IMPLICATIONS OF THE CIRCULAR ECONOMY AND DIGITAL TRANSITION ON SKILLS AND GREEN JOBS IN THE PLASTICS INDUSTRY

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KEYWORDS

- DIGITALIZATION
- CIRCULAR ECONOMY
- GREEN JOBS
- SKILLS
- COBOTIZATION
- BLOCKCHAIN

Europe's plastics industry employs 1.5 million people and its 60,000 businesses generate revenue of €350 billion. This industry is particularly impacted by the rise of the circular economy and digital transition: in addition to changing businesses' economic models, these developments also bring with them structural and workforce changes that require taking a fresh look at traditional roles and their associated skill sets. Jobs are changing in shape and content, from design to production, all the way to waste recovery. The arrival of cobotization (human-robot collaboration) and blockchain are part of this movement. Businesses and training bodies are adapting their support strategies in response to this phenomenon and growing skills hybridization.

INTRODUCTION

Public policy in recent times has encouraged development of the circular economy as a response to overarching environmental challenges and a promising source of jobs. This paradigm challenges businesses' economic models and initiates concrete changes in actors' uses and practices. Similarly, societies are being swept by digital transition, leading to changes that are sufficiently far-reaching that they require public and private bodies to prepare for changing job roles and the skill sets associated with them. Digitalization opens up new prospects for economic actors of all types in terms of organizational structure, productivity and skilling. Green jobs seem more attractive than ever as they are to be found in promising sectors destined to grow during the decades ahead. This paper seeks to identify interactions between various challenges related to the development of the circular economy, digital transition and changes in skill sets.

THE CIRCULAR ECONOMY AND CAREERS

EMPLOYMENT IN THE CIRCULAR ECONOMY

The circular economy encompasses environmentally focused activities, including remediation, that make a direct contribution to protecting the environment and sustainably managing resources, as well as peripheral activities that help to improve environmental quality. Discussions are under way at present into how to draft indicators to assess the circularity of an economy, and one such indicator is employment. This is because a move toward greater circularity can be assessed through examining the number of jobs reassigned from resource-intensive activities to activities that help to reduce resource use[1]. The jobs concerned are those that optimize use of materials (eco-design, recycling, reuse), that permit extended product life cycles (repair and repurpose, functional economy), and those that set up territorially based logistics circuits (industrial ecology, short circuits). An alternative reading distinguishes between green jobs and greening jobs[2]. The former are found in the following sectors: energy, water, sanitation, waste processing, and protection of nature and the environment.

1 Jolly, C. & Douillard, P. (2016) *L'économie circulaire, combien d'emplois ?* [The circular economy, how many jobs?], La Note d'Analyse, April 2016, issue 46. France Stratégie
2 French National Center for Monitoring Green Economy Jobs and Trades (Onemev)

PLASTICS INDUSTRY EMPLOYMENT: KEY FIGURES

Europe produced 64.4 million metric tons of plastic in 2017, generating revenue of €350 billion. Some 60,000 businesses employ 1.5 million people.
In 2016, the volume of plastic recycled in Europe exceeded the quantity sent to landfill for the first time. A total of 8.4 million metric tons were recycled, either within Europe or beyond its borders.
The French plastics industry is number six in the world and number two in Europe, behind Germany. In 2018, 3,500 businesses, over 90% of them SMEs, generated revenue of €30.2 billion. Together they employ 122,000 people, mainly in production[3], but with over 7,000 involved in R&D.
In France, the plastics industry, which is structured around 23 processing techniques, struggles to recruit people with the appropriate technical skills. This applies to people with cross-disciplinary skills (logistics) and semi-skilled jobs (manual workers) but also, and more acutely, to key specialist roles in the industry: fitters, senior technical sales specialists and plastics fabricators[4]. Faced with this skill shortage, the industry has taken steps to organize training paths leading to a professional qualification certificate (CQP). There are currently 17 training modules that lead to a CQP, covering all primary business functions (design, production and maintenance, sales and back office)[5]. These training offers have to address the challenges facing companies in the industry[6] as well as helping to make the sector more attractive.

