JOBSCAPE RESEARCH – Automotive and Oil & Gas in Romania

Secondary research based on analysis of documents available in the public domain
Lot I Data collection

March 2022

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Content

1 Introduction and objectives 4

2 Automotive industry 6

3 Oil & Gas Industry 3

Introduction and objectives

Introduction and objectives

THE OBJECTIVES

This document has been prepared by KPMG Advisory under the project WorkTransitionCEE, coordinated by Confederatia Patronala Concordia and co-finance by the European Union.

This material is the outcome of the desktop research activity executed during the project, Lot I Data collection.

The objectives of this activity was understanding current perspectives regarding the impact of technology on jobs, with a focus on the Oil&Gas and Automotive industries, based on desktop research of public information.

THE APPROACH

- The research included analysis of documents available in the public domain with regards to the impact of digitalization and automation on jobs and skills.
- The research was conducted based on a set of key themes, as described on the following page.
- **This activity was aimed to be used by the Project team as preliminary documentation for the primary research activities executed during the project (quantitative and qualitative analysis).**

Desktop Research themes

The objective of the Desktop Research is to answer to the following questions, based on the available literature and public Information:

1. **What trends influence the Automotive and Oil & Gas industries?**
2. **What technologies impact the Automotive and Oil & Gas industries?**
3. **What is the estimated impact of automation and digitalization on jobs in Automotive and Oil & Gas industries?**
4. **Which are the declining skills and jobs in the Automotive and Oil & Gas industries?**
5. **Which are the emerging skills and jobs in the Automotive and Oil & Gas industries?**
6. **What are some examples of reskilling plans and strategies in place at company/ national/ regional level to support workforce transition?**

Automotive industry

Key findings – current status of Automotive industry

Key figures prior to Covid-19 pandemic

- In 2017, global employment in the “Motor vehicles, trailers, semi-trailers” sector was estimated at nearly 14 million workers
- Globally, for each direct job created in the automotive industry, four additional jobs are created in another sector
- A study from 2020 shows that in EU, the automotive sector provides direct and indirect jobs to 13.8 million Europeans, representing 6.1% of total EU employment. 2.6 million people work in direct manufacturing of motor vehicles, representing 8.5 % of EU employment in manufacturing.
- The automotive industry plays a major role in the EU economy, accounting for 5% of the EU total value-added and corresponding to about €675 billion in 2019, generating various business services and influencing a vast supply chain.
- The sector is highly innovative as it accounted for 20% of industrial research funding in Europe for 2019
- In 2017, in Romania, 189,669 people were employed in the “motor vehicles, trailers, semi-trailers” sector. Also, direct automotive employment represented 15.3% of total manufacturing jobs

COVID-19 impact

- The automotive industry belongs to the industries hit hardest by COVID-19 during the first wave, with shutdowns of factories in Europe between March and May 2020 for an average of 30 days.
- In the first half of 2020, the EU automotive industry suffered production losses of 3.6 million vehicles, which reflects a loss of €100 billion. Until the end of September 2020, this number increased to over 4 million motor vehicles (22.3% of the EU total production in 2020).
- As of September 2020, the demand for cars in the EU decreased by 28.8% compared to the previous year.
- The pandemic affected more than 1.1 million jobs directly due to shutdowns of factories between March and May 2021.

