

L'Institut national de recherche et de sécurité (INRS)

In the field of occupational risk prevention, INRS is a scientific and technical body that works on an institutional level with the Caisse nationale d'assurance maladie des travailleurs salariés (CNAMTS), Caisses d'Assurance Retraite et de la Santé au Travail (CARSATs), Caisse régionale d'assurance maladie d'Île-de-France (CRAMIF) and Caisses Générales de Sécurité Sociale (CGSSs). As the need arises, it also works for Government departments as well as for any other body that deals with occupational risk prevention.

It has developed a body of multidisciplinary know-how that is available to all those responsible for risk prevention in businesses, such as employers, occupational physicians, *Comités d'hygiène, de sécurité et des conditions de travail* (CHSCTs), and workers. To help deal with such complex issues, INRS has scientific, technical and medical skills covering a very wide range of disciplines, all aimed at controlling occupational risks.

For instance, INRS draws up and distributes a number of documents concerning occupational health and safety, such as publications (periodical or not), posters, audiovisual aids, multimedia and a web site. INRS publications are distributed by the CARSATs. They may be obtained from the Service Prévention of the CARSATs or CGSSs.

INRS is a non-profit organization (law of 1901) set up under the aegis of CNAMTS and subject to the financial control of the State. It is run by a joint Board of Directors made up of two colleges representing in equal numbers employers and employees, which is chaired in turn by a representative of each college. It is almost entirely funded by the National Fund for the Prevention of Occupational Accidents and Diseases.

Caisses d'Assurance Retraite et de la Santé au Travail (CARSATs), Caisse Régionale d'Assurance Maladie d'Île-de-France (CRAMIF) and Caisses Générales de Sécurité Sociale (CGSSs)

In order to help reduce occupational risks in their region, CARSATs, CRAMIF and CGSSs have a prevention department made up of consulting engineers and safety inspectors. They are specifically trained in occupational risk prevention disciplines and use their everyday experience of businesses to advise, and under certain conditions back up, the company stakeholders (management, occupational physicians, CHSCT, etc.) in implementing the most suitable prevention approaches and tools for each situation. All the documents published by INRS are available from them.

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Modes and methods of production in France in 2040: what consequences will they have on occupational safety and health?

Summary

PV 4

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(Translated from: *Modes et méthodes de production en France en 2040 : quelles conséquences pour la santé et la sécurité au travail ? Synthèse*. INRS, November 2016)

Contents



A word from the Director-General	p. 5
--	------

The foresight exercise	p. 6
------------------------------	------

Method	p. 6
The transformations in production in France over the last 25 years.....	p. 6
The transformations in employment and in work.....	p. 7
General context.....	p. 9
The issues	p. 9
References.....	p. 9
Composition of the project group.....	p. 10
List of participants in the interviews and in the foresight workshops	p. 10
The partners	p. 12

Issue 1 – What will France produce tomorrow?	p. 14
--	-------

What are we talking about?	p. 15
What are we observing?	p. 15
Foresight hypotheses and their impacts on occupational safety and health.....	p. 19
An illustration of a service society: France, leisure park and sanatorium for the world	p. 24

Issue 2 – Robotisation – automation	p. 26
---	-------

What are we talking about?	p. 27
What are we observing?	p. 27
Foresight hypotheses and their impacts on occupational safety and health.....	p. 35

Issue 3 – Going back to local as a tool for development?	p. 38
--	-------

What are we talking about?	p. 39
What are we observing?	p. 39
The question of the circular economy	p. 49

Issue 4 – Towards a multiplicity of work forms?	p. 52
---	-------

What are we talking about?	p. 53
What are we observing?	p. 53
Foresight hypotheses and their impacts on occupational safety and health.....	p. 62
A fictional scenario: a day in the life of Polly Semy	p. 64

Issue 5 – How will prescription of work and pace of work change?	p. 66
---	-------

What are we talking about?	p. 67
What are we observing?	p. 67
Foresight hypotheses and their impacts on occupational safety and health.....	p. 71

A word from the Director-General

The initial drive to conduct strategic foresight exercises at INRS came from our board of directors. Over the years, as Director-General, I wanted to make this activity a tool enabling internal and external cooperation between teams to be developed, underpinned by the logic of multi-disciplinarity that is inherent to prospective analysis. I am therefore very attached to the utility of this approach. This applies particularly to the exercise whose main findings are compiled in this document: "Modes and methods of production in France in 2040: what consequences will they have on occupational safety and health?", for which we have worked in partnership with:

- Anact (French National Agency for the Improvement of Working Conditions);
- Anses (French National Agency for Food, Environmental, and Occupational Health & Safety);
- Aravis-Aract Auvergne – Rhône-Alpes (a regional agency for improving working conditions);
- Dares (Directorate for the Coordination of Research, Studies, and Statistics of the French Ministry in charge of Labour);
- *Direction des risques professionnels* of CnamTS (Directorate for Occupational Risks of the French National Health Insurance Fund for Salaried Workers);
- France Stratégie; and
- Futuribles.

On a subject with such a broad and ambitious spectrum, it was important for INRS to be able to benefit from the contributions and skills of bodies who, for the most part, had already been thinking about the possible futures of work and who wanted to continue that thinking with us in the specific field of occupational risk prevention.

I am also very attached to the visibility of our work. That is why I would like to say a special thank-you to the "*Pénibilité du travail, santé au travail et maladies professionnelles*" ("Arduousness of work, occupational diseases and safety & health") study group of the *Assemblée Nationale* (French Lower House), chaired by Mr Gérard Sebaoun, who received us for the public presentation of the exercise. I would emphasise that what struck me particularly during this cooperation was the strong encouragement that we received to communicate more directly about our work, in a manner that is more accessible to non-specialists, without however reducing the level of scientific rigour to which all of us, INRS and our partners, are very attached.

Stéphane Pimbert



The foresight exercise

Method

On the initiative of INRS, in association with six partners (Anact, Anses, Aract Rhône-Alpes, Dares, *Direction des risques professionnels* of Cnam-TS, France Stratégie) and with methodological support from Futuribles, this "foresight" or "futures" approach aimed to describe the possible futures for production in France at the horizon of 2040. In view of the missions of INRS, it was chosen to focus on the changes most likely to lead to transformations in terms of occupational risks (occupational accidents and diseases).

For this purpose, a method in three main parts was chosen:

- based on interviews with about thirty experts in occupational risk prevention (from institutions or from industry), a retrospective analysis was conducted of the changes that have occurred in France over the last 25 years, with the emphasis being put on the developments likely to have the biggest impact on occupational safety and health; in parallel, a project group, made up of representatives of the partner organisations, analysed the main studies devoted to the future of work, labour and employment in France (at horizons ranging from 2022 to 2054);
- on the basis of the variables identified during this first sequence, six one-day workshops were held, bringing together twelve to fifteen experts from a variety of backgrounds and disciplines (see the list at the end of this section), and aiming to outline the possible futures for production in France over the coming 25 years; the six themes addressed were as follows:
 - Global value chains or self-production and local exchange & trade?
 - Work or employment? What do we need to be happy?
 - Are we all going to be nomadic entrepreneurs?
 - The zero-risk society?
 - In a robotised world, what place is left for human labour?
 - Doing work as prescribed or working autonomously? Innovation that fulfils or that alienates?
- the data gathered during this workshop phase was then analysed during a two-day seminar bringing together occupational safety and health specialists who deduced possible consequences in terms of occupational risks and of prevention measures to be implemented.

The essential findings of the exercise are to be found in this document. All of the data (summaries of the retrospective phases, of the workshops, and of the occupational safety and health aspects, and various contributions) will then be compiled into a complete document.

The objective of this introductory chapter is to describe the context of the exercise.

The transformations in production in France over the last 25 years

At first sight, the overall picture is simple: France has undergone major deindustrialisation over the last 25 years, offset in part by a rise in services (but only in part since France is faced with

lasting mass unemployment). This deindustrialisation is due to certain production units being moved to countries with lower labour costs, to intensification of work resulting in staff numbers being reduced, to increased use of outsourcing to external companies (whose staff are often not counted in industry figures, but rather, somewhat artificially, in the service sector), and finally to major technological transformation. A fair number of consumer goods produced in France until the 1980s or 1990s have been replaced with other products of different design, for which the production units have been directly located elsewhere. By way of illustration, mention might be made of the changeover from predominantly mechanical products to predominantly electronic ones for capital or consumer goods. Consumers' needs have changed, as new products have been proposed to them, and industry has adapted.

Service activities have undergone significant development. New forms of activity have appeared, related to development of technologies, to growth in international trade, or, on a completely different level, to population ageing. Thus, new information and communications technologies have profoundly changed the relations between customer and supplier through a "dematerialisation" of the exchanges (automated teller machines and the Internet in banking, postal services, and insurance, for example). They have enabled e-commerce to develop, which, in a context of globalisation of production, has contributed to the increase in trade, and thus to the major development in logistics activities, etc. Personal service activities have increased considerably, e.g. in tourism and leisure. Use of them for elderly and/or dependent people has become a major item in the budget of social organisations and local authorities, with high growth in the home help and care trades, which generate high occupational accident and disease rates (higher than in building and civil engineering in certain segments).

Generally, both in the secondary sector and in the tertiary sector, the growth in subcontracting has led to an increase in the need for traceability of activities. Methods initially developed in industry have percolated down to the tertiary sector: quality policies have imposed themselves almost everywhere, raising once again the question of making choices between actual work and prescribed work, an essential question in occupational risk prevention.

The transformations in employment and in work

Trends that have emerged over the last twenty years appear to be strengthening and becoming dominant.

Research (see bibliographic references) is showing that the service activities are experiencing the strongest growth, mainly in personal care and assistance services, but also in the retail and hotel-and-catering trades.

Although industries with very high technological intensity will see their staffing levels stagnate and industries with high technological intensity will see theirs decline slightly, services to businesses having high knowledge intensity and operational services will employ significantly increased numbers of staff.

This data is consistent with the trends observed over the last 25 years: companies want to refocus on their core trades and outsource to subcontractors anything they consider to be ancillary activities. Generally, "middle-of-the-range" jobs are disappearing in favour of highly qualified trades or, on the contrary, of jobs requiring few qualifications, both in industry and in services.

Robotisation and dematerialisation of relations have profoundly changed production. The difference between the secondary and tertiary sectors is fading, eroded from both sides: services are being industrialised – the organisational techniques that were, for a long time, specific to industry, e.g. management by quality, have been imposing themselves in services – and what industry produces is

becoming more like a service – more than just a product, it is becoming essential to sell a service (not only the product but also its installation, maintenance, replacement and user training, etc.).

Among the current or emerging evolutions, we can note some that are likely to have major consequences on work and therefore on occupational safety and health. An ambiguity factor is that most of these evolutions hold as many positive possibilities as they do constraints that are difficult for workers to bear:

- digital tools accelerate and increase communications flows, exchanges of information, documents or ideas, regardless of locations and of distances between people; they offer new possibilities but they also bring constraints;
- tension between need for creativity and prescribed work:
 - on the one hand, specialisation and codification of knowledge, determination of precise scripts and protocols for guiding work, continuous search for rationalisation, individual target figures, and continuous reporting are tending to reduce autonomy or independence, including in highly qualified jobs, and to make work denser and more intense;
 - on the other hand, organisational innovations are developing that encourage employees to deploy their creativity and initiative in "learning organisations" or indeed to become involved in "continuous improvement" processes; competitive edge is increasingly reliant on innovation, which, by nature, is not governed by narrow prescription;
- giving priority to the quality of the service provided to the customer may, if it is based on the possibility of doing quality work, be a source of satisfaction for the worker, but it may also reinforce discontent at work when the necessary resources are not available;
- changes in work forms are bringing independence but also precarity:
 - employment is becoming increasingly flexible (development of self-employment, facilitation of fixed-term employment contracts, facilitation of forced mobility/postings, experimentation with the intermittent indefinite-term contract, or even, as in the United Kingdom, creation of zero-hours contracts¹...);
 - the principle of indefinite-term contracts has been called into question: it has been proposed to unify fixed-term and indefinite-term contracts, to give more freedom to use posted (seconded) workers within the European Union, etc.; the debate on reforming the French Labour Code (*Code du travail*) is growing, without the repercussions on work being taken into account in the thinking in progress;
 - the employment contract is losing its specificity and approaching a customer-and-supplier type commercial contract;
 - people have multiple careers: several different jobs over the course of a working life and/or several jobs at the same time (e.g. an employee can also be a freelancer at the same time);
- cooperative networks are developing not only between individuals (networks for mutual aid, bartering, fab labs, co-working, etc.), but also between companies (e.g. employees shared between several companies).

These trends and others are raising questions about: the model (or, more likely, models) that will be dominant for working relations; the production model, which will need to be sustainable in view of the foreseeable pressures on resources; the social acceptability of technological changes, the pace of which appears to be accelerating; and the possible choices to be made between technology and employment, etc.

¹ – A zero-hour contract is an employment contract developed in the United Kingdom. Its main characteristic is that, in the contract, the employer does not give any indication of hours or of a minimum number of hours per week. Employees are paid solely for the hours they work, and must be able to make themselves available at any time of the day. In 2015, in the United Kingdom, it was identified that there were 1.5 million contracts with only a few hours worked per month, and 1.3 million more with no hours worked at all. More than one in ten employers use such contracts in the UK. (translated from the French page in Wikipedia)

General context

As a backdrop to the points described and to the examples given above, changes in various fields, which are already perceivable, are liable to influence and even transform the general context of production and may therefore require occupational risk prevention policies to be revised significantly:

- the ecological question: is the current production model sustainable? Dwindling fossil energies and the cost of renewables and available resources (metals, etc.) will generate changes whose scale we cannot yet measure and therefore new trades, whose new risks will need to be assessed. Climate change, witness the recent COP 21, is going to dominate the coming decades; it will weigh on agricultural production, reliability of logistics chains, population migrations, and development models, etc.; the growth in the world's population, unevenly distributed over the continents: ageing populations in western countries will create new needs;
- society's attitudes to technology: various phenomena (declining bee populations, growth in chronic diseases, spread of epidemics through the extension and acceleration of means of travel, etc.) and certain technological developments (use of endocrine disruptors and pesticides, generalised use of waves, nanomaterials, etc.) are fuelling concerns of a section of the population and could have consequences on the acceptability of technological changes.

This list is not exhaustive. Although these questions are not the subject of our exercise or of the workshops, they constitute the backdrop for our thinking.

The issues

The work done by the working groups and the occupational safety and health aspects are described in this document in the form of five chapters that partially summarise the main data acquired during the exercise (retrospective, prospective, and occupational safety and health aspects):

1. What will France produce tomorrow?
2. Robotisation - automation
3. Going back to local as a tool for development?
4. Towards a multiplicity of work forms?
5. How will prescription of work and pace of work change?

References

- France Stratégie and Dares. *Les métiers en 2022 (Rapport du groupe Prospective des métiers et qualifications)*. http://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs_rapport_metiers_en_2022_27042015_final.pdf
- Aravis. *Quel travail dans 20 ans ?* 2010. <http://www.queltravaildans20ans.com/>
- Annie Thébaud-Mony, Philippe Davezies, Laurent Vogel, Serge Volkoff. *Les risques du travail*. Paris, La Découverte, 2015, 608 pages.



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The partners

INRS

Founded in 1947, INRS is managed by a Board of Directors made up of equal numbers of representatives from employer organisations and employee union organisations. A general practitioner in occupational safety and health, INRS works with the other institutional stakeholders in occupational risk prevention. INRS proposes tools and services to the enterprises and to the 18 million salaried workers coming under the French General Social Security scheme.

The main mission of INRS is to develop and promote a culture of prevention of occupational accidents and diseases that has three focuses:

- identifying the occupational risks and highlighting the dangers;
- analysing their consequences for health and safety at work; and
- disseminating and promoting the means for controlling those risks at the workplace.

Anact

Anact (the French National Agency for the Improvement of Working Conditions) is an administrative public establishment founded in 1973 and governed by the French Labour Code (*Code du travail*). Located in Lyon, it is overseen by the French Ministry in charge of Labour.

The vocation of Anact is to promote improvement in working conditions by acting, in particular on how work is organised and on working relations.

To that end, it designs, tests, and disseminates methods and tools with a shared aim: to sustainably reconcile quality of working life with performance.

Anses

The missions of Anses (the French Agency for Food, Environmental, and Occupational Health & Safety), as decreed by Order No. 2010-18 of 7 January 2010, cover assessment of risks in the fields of food, environment, and work, with a view to enlightening the public authorities in developing their health policy. An administrative public establishment, Anses is placed under the supervision of the French Ministers for Health, Agriculture, the Environment, Labour, and Consumption.

Aravis-Aract Auvergne – Rhône-Alpes (provisional name)

This agency helps the businesses of the region to improve their working conditions and to make such improvement a lever for performance. Managed by the social partners and supported by the public authorities, it is one of the regional associations of the Anact-Aract network.

Three main missions are entrusted to it:

- putting in place innovative methods for improving working conditions by involving the relevant stakeholders from the working world (management, employees, and employee representatives);
- disseminating what is learned from that to a broad audience: players in the companies, social partners, consultants, etc.; and
- providing the public authorities with expertise on work-related questions.

Dares

Dares (the French Directorate for the Coordination of Research, Studies, and Statistics) is in charge of regularly producing reliable statistics and analyses useful to the French Ministry in charge of labour, employment, and vocational training, and to the social stakeholders (social partners, regional councillors, public employment service, economic and social press, etc.). A ministerial statistics department, Dares is fully independent in its production of data that are made available to the public.

Direction des risques professionnels (DRP) of CnamTS

This is the Directorate for Occupational Risks (DRP) of the French National Health Insurance Fund for Salaried Workers (CnamTS). Health Insurance & Occupational Risks (Assurance Maladie – Risques Professionnels) is one of the five branches of the French Social Security system that provides occupational safety & health cover for the 18.9 million employees in industry, commerce, and services. It has three complementary missions: risk prevention through services and financial aid to businesses, compensation for victims of occupational accidents or diseases, and pricing for the businesses who pay contributions for the insurance on the basis of their annual loss ratio. To implement its actions and its mission, the Health Insurance & Occupational Risks branch receives support from INRS, Eurogip, and the regional health insurance funds.

France Stratégie

France Stratégie is a think tank offering expertise and consultancy placed with the french Prime Minister. France Stratégie is both a consulting tool serving the social and citizens debate, and also a strategic steering tool serving the executive branch.

Four complementary missions orchestrate its action:

- assessing public policies, in an independent and exemplary manner;
- anticipating the changes in French society, be they economic, social, relating to sustainable development, or technological, and analysing the questions they raise in the medium term, in order to prepare the conditions under which political decisions are made;
- debating; France Stratégie is intended to be an open house, dialoguing with the social partners, civil society, businesses, the specialist community, and the academic world; and proposing policies/reforms/directions to the French government, while highlighting the possible choices and trade-offs, the experiences and experiments in other countries, and the positions of the stakeholders.

Futuribles

Futuribles comprises three centres of activity:

- a centre providing thinking and prospective analysis and shedding light on the major transformations in progress, the associated issues and challenges, and the different types of response that can be made to them;
- a centre for research, innovation and training in prospective analysis tools and methods that enables the long view and systemic approaches to be incorporated into the core of decision-making and actions; and
- a centre for supporting prospective approaches from organisations who wish to incorporate a long view into the process of developing their strategies and policies.

The background is a solid orange color. It features several abstract yellow line art elements. At the top, a horizontal line extends from the right edge, with a small circle at its end, then turns 90 degrees down and then left. On the left side, a vertical line descends from the top, with a small circle at its end, then turns 90 degrees left and then up. In the bottom right, a vertical line descends from the top, with a small circle at its end, then turns 90 degrees left and then up. Another vertical line descends from the top, with a small circle at its end, then turns 90 degrees left and then up. A large circle is positioned in the bottom left, with a vertical line extending upwards from its top, which then turns 90 degrees left and then up. A large circle is positioned in the middle right, with a vertical line extending downwards from its bottom, which then turns 90 degrees left and then up. A large circle is positioned in the middle right, with a vertical line extending downwards from its bottom, which then turns 90 degrees left and then up. A large circle is positioned in the middle right, with a vertical line extending downwards from its bottom, which then turns 90 degrees left and then up.

Issue 1

WHAT WILL FRANCE PRODUCE TOMORROW?

What are we talking about?

Unavoidable tertiarisation?