3 https://www.laplasturgie.fr/chiffres-cles-en-france-et-en-regions/
4 Observatoire de la plasturgie (2017) *Besoins de main-d'œuvre et offres d'emploi dans la plasturgie.* Année 2017
5 https://cqp-plasturgie.fr/
6 DEFI & Observatoire de la plasturgie (2017) *Etude sur l'évolution des compétences nécessaires aux entreprises et actualisation des fiches métiers cœur.* [Study of the changes in skilling needed by business and updating core role descriptions]

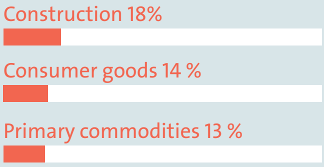
PLASTICS INDUSTRY EMPLOYMENT IN FRANCE: KEY FIGURES

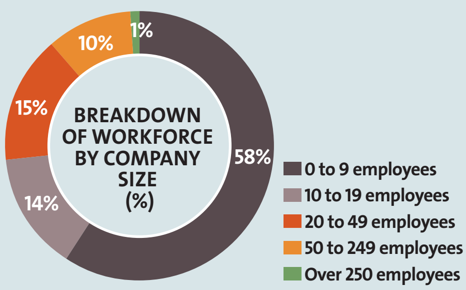
30.2
bn euros in revenue

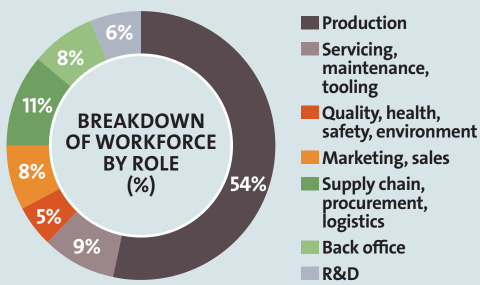
3,500
businesses

122,000
employees

PLASTICS INDUSTRY TOP 3 CUSTOMER MARKETS
(as total % of intermediate uses of plastics industry products)







Source: www.laplasturgie.fr

In other sectors, greening occupations include new skill sets to take account of environmental aspects. The green economy comprises green jobs and greening jobs, and in France these represented 3.7 million jobs between 2010 and 2014[7], or 14.6% of all of the country's jobs. The core of the circular economy comprises green activities, hiring, repairing and reusing or repurposing, and is estimated to number 800,000 FTE jobs.

Based on job creation patterns in waste management, ADEME (the French Agency for the Environment and Energy Management) judges that, on average, processing 10,000 metric tons of waste leads to the creation of one FTE when sent to landfill, three to four FTE when recovered by incineration, composting or methanation, 11 FTE when taken to a sorting center, and 50 FTE when complex end-of-life products are disassembled[8].

CIRCULAR ECONOMY: A SYSTEMIC VISION OF FLOWS THAT ALTERS THE VALUE PROPOSITION

For a business, a circular economy approach implies adopting a systemic vision of energy and raw material flows that must be closed, either internally or with the help of partners. This alters the company's value proposition and encourages it to examine other possibilities: extending operational lifespan, repair, repurpose or remanufacture. This also modifies elements of the business model: resources, skills, internal organization, value network, revenue flows and cost structure[9].

The circular economy stimulates servitization (transition from a supply of product to a provision of service) and the functional economy. Product-service systems (PSS) that deliver economic and environmental benefits also alter the structure of the value generated[10]. Once this occurs, value management skills become central. Product-oriented PSS add services such as maintenance or buyback to the product sold. This is a sales-based model that generates limited environmental benefits. Use-oriented PSS make the product available to the customer, who is then billed for each use (hires, shares, pooling)[11]. This can be used for products as common as vehicle tires. As part of its digitalization strategy, Michelin recently launched a tire hire product paired with connected services. This form of PSS tends to be disseminated via an ecosystem of associated services. For example, car-sharing leads insurers to offer per-journey contracts. The owner of a good is incentivized to organize its circularity by lengthening the time it is in use and extending its lifespan. Lastly, a result-oriented PSS makes it possible to levy a charge if the result (generally how an installation performs) conforms to the contract. This form of PSS, centered on meeting customers' needs and satisfying them, would appear to be the most eco-efficient[12].