Source: publicly available information, references listed on pages 28-30

Megatrends and drivers of change

Technological advances	○ ***Advanced manufacturing, smart manufacturing, digitalization:*** automation of production processes, integration of advanced analytics, artificial intelligence, the internet of things, cloud computing, blockchain, cyber-physical systems; high-performance computing (HPC)-powered computer aided design (CAD) and engineering (CAE) software; cloud computing; the Internet of Things; advanced sensor technologies; 3D and 4D printing; industrial robotics; data analytics; machine learning; wireless connectivity that better enables machine-to-machine (M2M) communications ○ ***Digitalization in the automotive value chain:*** Interconnected supply chains; Predictive maintenance of vehicles ○ ***New products and materials:*** Electric vehicles (EVs), Automated vehicles (AVs), New materials ○ **Greater digitalization of manufacturing, encouraged by the increasing use of new technologies such as Internet of Things, cloud computing, Big Data or 3D printing may also lead to a 20% reduction in the total costs of production**
Globalization	○ ***Offshoring and outsourcing*** fundamentally transformed national automotive industries into global networks of design, production and distribution across global supply chains ○ ***Increased competition*** on individual markets ○ Advanced automated production systems in the home countries of OEMs, a trend referred to as ***nearshoring of production***.
Demographics	○ ***Increase in world's population:*** The United Nations forecasts that the world's population will reach 8.5 billion in 2030 and will exceed 9.7 billion by 2050 ○ ***Increase in the size of the global middle class*** from about 3.2 billion in 2018 to 5.4 billion by 2030, leading to increase in automobile ownership
Climate change	○ ***Commitments made by the automotive industry as response to environmental regulations,*** to address climate change and the emissions crisis, including commitments to lower GHG emissions and produce ***zero-emissions vehicles*** (electrification and de-carbonisation of transport) and to increase the reuse of materials and recycling ○ ***A 24% decrease of CO2 emission from automotive manufacturing in Europe*** between 2008 and 2018, due to a shift towards lower-carbon and renewable sources of energy
Urbanization	○ ***New demand for automobiles*** in rapidly growing cities and by 2050, the total distance of urban kilometers travelled is expected to triple ○ ***Increase in urban population***: more than half of the population (55%) now live in urban areas; by 2050, 68% are expected to do so ○ ***Regulation of city transport*** to reduce emissions and traffic congestion

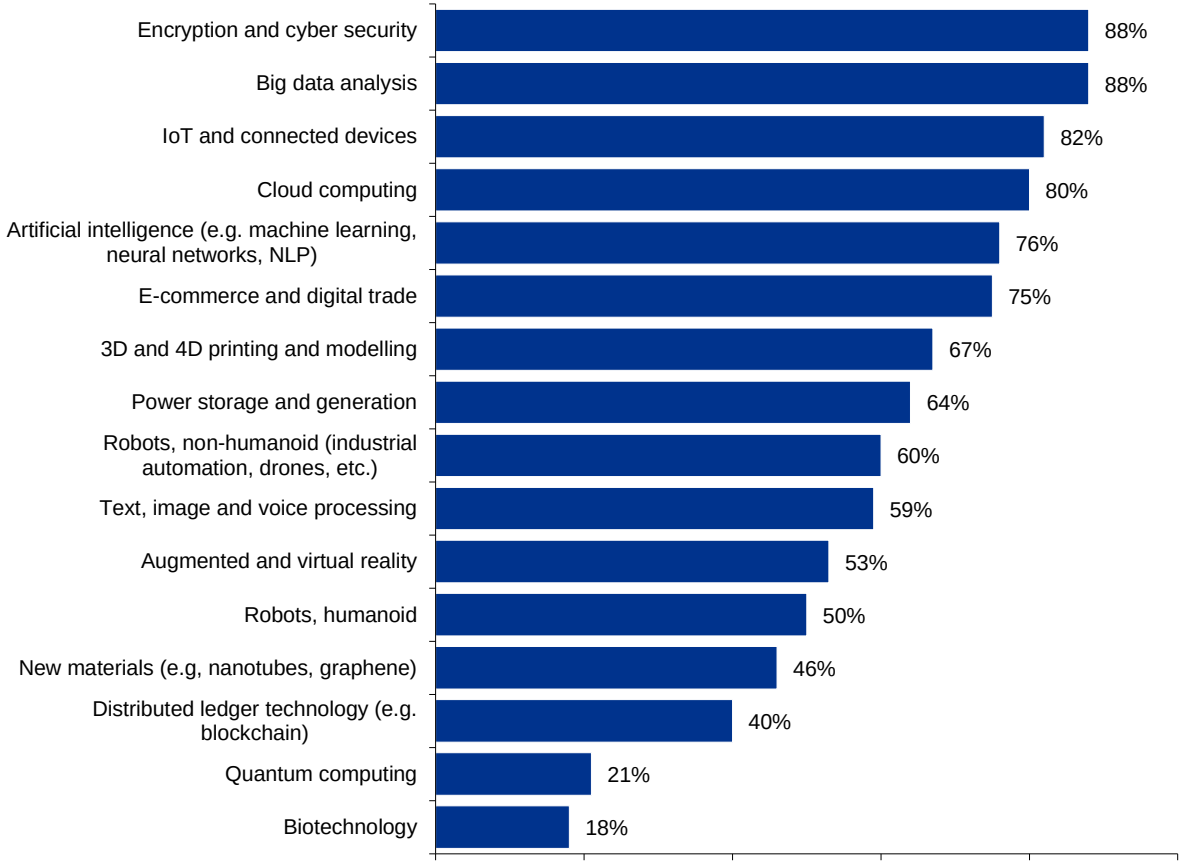
Source: publicly available information, references listed on pages 28-30