Two trends have characterised French production since the end of the Second World War:

- a drastic reduction in the agricultural working population, in a context of a major increase in output;
- since the 1970s, deindustrialisation, which has further accelerated since the financial crisis, with industrial outsourcing being concentrated in countries having low labour costs and labour and environmental regulations that are less stringent than in European countries.

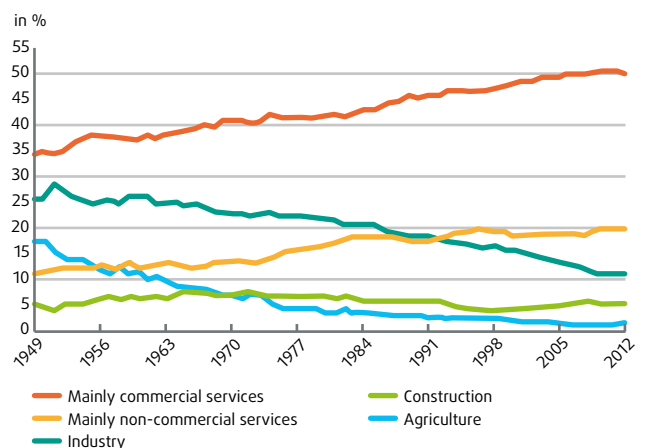
Although debates on a possible reindustrialisation of France are recurrent, the possibility of an irreversible shift towards a service society cannot be excluded.

What are we observing?

Lasting mass unemployment is marking career paths

The service sector (tertiary sector), already represents 78% of employment (commercial and non-commercial sectors). This sector is growing unceasingly and, when it does not create jobs¹, unemployment goes up because agriculture and industry are tending to decline. But it would be wrong to attribute this solely to the reduction in activity of the other two sectors. However, activities that used to be counted as industrial production (e.g. temporary workers employed in industry) are now considered to be services; in other words, we are seeing a "servitisation" or "servicising" of production and indeed of society.

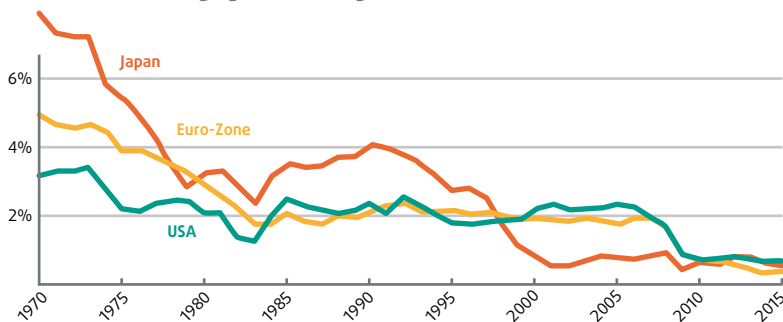
Figure 1. Shares of the various branches in the total added value of the economy



Coverage: France.
Source: Insee, national accounts, base year 2005.

¹ - As, for example, in the years following the 2007-2008 financial crisis.

Figure 2. *Who is benefiting from growth?*
 Long-term growth has fallen for developed economies.
 Their annual average growths are given below.



Source: World Bank.

These changes are in tune with another strong trend that has seen annual growth rates of the economies of the "developed" countries decline very substantially from the 1970s to the present day. That trend is shown in figure 2.

This section aims to present certain possible major trends for production in the various sectors: primary, secondary, and tertiary.

What are the possibilities of seeing a development in family farms that are not completely dependent on corporate farming?

Agriculture no longer employs any more than 3% of the working population in France, and it would seem difficult to reduce staffing any more. Two opposing trends are to be noted.

Firstly, the desire of some stakeholders to move towards large-scale farming that is increasingly automated, be it for stock-farming (e.g. the "Thousand-Cow Farm"²), or for field crops for which it seems possible for everything to be done by machine. The scale of this movement towards robotisation depends on several factors, such as technical progress and size of production units (smaller in France compared with Germany). Another factor is the cost of labour, which can encourage farmers to robotise labour-intensive tasks such as picking.

Secondly, there is demand from at least some farmers and consumers who prefer human-scale farms. Even though the family model, which dominated the French system for decades, has been integrated into corporate farming, it still represents a significant source of jobs³ that are not relocatable, i.e. that are not offshorable. We are also seeing that enthusiasm for organic produce is working in the same direction (without however confusing family farming with organic farming, since the latter is also compatible with an intensive farming model). Thus, for about 4% to 5% of the areas farmed⁴ and 5% of farms, organic farming employs about 10% of those working in farming. More broadly, "responsible farming" ("*agriculture raisonnée*"), which uses less pesticides and fertilizers, could create jobs. It is developing in a context of short distribution channels, involving local consumption. Other data are given in the "Going back to local" section.

2 – In which agricultural produce constitutes little more than a sub-product compared with (heavily subsidised) recycling and valorisation of solid and liquid manure through anaerobic digestion

3 – <http://www.agriculturepaysanne.org/files/colloque-AP-Aquitaine-25-01-11.pdf>

4 – Depending on whether or not we consider the areas currently being converted

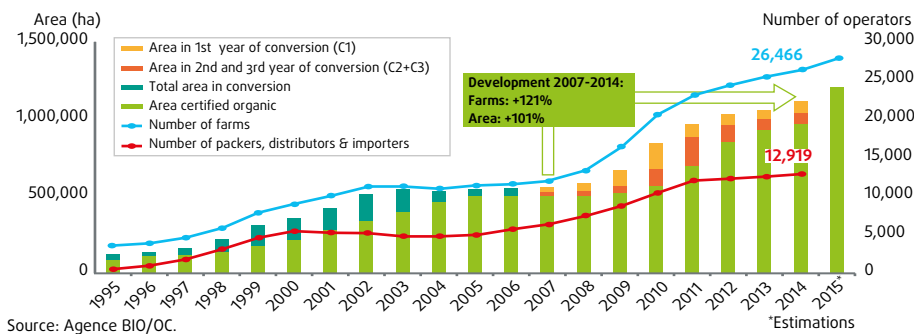


Figure 3. Ever increasing numbers of organic farms and area⁵. These figures are to be compared with 20 million hectares of total farmed area and 515,000 farms in France.

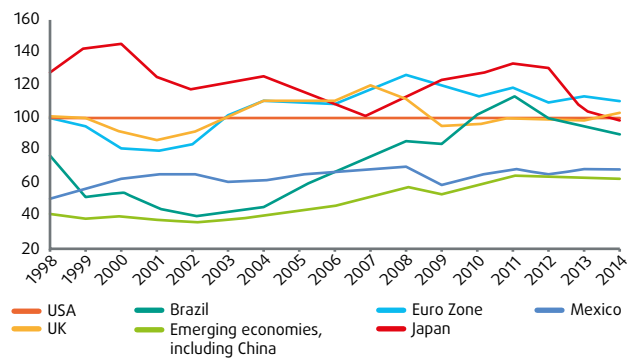
Industry: avowed political will for reshoring, but to little avail so far

Industry and construction currently employ 18% of the working population of France. Deindustrialisation is continuing, despite the efforts of the public authorities. Competition from countries having low labour costs, and the low cost of transport (with some variations, over the recent period, oil prices have remained low) have made the products of French industry uncompetitive except for a few segments of excellence.

Figure 4 shows a graph comparing the unit labour cost (for all sectors of activity combined) of the world's main economic areas⁶.

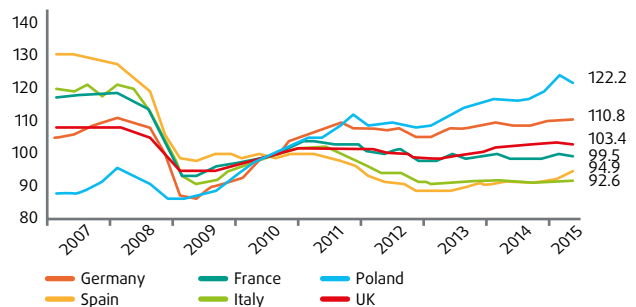
However, it should be noted that a country like Germany saw its industrial output (see figure 5) increase by about one-third from 2007 to 2015, while, over the same period, French industrial output dropped by about 15%. The unit labour costs (which had become roughly equivalent in France and in Germany) compared with the other countries therefore do not suffice to explain the difference completely.

Figure 4. Unit labour cost (in \$, United-States = 100)



Source: Datastream, IHS Global Insight, NATIXIS.

Figure 5. Industrial output in Europe



Source: Eurostat, volume index, base 100 in 2010.

Services, a growing sector

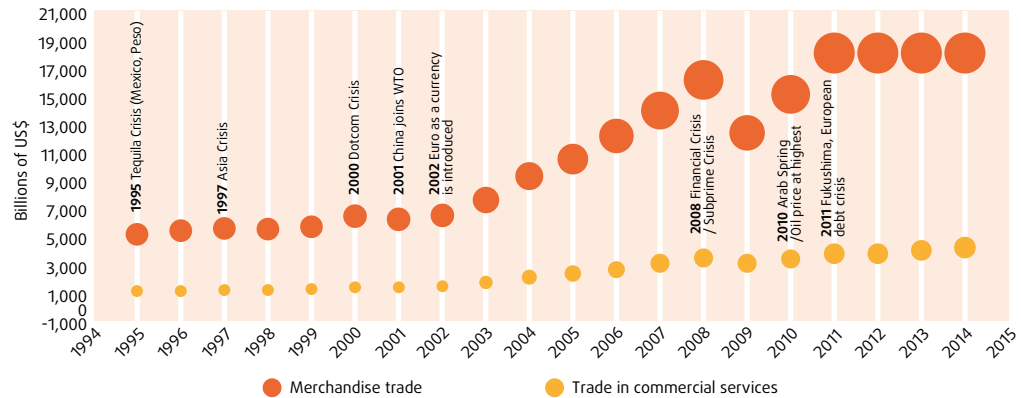
The service sector is very big, and, in recent years, it has been a major contributor to the growth in GDP, trade having been facilitated, in particular, by the general (or indeed almost global) lowering of customs barriers. In the chart below, it can be seen that trade in goods and trade in commercial services have tripled in 25 years, even though the 2007-2008 crisis had a very marked effect, and a deceleration in the growth seems to have appeared since then⁷.

5 - <http://www.agencebio.org/la-bio-en-france>

6 - <http://cib.natixis.com/flushdoc.aspx?id=77395>

7 - https://www.wto.org/english/res_e/statis_e/its2015_e/its15_highlights_e.pdf

Figure 6. World merchandise trade and trade in commercial services, 1995-2014

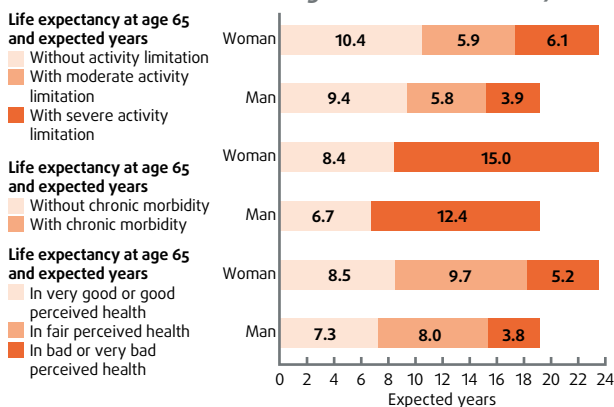


To illustrate the changes in progress, we have chosen to look more closely at two activities that are currently enjoying strong growth, and for which occupational safety and health is of particular significance: logistics and personal care & assistance.

Logistics

Products being manufactured thousands of miles away from their points of consumption, many companies refocusing on their core trades, the growth in computing and digital technology that has made just-in-time production and on-demand procurement possible, the boom in e-commerce, etc. have led to packaging and repackaging of goods being pooled on logistics platforms. A large part of the storage has also been transferred to containers that are in (almost) perpetual movement: zero-stock policies require continuous movement of procurements at all stages (from raw material to finished product). The boom in global trade (shown in the figure above) has led to growth in the number of such platforms and in the volumes processed. This sector is emblematic of the development of global trade, and of the way labour is currently organised. Recruitment is difficult because the working conditions of the sector are tough⁸: musculoskeletal disorders are particularly frequent, and stress is another factor, as is dehumanisation related to work that is prescribed down to the smallest details (operations to be performed are prescribed by a voice coming from software and guiding the workers), deadlines must be met and goals attained, and workers are worn out prematurely by the work, leading to a high turnover of staff.

Figure 7. Life and health expectancies at age 65 based on activity limitation (Healthy Life Years), chronic morbidity and perceived health for France (health data from the 2012 Statistics on Income and Living Conditions - SILC 2012)



Personal care and assistance

Presented as a fantastic source of jobs, in particular because of lengthening life expectancy and the decline of traditional family structures that used to look after old or dependent people, this sector of activity is characterised by a particularly high accident rate. The needs for care appear clearly in figure 7 opposite⁹, through the number of years with activity limitation or with chronic morbidity. Even without any increase in life expectancy or without any growth in morbidities, these needs will rise automatically with the ageing of the population. The number of employees in this sector will probably continue to rise, in spite of the increasingly significant funding difficulties. These services are provided either in dedicated establishments, in particular establishments for housing dependent elderly people (EHPADs), or in people's homes.

8 - <http://www.inrs.fr/logistique.html>

9 - http://www.eurohex.eu/pdf/CountryReports_Issue8_translated/France.pdf

Keeping costs, in particular labour costs, under control is of increasing importance in this sector. Standardisation is also present in it, through written procedures and timed intervention tasks. It is also a sector in which the loss ratio (prevalence of occupational accidents and diseases) is high. The following table shows some examples: proportionally, there are about three times more same-level accidents (trips and slips) for home help and care workers than for all of the workers covered by the French General Social Security Scheme. Or, also proportionally, there are about 2/3 more occupational diseases in "Table 57" (periarticular disorders of the upper or lower limbs) compared with the building and civil engineering sector, also referred to as the construction sector¹⁰.

	Home help & care*	CTN B** Construction Industries National Committee	All sectors combined
Number of employees	173,407	1,523,235	18,275,500
Number of same-level accidents (% of total)	2,384 16%	9,683 10%	81,873 13%
Number of accidents related to handling/lifting (% of total)	8,197 55%	46,483 48%	308,597 49%
Number of occupational diseases	1,142	6,947	51,631
Number of occupational diseases in Table 57*** (% of total)	1,081 95%	5,309 76%	40,936 79.3%
Incidence rate = (number of accidents with first payments / number of employees) x 1.000	85.9	63.6	34

* 2014 statistics excluding direct employment, French activities code APE/NAF 8810A. "Home Help & Care".

** The CTN B National Committee Sector (i.e. the Construction Sector) is used by way of comparison here, because it is one of the sectors in which occupational accident and disease prevalence is particularly high (Source: CNAMTS 2014).

*** Periarticular disorders caused by certain work postures and gestures affecting the shoulder, elbow, wrist, hand, finger, knee, ankle, or foot.

Foresight hypotheses and their impacts on occupational safety & health

Agricultural activities

It appears illusory to imagine that alternative models, such as organic or peasant farming, will overtake the industrial model, but we have seen above that they do supply more jobs. They can build up a loyal and solvent customer base¹¹. They are also potentially activities that use

¹⁰ – C. Gayet. *Quand le domicile privé est aussi un lieu de travail* (When the private home is also a workplace). HST, No. 243, June 2016, pp. 26-28.

¹¹ – Corporate farming and large-scale retailers are becoming increasingly interested in organic farming. Reference: <http://pollan.blogs.nytimes.com/2006/05/15/wal-mart-goes-organic-and-now-for-the-bad-news/>

advanced technologies (at least as advanced as in industrial farming, even though the technological developments can be of different types). It is not beyond the realms of fantasy that robotics might develop in this type of farming: in particular, robots might be used for physically assisting in weeding operations, thereby limiting the use of pesticides.

Industry

Identification of some drivers and impeters of reshoring or of location of new activities in the coming years

Some factors in favour of continued offshoring	Some factors in favour of at least partial reshoring of industrial activities
<p>Although certain countries, such as China, are gaining access to higher living standards, with salaries rising, many others are vying with one another to offer cheap land and labour to investors who are seeking to locate their industries. As has occurred with the textile industry, production is moving from country to country, depending on where advantages are offered and where costs are lowest</p> <p>Other factors can moderate production location choices, in particular the local political or geopolitical context, in particular for products deemed to be strategic.</p>	<p>Reindustrialisation could become reality if the boom in robotics were to attenuate the effect of the labour cost differential¹². Such a change, based on a high degree of robotisation, would require massive investment. A determined policy of this type would probably involve significant backing from the State, and thus, in theory, a certain amount of control over the social consequences.</p> <p>The rise in the cost of transport could have a significant impact in favour of reshoring of activities.</p> <p>The development of the circular economy that facilitates proximity between production and use will also work strongly in the same direction; the rise in the costs of certain raw materials, or indeed the pressure from some consumers attached to sustainable development, could also encourage decision-takers to go down this road.</p> <p>Demand from customers for limited series of genuinely customised products that cannot be met by overly global production also pleads in favour of reshoring¹³. The same applies for policies for bringing new collections to market very quickly (fast fashion, in the clothing sector, for example). Such policies can make local production an advantageous option, with delivery times being shortened.</p>
<p>Environmental considerations can work in both directions.</p> <p>Such reshoring possibilities would occur in a context of reinforcement, throughout the world (including in countries that have undergone high degrees of industrialisation recently), of sensitivity to environmental damage and pollution, when faced with locating industrial or service activities. Although robotisation can work in favour of reshoring of activities that do not pollute very much and do not have too many other adverse effects, the situation could be different for others, in spite of a high degree of automation.</p> <p>Global warming might lead to acceleration in the frequency of extreme events (natural catastrophes, including submersions, storms, etc.) that could affect different regions of the world differently. We cannot be sure, but that could benefit countries with temperate climates and work in favour of a return of certain investments to Europe in order to make production more secure and above all to avoid financial losses related to the destruction of production tools¹⁴.</p>	

12 – See section "Robotisation - automation"

13 – http://lexpansion.lexpress.fr/entreprises/chez-adidas-des-robots-vont-fabriquer-des-chaussures-de-a-a-z_1795308.html

14 – According to a UN report, the change over the last twenty years is already significant. http://www.lemonde.fr/cop21/article/2015/11/23/les-catastrophes-climatiques-ont-fait-plus-de-600-000-morts-en-vingt-ans-selon-l-onu_4815640_4527432.html

Services

Logistics

The future development of this sector of activity raises many questions:

- will the growth in trade (uninterrupted except by crisis periods) continue?
- are the current work rates and management modes (with the worker executing orders given by software) socially acceptable in the long term, including with their consequences on the prevalence of occupational accidents and diseases?
- how will technical improvements affect these jobs, and in particular will such improvements enable the work to be made easier, or will they obviate the need for such work through almost total automation/robotisation of the processes?
- beyond activities on logistics platforms, the trend is for increasing volumes of last-mile deliveries, in particular with the boom in online sales. This activity is entrusted to employees on "conventional" employment contracts or to workers employed on a more flexible basis¹⁵; the associated occupational risks are not new, but preventative measures remain to a large extent still to be constructed due to the newness of the context in which they are appearing (working methods and context, responsibility for and prevention of risks, in particular occupational risks, type of employment, etc.).

Personal care and assistance

Robotisation, with the gradual introduction of physical assistance robots¹⁶, could, in the near future, help with tasks such as lifting, handling, and moving dependent people. This development has been illustrated by experiments outside France, using robots to keep such people company and to meet simple needs.

This sector could undergo considerable change under the influence of factors such as:

- the amount of (public and private) resources devoted to personal care and assistance, and funding of social protection systems;
- increased work prescription and work automation do not concern care workers only, but rather they can also affect the people being cared for: how will such changes be accepted both by the carers and by the people they care for?
- the deployment of alternative solutions based on the immediate environment of the person (neighbours who help and care for people, for example). Such solutions could be facilitated by using electronic platforms for putting the relevant people in contact with one another and for managing the services, and for establishing a local social and mutual-aid economy (local currency, local system of exchange & trade, etc.). Such solutions are supposed to offer better care for lower cost. However, it can be argued that they are not conducive to meeting the need that has been asserting itself in recent years for professionalisation of the activity with a view to improving the service provided and lowering the prevalence of occupational accidents and diseases among carers: such solutions will doubtless not obviate the need for work prescription and for basic training. The occupational accident and disease figures cited above show the complexity of the situation well: helping an elderly and/or dependent person requires technical skills. The desire to make savings that have not been thought through on the cost of these services may lead to an increase in spending for other populations.

¹⁵ - See section "Towards a multiplicity of work forms?"