The circular economy is characterized by creating flow loops. The closed cradle-to-cradle loop appears to be the ideal scenario, requiring cooperation and involvement from consumers and local government. For example, digital apps allow people to hand over their empty plastic bottles at recycling centers in return for secure tokens that can then be used to pay for purchases or phone plans[13]. Other projects are also breathing new life into the long-established deposit model by monetizing savings made in carbon footprints[14]. The rise of waste exchanges via digital platforms facilitates circulation of information and exchanges of materials. These services make it far cheaper for users to search for what they want, and create lower recovery and transportation costs for those generating and collecting the waste. This is a clear example of how the circular economy, delivered via digital tech, extends possibilities for sharing value.

Apps can also change how people behave. Smartphone chatbots can guide consumers to improve their waste sorting practices[15]. Virtual reality animations can help consumers gain a better understanding of certain environments[16]. These customer relational mechanisms demand skills in artificial intelligence as well as communications, skills that local government is increasingly deciding to dedicate to waste management processing.

Moving to circular economy practices forces businesses to look again at internal organizational structures. They have to adapt to the digital transition, which modifies the shape of roles and the skills needed to perform them.

DIGITAL TRANSITION AND EMPLOYMENT IN THE CIRCULAR ECONOMY

IMPACTS OF DIGITAL TRANSITION ON ORGANIZATIONS AND SKILLS

Analyses of the impacts of digital and green transitions differ according to whether the focus is on new technologies or on demand-side changes. If we assume a scenario where new technologies accelerate their penetration into businesses (Artificial Intelligence, big data, cloud, Internet of Things, emerging web-enabled markets)[17], we will see major changes in the division of work between machines

7 Commissioner-General for Sustainable Development (2015); Onemev 2014 activity report. February 2015

8 Bibliographic review: *Quel potentiel d'emplois pour une économie circulaire?*,[Job creation potential of the circular economy], Institut de l'économie circulaire, 2015

9 Peillon, S. (2017). *Les systèmes produit-service conduisent-ils à des business models plus durables*? [Do product-service systems lead to more durable business models?], 26th International Conference on Strategic Management. June 2017

10 Antheaume, N., & Boldrini, J. C. (2017). *La convergence entre gain économique et gain écologique en économie circulaire. L›expérimentation d›une innovation environnementale dans le maraîchage nantais*. [Convergence between economic and ecological gains in the circular economy. An experimental environmental innovation in market-gardening in Nantes], LEMNA. Working document 2017/04

11 Boldrini, J.C. (2016) *Le management par la valeur : une méthode pour concevoir les systèmes produit-service de l'économie circulaire* ? [Value management: a method for designing product-service systems for the circular economy?], ACFAS 2016

12 Dahmani, S. (2015). *Proposition d'un cadre méthodologique pour la gestion du processus de servicisation en entreprise industrielle: approche basée sur les risques décisionnels* [Proposition for a methodological framework for managing the servitization process in a manufacturing company: an approach based on decisional risks], thesis, Saint-Etienne, EMSE.

13 https://www.forbes.fr/technologie/comment-la-blockchain-peut-elle-lutter-contre-les-dechets-plastiques/?cn-reloaded=1

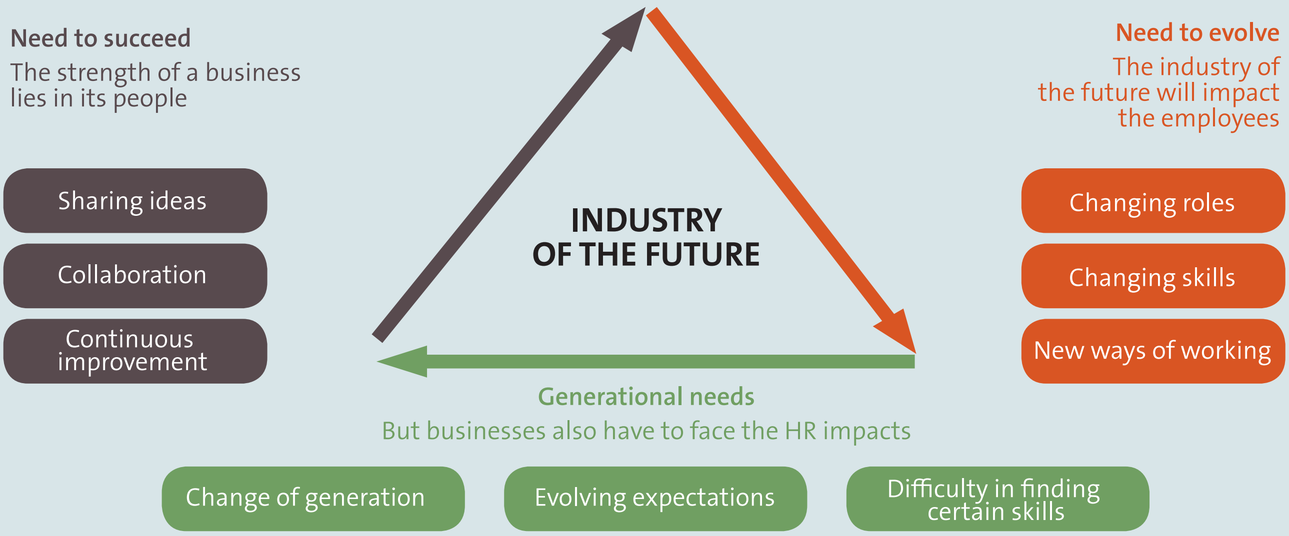
14 https://www.consoglobe.com/recycletocoin-appli-blockchain-plastique-oceans-cg