Automotive industry – From EACSY to CASE

The car of the future is best described by two acronyms, EASCY and CASE:	
EASCY	○ ***EASCY = The car of the future is electrified, autonomous, shared, connected and yearly updated*** - Electrified: Over 55 % of all new car sales could be fully electrified by 2030 - Autonomous, due to rapid progress made in areas such as artificial intelligence, machine learning and deep neural networks. 40% of the mileage driven in Europe could be covered by autonomous vehicles in 2030. - Shared: sharing concepts will become economically viable with the introduction of autonomous vehicles (on demand" service) based on the concept of "Mobility as a Service" (Maas). Up to one out of ten new cars sold in 2030 may likely be a shared vehicle, which could reduce sales of private-use vehicles. This would mean that more than 30% of distances driven in new cars sold could be from shared mobility. On this trajectory, one out of three new cars sold could potentially be a shared vehicle as soon as 2050.However, due to the Covid-19 pandemic, shared mobility growth is slowing down. - Connected. Connected Car represents two concepts at once. On the one hand, it applies to Car2Car and Car2X communication, which is the networking of the car with other cars or with the transport infrastructure (such as traffic lights). On the other hand, the term also covers the networking of vehicle occupants with the outside world - Yearly updated: the range of models will be updated annually in order to integrate the latest hardware and software developments; the short innovation cycles will enter the market primarily through regular upgrades of shared vehicles.
CASE	○ ***CASE = Connected, Automated, Smart mobility, Electric*** - S for Shared becomes Smart (Mobility), which describes a transportation ecosystem where stakeholders use data and connectivity to move people and goods sustainably and efficiently. Shared mobility remains as a sub-segment in this ecosystem focusing on people transport with passenger vehicles. ○ ***COVID-19 is argued to accelerate and amplify these trends and contribute to affect consumer behavior*** - Connected: Covid-19 digitizes society and increases acceptance and demand for digital and connected services - Automated: Covid-19 modifies competition: Big Tech benefits, asset-heavy OEMs struggle to keep up required R&D invest - Smart Mobility: Covid-19 reverses preference for mobility modes – own vehicles regain preference against shared - Electric: Covid-19 cools down economies, leads governments to subsidize EVs and increase EV market demand

Technologies in the Automotive industry (1/5)

Technology adoption in automotive industry (according to "The Future of Jobs Report 2020", World Economic Forum)



This bar chart represents the share of survey respondents from companies operating in the automotive industry who indicated that, by 2025, their company was "likely" or "very likely" (on a 5-point scale) to have adopted the stated technology as part of its growth strategy.
Source: World Economic Forum, Future of Jobs Report 2020

Technologies in the Automotive industry (2/5)