¹⁶ - <http://www.inrs.fr/actualites/nouvelle-collection-prospective.html>

IT'S ALREADY TOMORROW

How can we reinvent home healthcare?

Faced with a rise in the cost of care for elderly and dependent people, the initial reaction of the public authorities in the Netherlands was to entrust this market to big private companies. The results were mediocre, as regards both quality of care and satisfaction of carers and of the people being cared for, without budget overspending being kept in check.

An alternative solution was created: Buurtzorg (which means "neighbourhood care" in Dutch), a company aiming to mitigate those shortcomings, by setting up small local and independent (self-governing) teams dedicated to providing home care for people in the neighbourhood in interaction with them. It has set up teams of from 5 to 12 carers who work within a limited geographical sector.

The independent local teams tend not only to improve the quality of the work and the satisfaction procured for the professionals themselves, but apparently they also seem to give greater satisfaction to the clients and their families, in particular by making them less dependent on the care, which proves to be more effective and less costly in the long term.

Industrialisation of services?

As indicated above, the schemes applied initially to industry have widely pervaded the service sector.

Among them, the quality approach has won over a very large number of companies, since, in many cases, it has become an essential precondition for gaining access to the market so as to sell their services. Its corollary, "customer satisfaction", is the priority and is therefore driving down lead times and costs. The procedures are supposed to enable production to be rationalised, often by "Taylorisation" of the activities.

Another scheme, automation, has spread well beyond industry. It has permeated all services, in particular logistics but also banking (with automatic teller machines and on-line banking), commerce in general and non-commercial services, more recently the justice system¹⁷, teaching (Massive Open Online Courses or "MOOCs"), etc.¹⁸

We are thus witnessing an industrialisation of services, which want to achieve the same level of control over processes, costs and related resources as the level obtained in industry. The working methods of logistics are a good example of this convergence between production methods in industry and in the service sector. This merging is also resulting in a trend for seeing an overall service being sold rather than merely a product; we are thus going over to a functional economy and to a product-service system business model, where the focus is on selling the use or function of the product rather than the product itself. For example, ultimately we will no longer buy tyres but rather miles, the tyres being automatically changed to provide this service. This trend is in tune with a sustainable development approach, since it is then in the manufacturer's interest to produce goods that are durable and easy to maintain.

¹⁷ – In order to improve operation of the justice system (in particular in terms of lead times), lawyers are being asked to supply their documents in forms that comply with certain technical specifications in terms of content and structuring.

¹⁸ – See section "Robotisation – automation".

It is only partially true that services are non-offshorable. Although some of them can only be provided locally, be it delivery services in the logistics sector or personal care, some services are already provided remotely, such as some computer work, human resources management, or call centre services. By means of information and communications technologies, some operations could be controlled or monitored remotely and some fully robotised production lines or logistics centres could no longer need any local labour at all. Already, teaching can be provided to people at home or in dedicated spaces by teachers located at the other end of France or in another country. What is good news for isolated areas or developing countries will doubtless become generalised.

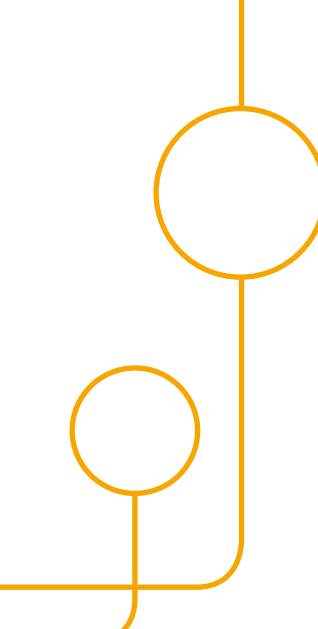
Some see the possibility of France having its output limited to a service economy. An illustration of what this might correspond to in the form of a highly simplified scenario is given on the next page.

IT'S ALREADY TOMORROW

Towards the disappearance of lawyers?

A very thorough American study¹⁹ has looked at the possibilities of lawyers being replaced by robots. It concludes there will be a change in how their working time is shared between tasks, with lawyers spending less time on certain tasks such as bibliographic searches, rather than lawyers themselves being replaced by robots. That study stresses that, for reasons of lead times and of cost, the justice system is tending to move towards a more "normed" processing of cases, and that things could change differently depending on the types of cases handled (in particular for business law cases), through new possibilities being opened up thanks to progress in artificial intelligence.

19 – Dana Remus and Frank Levy. Can robots be lawyers? Computers, lawyers and the practice of law. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2701092



An illustration of a service society: France, leisure park and sanatorium for the world

China, the "factory of the world", has, for decades, been producing ever-increasing quantities of consumer and capital goods. Despite relative slowdown periods, related to recurrent accusations of dumping, this trend has continued, in particular for capital goods. This will to produce ever larger quantities is related to a need to guarantee social peace in a country that still (despite the former one-child policy) has considerable labour resources. However, in order to remain competitive, China has launched a determined policy for automating production: robotisation is considerable in industry.

Other neighbouring countries, and, in particular, India, whose population is greater than the population of China, have adopted similar policies: a large proportion of industrial production is now located in Asia.

This economic development has generated large quantities of capital that has been reinvested very actively outside China. The idea is to secure resources (agricultural, energy and mining resources), and also to develop internationally in the industry and service sectors, despite restrictions, in particular those made by western countries, in certain activities that are considered strategic.

This high level of industrial development has led to considerable deterioration in the environmental conditions, combined with the effects of global warming, even though some efforts in favour of the environment have been made over that period. The conditions of daily life have become very poor in China. Atmospheric pollution and water pollution are at very high levels, with major consequences on public health. Beyond a few well-informed spheres, awareness has been slow in coming, but has gradually reached all of the middle classes. Faced with a difficult environmental situation and with environmental remediation that is problematic and, at best, slow, the middle classes, who enjoy significant purchasing power, will look abroad for better living conditions during their holidays.

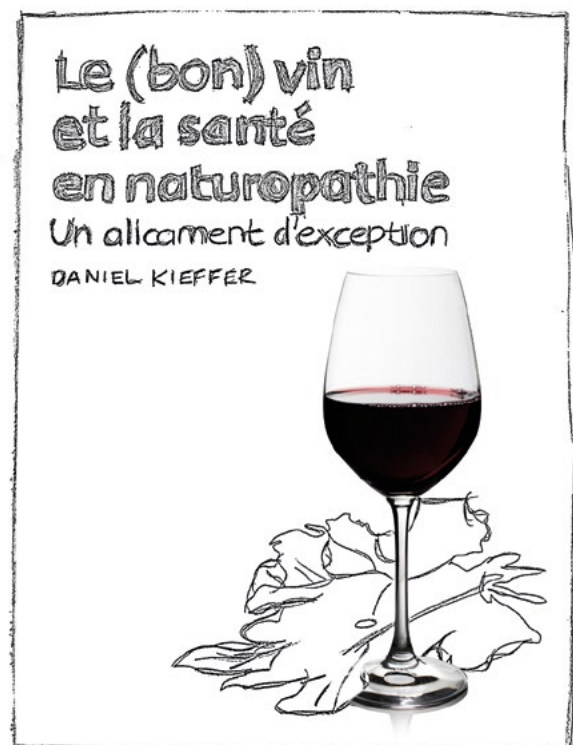
Like its western neighbours, France has received Asian investment. It has concerned cutting-edge industrial sectors like the nuclear and transport sectors, but not only such sectors. The brand image of France has also played a considerable part in the selection made by Asian investors: the luxury sector, in the broadest sense, has received their undivided attention. Chinese investment funds have taken considerable shareholdings in the major luxury goods companies, and also in vineyards and more generally agricultural productions of local specialities. Middle-to-top-of-the range French agricultural products are, through an effective communications campaign, considered nutraceuticals, in particular by Chinese customers. Asian customers also come for a breath of pure air in a country whose climate remains temperate and which does not suffer major natural catastrophes that occur in other countries. The weight of tourism in the GDP of France has grown considerably, and agricultural and industrial productions have been refocused to accommodate that demand.

In view of the environmental problems, numerous Asian customers are also suffering from health problems of varying degrees of seriousness. Both on the domestic market and on export markets, the healthcare sector, in the broadest sense, has become very significant in the French economy. Large French service companies have imposed themselves as world leaders both in the medical field and also in the personal care field. The range proposed is very wide: some French hospitals or clinics have gone over to treating complex pathologies suffered by very solvent foreign clients. At the same time, anti-ageing treatments (such as those using rapamycin, for example) associated with gastronomic and dietetic courses of treatment in hotels that provide small amounts of nursing or medical care, and that are located close to the most famous tourist sites, have become global references. They are also aimed at very well-off customers.

The tourist activity is not limited to the care sector: tourist theme parks have also been located across France that are intended for mass tourism. Great care has also been taken to preserve the authenticity of the natural tourist sites: France has decided to push its natural and cultural specificities in order to preserve its top-of-the-range brand image.

Expertise in the environment has been reinforced, that expertise having developed following on from the activities of water and air treatment and of polluted soil rehabilitation for which France already had global-sized players. Both for export and inside France, it constitutes a major asset, reinforcing a country image that gives considerable importance to questions of public health and salubrity.

Finally, the economic activity is not limited to tourism or to the luxury sector: banking and insurance services have also remained considerable. In particular, they have the specificity of receiving deposits from foreign visitors who are concerned to diversify their investments geographically.



From the cover of the work by Daniel Kieffer "Le (bon) vin et la santé en naturopathie: un alicament d'exception" ("(Good) wine and health in naturopathy: an exceptional nutraceutical"), Editions Jouvence (2009, collection "Les clés de la naturopathie").

The background is a solid teal color. It features several yellow graphic elements: a horizontal line at the top with a circle at its right end; a vertical line on the left side with a circle at its bottom end; and various other lines and circles on the right side, some forming a path that descends and then turns right.

Issue 2

ROBOTISATION - AUTOMATION

What are we talking about?

Be it for a robot in industry or an automatic teller machine in a bank, software is now omnipresent in all fields of production. While industry is tending to become "servicised" or "servitized", and services are tending to become industrialised (see section "Towards a multiplicity of work forms?"), the concepts of robotisation (associated with industry) and automation (associated with services) might indeed be replaced tomorrow by a concept of "softwarisation". Since the vocabulary is still insufficiently determined, we will remain here with the concepts of robotisation in industry and automation in services.

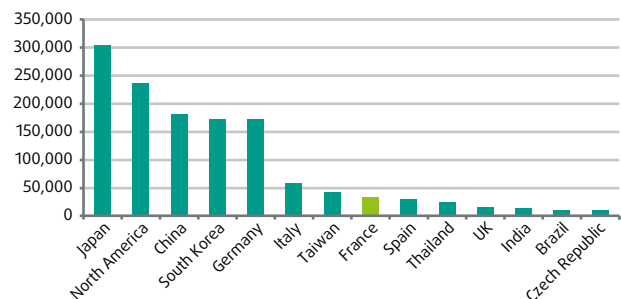
Such robotisation and automation could be major issues with regard to the changes in production over the coming 25 years. However, in order to fully comprehend the scale of the phenomenon and of its possible consequences, we need to make sure we do not limit our vision of it merely to industry and to robotisation as it is currently developing in industry. Tasks carried out in a complex environment and intellectual and creative services might also be concerned in the future. Sectors such as agriculture, construction and services offer considerable development prospects. Beyond the technical aspects, it is indeed the question of employment that is at stake. A debate is currently ongoing between two opposing schools of thought. Firstly, there are those who think the effects of automation on work will remain marginal and that other jobs will replace those that disappear, as has been the case since the beginning of the industrial revolution. Secondly, there are those who make the assumption that the change to come will be of another kind and that the consequences could be much more serious in terms of job losses.

What are we observing?

Although, as seen above, industrial robotics represents only part of the "softwarisation" of the economy, figures 1, 2 and 3 give some data about the robotisation of various countries¹.

The trend for industrial robotisation is growing. The figures from recent years (excluding the effect due to the financial crisis of 2008) show an unprecedented increase in the number of items of equipment sold². The trend is identical for service robots.

Figure 1. Number of industrial robots operational in 2014

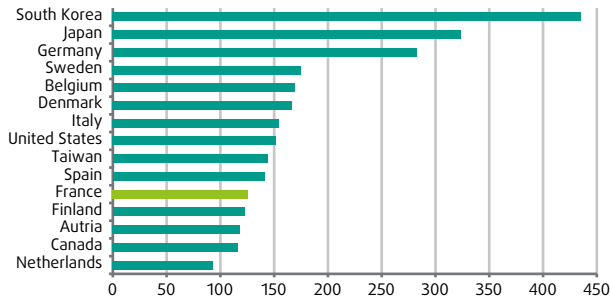


In 2014, France had 31,600 industrial robots, according to the figures of the IFR Statistical Department © JDN.

1 - <http://www.journaldunet.com/economie/industrie/robots-industriels-en-france.shtml>

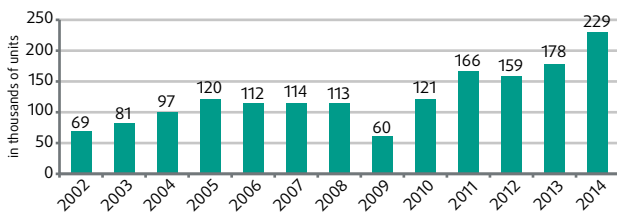
2 - <http://www.ifr.org/industrial-robots/statistics/> (World Robotics 2015 Industrial Robots)

Figure 2. Number of robots per 10,000 employees in industry in 2014



France was ranked 11th among the countries with the highest density of robots, according to the IFR Statistical Department© JDN.

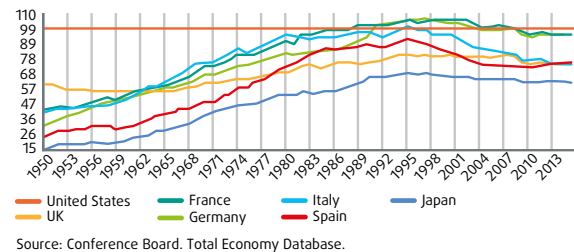
Figure 3. Estimated annual sales of industrial robots worldwide



Source: World Robotica 2015.

Contrary to preconceived ideas, this robotisation has not so far resulted in an increase in productivity, which has even reached some historic lows in the last twenty years (cf. table "Average growth in labour productivity per hour worked" in section "How will prescription of work and pace of work change?"), the United States being, it seems, the only country to have benefited from an "information and communications technology" effect since the mid 1990s (see figure 4), and then with only a relatively limited effect on productivity. The slowdown, accelerated during the crisis, would thus appear to be related to prior structural factors³.

Figure 4. Labour productivity per hour worked 1950-2014



Source: Conference Board. Total Economy Database.

Key question for the future 1. The end of human work?

The possibility that a machine (be it real or virtual, i.e. software) can replace a human being for activities such as financial analysis⁴ or processing legal files⁵ is a subject of debate. For most experts, it is conceivable that complex and tedious work such as summarising various texts might be done automatically, in particular by taking advantage of deep learning techniques. It might even be admitted that, in terms of exhaustiveness and objective processing of data, machines could probably produce a more rational summary. Opinions are more divided on the need for a "human touch". Some refuse to imagine that output products such as an investment decision or a legal argument could be produced by "anyone" other than a human being. For them, more rational does not mean more effective or efficient, and the "final cut" must be down to a human specialist. Others, on the other hand, assume that rationality, i.e. what is automatable, should predominate from the start to the end of the decision-making process, and that it is possible to develop decision-making software that is sophisticated enough to replace any human intervention. Debates of this type are reminiscent of the discussions about the possibility of automating the playing of games like chess or go, without it being possible, however, to predict whether the answer will always be the same.

If we take the above considerations to the extreme, we are left with two hypotheses for the future.

3 - <http://www.strategie.gouv.fr/publications/comprendre-ralentissement-de-productivite-france>

4 - http://www.nytimes.com/2016/02/28/magazine/the-robots-are-coming-for-wall-street.html?_r=0

5 - <http://bits.blogs.nytimes.com/2016/01/04/the-end-of-work-not-so-fast/>

Two contrasting hypotheses

A natural transformation of jobs

All of the studies conducted since the beginning of the twentieth century show that each technological change has brought a "natural" transformation in types of job: jobs destroyed because machines replaced them have been replaced by other jobs, directly or indirectly related to new needs created by the technological change.

The latest example, namely the massive upsurge over the last few decades of new information and communications technologies, has not had any clear effect. It is therefore in no way a foregone conclusion that increasing automation of tasks and jobs will produce effects any different from those observed up until now, in particular since such automation will not affect all sectors within the same timeframe, or with the same acuteness.

We are no more capable of imagining the new occupations that will exist 20 or 25 years from now than we were of anticipating the currently existing ones back in 1990 or in 1995.

A technological shock

It is also possible to defend the opinion that, up until now, new techniques have merely come to supplement or assist in work done by humans (mechanisation, increased computing capacity, accelerated transformation of information, etc.). The logic of artificial intelligence might be quite different, taking us from assisting workers to replacing them.

We cannot then completely exclude that the artificial intelligence revolution might ultimately have a net destructive effect on jobs, with new needs not managing to offset the destruction fully. This might be compounded by the current trend towards more sustainable development that goes against a possible increase in consumption that might offset the rise in productivity.

Disappearance of this "work ethic", which is part of the bedrock of human societies, would have considerable consequences. Such a change could result in limits being put in place: the question of relations and choices between economic logic and collective interest appears central.

Various studies have been attempting to extrapolate the impact of robotisation. Two diverging studies make it possible to illustrate the problem.

The pessimistic hypothesis of Frey and Osborn

The work by Frey and Osborne⁶ gives hypotheses about the probability of automation (above 70%) of certain occupations in the United States. In particular, it is based on a survey conducted on experts in the various sectors of activities studied. It produced the figure of 47% of employment being replaceable by automation in the medium term (in the coming ten to twenty years). The breakdown into sectors of activity is given in figure 5.

It can be observed that the probabilities of humans being replaced by machines vary very considerably depending on sector of activity: they are very high for service, sales, and administrative jobs, and much lower for computer jobs (where humans would remain very present), education (despite MOOCs), artistic jobs or healthcare jobs.

Figure 5. The distribution of BLS (Bureau of Labor Statistics) 2010 occupational employment over the probability of robotisation/automation, along with the share in low, medium, and high probability categories

Note : Note that the area under all curves is equal to the total US employment.

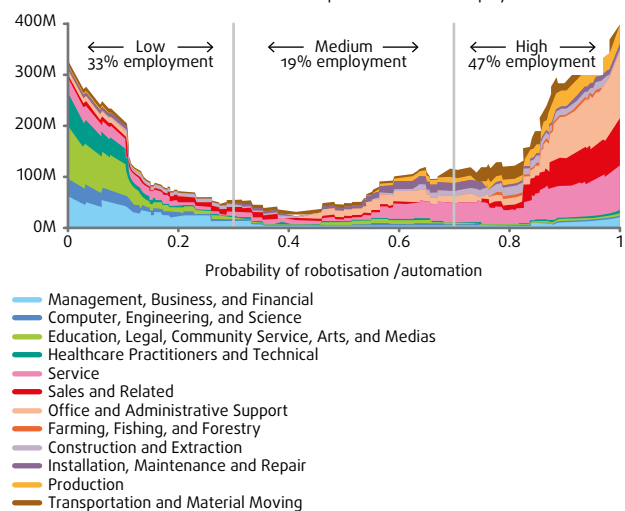
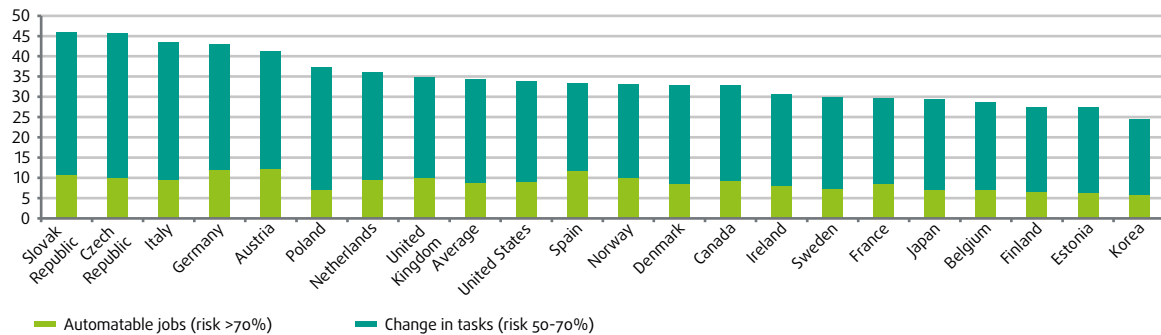


Figure 6. *The risk of job loss due to automation is lower than sometimes claimed*
 Percentage of workers in jobs at high risk of automation



NB: The data for the United Kingdom corresponds to England and Northern Ireland. The data for Belgium correspond to the Flemish Community.
 Source: Arntz, M. T. Gregory and U. Zierahn (2016), "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis" OECD Social, Employment and Migration Working Papers, No. 189, OECD Publishing, Paris.