15 SMICVAL (2018) Annual report 2017

16 https://www.eco-mobilier.fr/vivre-lexperience-du-recyclage-en-realite-virtuelle/

17 World Economic Forum (2018) The Future of Jobs Report 2018

People at the heart of digital transformation



Transformation and HR challenges: change of generations, new attitudes to work (flexibility, mobility, work-life balance, quest for meaning), more third-party colleagues, need for specific skills, recruitment difficulties (industry attracting fewer new graduates).

Source: French plastics and composites industry federation

and people. Archetypally human activities – such as communication and interaction, development, supervision, consultancy, reasoned argument and decision-making – will be increasingly automated and reliant on algorithms. In the French case, this can be relativized as digitalization of the productive fabric appears to be taking place at a slower rate than in other countries[18].

For French companies[19], changes instigated by these two types of transition will be felt more in terms of transformation of tasks and skills[20] or impacts on roles and activities, rather than in the appearance of new green occupations (Figure p. 104).

DESIGN

Eco-design presupposes a life cycle analysis involving every function of the business, and will generally also reach out to external stakeholders such as suppliers, transporters and users. The circular economy reshuffles the pack, fostering the emergence of new vocations and alliances. Experiments have been run using building information modeling (BIM) to include end-of-life management and recyclability of construction materials. This means that traditional design engineering firms are integrating material recycling criteria in collaboration with property developers, and are also moving to digital platforms.

18 Gaglio C. & Guillou, S. (2018) *Le Tissu Productif Numérique en France* [France's Productive Digital Fabric], OFCE Policy brief 36, July 12.

19 MEDEF (2017)

20 Marin, G., & Vona, F. (2018). *Climate policies and skill-biased employment dynamics: evidence from EU countries* (No. 2018-23). Observatoire Francais des Conjonctures Economiques (OFCE).

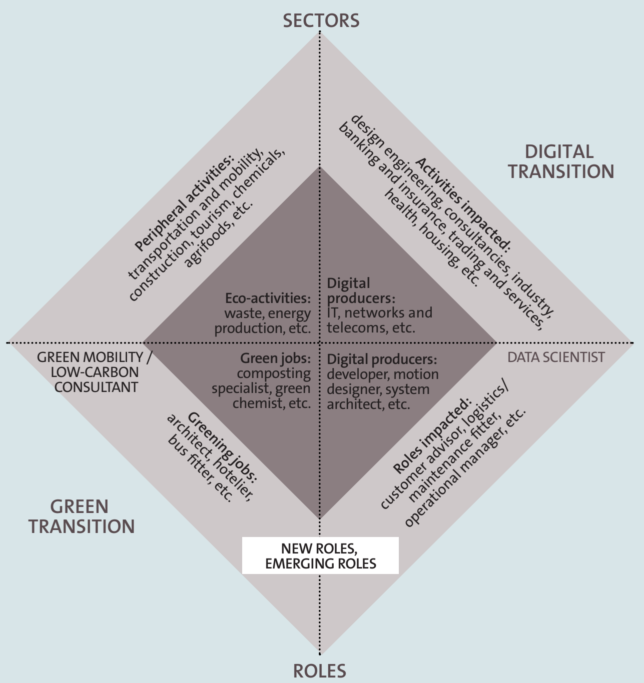
As part of strategies aiming to improve efficient use of materials, functions such as management, design engineering, R&D and design play key roles at this early stage in helping industrial processes to evolve – incorporating recycled material into a production process is no simple affair. The material must meet the user's specifications for its industrial process, but in the case of an open loop it must also meet the needs of the new user market; all of this represents multiple upstream constraints. The example of plastics is illustrative of the knowledge needed to characterize and then process different resins. A range of different skills are needed to find applications, determine compatibility (anything from vehicles to food packaging to construction) and obtain the necessary approvals from certifying bodies. Bioplastics require collaboration between experts in chemistry, biotechnologies and electronics. These same skills also make it possible to find downstream recycling solutions for the material.