Industry 4.0	○ **Industry 4.0 brings increased flexibility, quality standards, efficiency, and productivity** - Industry 4.0 includes inventory control and automation, high-performance computing (HPC), powered computer aided design (CAD) and engineering (CAE) software; cloud computing; the Internet of Things; advanced sensor technologies; 3D printing; industrial robotics; data analytics; machine learning; and wireless connectivity that better enables machine-to-machine (M2M) communications - **The implementation of enterprise resource planning (ERP**) systems is a key tool in achieving increased connectivity of production processes such connectivity and this can be taken as an indicator of Industry 4.0 maturity - Industry 4.0 technologies further advance the principles of lean production in the companies adopting them
Digitally Enabled Product Design (CAD, CAE, CAM)	○ **CAD (computer-aided design), CAE (computer-aided engineering), CAM (computer-aided manufacturing)** - Computer-aided design involves creating computer models defined by geometrical parameters, whereas computer-aided manufacturing (CAM) uses geometrical design data to control automated machinery. - The functionality of CAD, CAE, and CAM systems has grown significantly in recent years, and they have become much cheaper, more powerful, more accessible, and easier to use.
High Performance Computing (HPC)	○ **High performance computing (HPC) is the ability to process data and perform complex calculations at high speeds** - As automobiles gain more capabilities and electrification options the computing power to support them is continually growing through high performance computing (HPC) - HPC systems are able to solve complex problems by pooling the computing power of multiple nodes in parallel.
Quantum computing (QC)	○ **By quantum computing (QC), data are "transported", computed, stored dramatically faster than in traditional computing** - Quantum technologies exploit the properties of quantum mechanics and physics to solve complex problems much faster or much better than traditional methods; it can be applied and in combination with other digital technologies
Robotic automation	○ **Key Robot Applications in Automotive Manufacturing:** Robotic Vision, Spot and Arc Welding, Assembly, Painting, Sealing and Coating, Machine Tending and Part Transfer, Materials Removal, Internal Logistics; driverless in-plant transport systems (AGVs - Automated Guided Vehicles) ○ **Cobots** - robots that work independently without humans invading their workspace; handle a large part of the job ○ **Exoskeletons** are robotic suits that can reduce the strain of repetitive tasks for workers ○ **Robot Process Automation:** by implementing RPA, the automobile manufacturer can enhance business value by achieving leaner operations, better inventory control and resource procurement, and improved communication with suppliers and customers ○ Automotive industry is the largest user of robots among manufacturing industries

Source: publicly available information, references listed on pages 28-30

Technologies in the Automotive industry (3/5)

3D and 4D printing	○ **3D printing (or additive manufacturing) helps the automotive industry in three primary ways:** - it enables rapid prototyping with 3D printed models that accelerate the design and testing phases of production. - it allows manufacturers to print spare parts to match their requirements. - additive manufacturing of composite materials leads to automotive parts that are lighter, stronger, and more durable. ○ **4D printing** is a digital manufacturing technology -3D printing- which includes a new dimension: the temporal. This means that the printed material, once ready, will be able to modify, transform or move autonomously due to its intrinsic properties that respond to environmental stimuli.
Augmented Reality (AR) and Virtual Reality (VR)	○ **Wearables, AR and VR** present valuable use cases for quality inspection, work instructions, training, workflow management, operations and safety, logistics and maintenance
Electric Vehicles (Evs)	○ **Electric vehicles (EVs):** - in 2030, EVs will make up 70% all vehicle sales in China, almost 50% in Europe, 37% in Japan, more than 30% in Canada and the United States, 29% in India and 22% in all other countries combined.
Automated Vehicles (Avs)	○ **Automated vehicles (AVs):** - AV technology is being tested in advanced economies, but not yet widespread on the road. - Assisted driving is becoming increasingly common in new models
New materials	○ **New materials:** - Polymers and composite materials (carbon fiber and biosourced materials), nanomaterials, aluminum are lightweight and have increased durability and resistance to impact, extreme heat, cold and other weather conditions, flexibility in terms of the ability to be moulded into complex and elaborate shapes
E-mobility innovations	- Cars that are self-aware and provide a connected platform for new business models. - Vehicles with hundreds of Internet-connected engine control units (ECUs) and sensors, providing data and insights. - The capability to bundle vehicle sales with new subscription-based offerings for parking, electric vehicle (EV) charging, rideshare, and car share services. - Algorithm-based insurance based on data from connected cars