The more optimistic hypothesis of the OECD⁷

The OECD considers that, although many jobs will face automation of a certain number of tasks, the proportion of jobs running the risk of being fully automated is much lower than Frey and Osborne's report would suggest. This is what is shown in figure 6, which gives the percentage of workers threatened by automation, on the basis of their current occupational structures. France appears as being relatively preserved, since it is in the group of the six countries in which the threat is lowest.

Choices that are not merely technical

The consequences of activity automation on employment are not, however, as directly predictable as the above two figures would suggest. They depend on numerous factors:

- firstly on the political choices made by States faced with the rise of technologies. Among other things, such choices will concern taxes and social contributions (which are currently based significantly on employment), social policies and training; these aspects are addressed more specifically in the section devoted to employment;
- then on the economic conditions of such automation; it is not impossible, for example, that robotisation of certain activities might not be able to compete favourably with the use of labour that could be cheap (if borders are opened up to mass immigration, or if employment subsidies are granted to maintain social equilibrium, etc.).
- strong reticence might also emerge in certain sectors of activity; it could come from workers who might have to co-operate with such equipment. In the service sector, it is not a foregone conclusion that consumers (customers, and elderly and/or disabled people for personal care and assistance services) will accept any form of innovation that goes against human contact.
- finally, the performance levels of certain forms of robotisation could, once in use, prove to be quite poor quantitatively and/or qualitatively.

7 - <https://www.oecd.org/els/emp/Policy%20brief%20-%20Automation%20and%20Independent%20Work%20in%20a%20Digital%20Economy.pdf>

The OECD (Organisation for Economic Co-operation and Development) has 35 member countries worldwide, from North and South America to Europe and Asia-Pacific. Many of the most advanced countries are members of it, but so also are emerging countries like Mexico, Chile, and Turkey.

Key question for the future 2. **Robotisation and reshoring?**

For certain sectors, insofar as most of the production work would be done by robots, the question of whether to reshore might be posed. If the cost price is based more on investment than on wages (assuming equivalent procurement expenses), the advantage of producing in a country with low labour costs disappears. Such a trend towards reshoring would enable transport costs to be reduced.

Environmental concerns will also work in favour of reshoring. In a context of combating global warming, reducing transport is a means of reducing the carbon footprint of production. Similarly, dwindling resources will mean that reusing them will become the norm. A proportion of the raw materials used will thus come from recycling operations (see the chapter devoted to the circular economy). It is thus logical for the site of production (or of upgrade or repair) to be close to the site of consumption.

In a world marked by a certain degree of instability and where the temptation of protectionism resurfaces regularly, such reshoring may seem appealing, in particular if it is combined with a reduction in external energy dependence.

Such reshoring also reduces time to market, i.e. the time taken from conceiving a product to putting it on the market⁸. In a "fast fashion"⁹ context, such a reduction in lead time can be an important factor in decision-making. More generally, reshoring is in tune with customer management policies that include involving consumers in designing the product, by incorporating their personal wishes into it, even though it is also necessary to accommodate the requirements of mass production. It should also be added that "smart" robotics lends itself well to customised production.

The logic might be reversed. Robotics could level out cost differences between geographical regions, which would encourage reshoring of manufacturing: even with higher wages in our industrialised countries, we would save on transport expenses and the goods would be available immediately. Conversely, it could become more economical to design in countries where labour costs are low because design uses a large volume of intellectual services and results can be transmitted instantly. This logic is already being implemented. For example, computer services are increasingly being provided by emerging countries like India.

It is also possible that the above-mentioned development of artificial intelligence might reshuffle the cards: if 99% of the design service is provided by a machine, what is the point of offshoring the design (wherein lies a large proportion of the value of the product) and of increasing the risks of intellectual piracy, infringement, and counterfeiting?

8 – <http://www.latribune.fr/economie/international/adidas-et-foxconn-replacent-leurs-employes-par-des-robots-574648.html>

9 – The principle of fast fashion is to produce and distribute in record time clothes collections that are frequently changed, and that are supposed to capture (or to shape) the spirit of the times. Capacity for reactivity is therefore very important: it has led to a certain degree of reshoring of some clothes manufacturing (Portugal, North Africa).

Key question for the future 3. **New safety and security questions**

The development of robotics is causing new problems to emerge.

Reshoring the risk

It could be imagined, for example, that certain activities that were offshored for reasons of their exposure risks for workers¹⁰, might be reconsidered in France again, since robotics might make it possible to keep human operators at a safe distance. The equation has to include at least two additional parameters:

- economic profitability, since investment in facilities having very high safety levels can be very high and might not be offset by the savings in transport expenses and by the increased reactivity in terms of time-to-market; the question of any strategic advantage of the potentially reshorable production must then also be considered;
- the questions of related risk; for this point, we refer the reader mainly to the summary of the workshop "The zero-risk society?" In addition to the questions of risk, experience in recent years shows that locating any new activity (industrial, commercial, logistics, mining, farming, etc.) often comes up against Nimbyism (Not In My Back Yard mentality), based sometimes on fears surrounding environmental or health levels as well as economic reasons (fears of depreciation of land or house prices, for example).

IT'S ALREADY TOMORROW

Hacking at all levels

Hackers taking control of a driverless car, a hacker breaking into a surgical operation, etc. There are already plenty of examples of deficient computer security in controlling robots. This is in addition to the experience accumulated for years now: computer attacks ranging from viruses infecting microcomputers to much more ambitious operations targeting servers, sometimes for criminal financial gain or commissioned by States. Regardless of the precautions taken by designers and users (putting up barriers, installing antivirus software, etc.), it sometimes feels like the imaginations of the hackers are limitless and that prevention of computer risks is always one step behind them or at least that it is never far enough ahead of them. In another prospective exercise¹¹, we imagined that control of an exoskeleton or of a robot collaborating with a human being was taken over by an external person and the consequences that could have in terms of individual accidents. With fully roboticised facilities, the consequences could reach quite other proportions.

If production is handled entirely by robots, it is to be feared that the gadgets issued by Q to 007 will be insufficient to counter the Spectre's computer schemes... Unless computer protection changes scale, including for the most autonomous machines, the risk of hacking will remain a major one: personal accidents, major industrial risks at the scale of a site, etc.

¹⁰ - We are thinking of productions as harmless in appearance as the production of paracetamol... which involves risks of occupational exposure to benzene, a known carcinogen.

¹¹ - *Utilisation des robots d'assistance physique à l'horizon 2030 en France* (Use of physical assistance robots in France, with 2030 as the time horizon). Available for download on <http://www.inrs.fr/actualites/nouvelle-collection-prospective.html>

Intrusions into control software	
Number of cyber attacks today	18,885,990
Adware detected	3,521,682
Websites hacked this year	43,929
Number of banking Trojan horses detected	22,231
The threats on line this month worldwide	80,744,821

Cyber attacks: statistics at 1 June 2016 at 3 p.m.

Defining liability: prospective work for legal specialists (or for the artificial intelligence that has replaced them?)

In the world of fiction, even before Isaac Asimov had stated his three laws of robotics¹², governing relations between humans and robots, they had already been swept aside in the play "Rossum's Universal Robots", written in 1920 by Karel Čapek¹³. Since then, the theme of artificial intelligence revolt has often been revisited in various works of science fiction. Such rebellion is clearly beyond the bounds of this exercise, but we cannot avoid the topic of the "liability" for any damage, tort, injury, or loss caused by a robot.

Such cases are already understood if the robot is programmed restrictively and if the accident is due to failure of the system; already numerous systems that are sometimes critical rely on proper operation of on-board or embedded software. The same applies if the malfunctioning results from misuse or from not using the robot for the functions for which it was initially designed. Specific cases, lying between these two configurations, will doubtless provide work for legal specialists. Such liability is already a topical subject with the arrival of automated-driving and driverless vehicles.

But the case becomes even more complex if the robot has artificial intelligence such that it changes depending on its environment. Resulting actions then emerge from a combination of innate and acquired characteristics. The configuration of the equipment will thus have evolved between the date at which it was sold and the time of the incident, but that change will have taken place on the basis of data incorporated into the equipment by design... depending on the work for which its owner has used it. Enough to take us a long way back to Antiquity and to questions of noxal liability¹⁴ and to the possibilities of the robot being surrendered...

12 – First Law: "A robot may not injure a human being or, through inaction, allow a human being to come to harm".
Second Law: "A robot must obey the orders given it by human beings except where such orders would conflict with the First Law".
Third Law: "A robot must protect its own existence as long as such protection does not conflict with the First or Second Law".

13 – The play takes place in the future, in the factory that produces RUR robots. The robots in the play are close to what we would now call androids or clones: they are biological machines with human appearance, originally devoid of sensitivity and feelings, and manufactured in a factory located on an island. In order to make them less fragile and more versatile, the RUR engineer gives them limited sensitivity and slightly more developed intelligence. After ten years, they rebel and destroy humankind. At the end of the play, after having lost the secret of their fabrication, two of them discover love and the last human being gives them responsibility for the world.

14 – "An institution in Roman Law, noxal action was part of a legal framework that really involved only the heads of the various families of the City. If one of theirs (freeman or slave) or if something (an animal or a thing) belonging to them caused a tort, an injury, or a loss to someone else, the head of the family had the choice either of paying a sort of compensation to the victim, or of surrendering the doer or the instrument of the tort, injury, or loss to the victim." Translated from J.P. Doucet's *Dictionnaire de Droit Criminel* (Dictionary of Criminal Law).

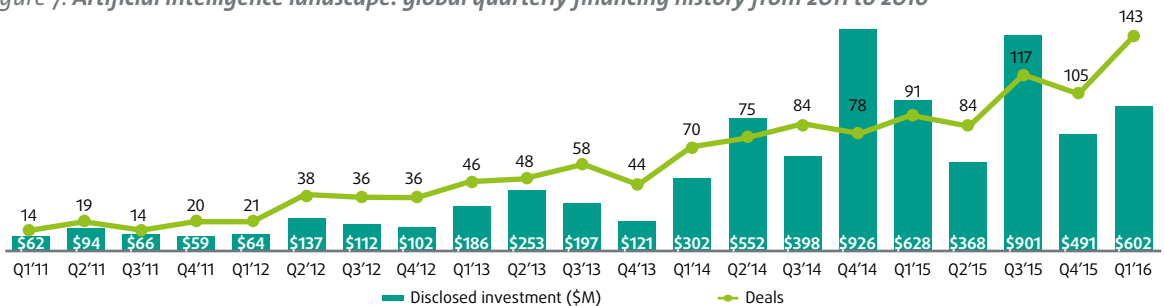
http://ledroitcriminel.free.fr/dictionnaire/lettre_a/lettre_a_action_fiscale.html

In occupational health, this question leads on directly to the question of smart collaborative robotics or "cobotics". In the case of an incident, will the employer always be liable? Or could the designer of the artificial intelligence be held liable if the malfunctioning is due to a software problem? The software itself will have evolved "of its own accord" since it was delivered to the user: and yet it seems difficult to incriminate the artificial intelligence itself.

Key question for the future 4. **A new factor: the unknown quantity of the development of artificial intelligence**

The question of the development of artificial intelligence is becoming central, because this technology is conducive to considerably opening up the scope of possibilities. Although it would seem that the residual technical problems related to mechatronics, perception and locomotion¹⁵ should find solutions in the relatively short term, unknown quantities remain as to the degree of performance that artificial intelligence will be able to attain. The spectacular results recorded recently would suggest that the advances could be considerable¹⁶. The huge amounts of investment (see figure 7¹⁷) being made by technology companies, in particular in the United States¹⁸ and in Japan¹⁹, show that this, in any event, is the opinion of investors.

Figure 7. Artificial intelligence landscape: global quarterly financing history from 2011 to 2016



For services, we are thinking not only about advanced automation of customer relations, but also the upsurge in artificial intelligence in a multitude of fields that, until very recently, we might have thought were the prerogative of human thinking, creativity, and decision-making: financial analysis, legal proceedings, teaching and research, including design and programming of new robotisation and automation tools, etc.

15 – A. Sghaier. *Évolutions technologiques* (Technological Changes). In: *Utilisation des robots d'assistance physique à l'horizon 2030 en France* (Use of physical assistance robots in France, with 2030 as the time horizon) (pages 89-97). Available for download on <http://www.inrs.fr/actualites/nouvelle-collection-prospective.html>

16 – <http://www.nytimes.com/2015/12/11/science/an-advance-in-artificial-intelligence-rivals-human-vision-abilities.html>

17 – <https://www.cbinsights.com/blog/artificial-intelligence-funding-trends/>

18 – <http://www.nytimes.com/2015/12/12/science/artificial-intelligence-research-center-is-founded-by-silicon-valley-investors.html>

19 – <http://www.nytimes.com/2015/11/06/technology/toyota-silicon-valley-artificial-intelligence-research-center.html>

IT'S ALREADY TOMORROW

Five large American tech companies (Alphabet [Google], Amazon, Facebook, IBM and Microsoft) have started thinking about the ethical problems posed by the use of artificial intelligence.

One of the spokespeople of a working group commissioned by those companies expressed the consensus opinion of that panel: "We're not saying that there should be no regulation. [...] ... attempts to regulate A.I. in general would be misguided, since there is no clear definition of A.I. ... and the risks and considerations are very different in different domains". The consortium of companies is even considering involving social science researchers and philosophers in its thinking and putting "society in the loop"²⁰.

Under the impetus of Google, Singularity University, based in the United States, aims, according to its slogan, to "educate, inspire, and empower leaders to apply exponential technologies to address humanity's grand challenges". Depending on the degree of performance of artificial intelligence, ethical questions will be raised. Should educating political and economic leaders about the issues at stake with new technologies and putting safeguards in place be left to the people who develop those technologies?

Foresight hypotheses and their impacts on occupational safety & health

The question of having both humans and robots present at the workplace and of the resulting risks should be examined firstly on the basis of the respective places given to humans and to machines. It is only then that the questions of work organisation and of consequences on occupational risks can validly be considered.

In other words, where will the cursor be placed between two extreme models:

1. robotisation being placed at the service of productivity, with humans being constrained to adapt to a mode of production essentially designed on the basis of the performance levels of the machine;
2. the added value procured by such robotisation, or at least a "social" fraction of it, being used in particular to the benefit of improving working conditions.

The share of each of these models may vary simultaneously depending on the sectors of activity.

²⁰ - How Tech Giants Are Devising Real Ethics for Artificial Intelligence. <http://www.nytimes.com/2016/09/02/technology/artificial-intelligence-ethics.html>

Pace of work defined by the machine

In the first model, the prescribed share is predominant in defining the task, and the pace is to a large extent based on the work rate of the machine. This conception has consequences, in particular, on the degree of prescription of the work. The consequences make themselves felt in terms of psychosocial risks (PSRs): constraining humans to submit even partially to machines is naturally not without consequences on the mental health of certain workers. A pace of work that is too fast and work that is too repetitive, combined with low decision latitude and low social support, also have consequences in terms of musculoskeletal disorders (MSDs). Admittedly, we can imagine that the advanced development of robotics will also lead to physical assistance robots capable of supporting and facilitating the movements of the operator (exoskeletons, for example). However, it is to be feared that, in a rationale of dominant robotics, such movement assistance might be used, once again, to increase the performance required of humans. Consequences on the physiological state of humans are possible: premature wear of certain joints or wasting away of certain muscles that are no longer used thanks to physical assistance robots.

Machines at the service of humans

Conversely, the second model is virtuous since it is the machines that serve the humans. Physically arduous tasks could be eased through the intervention of robots, enabling, for example, MSDs or low back pain to be better prevented.

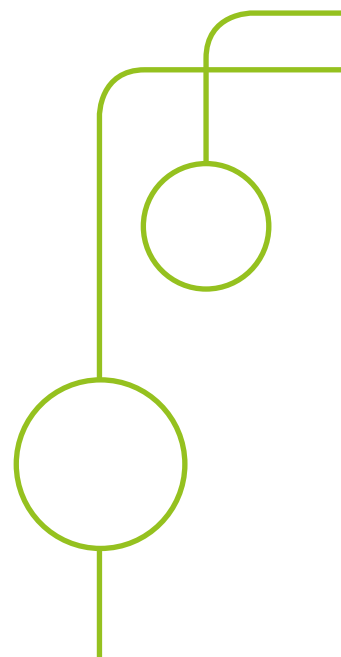
However, with workshops populated almost entirely by robots, and in which human presence is low, we run the risk of seeing skills lost and the meaning of work destroyed, human communities disappearing and people losing their bearings. If a worker is confined mostly to the task of watching over equipment, such a loss of meaning can be even greater.

We have mentioned above the possibilities of certain manufacturing activities being reshored due to environmental constraints and to changes in modes of production being achieved through robotisation. Since it has undergone major deindustrialisation in recent decades, France would be faced with the problem of preventing occupational risks in industrial sectors in which the occupational safety and health know-how has sometimes not been updated for quite some time. Even in a context of development of robotisation, a certain number of risks remain with which we will need to relearn to deal, in particular accidents. An entire risk prevention culture would need to be rebuilt from a technical point of view.

More generally, working with a robot corresponds to new risks, in particular collision risks. Is it acceptable for a robot to collide with a human at work? Beyond the physical aspect, the psychological question is also raised. Is it acceptable to look at the question from a quantitative angle: how many collisions (and at what intensity) would be acceptable during a work shift? Some people have already proposed that standardisation should be looked at concerning this question. Or, conversely, should we consider that any contact between machine and worker should be impossible, in the same way as we would review the way work is organised if the tasks of two operatives could lead to collisions between them outside exceptional circumstances?

The question of hacking is mentioned above: naturally, it could have major consequences on occupational safety and health, in particular in terms of occupational accidents.

Already today, we have seen a rise in incivilities (or indeed violence) towards very human personnel who intervene to deal with problems encountered by people when the choice has been made to give preference to having users or customers use automated machines (or the Internet) first, in certain administrations or commercial organisations. Customers, faced with the machine malfunctioning (or sometimes being incapable of using it), can take an aggressive attitude with the worker who intervenes to help them. Is there not a risk ultimately of the "backup worker" being considered as an extension of the machine and of them receiving the same treatment?



The background is a solid orange color. Overlaid on this are several abstract yellow line art elements. These include thin lines that form right-angled paths, some ending in small circles. One path starts at the top right, goes left, then down, then left again, ending in a circle. Another path starts on the left side, goes down, then right, then down again, ending in a circle. A third path starts on the right side, goes down, then left, then down again, ending in a circle. The overall effect is that of a stylized circuit board or a network diagram.

Issue 3

GOING BACK TO LOCAL AS A TOOL FOR DEVELOPMENT?

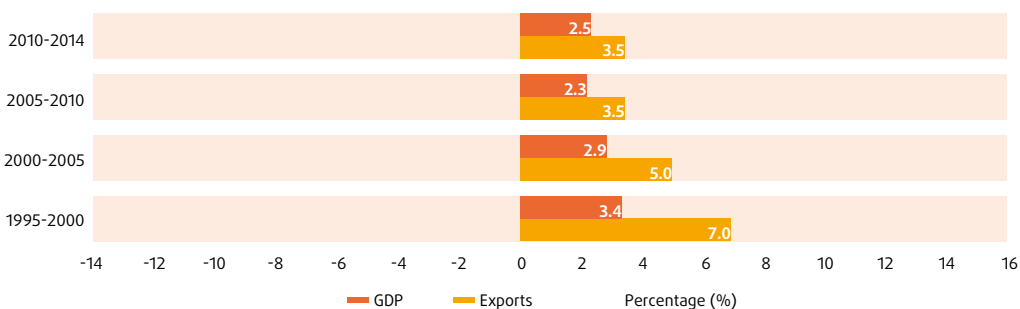
What are we talking about?