COBOTIZATION

Whereas automation supposes a transfer of knowledge and expertise from operator to system, cobotics provide operators with assistance from a robot they can interact with. Today, this involves pooling skill sets between people and machines. Applications include tele-operation (remote collaboration), collaborative co-presence (human and robot share a workspace), co-manipulation (the operator directly manipulates the robot to accomplish a task, for example, providing greater force for handling heavier loads), or even exo-manipulation (a human wears an exoskeleton that reduces efforts required but provides no directional guidance). The challenge of tele-operation lies in the way that operators at the controls perceive the task performed by the robot[21]. At a waste sorting center, tele-operated sorting enables operators to work from a touch-screen in a cabin, away from the sorting belt, after an initial fully automated sorting operation. Sorting waste such as plastic bags still demands a combination of a three-step process: hand sorting for large film plastic, ballistic separator for other films, and a final optical sorting. The impact this has on workstations has yet to be studied in detail, and there remain unanswered questions for specialists in ergonomics in terms of the physical constraints on operators, particularly regarding exoskeletons.

21 Moulières-Seban, T., Bitonneau, D., Thibault, J. F., Salotti, J., & Claverie, B. (2016). Cobotics: an emerging cross-disciplinary domain of interest to ergonomics, Congress of the French-Language Society of Ergonomics.

Sectors and roles in France most impacted by green and digital transitions



Source: MEDEF, 2017

LOW-TECH ANSWERS TO DIGITAL LIMITATIONS

Automation can be limited by the complexity of certain tasks. In several recycling processes, operators performing hand sorting become more efficient than the machines. For textiles, the first sorters were women, who were accustomed to assessing the quality of a fabric and the degree of wear in an item of clothing. As with plastics (box on this page), hands and eyes sometimes remain the best tools for abstracting recoverables from an input, as well as adapting easily to the variability of situations.

LOW-TECH SOLUTIONS ARE THE MOST EFFICIENT FOR SORTING PLASTICS

Several years ago Actes, a disability-friendly company operating in Bordeaux and the Basque country (France), began to diversify the range of materials it recycles, and it now also processes disposable plastic cups made from polystyrene and polypropylene. A manual pre-sort and material separation process using buoyancy was designed in collaboration with the University of Bordeaux. The company boss was trying to create as many manual jobs as possible, seeking to turn on its head the industry's rush to automate. He looked at experiences from other material recovery industries, paper in particular, that showed how manual sorting could be more efficient than automated processes.

After a year's training and practice at the sorting table, Franck and François have learned how to tell the difference between polypropylene and polystyrene resins. They look at a number of material properties (color, thickness, texture, breakage patterns) to quickly identify the product being sorted. They work more efficiently than any automated machine and can also sort the polylactic acid (PLA) cups that are increasingly common.

Purity rates can reach 100% when waste producers run pre-sorts correctly. This is the result of an end-to-end approach: sorting and recycling are simply stages in a recovery process for a material that had a very short life. Upstream, the waste producer was well aware of the importance of sorting. Downstream, a simple machine is used to provide plastic pellets to traders. Above all, the machine is also a tool for employee upskilling.

For sorting of plastics, optical recognition still struggles with new bio-sourced materials. Human input is not yet irreplaceable, and a number of secondary manual sorting posts remain[22].