Technologies in the Automotive industry (4/5)

Cognitive Computing (CC)	○ **Cognitive Computing in IoT Connected Cars:** - These are technology platforms based on artificial intelligence and signal processing and which encompass and use machine learning, reasoning, human language processing, speech and object, human–computer interaction, dialog and narrative generation, among others
Artificial Intelligence	○ **Artificial Intelligence for Driverless/Autonomous Cars** - Artificial Intelligence system is defined as, “any system that perceives its environment and takes actions that maximize its chance of success at some goal.” - Applied for the on-research driverless or autonomous or self-driving cars that are using various levels of artificial intelligence ○ **Artificial intelligence in production process** helps to identify recurring patterns in the production process, based on the data collected in real-time, to support continuous optimization, and to gain a clearer picture of the entire manufacturing process
Cloud computing	○ **Cloud computing and other cloud solutions** are deployed from smart factory Internet of Things (IoT) applications that improve quality and efficiency; to product design accelerators that enhance areas such as sales, marketing, customer service, and aftermarket service; to applications that enable new connected vehicles (cars, trucks, shuttles, scooters, etc.).
Machine Vision	○ **Machine Vision** works as the eye of the automotive production process using imaging processes including conventional imaging, hyperspectral imaging, infrared imaging, line scan imaging, 3D imaging of surfaces, and X-ray imaging. These cameras capture images of the surface of the automobile component to be inspected, which are then analyzed and processed by specialized analysis software
Big Data & Data Analytics	○ **Advanced data analytics** informs various decisions throughout the lifecycle of a vehicle. Data gathered from vehicles enables predictive maintenance, informs managers about their fleets, and alerts concerned authorities in case of accidents. Moreover, customer automotive data finds applications in driving sales, optimizing supply chains, and enhancing product design for newer vehicles.
Encryption and Cyber security	○ **Encryption** helps protect data sent and received over the internet ○ **Automotive cyber security refers to three areas:** - Authentication and Access Control (Who is allowed to do things, and what do they have access to do) - Protection from External Attacks — Preventing unauthorized controls and malware, protecting data, protecting communications, etc. - Detection & Incident Response — Identifying, reporting, and responding to attacks and threats.

Technologies in the Automotive industry (5/5)

The Internet of Things (IoT)	○ **The Internet of Things, or IoT,** refers to the billions of physical devices around the globe connected to the internet, all collecting and sharing data without human intervention. - Top Five Applications: Fleet And Driver Management; Real-Time Vehicle Telematics; Cellular Vehicle To Everything (CV2X); IoT Based Predictive Maintenance; In-Vehicle Infotainment - IoT enables secure communication between vehicles as well as vehicles and infrastructure components. The technology improves road safety, solves traffic congestion, and reduces pollution and energy expenditure with better fleet management.
Blockchain	○ **Blockchain** applications include sharing vehicle data over a secure network for connectivity and shared mobility solutions such as ride-hailing, urban transportation, and deliveries. Also, it finds application in verifying the supply chain of spare parts or making sure that the raw materials and spare parts are sourced exclusively from legal and trusted sources.
Drones	○ **Drones are used for:** car part delivery, performance of tasks that are too dangerous for human employees, plant upkeep or vehicular inspection process. Also, drones would help stranded drivers receive help with their vehicles faster
Digital Twin & Digital Thread	○ **A digital twin** is a near-real-time data model of a physical object, equipment, or asset ○ **A digital thread** creates universal access to data and aligns different processes around a single set of data. It provides employees with a record of a product or system's lifetime from its initial stage—including design, fabrication, and manufacturing—to the actual usage of assets in the real world. Authentication and Access Control (Who is allowed to do things, and what do they have access to do) ○ The work of digital twins and digital threading relies on IoT sensors that collect real-time data on the assembly line performance and transmit it to servers, either on the premises or in the cloud. ○ In the automotive industry, digital twins and digital threading help monitor, simulate, and optimize production, quality control, and operational performance.
Horizontal and Vertical Integration	○ **Integration, vertical or horizontal,** helps connect business units and make them more visible. **Horizontal integration** ensures networking between individual machines, items of equipment, or production units. **Vertical integration** streamlines business data from the sensor to the business level of the company. ○ **Typical for a Smart Factory,** where data is extensively integrated at every level of the production cycle. It allows plants to react quickly to changes in demand or faults, introduce necessary adjustments and customer-specific adaptations, and rapidly deal with fluctuations in quality or machinery breakdowns.