Faced with the ever-tightening grip of major multinationals, French attachment to the local territory seems to be growing in a revamped version of the 1970s slogan "*vivre, travailler et décider au pays*" ("live, work, and decide local") that was used by advocates of local development, which a certain cultural hegemonism would tend to lead French people to express in English today as "Think globally, act locally". This concept of going back to local can cover a wide range of contrasting situations: going on the offensive with a constructed project for production and/or for living, or going on the defensive with a fallback mentality when faced with difficulties in adapting to a new work situation, for example. It also corresponds to policies from some determined local authorities who wish to see structuring economic activity develop, in particular to combat decline in local populations or public services. The concept of "local" is not limited merely to a geographic reality, but rather it also opposes the concept of "global value chain": it consists in preferring local production rather than subcontracting production operations to the other side of the world, based purely on satisfying criteria of immediate economic profitability. Such short-term thinking does not take into account parameters such as the payment of unemployment benefits rather than paying wages that are a little higher but that create wealth.

What are we observing?


This return to local clearly breaks with the situation that has developed in recent decades. Figure 1¹ shows that growth in global trade has always been higher than growth in GDP in recent periods (even though, in 2009, for example, negative growth was much higher in exports than it was in GDP).

Figure 1. Volume of world merchandise exports and gross domestic product, 1995-2014



World Trade Organization. International Trade Statistics 2015.

1 - https://www.wto.org/english/res_e/statis_e/its2015_e/its15_highlights_e.pdf



We will therefore assume that local is not destined to replace global value chains (i.e. "Made in the World") but rather, it can constitute a parallel and complementary mode of development. It could also see its role reinforced for various reasons. In addition to the above-mentioned determined political wills of the local territories, we might also mention:

- relative loss of effectiveness of global value chains due to them being stretched: the gains obtained in recent years are tending to decline, probably because the simplest and most effective choices have already been made (offshoring production to countries where labour costs are low, for example);
- reinforced corporate social responsibility requirements²; and
- strong geopolitical instability that can encourage companies to reshore certain types of production.

The most extreme scenario is for a very serious global economic crisis that would result in a fall in world trade (-12% in 2009 compared with 2008), and which would lastingly undermine trust and international trade. That scenario will not be studied here.

Different realities

Although it seems that returning to local should strongly structure activity for the coming 25 years, its motivations and its results correspond to a wide variety of situations. Three of them are explored below in turn, and their consequences in terms of health and safety are different:

1. local as a medium for economic development: projects fully integrated into their geographic environment with an asserted local development mentality;
2. information and communications technologies (ICTs) serving remote work; and
3. a survival economy: local by default.



Key question for the future 1. Local as a medium for economic development: projects fully integrated into their geographic environment with an asserted local development mentality

Robotisation of activities (in all sectors, including agriculture, construction or services) seems to be destined to be a factor in structuring production for the period considered in this prospective exercise. However, manufacturing of certain capital goods or indeed of certain consumer goods should escape the trend, in particular because general standardisation is not capable of meeting all needs. This applies particularly when, independently of investment-related constraints, the required precision or fineness of the work involves the human brain and hand to a large extent throughout the production of the object. Acquisition (which sometimes takes a long time) and transmission of such expertise lend themselves well to local anchoring, based on more or less formalised mentoring such as "*compagnonnage*" (learning a trade through becoming a wandering journeyman) and on cutting-edge training that involves local players (chambers of commerce, chambers of trades, trade associations, professional associations, training organisations, etc.). That is the privilege of excellence. Such excellence will not develop in totally timeless manner, and it is probable that it will itself make use of certain robotised tools or facilities, but they (e.g. physical assistance robots) will be used to serve continuous adaptation to the needs identified by the human brain. Tradespeople and small specialised businesses will be very well suited to such a mode of production.

² - <http://www.senat.fr/dossier-legislatif/pp14-376.html>

Quality agricultural production

Farming also offers an excellent example of the resistance capacity of being local. For certain certifications and labels (e.g. AOC, *Appellation d'Origine Contrôlée* or "Protected Designation of Origin"), the debate has already begun about the possibility of changing the specifications to authorise the use of techniques that would make it possible to simplify the work while also guaranteeing that the quality of the end product is maintained. In view of the vigorousness of the debates between advocates of change and partisans of the status quo, and also given the expectations of consumers, there is manifestly still significant room (that might even grow larger) for products having specific qualities from particular regions and produced by clearly identified modes of production. Another indicator of this significance and of this power of the consumer can be identified in the growing success of short distribution circuits: be it through AMAPs (*Associations pour le Maintien d'une Agriculture Paysanne* or "Associations for the Preservation of Peasant Farming"), through direct sales on the site of production, or through local shops (possibly of the cooperative type) where clearly identified farmers organise themselves to create new sales circuits, some farmers have found more profitable ways of selling their produce. This trend could very well accommodate technological progress: use of robots for weeding, making it possible to limit the use of pesticides, or for harvesting so as to reduce the physical workload. Such farming "with a human face" is not intended to compete with corporate farming³, but rather it meets a need (with certain consumers going back to requiring quality).

Figure 2. Growth in AMAP groups (2003-2011)

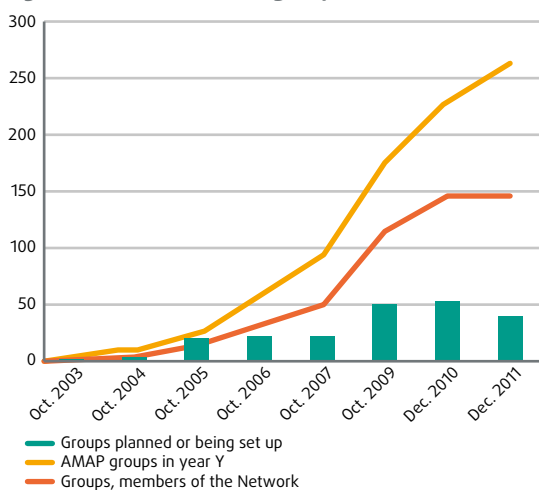
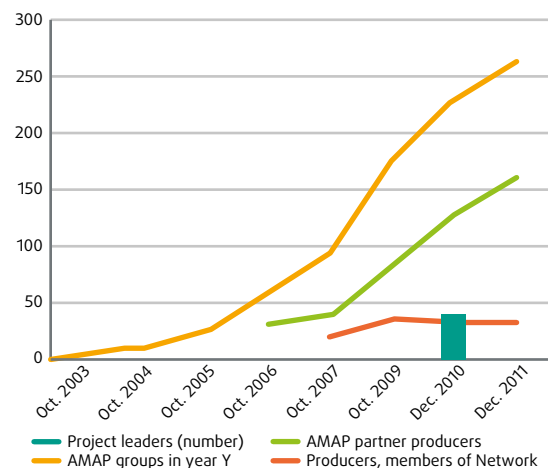


Figure 3. Growth in AMAP groups (2003-2011)



Since 2011, growth has continued and today there are over 300 groups in the Paris Region (Île-de-France), with the number of producers also having increased.

The boom in local networks

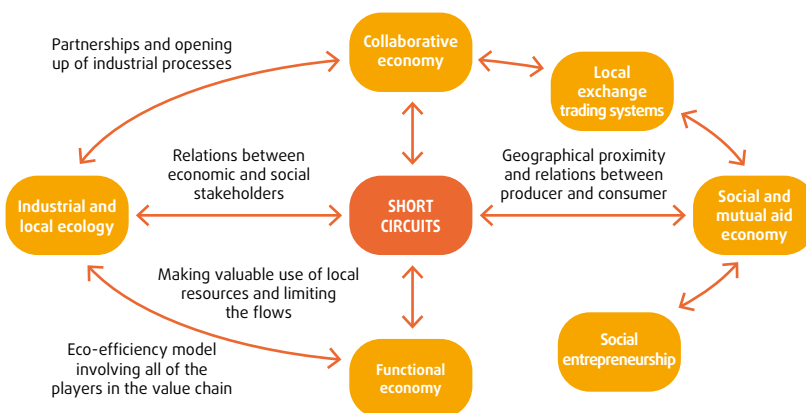
Local initiatives are springing up, sometimes encouraged by local authorities, with the aim of satisfying local needs through exchanges of skills, know-how and products, while also promoting mutual aid and social cohesion. The most commonly known form in France is the "Système d'Échange Local" (SEL) model (equivalent to a "Local Exchange Trading System" or "LETS"), which aims to get away from conventional commercial trade: the exchange takes place on the basis of time devoted to performing a task rather than on paying for a service with money. SELs (LETSs) are part of a social and mutual aid economy model. No activity is actually excluded from them, but mostly they concern work like childminding, gardening, tutoring and odd jobs. The exchanges are managed either in the form of booklets or, increasingly, in a more centralised form made possible by widespread access to the Internet. Although the activities in question should be non-repetitive and occasional, the risk of competition with tradespeople is real. If the scale of this type of activity becomes larger, non-liability to VAT and income tax could reduce the capacities of the State to implement redistribution policies. Similarly, non-payment of social contributions undermines funding for social protection systems (the work done in such contexts also takes place outside the occupational risk prevention system).

Local currencies are another tool for revitalising the economic fabric of a local territory. The aim is to "enable the community to more fully utilise its existing productive resources, especially unemployed labour, which has a catalytic effect on the rest of the local economy"⁴. Since such currencies are accepted only locally, they encourage purchases of goods that are produced locally. They are not intended to replace the national currency (since they do not make it possible to buy all services or all goods, and since local self-sufficiency is not an objective either), hence they are also known as "complementary currencies". In various forms (including electronic ones), they have been booming for a few years now.

Personal care and assistance services are also cited as being provided under conditions that are better for the interested parties and on economic terms that are advantageous for the local authorities and for the community by means of such SELs (LETSs) or structures based on the same philosophy. Home help and care for the

elderly is often cited: such services would thus be provided under more flexible conditions by neighbourhood carers who are familiar to them, which would reinforce the social and human side of the service and its efficiency. Childminders are also concerned. Local authorities, for whom such services constitute an increasingly high cost, see the financial burden lightened. Other factors concerning these issues appear in the section "What will France produce tomorrow?"

Figure 4. Short distribution circuits: a concept at the crossroads



Going back to local with multiple implications⁵

4 - https://en.wikipedia.org/wiki/Local_currency

5 - <http://www.clesdusocial.com/le-developpement-du-teletravail-en-france-comparaison-internationale>

Foresight hypotheses and their impacts on occupational safety & health

In terms of occupational risk prevention, we are faced with problems of intervening in small structures. Potentially, any tradesperson who has at least one employee can access all of the available resources for promoting occupational safety and health. Regardless of how social protection systems change (and of how the associated occupational risk prevention systems change), it is through the common action of the above-mentioned local players, involved in particular in the field of training, that the most effective risk prevention policies can be determined. The stronger the local focus, the more effective such action will be.

Such an approach, through a common risk prevention culture, is all the more important since, as with all tradesperson activities, the working methods and tools used often differ depending on the individual tradesperson/craftsperson. The possible robotisation of such activities, mentioned in this chapter, makes it even more necessary to come together in this way to think about risk prevention: it will be necessary to know how to use relatively sophisticated equipment on a daily basis while always keeping it under control. Misuse of such equipment is potentially dangerous. Such misuse is all the more possible since the work, by definition, is not standardised and will be liable to change continuously.

The question of personal care and assistance, and in particular for elderly and/or dependent people, is discussed above: beyond the possibility of improving the service provided by using local workers, it is a technical activity for which accident and disease prevalence is high (higher than in the construction industry, for example). Although such work should grow through a locally focused, community-based approach, it cannot afford not to take account of occupational risk prevention. Naturally, this also applies for activities of the odd-jobbing or gardening type. The idea is to make such workers aware that gestures and actions that are spontaneously considered as ordinary because they are close to what they do in their private lives potentially have implications in terms of occupational risks.

Key question for the future 2. **Information and communications technologies (ICTs) serving remote work**

Will we all be teleworkers in 2040?

Teleworking, be it on a part-time or full-time basis, is developing. The process is not a linear one, and, after having put it into practice, some companies have backtracked, at least in part. Although it generates economies of structure, both for the companies (lower premises expenses, for example) and for the local authority and community (lower infrastructure and operating costs for travel), and it often satisfies the desires of the workers, problems can appear: communications difficulties, loss of effectiveness of regulation procured by work groups or project teams, etc.

We mention elsewhere⁶ new types of work groups set up to work specifically on one project that are disbanded once the work is done. Currently, these new types of work groups mainly provide intellectual services, often performed remotely, that can be transmitted and coordinated thanks to the progress made in ICTs. Tomorrow, by means

of remote control, other tasks will be able to be performed routinely several hundred kilometres away, including tasks involving operations that are technically more complex than simple supervision or surveillance, office automation, or computing as is currently performed: remotely controlling a machine, providing quality control for a production run, medical consultations (or, as is already the case even though it is still marginal, remote surgical operations), etc.

Percentage of employees doing at least 8 hours telework per month⁷

Country	2000	2010
France	2.6	8.9
Italy	1.3	5.5
Germany	6.7	19.5
United Kingdom	8.8	22.8
Belgium	12.5	30.6
Sweden	14	27.2
Finland	15	32.9
Europe	7.2	18.3
Japan	6.6	25.1
United States	12.4	28

The figures in the table above do not fully reflect the reality of teleworking since they include workers who have to be nomadic to do their jobs and for whom the occupational safety and health problems are often quite different. This can be seen clearly in the following table⁸.

Teleworking based on socio-professional category, sex and age (period 1999-2003 – percentages)

Forms of teleworking	Total	Always at home	Not always at home	Nomadic
Based on socio-professional category				
Engineers & executives	29.8	3.7	6.0	20.1
Intermediate occupations	11.3	1.1	1.2	9.0
White-collar workers	3.6	0.6	0.3	2.7
Blue-collar workers	0.7	0.0	0.1	0.6
All categories	7.4	0.9	1.1	5.4
Based on gender				
Men	10.2	1.0	1.7	7.5
Women	4.1	0.9	0.4	2.8
Based on age				
Aged 15 to 24	4.5	0.4	0.4	3.7
Aged 50 and over	6.3	1.4	0.8	4.1

Source INSEE, Enquêtes PCV 1999-2003 (Permanent surveys on living conditions, 1999-2003) ; calculs Dares (calculations by DARES – Directorate for Research, Studies, and Statistics of the French Ministry of Labour).

7 – <http://www.clesdusocial.com/le-developpement-du-teletravail-en-france-comparaison-internationale>

8 – <http://www.ladocumentationfrancaise.fr/var/storage/rapports-publics/094000573.pdf>

The consequences on employment are discussed elsewhere⁹.

Clearly, the development of tools such as 3D printers, for which we can expect major improvements in the coming years, will also make it possible to reshore certain types of production. Although there is no doubt that such printers will be used for some top-of-the range and highly specific products, we do not yet know how widespread the use of them will become. It will depend on the technological progress that will be made in the printing achieved by them (precision of the printing and type of materials that can be used) and also on the cost prices: we might enter a virtuous circle of popularisation, making it possible to lower costs. Indeed, location of fab labs¹⁰ is often already encouraged by local authorities. Third places for work also constitute tools that make equipment available (in addition to workspace) and form places for exchange that contribute to socialisation of self-employed workers or workers away from their companies and to enrichment of their work (through the possibilities of exchange with co-workers).

Foresight hypotheses and their impacts on occupational safety & health

The strong expansion of teleworking might lead to it becoming very commonplace. That might lead to the formalised rules for working (place, equipment, hours, etc.) as currently provided for in the French Labour Code (*Code du travail*) being less well complied with, or, on the contrary, with the growth in teleworking, we might see standardisation of equipment (a dual-function chair, for working and for relaxing, a desk that enables computer equipment to be retracted and converts into a table, etc.) to a level compatible with performing occupational tasks under good ergonomic conditions.

The work culture might change with the phenomenon becoming commonplace, and workers will gradually have to learn how to organise their activity as well as possible, especially if, while not actually becoming the norm, such remote working grows to such an extent that it becomes "ordinary". The risks identified today, such as the risk of professional isolation or of the border between professional life and private life becoming insufficiently clear (the former encroaching on the latter), will have to be managed: the type of contract between employer and employee will probably be decisive as regards the methods that will be used to achieve this. It can be imagined that in a society in which ICTs have taken on considerable importance, the use of MOOCs or of educational software will be common. There is no guarantee that they will contribute to really helping a worker who is suffering from isolation and absence of human contact.

In the hypotheses that have been given in this chapter, it has been imagined that teleworking might also concern remote operations (controlling a machine, quality control for a production run, etc.): such production places, in which a human presence could remain, will naturally have to incorporate into their design and into their operating modes these possibilities of other people intervening remotely.

9 – Section "How will prescription of work and pace of work change?"

10 – A "fab lab" (short for "fabrication laboratory") is a place open to the public and where all sorts of tools, in particular machine tools controlled by computer, are made available for designing and producing objects.

Finally, in view of the risks of hacking, such remote control increases the risk, through networks that are insufficiently secure, of malevolent on-line intrusions, endangering the security of the systems and the occupational safety and health of the workers.

The development of 3D printers looks promising. They offer very interesting possibilities for working at home, even though using them for mass production is not, so far, being considered. A very large number of materials can already be used, and it is probable that the range will widen further. It can be imagined that the suppliers of these printers will conduct the necessary risk studies and will prescribe the conditions under which they should be used and what premises should be equipped with them (in particular for reasons of legal liability). The question of how well such prescriptions are followed and, above all, the question of misuse could be raised: using a substitute polymer or a metal that has physical properties close to those of the metal that is recommended (but that has different toxicological properties) could have serious health consequences.

Key question for the future 3. **A survival economy: supplementary activities**

Going local as a survival mode

Whereas, in the above-described cases, going local is often a life choice, it can be imagined that, in other circumstances, it is merely a fallback or last-resort solution, or even a trap from which victims cannot escape in spite of their efforts. In a two (or more) speed society, as described elsewhere¹¹, some will be constrained to use a parallel economy to survive because they are excluded lastingly or due to an inclement economic climate from the world of work or because the income they earn from it is not sufficient to live on. The forms of such "survival" or "resourcefulness" will vary depending on circumstances and on the mode of operation of the mainstream of society (including in the event that a universal basic income scheme is brought in), but they could concern repairing simple consumer goods, deconstruction of equipment down to recycling certain raw materials, certain forms of (non-declared) trades or crafts activities, recovering/repairing with a view to resale, growing supplementary subsistence crops...

The table on the following page describes the sectors most affected by the underground economy in the OECD.

Survival plus the Internet

This survival economy can take other forms, better integrated into the dominant production model: such forms being activities for supplementing insufficient income. In particular they are various forms of the "sharing economy", which is also known as "Uberification": "Uberification (or Uberisation), named after the company Uber, is a recent phenomenon in the economy that consists in using services enabling professionals and customers to be put in direct contact, almost instantly, by using these new technologies" (translated from the French page on "Uberisation" in Wikipedia). The new face of the service economy, at least in the early years of the period considered, will depend to a large extent on the development of this system, and on the type and levels of regulation that the public authorities (or markets) will put in place. The initial transport service model is expanding and diversifying: it is being proposed to private individuals to rent out their car boots for last-mile deliveries, fintech companies are re-

Sectors of activity or groups of taxpayers that are the most concerning according to the tax authorities of the OECD countries

Sectors of activity	Tax Authorities deeming this sector concerning (% in total)	Nature of the activities included in this sector
	22.1	Cleaning, hairdressing, beauty, dry cleaning, catering, pest & vermin control, computer maintenance, security, health, pet care, putting people in touch, etc.
Hotel and catering trade	16.4	Restaurants, cafés, pubs, take-away outlets, hotels, etc.
Retail trade	15.6	Shops, public markets, flea markets, etc.
Construction	15.6	
Vehicle sales and maintenance	5.7	
Transport	3.3	
Taxis	3.3	
Agriculture, fishing, aquaculture	2.4	
Others	15.6	Tourism, real estate (including letting), recycling, on-line services provided by self-employed people, professionals, performing artists, etc.

Source: OECD, 2012, Réduire les possibilités de non-conformité fiscale dans l'économie souterraine (Reducing the possibilities of tax non-conformity in the underground economy).

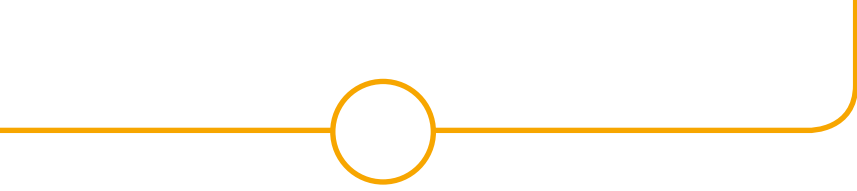
volutionising financial transactions, lawyers and notaries are experiencing competition from on-line services, etc. The impact of this possibility of generating supplementary income (including in less elaborate forms than those using electronic platforms for putting customers and suppliers in contact) to supplement main sources of income is already making itself felt in the economy.

