible to both students and employers. On the other hand, there is clearly a lack of places for certain industrial sectors whose training mostly relies on apprenticeships. Few industrial companies in the high-tech sector offer apprenticeships: only 22% of apprenticeship contracts were signed in the industrial sector 2015, and the high-tech industrial sectors accounted for only 2.5% of all apprenticeship contracts signed in 2015 (DARES, 2016a).

[12] In relation to the number of graduates of the higher education in new technologies in 2011, France ranks first in the EU as to the provisions of university training of ICT graduates with 18% of the total European labour market entry, exceeding the United Kingdom (17%) (European Commission, 2014).

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Annex 1: Glossary

Abbreviation	Original term	English translation/explanation
BEP	Brevet d'études professionnelles	Level-3 diploma delivered by vocational lycées
CAP	Certificat d'aptitude professionnelle	Level-3 diploma delivered by vocational lycées
CCI	Chambre de Commerce et d'Industrie	Company interest representation organisation providing them with support and advice
CDD	Contrat à Durée Déterminée	Fixed-term contract
CDI	Contrat à Durée Indéterminé	Permanent contract
CFA	Centre de Formation d'Apprentis,	Apprentice training centre where the training is realised for apprentices (in complement to the training received in companies). Managed by the National Education, or professional branches, or consular chambers.
CNCP	Commission Nationale de Certification professionnelle,	National Centre for Professional Certifications. Commission under the control of the Ministry of Labour, in charge of identifying and validating professional certifications.
CNEFOP	Conseil national de l'emploi, de la formation et de l'orientation professionnelle	National consultative body on vocational training, employment and guidance. Advisory body created after the 2014 Law, under the principle of 'quadripartism' (involving state, regions and social partners). It also exists at a regional level (CREFOP).
CNI	Conseil national de l'indsutrie	National Council of Industry An instance composed of industry actors whose mission is to advise the government on industrial policy
CPC	Commissions Professionnelles Consultatives	Professional advisory commissions. In charge of making proposals on the creation, modification or suppression of technological and vocational training programmes
CQP	Certificat de qualification professionnelle	Certificates of Professional Qualification. Vocational diplomas created and recognised by a professional branch.
OPCA	Organisme Paritaire Collecteur Agréé par l'État	Bodies collecting funds for vocational training. They do not as such collect the apprentice tax.
RNPC	Répertoire National des Certifications	National register of professional qualifications, recognised by the CNCP.

	Professionnelles	
UIMM	Union des industries et des métiers de la métallurgie	Main metalworkers employers' organisation

Annex 2: List of consulted national stakeholders and experts

Type of organisation	Name of organisation	Position
Ministry responsible for VET	Ministère du travail, de l'emploi, de la formation professionnelle et du dialogue social	Head of the Unit 'Training and Qualification Policies'
VET provider	AFPA	Director of observatory 'Jobs and qualifications'
Employer organisation	UIMM - Union des industries et des métiers de la métallurgie	Advisor, responsible of the training centres, General Delegation Employment and Training
Trade union organisation	Fédération Générale de la Métallurgie et des Mines - CFDT	Confederal Secretary in charge of industrial policies
VET expert /research institute	CNEFOP - Conseil national de l'emploi, de la formation et de l'orientation professionnelle	General Secretary

Annex 3: Nomenclature of technical and vocational training specialties in the field of production (industry, agriculture and construction)

Field	Specialities
Multi-technology production specialties ***Spécialités pluri-technologiques de production***	Basic industrial technologies (industrial engineering, industrial design) *Technologies industrielles fondamentales (génie industriel, conception industrielle)*
	Control technologies for industrial transformations (robotics, automation, IT) *Technologies de commandes des transformations industrielles (robotique, automatismes, informatique)*
Agriculture, fishing, forest and green spaces **Agriculture, pêche, forêt et espaces verts**	Multi-disciplinary specialties of agronomy and agriculture *Spécialités plurivalentes de l'agronomie et de l'agriculture*
	Vegetable crops, special crops and crop protection *Productions végétales, cultures spécialisées et protection des cultures*
	Animal production, specialized breeding, aquaculture, animal care *Productions animales, élevage spécialisé, aquaculture, soins aux animaux*
	Forest, natural areas, wildlife, fishing *Forets, espaces naturels, faune sauvage, pêche*
	Landscaping (parks, gardens, green spaces, sports fields) *Aménagement paysager (parcs, jardins, espaces verts, terrains de sport)*
Transforming ***Transformations***	Pluritechnological specialties of transformations *Spécialités pluritechnologiques des transformations*
	Agri-food, food, kitchen *Agro-alimentaire, alimentation, cuisine*
	Chemical and related transformations (including pharmaceutical industry) *Transformations chimiques et apparentées (y compris industrie pharmaceutique)*
	Metallurgy *Métallurgie*
	Building Materials, Glass, Ceramics *Matériaux de construction, verre, céramique*

Field	Specialities
	Plastics, composite materials *Plasturgie, matériaux composites*
	Cardboard *Papier, carton*
	Energy, climate engineering *Energie, génie climatique*
Civil engineering, construction and wood ***Génie civil, construction et bois***	Specialties pluritechnologiques civil engineering, construction, wood *Spécialités pluritechnologiques génie civil, construction, bois*
	Mining and quarrying, civil engineering, topography *Mines et carrières, génie civil, topographie*
	Building: construction and roofing *Bâtiment : construction et couverture*
	Building: finishes *Bâtiment : finitions*
	Woodworking and furnishing *Travail du bois et de l'ameublement*
Flexible materials ***Matériaux souples***	Pluritechnology specialties flexible materials *Spécialités pluritechnologiques matériaux souples*
	Textile *Textile*
	Clothing *Habillement*
	Hides and skins *Cuirs et peaux*
Mechanics, electricity, electronics ***Mécanique, électricité, électronique***	Mechanical-electrical specialties *Spécialités pluritechnologiques mécanique-électricité*
	General and precision mechanics, machining *Mécanique générale et de précision, usinage*
	Motors and mechanics *Moteurs et mécanique auto*
	Aeronautical and Space Mechanics *Mécanique aéronautique et spatiale*
	Metal structures (including solder, bodywork, boat hull, airframe) *Structures métalliques (y.c. soudure, carrosserie, coque bateau, cellule avion)*
	Electricity, electronics *Electricité, électronique*

Source: Commission nationale de la certification professionnelle (CNCP)

The European Foundation for the Improvement of Living and Working Conditions (Eurofound) is a tripartite European Union Agency, whose role is to provide knowledge in the area of social, employment and work-related policies. Eurofound was established in 1975 by Council Regulation (EEC) No. 1365/75, to contribute to the planning and design of better living and working conditions in Europe.