Impact on jobs (1/2)

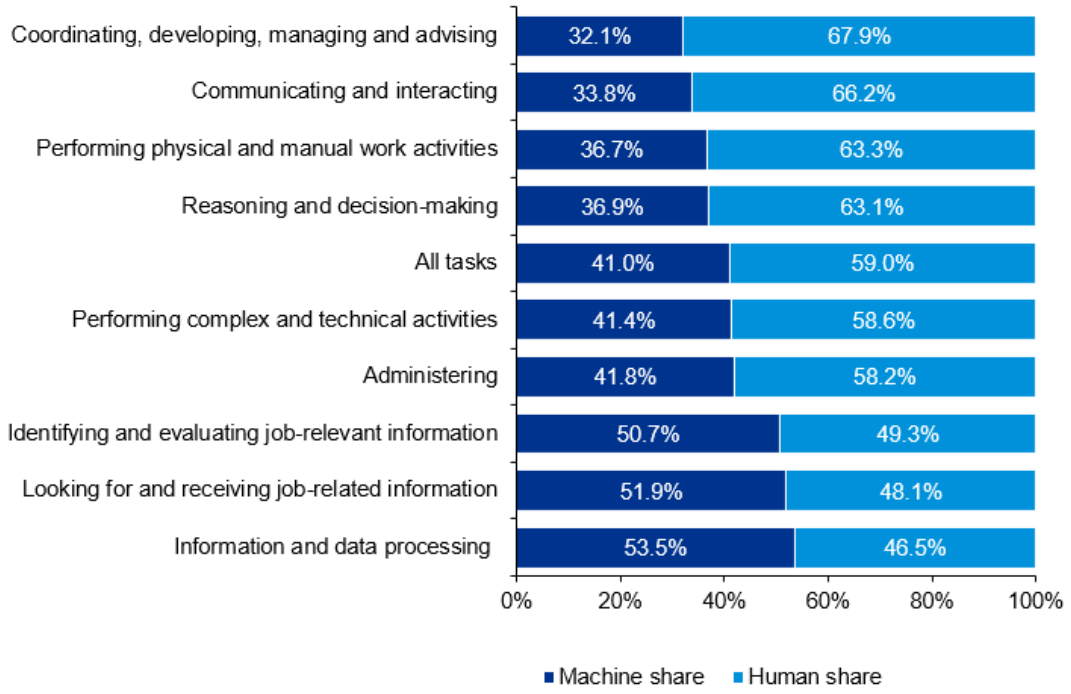
Key ideas

- Investments in new task-replacing technologies are generally made where investors believe them to be at least as profitable and to have a similar or lower-risk profile than existing labor-intensive processes
- Investments in robotics, automation and digitalization depend to a large degree on where a firm is situated in the global supply chain. Leading OEMs and part manufacturers, are well positioned to make investments in advanced manufacturing and robotics systems.
- The impact of technological advances on employment is dependent on the starting point of the industry in the country in question. The automotive industry is already relatively advanced as far as the automation of low-skilled and medium-skilled jobs is concerned, particularly in developed countries.
- In developing countries, where significant numbers of workers are still employed in areas such as assembly and painting, low-cost and low-skilled jobs might be replaced or at least transformed at a much higher rate through automation in the future.
- Middle-skilled tasks and occupations, in addition to lower-skilled activities, could increasingly be automated. This includes tasks ranging from assembly to painters – “routine” tasks which are already declining in significance within the automotive industry.
- According to the survey applied by the World Economic Forum Report to develop the Future of Jobs (2020 edition), in order to deliver the current growth strategy of the company in the next four years:
    - 61.1% of surveyed companies should reduce their current workforce due to technological integration or automation
    - 33.3% of surveyed companies should expand their current workforce due to technological integration or automation
- The same report found that in response to current outbreak of Covid-19:
    - 82.4% of surveyed companies plan to accelerate the digitalization of work processes (e.g. use of digital tools, video conferencing)
    - 64.7% of surveyed companies plan to provide more opportunities to work remotely
    - 58.8% of surveyed companies plan to accelerate ongoing organizational transformations (e.g. restructuring)
    - 41.2% of the companies plan to temporarily reduce workforce
    - 41.2% of companies plan to accelerate automation of tasks
- Three possibilities are further analyzed: job losses, job creation and job transformation
- Automation will not only impact on low-skilled, low-wage employees, but increasingly parts of some of the highest paid occupations. Many jobs and processes will need to be redefined to take advantage of the potential that automation offers.

Source: publicly available information, references listed on pages 28-30

Impact on jobs (2/2)

Augmentation of key job tasks by 2024 (according to "The Future of Jobs Report 2020", World Economic Forum)