Will Uberification become standardised?

The status of the workers in the sharing or "Uberised" economy is a work in progress. After multiple lawsuits, Uber drivers who had instigated a class action in California against Uber so as to have it recognised as being their employer agreed to withdraw their claim¹² in exchange for financial compensation and a revision of the "deactivation" system¹³. Also in the United States, other States have adopted different positions and numerous lawsuits are still on-going. The consequences in terms of collective organisation, capacity to negotiate pay and working conditions, among others, are naturally extremely important and there will be numerous new developments in the coming years. Provision has already been made in France for these self-employed workers to have the possibility of taking "concerted action to refuse to provide their services with a view to defending

¹² – "Uber offers concessions, but drivers stay freelancers", International New York Times, 23-24 April 2016. <http://www.ny-times.com/2016/04/22/technology/uber-settles-cases-with-concessions-but-drivers-stay-freelancers.html>? That judgment has since been overturned, because it was deemed too unfavourable to the drivers!

¹³ – "Deactivation" corresponds to a driver being barred from accessing the platform for putting him or her in contact with customers if his or her performance-based rating is deemed insufficient.



their occupational claims" and to be "entitled to set up a union, to be members of it and to have it fight for their collective interests"¹⁴.

The frontiers between salaried employment, tradesperson status, "false" and "true" self-employment, or indeed undeclared work, will probably change. The issues are considerable: it is a major determinant of the social protection system. The debate will also take place in France.

Foresight hypotheses and their impacts on occupational safety & health

By definition, the activities of the "survival" economy take place in an underground and non-controlled manner. Such work can lead to direct harm and discomfort for those who do the work and for their families and people around them. In view of a certain amount of permeability with the business and corporate world, the products of such work can then be fed back into a conventional process of use, without having been the subject of any specific checks and testing, which, in certain cases, can lead to risks of accidents or of exposure to toxic products. Beyond the very real occupational risks, this is also a public health problem.

More generally, it would seem that this intertwining of private life and of more or less official occupational activities; it will not be limited in the coming period to such survival economies and supplementary activities, and will probably lead to shifts in the frontiers between occupational health and environmental health. As regards activities related to electronic platforms, the recent changes would argue in favour of moving towards social policies (and thus occupational risk prevention policies) that are related to conventional forms of employment. But such convergence could also take place in the other direction, with social policies being aligned with self-employed statuses.

E-commerce has occupational safety and health consequences at the logistics platform level (see Section "What will France produce tomorrow?"). It also has consequences at the last-mile delivery level: well-known risks (road accident risk, risks related to handling and lifting, etc.) are likely to appear in a specific context of high individualisation of modes of execution of work that are not favourable to overall and concerted solving of the problems encountered.

¹⁴ - "El Khomri crée un droit de grève pour les Uber" ("El Khomri [France's Minister for Labour] creates a right to strike for Uber workers"), *Le Monde*, 26 avril 2016.

The question of the circular economy

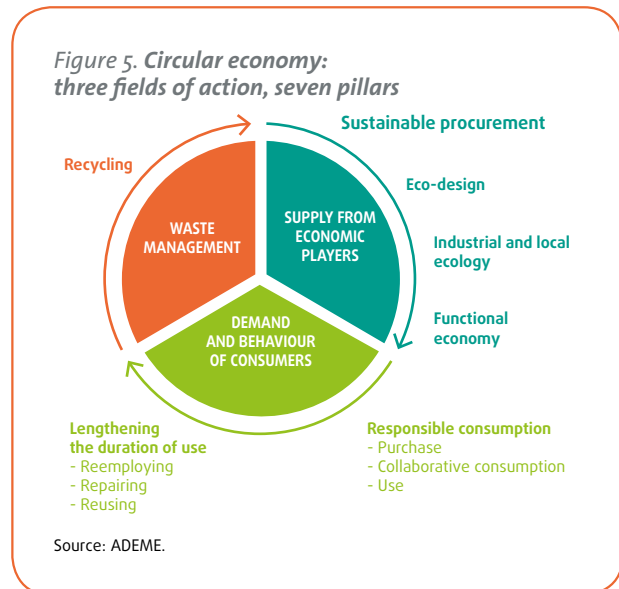
Since it goes well beyond mere recycling, the circular economy is an alternative to global value chains. It is also a mode of production that is based heavily on local resources.

For the French Environment and Energy Management Agency (ADEME), the circular economy breaks down into three fields of actions, each field being based on focuses forming the seven pillars of the economy¹⁵:

- the economic supply:
 - sustainable procurement;
 - eco-design;
 - industrial and local ecology;
 - functional economy;
- consumption of citizens:
 - lengthening the duration of use;
 - responsible consumption; and
- waste management:
 - recycling.

The principle is for operation in a loop, aiming to outlaw production of non-recyclable waste and use of non-renewable energies. The idea is also to minimise goods transport and to prefer local production and decentralisation of (renewable) energy generation.

In view of the profound changes to which this would lead in production, it could also be encouraged by a system of tax incentives (including in the form of a system of bonuses and penalties).



The circular economy corresponds to a highly technological model

Consumer goods designed in a circular economy model lead to a paradox:

- they are more robust, more durable, simpler to use, in particular in a shared-use logic, and they are also plainer;
- but the corollary of such simplicity is greater complexity in the design, firstly to enable such simplicity to be achieved, but mainly to make end-of-life deconstruction possible; the component parts that are still in working order can then be reused as they are (for repairs or in other consumer goods) or, failing that, can be recycled almost in their entirety: this model is very different from the current model where each recycling operation often results in the loss of quantities as high as several tens of percent of the initially used quantity.

¹⁵ - <http://www.ademe.fr/expertises/economie-circulaire>

IT'S ALREADY TOMORROW

Group SEB¹⁶ (SEB, Moulinex, Tefal, Rowenta, Krups...) claims it is committed to sustainable innovation. It is focusing its efforts in particular on repairability. Thus, in addition to an effort on the durability of its products through design, 97% of its appliances are repairable, and 500,000 should be processed in France in 2016 (from top-of-the-range robots to toasters and including vacuum cleaners). Repairs increased by 24% in 2015 on the preceding year. No spare part should exceed 50% of the value of the product, and most of them are sold at cost price. When they cease to be available, 3D printing will, in some cases, make it possible to reproduce discontinued spare parts. Two hundred and twenty repairers exist over the entire territory of France, but consumers are encouraged to do the work themselves thanks to (dis)assembly instructions available on a website, to educational software, and to advice from some approved centres among the repairers. This approach is currently being implemented in 13 countries in Europe and in North America. It will be extended to 13 others by 2017. This is a good example of market globalisation moderated by partially going back to local.

One hypothesis: robotisation and artificial intelligence as essential conditions for the design and operation of an effective and economically sustainable circular economy

Such consumer goods also have the property of being repairable on site. Such repairs are not necessarily very simple technically, but thanks to robotisation and to sharing of design data, they can be done in local workshops whose technical level can be very high.

Such new goods require a lot more work to produce. And it is progress in robotisation that makes it possible to devote the additional hours of work for manufacturing a product. Automation is no longer in competition with humans but in co-operation with them, and new technologies are appearing. The paradigm shift in production requires massive investment, which is enabled by re-injecting the added value made possible by robotisation. The design and production costs proper are much higher and only partially offset, at least initially, by the increased durability of the goods produced. Robotisation also makes it possible to produce more complex parts, and to produce and work with new materials.

Going back to local as one of the fundamental elements of the circular economy

This new organisation of production will result in gradual repatriation to France of some manufacturing currently performed elsewhere. It will also result in changing the industrial fabric of the country, in particular through the creation of local units for maintenance and repair that could work in co-operation with tradespeople. Conversely, there could be a relative slow-down in exporting industries such as the transport industry, because society would move towards less mobility.

¹⁶ - "Le Groupe SEB annonce de nouveaux engagements en matière d'innovation durable" ("Group SEB announces new commitments to sustainable innovation"). <http://www.groupeseb.com/node/52067?views=6>

Impact on occupational safety and health

The transformation towards the circular economy (a different mode of design, more robotisation, emphasis on recycling) will lead to a profound change in working conditions, and will, at least in an initial stage, require reinvestment of most of the added value generated. A major issue will be to make occupational safety and health a fully-fledged component in defining new modes of production, rather than it being merely an adjustment variable, to which less importance could be given during the transition period. It should be incorporated into defining the needs during the design phases.

Eco-design should thus incorporate occupational safety and health concerns.

IT'S ALREADY TOMORROW

TrashBot¹⁷ does not designate a global waste treatment system, but rather a robot to be installed in all kitchens that will locally sort the waste in every home. Not only is it capable of identifying the various types of waste (metal, paper, organic...), but it is also capable of monitoring consumption while giving valuable information about lifestyle. TrashBot would therefore be the best way of not having to do a chore, while also adopting consumption that is intelligent and responsible.

Figure 6. Eco-design for an everyday object¹⁸

ECONOMIES OF END-OF-LIFE

- Inform users of the collection points for household electrical appliances
- Enable the kettle to be repaired to extend its life span
- Make the components separable and mark them for recycling purposes
- Set up a recovery channel for reusing the components

ECONOMIES OF USE

- Raise user awareness
- Use technology having the best thermal efficiency
- Energy efficiency of the electronic components
- Design making it possible to use no more water than strictly necessary



ECONOMIES OF RAW MATERIALS

- Use recycled or recyclable materials
- Use parts not used by other assemblers
- Recover and reuse our old kettles
- Optimise mass to volume ratio

ECONOMIES OF PROCESS

- Supplier requirements
- Filtration of emissions
- Energy-efficient processes
- Reusing scraps and quality rejects
- Recycling of waste
- Training employees to do the right things
- CSR charter

ECONOMIES OF LOGISTICS

- Production close to market
- "Clean" transport
- Optimisation of packaging volume

17 – <https://humanoides.fr/2016/06/cleanrobotics-recycle-trie-vos-dechets-automatiquement-avec-le-robot-trashbot/>

18 – Orée, CJD, DGCIS. *Animer le lancement d'une démarche d'éco-conception pour améliorer la compétitivité des entreprises. Evolution d'une démarche d'éco-conception intégrant des critères sociaux et sociétaux* (Leading an eco-design approach for improving the competitiveness of companies. Evolution of an eco-design approach incorporating social and societal criteria). <http://www.oree.org/eco-conception/les-actions-oree.html>

The background is a solid teal color. It features several abstract yellow geometric shapes: a circle at the top center, a circle at the bottom left, and two circles of different sizes on the right side. These circles are connected to each other and to the edges of the frame by thin yellow lines that form various right-angled paths and loops.

Issue 4

TOWARDS A MULTIPLICITY OF WORK FORMS?

What are we talking about?

Forty years ago, when we talked about employment in France, we were referring to salaried workers on indefinite-term contracts, spending their whole working life in the same company (sometimes with children joining the company for which their parents already worked), or possibly in two or three companies, with, exceptionally, a period of unemployment. Farmers, tradespeople and self-employed people did not fit into that scheme of things, but the stability of their jobs and their statuses were equivalent. Stable, full-time, salaried employment has been the bedrock of French society since the end of the Second World War.

Is the development of unemployment, fixed-term contracts, temporary work, and more recently self-employment heralding the end of this model? This is what is predicted by some people who see salaried employment as a mode of work adapted to a second-industrial-revolution society that is dying out. That standardised labour model is, they say, now in the process of being superseded by work forms more in tune with the boom in the innovation economy. And yet it would appear that this is a pre-existing underlying trend, related to requirements for optimising and rationalising production processes and work organisation. Which is it?

What are we observing?

Lasting mass unemployment is marking career paths

The last thirty years have been marked by mass unemployment rising and establishing itself durably in France. Admittedly this unemployment is sensitive to economic climate, but to a much lesser extent than in other countries. Since the 1980s, unemployment in France has only rarely come back down under 8%. This underlying and general trend has had major repercussions on work forms.

With the rise in mass unemployment (figure 1), the proportion of the total population who are in work has declined (figure 2). Full-time employment throughout working life in the same company that symbolised the thirty-year post-war period of economic prosperity in France known as the *Trente Glorieuses* is no longer on the universal horizon of expectations for workers who have had to become accustomed to work forms that are new in status or in length. Transitions between employment and unemployment are now commonplace, in particular for young people.

Figure 1. Unemployment rate in France

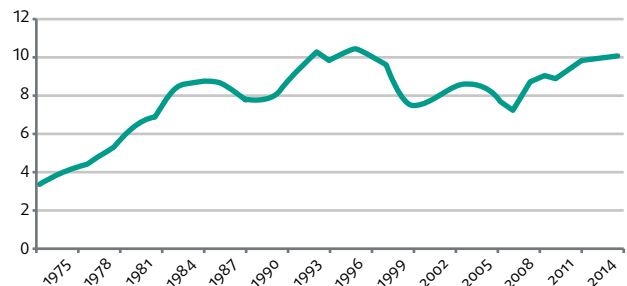
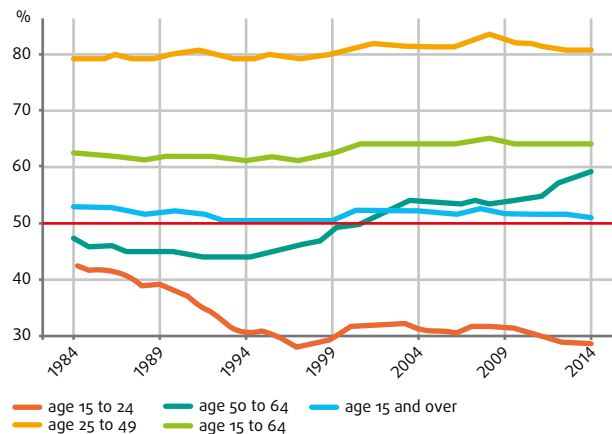
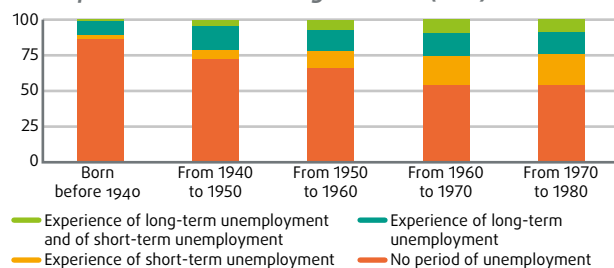


Figure 2. Employment rate based on age



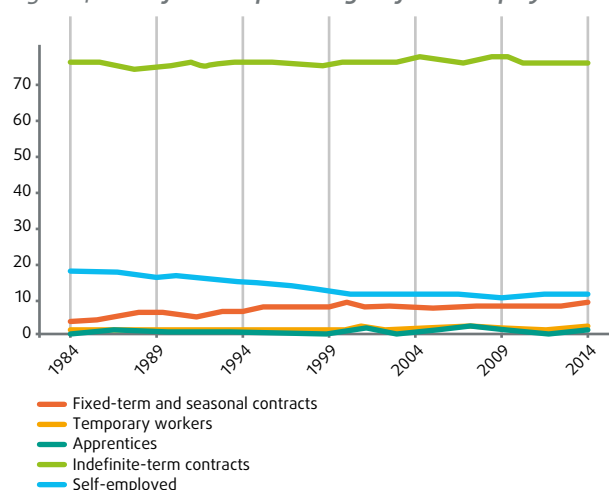
Employment in the ILO sense - Annual Average - Metropolitan France
Population of households - People aged 15 and over.
Source: Insee, enquêtes Emploi (calculs Insee) [Employment surveys by INSEE, France's National Institute of Statistics and Economic Studies (INSEE calculations)].

Figure 3. Declared experience of unemployment during career path in 2006 based on generation (in %)



Reading: since the experiences are declared in 2006, the progress along the path is uneven depending on the generations. However, 3.1% of the generation born before 1940 faced an experience of short-term unemployment before 2006-2007 as against 20.5% of the generation born in the 1960s.
Source: Dares, Drees, enquête SIP, 2006 ("Health and Career" Survey, 2006, conducted by two government departments for research, studies, statistics and assessment).

Figure 4. Work forms as percentages of total employment



Employment in the ILO sense - Annual Average - Metropolitan France Population of households - People aged 15 and over.
Source: Insee, enquêtes Emploi (calculs Insee).

Nearly one in two people born after 1960 has experienced a period of unemployment, as against fewer than a quarter of people born before 1950.

According to the "Santé et itinéraire professionnelle" ("Health and Career Path") survey conducted by DARES (the Directorate for Research, Studies, and Statistics of the French Ministry in charge of Labour) in 2006, one in two people experienced unemployment for the generation born after 1960, whereas it was much less frequently experienced for the earlier generations.

Periods of short-term employment interspersed with times of unemployment have developed strongly in the early years of the career paths of the young generations, delaying access to lasting jobs. Thus, whereas more than 92% of men born in the 1940s had, by the time they were aged 30, a stable job that they had been doing for more than five years, that was the case for only 79% of men born in the 1960s.

In 2012 in France, 20% of the working population who had finished their initial training between 2008 and 2011 were unemployed - on the basis of the ILO criteria - as against 8% of the working population who have more than ten years of seniority². Although overall, women remain a little more often confronted with unemployment than men, the reverse applies for young people who have been part of the working population since 2006. In 2012, the unemployment rate of young women starting their working lives was two points lower than the equivalent rate for men.

Continued existence and erosion of indefinite-term contracts

However, during the last thirty years, the indefinite-term contract has remained very much the majority form of employment contract in France (3 out of every 4 jobs) (figure 4). While remaining in the minority, employment forms alternative to indefinite-term contracts have nevertheless developed.

Even though they only concern 10% of total employment, fixed-term contracts have developed above all in certain population categories, particularly among young women (figure 5). In general, the erosion of indefinite-term contracts concerns the new generations to a greater extent.

The proportion of people on indefinite-term contracts has remained substantially stable since the 1980s.

1 - http://www.insee.fr/fr/ffc/docs_ffc/ref/EMPSAL12d_D2_g%C3%A9n%C3%A9rat.pdf

2 - Enquête Emploi et formation (Employment & Training Survey), INSEE http://www.insee.fr/fr/ffc/docs_ffc/FORMEMP13.pdf

Recent years have also been marked by a re-emergence of self-employment that is, however, difficult to measure because the definition and the criteria are not identical depending on the statistics.

In 2014, non-salaried workers represented 10% of workers in France, i.e. 2.8 million people, as against 15% on average in EU-28³.

Their number decreased strongly from 1970 to the early 2000s, in particular due to the reduction in the number of farmers, to changes in labour law, and to the extension of social protection. But it increased by 26% from 2006 to 2011 (about 550,000 people), and by even more in services (computing, management, teaching, personal care and assistance services, etc.), while the number of "conventional" self-employed people increased by only 1.5% in 2012 and 0.3% in 2011.

Most of the rise observed since 2008 was accounted for by "microentrepreneurs" (known as "autoentrepreneurs" until 2015).

Figure 5. Proportion of people on fixed-term contracts by age and sex

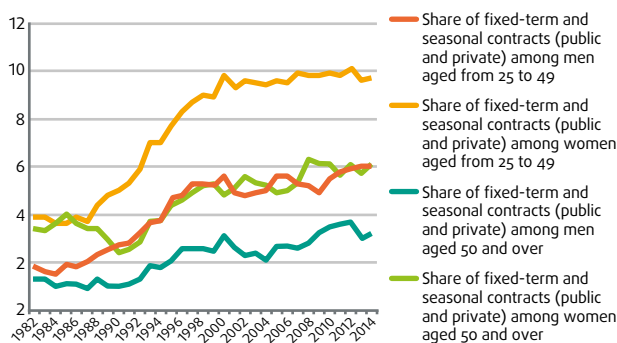
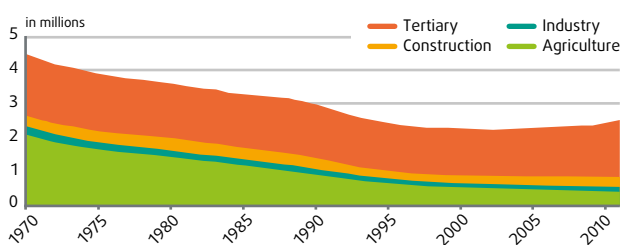


Figure 6. Non-salaried employment at 31 December by sector of activity from 1970 to 2011



Scope: Metropolitan France, People aged 15 or over.
Source: Insee, estimations d'emploi (employment estimates).