BLOCKCHAIN

Of the many technologies emerging in the industry, blockchain is emblematic of digital transformations and the rise of the circular economy. This certification system by a virtual third-party[23] runs the risk of being disruptive to certain sectors of activity[24], in particular to those whose activity is based in some way on certified services or traceable products (energy suppliers, extractive industries, recyclers). Large numbers of trials are running to test these

22 http://www.smitred.com/fr/content/le-tri-optique

23 https://www.industrie-techno.com/les-promesses-de-la-blockchain-pour-l-industrie.49239

24 https://blog.d2si.io/2017/06/01/competences-metiers-blockchain/

markets, a process that requires businesses to integrate strategy, marketing, sales and technical skills[25]. This is about appropriating the technology and identifying the challenges: avoiding disintermediation in your own market and identifying new uses. For example, an energy generator must be able to pick up on emerging practices encouraged by a secure and transparent technology (consum'actors, arrival of small suppliers)[26]. In terms of recycling, blockchain can enable real-time trust and reputation systems[27].

Blockchains use existing skills (coding, security, network management) to deliver new applications. Data engineers, distributed register architects and specialist project leaders are the new figures leading this transformation. Distributed register architects play a key role, ensuring that the client's demands are properly translated into uses of blockchain. This is a skill that remains relatively rare.

Setting up a blockchain in recycling also requires suitable logistics, which is something that ties together the sector's traditional roles with the new uses (tracking the filling of containers and optimizing collection rounds, identification of waste and traceability)[28]. Logistics roles become levers for improving the environmental performance of the recycling chain. Today we still find that 25% of journey distances are run by heavy vehicles that return empty. Haulers and logistics chain designers need to deliver improvements in terms of pooling[29]. The business workplace trainer teaches drivers to drive in a more environmentally friendly way, and might in future be assisted (or maybe competed with) by in-vehicle assistance systems for eco-friendly driving[30]. In reverse logistics systems, the pick-up point becomes the starting point for a new recycling loop. The internet of things makes it possible to collect and prepare recovery processes optimally[31].

It is thought that millions of jobs worldwide will be lost to machines. In 2022, the share of total work hours performed by humans will fall to 58%, with machines performing the other 42%, up from 29% in 2018.

TRAINING CHALLENGES

IMPACTS OF DIGITAL TRANSITION ON SKILLS

The impacts of digital transition are massive and felt across all sectors of the economy. It is thought that millions of jobs worldwide will be lost to machines. In 2022, the share of total work hours performed by humans will fall to 58%, with machines performing the other 42%, up from 29% in 2018. New roles will emerge, more suited to the new division of labor between humans, machines and algorithms: specialists in machine learning and artificial intelligence, big data, experts in automation, data security, customer experience and human-machine interaction, robotics engineers and blockchain specialists. In manufacturing, machines generate vast datasets that are collected, exploited and prepared by engineers for operators. For example, extruders and machines for printing, gluing and spooling plastics can operate continuously while simultaneously generating several gigabytes of data daily, data that will be used for monitoring and predictive maintenance[32].

This will in turn lead to hybridization of skills and roles. Digital skills will find their way into roles that were originally non-scientific (marketing, design, etc.), whereas other technical roles will require additional skills of a more cross-cutting nature (social, creative, etc.)[33]. These mutations, combined with rapid changes of economic models, destabilize skills bases. Businesses can then either adapt via learning and knowledge engineering strategies, or by calling in outside resources via recruiting new permanent staff, temporary staff or freelancers. Such changes demand matched training offers, with some of the skill sets to acquire being spread across very different industries. In the future, advanced engineering schools will embed digital advances within their syllabuses (box p. 107).

Transformations impacting employment types and how they are organized will lead to more frequent changes of job and task. Training methods will also evolve toward a peer-to-peer model, via platforms or augmented reality, allowing people to acquire the skills they need as and when they need them. However, not all employees within an organization will necessarily be treated equally, if only because some will be digital natives and others not. People occupying the most-impacted posts will have the greatest need for upskilling, but they risk being disadvantaged in favor of those occupying roles judged strategically important[34].

25 Charue-Duboc, F., & Gastaldi, L. (2017). *Le pilotage des processus d'innovation amont-Vers de nouvelles modalités de couplage entre technologies et usages* [Upstream management of innovation processes - toward new technology-use pairings], Revue française de gestion, 43(264), 23-42.