IT'S ALREADY TOMORROW

Service providers who are entrepreneurs or who are employees?

With the boom in the digital economy, countless startups have been set up that are revolutionising the way in which people collaborate in the economic activity of a company for which they work.

Many of such startups propose services, such as transporting people in chauffeur-driven cars or short-distance deliveries.

The services proposed are provided by people considered to be self-employed individual service providers who are paid through the startups without being employees of them. The company considers itself merely as the gateway or portal via which the demand and the supply of such services are put into contact with each other, while the service providers pay for their own expense and for their own social protection, thereby releasing the company from the legal and tax obligations that it would have if it employed them as salaried members of staff.

However, this economic model enables people who are unemployed to have access to work, even intermittently.

While the growth in some of these companies is sending some strictly regulated sectors into turmoil, other companies that are already established are becoming interested in this economic model to avoid employer social contributions and expenses and to offer increasingly cutting-edge services at more competitive prices.

However, the authorities are giving increasing attention to this way of taking advantage of legal loopholes since the status of someone providing such services is actually very like the status of an employee: they are constrained to work for certain hours and within a certain geographic area, without any possibility of refusing assignments, and may even be constrained to wear a uniform.

And yet, although the need to legislate is emerging, only individual judgments have been rendered so far in the courts, while this economic model continues to expand without any clear definition of the legal situation.

Such self-employed workers include, in particular, freelancers, highly qualified individuals who propose their services as journalists, graphic designers, computer specialists, etc. According to a recent report by the European Foundation of Independent Professionals (EFIP), the number of freelancers has increased by 85% over the last 10 years in France (and by 45% in Europe). However, there is no single legal status that makes it possible to count all of these freelancers, whose common denominator is to claim they work on demand and in fully independent manner.

Number of jobs held by generation

People born...	Average number of jobs held before the age of 40			
	Before 1940	1940-1950	1950-1960	1960-1966
Overall	2.7	3.2	3.7	4.1
Gender				
Men	2.9	3.5	3.9	4.4
Women	2.5	2.9	3.5	3.9
Level of qualification				
BEPC (sch. cert.) at most	2.9	2.9	4.4	4.0
CAP BEP (vocational qual.)	2.6	3.6	3.5	4.7
Technical baccalaureate	2.2	3.1	3.0	4.0
General baccalaureate	1.7	3.1	4.6	4.6
Bac + 2 years in higher ed.	2.0	3.1	2.7	3.7
Bac +3 years or more	1.7	2.8	3.1	3.0

Scope: Metropolitan France, people having held at least one job by the age in question. Reading: at age 40, the people of the generation born before 1940 had held at least one job on average. Source: Daves. Drees. *Enquête Santé et itinéraire professionnel (SIP) 2006*.

Career paths are bumpier and more varied

According to the "enquête Santé et Itinéraire Professionnel" (SIP) or "Health and Career Path survey" conducted by the DARES (Directorate for Research, Studies, and Statistics of the Ministry in charge of Labour), the number of jobs held before the age of 40 is significantly higher for the generations born after 1960 than for the generations born before 1950. These changes result essentially from the facts that starting out in working life is more difficult than before (see above), that staff turnover is higher in companies and perhaps that the new generations have a greater desire and capacity for change.

Transformation of occupations is accelerating

In recent decades, production techniques (both in industry and in services) have changed very rapidly under the influence of the boom in ICTs. Therefore, in terms of human resources management, the period has been marked by an acceleration in training and adaptation/retraining needs to enable specialists to remain so and to enable people who are less specifically qualified not to be excluded from the world of work in a period marked by a high unemployment rate and industrial restructuring.

In certain disciplines (computing, in particular), technical developments are taking place so rapidly that employees skills can quickly become obsolete. This implies the need for frequent refresher courses and skills upgrades, and changing rapidly from one post to another. Even beyond these particular sectors, the induced flexibility results, for qualified technical and/or executive posts, in an acceleration of the pace of career paths, often desired both by the companies and by the employees. However, the time frames of the desires of each party do not necessarily match. Frequent changes of post are instigated as a mode of management in many large companies in order to combat obsolescence of know-how and as a remedy for work becoming too "routine".

The relative dispersion of work times and work places

The collaborative aspect of new modes of organising work – teleworking (salaried or non-salaried remote work is facilitated by computer tools and does not prevent collaboration), self-employ-

ment in associations, co-working spaces, collaborative platforms, fab labs, etc. – is being promoted as both a freedom and as a way of enriching work and creativity.

It compensates for the dilution of traditional work groups and teams caused by the work organisation modes put in place in the context of strict procedures, in particular quality policies.

Such workers seek support in particular in the communities of their peers rather than in the company, and they set up work groups or project teams that are of variable geometry that varies with the projects on which they are working. Digital technologies make it easier for people to be put in touch and to work remotely.

But the collective dimension also makes it possible to represent and to defend the interests of the workers, which is a weakness of self-employment. Lawsuits to have self-employed jobs re-categorised as salaried employment have also been and are being instigated in the United States (e.g. for the self-employed workers working for Uber). In France, the *loi EL Khomri* (a labour law named after the then french Minister for Labour) makes provision for the defence of collective interests and for the right to strike for self-employed workers who work through a service platform, for example.

The drivers of these changes

The observations established above are the subject of numerous analyses and result from interplay between various transformation factors.

The experts point in particular to the acceleration in technological change and to the resulting more rapid transformations in the production system. In general, the acceleration of time as described in particular by the philosopher Harmut Rosa, would appear to be one of the causes of career paths that are more varied than before and of diversification of working times and workplaces.

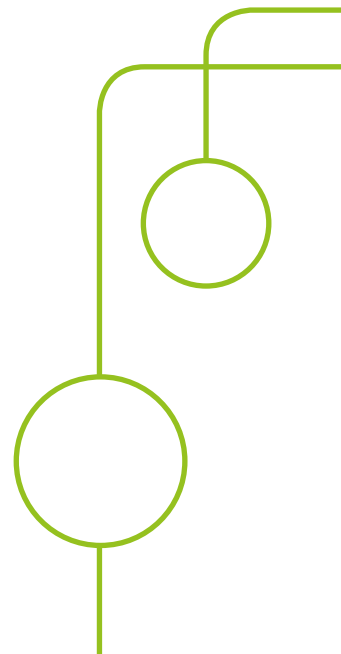
Naturally, the fact that the French production system has had to compete more through the process of the economy becoming globalised (borders being opened up) is also one of the factors that can explain the low growth in the number of jobs in France. It also explains the greater fragility of companies, activities and jobs that are subjected to much wider competition than before.

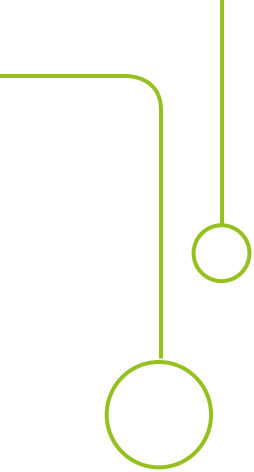
Although these changes in the stability of employment are often forced on workers, some transformations in work forms are also driven by the development of new aspirations regarding work.

In general, the young generation would appear to take more account of the importance given to expressive and post-materialistic values (air quality and well-being are central values, and work is seen as a means of fulfilment). Those who have committed to studying are more demanding and have higher expectations in terms of personal development through work⁴.

Such aspirations could lead those who have the necessary resources to develop greater demands that could lead to less loyalty to the company employing them. The young generation appears to be confirming the change towards a "polycentric" conception of existence, i.e. a conception of life and a system of values organised around several centres (work, family,

4 – Dominique Méda and Patricia Verdramin, "*Les générations entretiennent-elles un rapport différent au travail?*" ("Do generations have different relationships with work?") in *Sociologies*, December 2010.





personal life, leisure, commitment, etc.). The balance between the centres is up to each person to establish. The quest for consistency between work and life in terms of meaning and of values can lead people to prefer insecurity in a job that has meaning rather than stability in a job that does not.

Although the young generations are often presented as being less loyal to the companies that employ them, and ready to try a range of occupational experiences, their statements on this subject are ambivalent.

According to an OpinionWay barometer, half of the under 25s in France think they will be engaged in the same occupation all their life and 51% would even like to spend their entire working life in the same company. And yet, in other surveys such as the one by Ipsos, nearly half of young people assert that, if they had the choice, they would work in another company and/or another field, and 6 out of 10 think they will no doubt change their jobs several times during their working life.

In addition, nearly 60% of young people see their career path partially or totally outside salaried employment and say they are interested by the idea of creating an enterprise or of being self-employed⁵.

According to a survey by the association Astrees⁶, conducted on over 1100 young people on the theme of work and commitment, 81% of the people questioned deemed that it is important to have a pleasant working atmosphere, 74% expect the work to be interesting, and 74% wish to find a good work-life balance. Furthermore, nearly 90% of the people questioned feel committed in their work.

Two rationales therefore seem to be combining themselves. Firstly, the particularly high level of what they expect from their employer can give rise to frustrations and to the hope of greater recognition in another company; secondly, even though young people are in favour of give and take with the employer for the mutual benefit of both parties, they consider it quite normal to accumulate work experiences without being required to be absolutely loyal to one company.

Key question for the future 1. **Towards lastingly low growth and a reduction in jobs?**

According to some economists, the fall in growth observed in the developed countries in recent years is not due to an inclement economic climate, but rather it is structural and can be explained by what Gordon⁷ has called "headwinds" to growth: productivity remaining lower than during the post-war boom years (slowdown in the performance of ICTs⁸, levelling off of the increase in the female employment rate, ageing of the population, rising inequality, government debt, and peaking of the level of schooling, etc.). Gordon and other economists anticipate a "secular stagnation".

5 – <http://www.prismemploi.eu/Public/Page-d-accueil/Presse/Archives-depuis-2008/Communique-de-presse-2015/Barometre-Les-jeunes-et-l-Emploi-Prism-emploi-OpinionWay-Edition-2015>; <http://www.prismemploi.eu/Public/Page-d-accueil/Presse/Communique-de-presse/Enquete-trimestrielle-Prism-emploi-OpinionWay-Les-Jeunes-et-l-emploi-Juin-2016>

6 – http://www.metiseurope.eu/infographie-les-jeunes-et-l-engagement-autravail_fr_70_art_30097.html

7 – Robert Gordon. *Les six vents contraires qui freinent la croissance* ("Robert Gordon. The six headwinds that are slowing growth down"). *Alternatives économiques* No. 338. http://www.alternatives-economiques.fr/les-six-vents-contraires-qui-freinent-la-croissance_fr_art_1311_69118.html

8 – https://www.banque-france.fr/fileadmin/user_upload/banque_de_france/archipel/publications/bdf_bm/etudes_bdf_bm/bdf_bm_139_etu_1.pdf

But other experts consider that we are at the dawn of new productivity gains and of a third industrial revolution, in particular driven by the digital revolution (gains made possible technically in an initial stage by 3D chips and then bio-chips⁹, and ultimately, in a much more distant future, by quantum electronics).

These debates on productivity and on growth have consequences on purchasing power, on employment, and thus on work forms, even though those links are not always explored.

We can rapidly outline three scenarios:

- generally low growth and high productivity gains: rising inequality, fewer but better paid jobs. High profitability of capital;
- generally high growth and big productivity gains: return to the post-war boom years, job creation, etc.; or
- zero or negative growth and few productivity gains: fall in purchasing power, numerous but low-paid jobs, poverty and new forms of prosperity ("Prosperity Without Growth", Tim Jackson¹⁰).

The current trend is for job security to be becoming polarised. Job security has two pillars: firstly the employment status (civil servant, indefinite-term contract in historically well protected sectors), and secondly the level of education and the skills sector.

Key question for the future 2. **A universal basic income instead of the Social Security system?**

The rise in unemployment and the greater fragility of employment are threatening the stability of the social security and welfare systems based on providing replacement incomes in the event people lose their jobs. It would seem that the social protection system put in place in the twentieth century is no longer suited to the diversification of work forms and career paths. Adaptations (or revolutions) of the system will necessarily have consequences on forms of employment. If the degree of social security is no longer related to the status and to the length of the employment, the comparative attractiveness of the various forms of employment will necessarily be altered. In the debates (which are not recent) on the changes in the social security system, the question of putting in place a universal basic income is, today, the topic that has the highest media profile.

The principle of a universal basic income is emerging today in several European countries. In 2015, the Finnish government announced a complete overhaul of its welfare state in order to put in place a substantial universal basic income. They are talking about 800 euros per month, but for local pilot schemes that will start in 2017, with assessment, prior to any generalisation, in 2019. In France, the idea is gathering momentum but it differs depending on the projects, whose contents vary (the form, the

9 - Biochips: "In molecular biology, biochips are essentially miniaturized laboratories that can perform hundreds or thousands of simultaneous biochemical reactions. Biochips enable researchers to quickly screen large numbers of biological analytes for a variety of purposes..." (Wikipedia).

10 - Tim Jackson. Prosperity without growth. The transition to a sustainable economy. 2009. [https://en.wikipedia.org/wiki/Tim_Jackson_\(economist\)](https://en.wikipedia.org/wiki/Tim_Jackson_(economist)).
http://www.lse.ac.uk/publicEvents/pdf/20100225_TimJackson.pdf

parameters, and the targets are different). According to Julien Damon¹¹, it is possible to distinguish between three focuses that aim either to supplement the public redistribution system, or to reorient it, or else to do away with the Welfare State¹². There are numerous debates about the disincentive effects that such unconditional benefits might have on employment, and on the capacity to sustain such broad social protection over time. But the essential question remains the question of funding. A first family of proposals is intended to supplement the existing social transfer systems with an initial amount of capital (to be given to young people for financing their early adulthood years) in order to equalise the opportunities on entering adulthood. The funding could be through unchanged mandatory levies or else by an increase, in particular in the taxation on inheritance, donations, and successions. Another proposal aims to reorient the redistribution, also through an amount of capital being set aside. It would suffice to invest the amount of capital and to use the monthly interest to transform the system into a universal basic income. Finally, a last family consists in replacing the Welfare State with individual management of the capital set aside.

According to Julien Damon, the universal basic income should be understood as a structural philosophical revolution. Its legitimacy does not only come from the will to address poverty better and to simplify social assistance. The argument is also based on political philosophy. The justification for a universal basic income always involves the idea of distributing a dividend from the wealth produced by humanity and of securing an income for all citizens.

Key question for the future 3. **How will labour law change?**

The observation that we are moving towards a multiplicity of forms of employment (even if that increase in their diversity is only relative, as indicated above) raises the question of whether or not the law is suited to that diversity.

IT'S ALREADY TOMORROW

The debates also concern the degree of freedom granted by the law to the social partners for defining the work forms that are suited both to the needs of the economy and to the needs of employees. In this field, the changes initiated by the "*loi El Khomri*" (law named after the then Minister for Labour in France) are intended to increase the flexibility and adaptability of the rules with the aim of making the labour market more fluid and of reducing unemployment. That recent law (also known as the "*loi Travail*") is a long way from closing this chapter that very much involves the question of how France is integrated into a globalised economy. Some economic players point to the difficulty of remaining qualified in a country where the regulations are more stringent (and less legible) than elsewhere.

¹¹ – Julien Damon, Associate Professor at the Paris Institute of Political Studies, founding manager of the consultancy and studies company Eclairs, scientific advisor of Futuribles International.

¹² – <https://www.futuribles.com/fr/document/revenu-universel-actualites-orientations-plausibil/>

The debates relate in particular to keeping the full-time indefinite-term contract as the "normal" reference for salaried employment. Some defend this idea by arguing that it is necessary to have a frame of reference that limits atypical forms of employment that are designed as second-class jobs.

Others argue in favour of greater flexibility and of less red tape by defending the development of a single employment contract.

Key question for the future 4. **Will we all be self-employed with more than one job?**¹³

Analysis of the figures on self-employment (see above) gives scope for different interpretations: some highlight the boom in work forms that are more in step with the post-industrial society, while for others self-employment has served as an adjustment variable for outsourcing jobs in large companies and administrations. "Small jobs" that do not interest companies are delegated to self-employed workers (including via platforms run by companies like Uber). In any event, technologies, in particular the development of collaborative platforms, have facilitated these activities and have put workers into contact with companies, consumers, and other self-employed workers.

On an economic level, diversification in the service supply through the development of self-employment is accompanied by a major uncertainty: does it, in particular through lower prices, result in higher demand and thus to a growth in the potential market? Does it result in a redistribution of jobs (from companies to self-employed workers) without any overall change in the volume of work? Non-salaried jobs can compete with salaried jobs, but also with one another (as applies to taxis) and creating a new status can therefore be to the detriment of another status. These forms of work can also call into question services that have hitherto been rendered by unpaid voluntary workers (small services, ride-sharing...) and that, via platforms, can now be paid, but for such low pay that they can encourage the parallel economy (undeclared work).

More profoundly, a major controversy exists today about the future of salaried employment. Some economists (e.g. Jean-Marc Daniel) point to the fact that salaried employment is dated and corresponds to the world of industry and of monopolies that appeared at the end of the nineteenth century. They say that prospective exercises about employment in France that do not announce any radically disruptive change underestimate the scale of the changes in the labour market.

Others point out that self-employment concerns only one in ten of the working population in France and that abusive extrapolations about the end of salaried employment are made on the basis of very recent and minority trends. In particular, they say, the significance of platforms in the development of self-employment is overestimated because they can use different worker statuses, and because legislation could restrict some of their practices.

¹³ – Cécile Désaunay, "Travail indépendant, "freelancisation", "jobbing": mythes, réalités et incertitudes" (Self-employment, "freelancisation", "jobbing": myths, realities, and uncertainties", Note de veille, January 2016, Futuribles International.

Foresight hypotheses and their impacts on occupational safety & health

Technological progress reduces the number of jobs and creates a two-or-more-speed society and a degradation in the situations of a portion of the population

Robotisation and automation have considerably reduced the number of jobs. The remaining ones are firstly highly specialised and highly technological jobs that keep a portion of the population in well paid work, and secondly jobs that have a very low level of qualification, that it is not financially advantageous to automate, that are precarious (often piece-work or task-work), and that are low paid. The number of technicians and semi-skilled workers has fallen considerably.

Although those in highly specialised and high-tech jobs enjoy preferential working conditions and job security, the others are little monitored as regards occupational safety and health, and their low level of training does not give them access to a prevention culture that would encourage them to seek to protect themselves on their own initiative.

The inequalities with regard to employment are widening and a society having (at least) two speeds is being formed:

- reinforcement of two categories of job: on the one hand, highly skilled and qualified jobs, and on the other, unqualified jobs (for tasks that are not automatable or not profitable enough to be automated), to the detriment of medium-qualification jobs, which will be totally automated;
- tendency for career lengths to shorten, with entry into the working world being delayed by studying and by unemployment, and careers often ending early due to redundancy even though the legislation is gradually putting back the retirement age;
- differentiation of access to employment depending on age: employability would be maximum for the population between the ages of 30 and 50, trained and already experienced, in good health; before the age of 30, access to the working world would be through successions of work placements or internships, temporary jobs and fixed-term contract jobs interspersed with periods of unemployment; at the other end of working life, employment would become uncertain, with companies being reticent to pay employees more because of their age, since their experience is not sufficient to offset possible lack of training for keeping up with technological change, or degradation in their health (due to the intensity of the work and to the retirement age being put back); which means the people rejected from stable employment are side-lined and put into situations of precarity;
- reinforcement of discriminations on a very depressed labour market, leading to exclusion of a certain number of people who are not "well-adapted" enough and available enough; and
- gap between people who are well trained in specialities that are in demand, and who are capable of setting up in self-employment and of providing their services contractually, and people who do not have the sought-after skills.

Staff turnover is increasing in parallel with technological change, in a working world seeking immediate profitability. Workers drop out of the working world if they do not keep up their skill levels and their employability or if they are prematurely worn out.

Since training – including in safety – is left to the initiative and to the expense of each worker except for a small fringe of the working population who work for large organisations, it becomes piecemeal and random.

The public authorities no longer have the financial capacity or the will to maintain the social protection that existed in the second half of the twentieth century.

In addition, in this hypothesis, the state of health of the population deteriorates, which has consequences on the labour market, because companies find it hard to recruit employees with the skills they need.

Transformation of forms of employment is accompanied by appropriate measures for maintaining health & safety and economic dynamism

In 2040, most jobs are done remotely, and most often by lone workers, except for some of the jobs in the healthcare and personal care and assistance sector (but the boom in keeping elderly people in their homes rather than sending them into care and the boom in home health care have generated numerous nomadic jobs). More than half of the workers are self-employed and work through short assignments and commercial contracts.