26 Stavenhagen, P. (2016) *La blockchain: Une opportunité pour les consommateurs d'énergie ?* [Blockchain: an opportunity for energy consumers?], study for the North Rhine-Westphalia consumers' association, Düsseldorf. July 2016

27 European Parliament resolution on distributed ledger technologies and blockchains: building trust with disintermediation http://www.europarl.europa.eu/sides/getDoc.do?type=MOTION&reference=B8-2018-0397&format=XML&language=EN

28 https://www.infohightech.com/du-diamant-au-recyclage-comment-la-blockchain-peut-conduire-des-entreprises-responsables-et-ethiques/

29 Onemev (2018) Activity Report 2017

30 https://www.bnpparibascardif.com/-/big-data-drives-environmentally-friendly-and-sustainable-transport

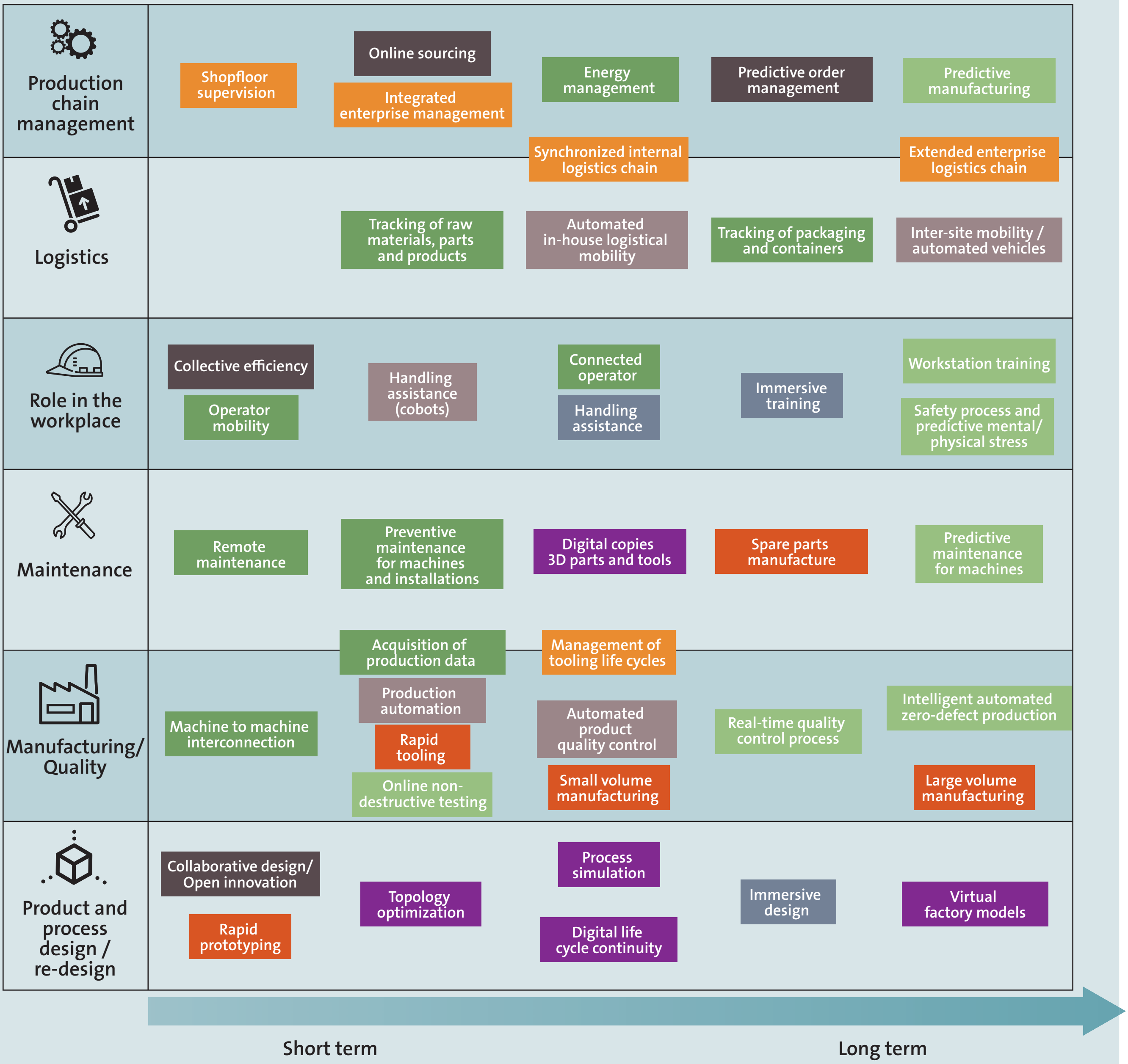
31 https://lesclesdedemain.lemonde.fr/dossiers/dechets-de-l-energie-a-recycler_f-208.html#pdvLcdd