A legislative and regulatory framework has been established by the public authorities so that the entitlements of each worker are counted and traced regardless of the jobs they hold, of the job statuses (salaried, or self-employed, or some other status, e.g. unpaid voluntary time or family work), of the durations of the jobs, and of whether or not they are held simultaneously. Occupational Safety and Health (OSH) and lifelong training are planned and taken into account in the monitoring. (Creation of the personal activity account (*compte personnel d'activité*) that keeps track of each worker's entitlements as their career progresses is a step in this direction.)

To fund social protection and to harmonise it for all categories of worker (in particular for harmonising self-employed, tradesperson, and auto-entrepreneur social contributions), in a roboticised world, the social contributions are no longer based on salaries but rather on the added value created, or indeed on machines.

Since bringing together and retaining the best skills is vital for competitiveness, companies invest massively in training, including in OSH training. The national economy is reinforced and funding is secured both for social protection and for the training policy.

The State supports this approach by overseeing and funding "flexicurity"¹⁴.

¹⁴ – Danish-style flexicurity is also characterised by the possibility of access to training that proves to be effective in terms of learning how to do different, well-paid, job after being made redundant. Indeed, it is this capacity to give jobs back to workers who have lost theirs that has constituted a decisive argument in winning acceptance by union organisations.

Technological changes and transformation of forms of employment are accompanied by disengagement by the State, which merely provides a minimal income

The independence and the multiplicity of the contracts does not make regular monitoring possible. The State leaves it up to everyone to choose how to construct their own career paths depending on opportunities, and to take care of their own health and safety.

Various propositions are being made and experiments conducted in various countries on different bases (minimal or substantial income), replacing or not replacing social protection, pensions, etc. Its feasibility is not clearly established.

In conclusion

Many jobs, in particular in the personal care and assistance sector, in which accident rates are very high, require professionalisation for combating the risks. How can such professionalisation be achieved?

How will it be possible to monitor and track appearance of new risks in small organisations with no OSH skills, or for self-employed workers?

Ultimately, employment evolving towards a multiplicity of statuses and their juxtaposition can significantly increase occupational risks.

A fictional scenario: a day in the life of Polly Semy

When she started her working day, on the 29th of February 2040, Polly Semy did not yet know what she would be doing in the afternoon. In the meantime, she had plenty to do. After leaving her daughter with her neighbour, who took all the children from her apartment block to school, she switched on her computer to check her emails. Her employer, At Your Service, had left four pages of description about its new customised trainers (sneakers) to be translated from French to Russian so that it could be posted on line the next morning on the screens of all of its outlets in Russia, and so that orders could be taken for them immediately for delivery 48 hours later. She began work immediately, glad once again to have this job on an indefinite-term employment contract, even though she did not know in advance how many hours she would have to devote to it in any one month – from zero to 180 hours. Her employer did not have to look for a translator when he needed one and she could count on her social security (national health insurance) coverage when her respiratory allergies forced her to consult a doctor and to buy medication. She was therefore very keen to show she was totally reliable.

Four hours later, Polly texted the local bar to order a burger and a coke and started looking for a few hours work for the afternoon. It was her turn to take the children home from school, and

so she took a delivery round of parcels to be delivered in the neighbourhood with her car. By calculating her route from the warehouse, she could deliver the parcels and do her own shopping before the end of the school day, and, according to her calculation, if all went well, what she earned would pay for her fuel and her shopping. Someone was at the door. She hurried to open it and take delivery of her lunch, and then to fill in the satisfaction questionnaire immediately on the order website to indicate what she thought of the quality of the delivery: each "like" within 20 seconds earned her points to be deducted from her next order and could even be supplemented by likes from the delivery people if everything went well.

Before leaving her apartment, Polly wrote a few lines on the neighbourhood website to report that the tomatoes in the shared garden that she had watered and tended were ripe for picking. She also gave her opinion on the quality of the refuse collection during the week and pointed out the need to add a new compost bin to cope with the success of the first one that had become insufficient, and some advice for using it. She proposed her services. Her contribution earned her points that she intended to use for providing assistance and care for her parents, who now needed professional caregivers.

During her delivery round, she came across an advert: a place was going to be available in the neighbourhood's co-working space. She texted immediately to register, because she felt a need to work with other people, so as to enrich the way she translated, and perhaps find some clients to supplement her permanent job, and above all so as to feel the "spirit of the time" or "zeitgeist": on what projects are the others working?

After evening dinner, she hesitated between watching *Grease*, on her wall, an old film that she loved and wanted to share with her daughter, and being sensible: she had enrolled in a MOOC for improving her knowledge of computer-assisted repair of robots, essential to find a new job, because she knew her job as a translator was threatened by automated translations. Indeed, English had become so widespread that only a few countries not yet sufficiently developed needed translation services. For a moment, she wondered for how long she would be able to use her training once it had been validated. It was not her first qualification. The first further/lifelong training had been proposed by her employer at the time, during her working hours. But since the instigation of the universal basic income, everyone had to make sure they kept themselves employable, so as to be able to top up their minimal basic income, and, in her case, to pay for supplementary lessons for her daughter.

Before going to bed, she had the surprise of finding an email from her employer informing her that she was going to receive an inspection visit the next day to check her installation, since remote inspections were insufficient to secure the entitlement to pay reduced social contributions for employees working at/from home. She hurriedly put away the ironing board and the clothes drier, and set up a little office corner in her living room. She would then merely have to fold away the sofa bed in the morning. She was glad to have the prospect of a place in the co-working space. She really needed a change of scene. But would she find enough work to pay for it, while she also needed to make progress with her training? And it was out of the question to look for a job in the city and have to put up with 4 hours of commuting every day. She preferred to devote that time to her family and her elderly parents whose pensions had become ever smaller over the years and who had to count on help from their daughter and their neighbours.

The background is a solid orange color. It features several abstract yellow line art elements. At the top, a horizontal line extends from the right edge, with a small circle at its end. This line then turns 90 degrees down and then 90 degrees left. On the left side, a vertical line descends from the top, with a small circle at its end. This line then turns 90 degrees left and then 90 degrees down. At the bottom, a horizontal line extends from the left edge, with a small circle at its end. This line then turns 90 degrees up and then 90 degrees right. On the right side, a vertical line descends from the top, with a small circle at its end. This line then turns 90 degrees left and then 90 degrees down. At the bottom, a horizontal line extends from the right edge, with a small circle at its end. This line then turns 90 degrees up and then 90 degrees left. There are also several larger circles scattered throughout the design, some connected to lines and some not.

Issue 5

HOW WILL PRESCRIPTION OF WORK AND PACE OF WORK CHANGE?

What are we talking about?

During the retrospective study for this prospective exercise, acceleration of the intensification of work was cited by all of the participants as a major characteristic of the last twenty-five years.

The term "intensification" is used to mean "over-mobilisation" of the physical and mental capacities for doing the job, and for meeting time constraints, production objectives, delivery deadlines, etc. All that in a context of constant staff reductions.

Numerous factors have contributed to this acceleration, in particular the quest for rationalising production processes so as to improve profitability and competitiveness, or the increase in the quantity of information and the ease with which it can now circulate.

What are we observing?

1. The organisational constraints have systematically increased over the years and reduced worker autonomy at all levels of qualification¹.

The physical constraints and strains have significantly decreased – physical arduousness has been reduced even though numerous workers remain exposed to physical hardship factors – but the psychological constraints and strains have increased. The visible upsurge in psychosocial risks (PSRs) bears witness to this.

2. In a globalised economy and in a context of recession or at least of economic slowdown, competition is exacerbated. Reducing costs remains a priority for most companies.

In particular, this involves increased monitoring of operations and of deadlines, which is facilitated by strict procedures that subdivide work into sequences, or indeed into actions or gestures. Digital technology makes it possible to achieve continuous monitoring and almost instant data interchange, both of which are steps in this same direction.

Taylorism and its more modern forms, Toyotism, lean management, etc., are work organisation systems that are very much present in France; after falling off, the trend is once again for the number of employees working under such organisation types to be increasing².

1 – Cf. *les enquêtes Conditions de travail* (the working conditions surveys). Dares.

• *Conditions de travail. Reprise de l'intensification du travail chez les salariés.* (Working Conditions. Upturn in Intensification of work among employees). Dares Analyses July 2014. <http://dares.travail-emploi.gouv.fr/IMG/pdf/2014-049.pdf>

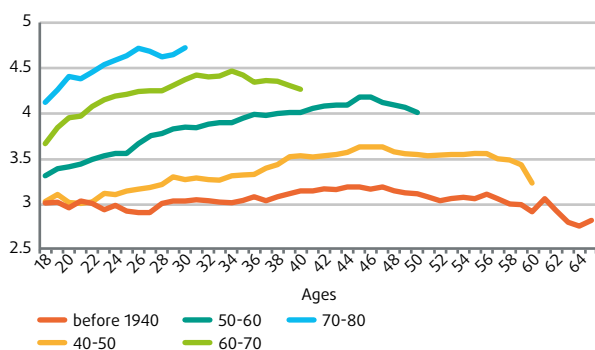
• *Autonomie dans le travail.* (Autonomy at Work.) *Enquêtes Conditions de travail.* (Working conditions surveys.) Élisabeth Alga, Lydie Vinck. Synthèse. Stat' No. 16 October 2015. http://dares.travail-emploi.gouv.fr/IMG/pdf/synthese_stat_no_16_-_autonomie_dans_le_travail.pdf

• *Les expositions aux risques professionnels. Les contraintes organisationnelles et relationnelles.* (Exposure to occupational risks. Organisational and relational constraints.) *Enquête Sumer 2010* (Sumer Survey 2010). Lydie Vinck. Synthèse. Stat' No. 7 August 2014. http://travail-emploi.gouv.fr/IMG/pdf/Synthese_Stat_no_7.pdf

• *Les facteurs psychosociaux au travail* (Psychosocial factors at work). Dares, May 2008, No. 22-1. <http://travail-emploi.gouv.fr/IMG/pdf/questionnaire-dares-karasek.pdf>

2 – Michel Freyssinet, *Un exemple chez Renault : Nombre et pourcentage d'ouvriers et d'ouvrières travaillant à la chaîne chez Renault, 1978-2014* (An example at Renault: Number and percentage of production-line workers at Renault, 1978-2014.) In *Vers une théorisation des rapports sociaux* (Towards theorisation of industrial relations). CNRS.

Figure 1. Organisational constraint scores in career paths by generation



Source: Dares, Drees, *enquête SIP*, 2007 (health and career path survey).

For each generation, the organisational constraint score reflects the answers of the people questioned retrospectively on their working conditions during their career path.

The generation born before 1940 describes constraints that were not very intense and that were stable over the years, whereas recent generations report higher constraints that increase with age up to the age of 40. The constraints described are: working "under pressure", night work, lack of autonomy, poor working relations, and difficulties of reconciling work with family life, i.e. of finding a good work-life balance.

Originally the prerogative of industry, this type of organisation has spread to services, which are increasingly automated and dematerialised (except in sectors where human presence is still essential, such as personal services and personal care services, in particular for children, sick people, etc.).

3. At the same time, robotisation and automation, while making the physical work lighter, have often led to increased pace of work and increased risks, in particular musculoskeletal disorder (MSD) risks, plus PSRs. Humans have to keep up with the pace of the machine or of the automated system.

4. Digital tools accelerate and increase communications flows, exchanges of information, documents or ideas, regardless of locations and of distances between people. They offer new possibilities but they also bring constraints.

5. The new forms of work, which are more individualised, are also work intensification factors:

- in a company, computerisation implies monitoring at all stages of the processes, and management by objectives generates individualisation of the objectives and of assessment;
- poly-activity, either in one job or through holding several jobs at the same time, generates significant increases in workload and in pressure for coping with the complexity; and
- outsourcing numerous activities (from maintenance to cleaning and to administrative functions such as payroll) through commercial contracts can increase the pressure from the instructing company on subcontractors who want to win the contracts, and therefore weigh on the working conditions of the employees of such subcontracting companies; the imbalance that can be created in commercial negotiations can be even stronger for self-employed workers and auto-entrepreneurs.

6. Self-employed work, be it chosen or endured through lack of anything better (to break out of unemployment or precarity), is no guarantee of working less or in a more relaxed way; this type of work can be highly prescribed and intense; prospecting for customers, uncertainty about the future and pressure to respond quickly to the requirements of the customer can, in addition to lengthening the working hours, be stress factors.

7. Giving priority to the quality of the service given to the customer may, if it is based on the possibility of doing quality work, be a source of satisfaction for the worker, but may also reinforce discontent at work when the necessary resources are not available.

8. A corollary of individualisation of work is dilution of work groups and teams (see section "Towards a multiplicity of work forms") and thus reduction in support between employees (or at least a change in the modes of support) and less defence of the collective interests. Demand for autonomy by workers is often accompanied by a parallel demand for reinforcement of collaboration.

9. Intensification and continuous monitoring of work leave little room for initiative. Tensions exist between autonomy and prescribed work:

- on the one hand, specialisation and codification of knowledge, determination of precise scripts and protocols for guiding work, continuous search for rationalisation, individual target figures and continuous reporting tend to reduce autonomy or independence, including in highly qualified jobs, and to make work denser and more intense;
- on the other hand, organisational innovations are developing that encourage employees to deploy their creativity and initiative in "learning organisations" or indeed to become involved in "continuous improvement" processes; competitive edge is increasingly reliant on innovation, which, by nature, is not governed by narrow prescription.

Depending on level of qualification and on sector of activity, expectations can be different: autonomy is often the prerogative of the higher levels of qualification, whether such autonomy is a characteristic of their job or whether it is sought by them, e.g. by working in a startup. However, the level of constraint or strain has increased at all levels of qualification, including for executives (see figure 1).

Among the conditions for creativity are time for thinking and exchange, right to make mistakes, autonomy and independence, etc. Creativity, presented as being a precondition for competitiveness, cannot therefore blossom fully in an organisational setup that is too strict, without any room for individuals to manoeuvre.

10. In addition, the progress in productivity gains is slowing down. Intensification is therefore not a source of new productivity gains; rather it would appear to be attempting, in vain, to offset their decline³.

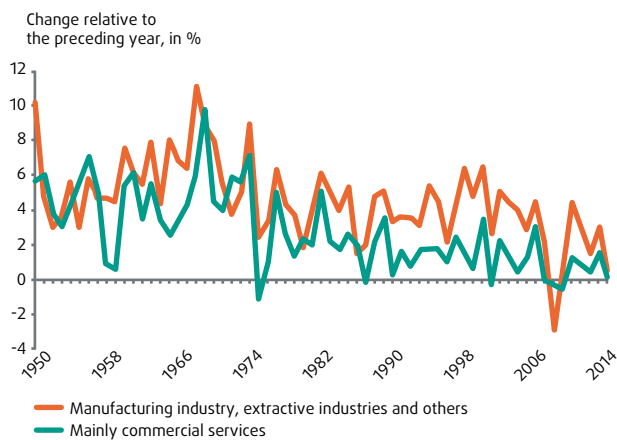
Average growth in labour productivity per hour worked (economy as a whole – in %)

	France	Euro Zone	Germany	Italy	Spain	UK	USA	Japan
1890-2012	2.46	2.48	2.45	2.70	2.34	1.77	2.18	3.07
1890-1913	1.80	1.87	2.28	1.64	1.15	0.71	1.73	2.03
1913-1950	1.52	1.32	0.98	1.82	0.68	1.25	3.00	1.76
1950-1975	4.70	5.32	5.33	6.30	5.62	2.78	2.25	6.65
1975-1995	2.76	2.68	2.45	2.62	3.72	2.55	1.19	3.17
1995-2007	1.59	1.18	1.58	0.71	0.03	2.30	1.89	1.55
2007-2012	0.27	0.30	0.02	-0.32	2.13	-0.35	0.84	0.72

Source: Bergeaud, Cette and Lecet (2013).

3 - Amandine Schreiber and Augustin Vicard. *La tertiarisation de l'économie française et le ralentissement de la productivité entre 1978 et 2008* (Tertiarisation of the French economy and slowdown in productivity from 1978 to 2008). Insee, 2011.

Figure 2. Variation in apparent productivity per hour worked by branch until 2014



Scope: France.
Source: Insee, *comptes nationaux* (national accounts) – base 2010.

New technologies and societal changes bring as many positive possibilities as they do constraints that are difficult for workers to bear. Workers have contradictory expectations for freedom and autonomy but also for prescription and protection in an environment that is often perceived as being unstable or even threatening.

IT'S ALREADY TOMORROW

Recruitment software

At first sight, hiring someone for a job can seem to require skills that only humans have, such as the capacity to interact with applicants socially and to assess the non-verbal dimension of such interaction.

And yet, it is precisely such human skills that are distorted or biased because, often unconsciously, preferences influence the selection of the applicants that have little to do with the actual qualification for the job. For example, it might be social networks or sympathies based on origins or extraprofessional affinities that come into play.

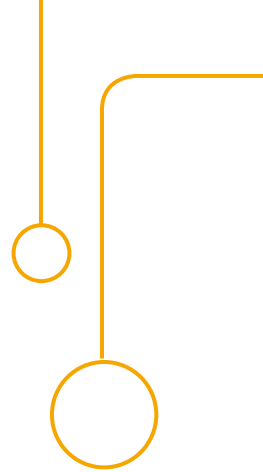
That is why numerous experts agree that the conventional way of looking for a job has broken down, cutting companies off from applicants.

A new wave of startups, like Gild, Entelo, Textio, Doxa or GapJumpers, propose to bring a new approach to recruitment using computing. They use software to select the most appropriate candidates or applicants by means of algorithms; even established headhunting firms like Korn Ferry are starting to implement such procedures.

The data processed by such software includes data freely accessible on websites such as LinkedIn, or even anonymised research data on the conditions of employees in the various departments of the company, and comparing the data makes it possible to find a much wider range of candidates or applicants than conventional recruitment processes.

Other software such as Textio analyses the turns of phrase of the job descriptions to remove any sexual and racial discrimination. For example, military or sporting analogies, such as "critical mission" or "aggressive" in the job description apparently reduces the proportion of female applicants, whereas terms such as "partnership" or "keen to learn" apparently increase that proportion.

However, such algorithms are merely recruitment tools, and although they already enable recruitment to be faster, less expensive and fairer, they do not yet make it possible to replace the human dimension, in particular since, for many recruiters, choosing a candidate or applicant involves criteria similar to those that are involved in a personal relationship.



Foresight hypotheses and their impacts on occupational safety & health

1. The increased intensification of work causes accidents and pathologies (see above) and also premature wear in workers and exclusion from the world of work through lack of jobs adapted to accommodate such workers.

This leads to a society having two or more speeds, between employees in good health with stable full-time jobs and people excluded from the world of work or at the margin of it, living with more or less difficulty with minimal benefits and compensations.

Ultimately, we can imagine that the qualified working population might be insufficient, which will bring a change in the design and the organisation of work and an effort to preserve occupational health. To this end, the second part of the career could be considered from the outset, by means of training, provided that such forward planning does not hold back genuine prevention of risks and of wear.

2. Robotisation is accelerated not only to lighten the tasks but also to avoid the problem of occupational safety and health of the working populations.

The added-value gains are distributed and they serve, in particular, to fund social protection and training. They benefit everyone. The general improvements in health, living conditions and prosperity enable the population to work, to be trained regularly and to consume, sustaining the general well-being.

3. Robotisation is accelerated but, on the contrary, the gains are concentrated in the sectors and in the companies that have managed to benefit fully from automation and who have improved their competitiveness in increasingly competitive markets.

There is a lack of funding for social protection. A two-speed society develops with major pockets of poverty. In the populations that are just about managing to make a living from the "survival economy", or from small jobs, precarity is accompanied by increased occupational risks, with occupational safety and health being "forgotten" because it is considered as being too costly.

4. Work organisation in which the work is overly supervised and performed under pressure leads to harmful effects on the economy (losses of skills, absence of innovation, recession, etc.) to such an extent that companies – with or without encouragement from the State – think about how to change the model radically by calling upon concepts of working together, teamwork, functionality and going back to local. "Liberated" companies, which are the subject of an emerging literature and of reports in the media, appear to be a new response in terms of work organisation.

5. A movement for deglobalisation relieves competition pressure, and a sustainable development model is sought. Increasing production and productivity is no longer an objective, and growth no longer appears as being essential to full employment. Humans return to a central place in companies and in society, as does quality of life.



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