32 learning by experience applied to a machine

33 CEREQ & France STRATEGIE (2017) *Vision prospective partagée des emplois et des compétences. La filière numérique. Rapport du Réseau Emploi Compétences.* [Joint future prospects for jobs and skills. The digital indistry. Réseau Emploi Compétences report], June 2017

34 WEF (2018) The Future of Jobs Report 2018

How plastics industry businesses are being transformed by digital



TECHNOLOGIES FOR THE INDUSTRY OF THE FUTURE

- Digital simulation / 3D
- IoT
- Management tools
- Virtual and augmented reality
- Robotics
- Collaborative tools
- Additive manufacturing
- Big data / data analytics

Every business has its own pathway to the future. Digital transition brings multiple opportunities. Businesses will seize those that deliver the most added value to their activity, working in ways that encourage open and collaborative innovation to reach the goal faster.

Source: French plastics and composites industry federation

Virtual reality technology in industry 4.0.

THE IMPACTS ON SKILLS IN THE CIRCULAR ECONOMY

The circular economy stimulates the appearance of new roles, new skills and new combinations of existing know-how[35]. Its activities are more labor-intensive but this should be a transitional situation with the rise of automation and robotization already under way in the waste sector. Job losses at automated sorting centers mainly concern sorting operator posts and are not compensated for by the number of new posts created for technicians[36]. And although the level of educational attainment among people employed in the green economy is trending upward (20% of workers are unqualified, 33% have a basic vocational qualification), climate policies tend to favor qualified professionals and technicians over manual workers. Faced with this phenomenon some employers are adopting upskilling strategies, soft skills included. SMICVAL, a municipal waste treatment authority in southwest France, has upskilled its waste drop-off center staff to become recovery staff with responsibility for sorting, repairing and returning used items to use.[37] Such a move requires the acquisition of a range of human, diagnostic and repair skills, fields that are also promoted by businesses from the social and solidarity economy. SMICVAL achieved a 50% upskilling rate in 2017. In a related domain, ancillary roles such as machinery maintenance could also be developed to allow for operator upskilling. The CNAM, a French high-level engineering school, now includes green jobs among its training offers.

TRAINING IN DESIGN ROLES: FROM CUTTING UP PLASTIC PELLETS TO MODELING THE REAL WORLD

The training for engineers offered at Arts & Métiers Paris Tech reflects the increasing importance of digital. It combines knowledge and understanding of physical phenomena with digital technologies' ability to represent and model those same phenomena. Students work on a digital "reality twin": the virtual component enables them to reproduce part of the real (the physical model), to represent complex systems and run different scenarios. For example, it is possible to change the settings of a motor or machine in operation to observe the resulting changes in physical and virtual behavior. Physical-digital pairing speeds up problem-solving as digital and physical approaches were previously separate.

Teaching methods are inspired by the world of gaming. A computer, mouse, camera (to film reality) and augmented reality goggles (to map data) allow students to step inside the motor, thanks to immersive technologies. These are technologies that are also used in professional environments. The idea is to gain better insights into phenomena, to have inputs about the same representation from several different participants. Skills that were previously exercised separately become complementary in real time. The department of mechanical engineering and design is developing design tools and methods that take account of the phases of a product's life. This whole-life approach makes it possible to run and assess different scenarios for uses and tasks, looking at issues such as the technical, economic and environmental performance of recycling scenarios and making it possible to decide on the best technology mix from a very early stage.

35 Consoli, D., Marin, G., Marzucchi, A., & Vona, F. (2016). *Do green jobs differ from non-green jobs in terms of skills and human capital?* Research Policy, 45(5), 1046-1060.

36 ADEME (2014) *Etude prospective sur la collecte et le tri des déchets d'emballages et de papier dans le service public de gestion des déchets.* [Study of future patterns for collecting and sorting waste packaging and paper in a public waste management service.] May 2014

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