The bar chart depicts the share of time that will be performed by humans compared to machines by 2024 for each task. It is based on the responses to the following question "Currently, what proportion of time spent doing tasks in your organization is spent by your employees performing the work?" from the Future of Jobs Survey. This stacked bar chart is ranked by share of time spent doing tasks by humans.
Source: World Economic Forum, Future of Jobs Report 2020

Declining skills and jobs

Considerations for identifying declining skills and jobs

- Middle-skilled tasks and occupations, in addition to lower-skilled activities
- Jobs including routine tasks which are already declining in significance (ranging from assembly to painters), in the medium-wage sector
- Jobs involving standardized manual operations at the assembly line
- Jobs requiring technical skills needed for more specialized tasks
- Jobs affected by production of electronic components (electric cars contain fewer parts than ones with internal combustion engines and require less maintenance)
- Jobs where high Investments in technology have been recently made
- Jobs affected by automated driving, which would reduce the need for body repair
- Jobs involving recurring patterns in the production process
- Jobs based on hard and dangerous work
- Jobs based on repetitive and monotonous work
- Jobs based on physical work in predictable environments
- Jobs involving collecting and processing data
- Both blue and white collar sectors are affected to the same extent

Examples of declining jobs

- Data entry clerks*
- Client Information and Customer Service Workers*
- Accountants and Auditors*
- Accounting, Bookkeeping and Payroll Clerks*
- Administrative and Executive Secretaries*
- Material-Recording and Stock-Keeping Clerks*
- Cashiers and Ticket Clerks*
- Business Services and Administration Managers*
- Assembly and factory workers*
- Production line workers**
- Welders, solders and brazers**
- Machinist**
- Automotive marketers**
- Transportation Attendants and Conductors**
- Automobile tester**
- General and Operations Managers**
- Electrical and Electronics Installers and Repairers, Transportation (0.91 probability)***
- Automotive Body and Related Repairers (0.91 probability)***
- Automotive and Watercraft Service Attendants (0.83 probability)***
- Automotive Service Technicians and Mechanics (0.59 probability)***
- Automotive Glass Installers and Repairers (0.55 probability)*

**Source: Frey C.B., Osborne M. (2013): "The future of employment: how susceptible are jobs to computerization?"*
***Sources: The future of work in the automotive industry: The need to invest in people's capabilities and decent and sustainable work – Issues paper for the Technical Meeting on the Future of Work in the Automotive Industry (Geneva, 15–19 February 2021) – ILO (2021)* and *"The Future of Jobs Report 2020", World Economic Forum, 2020*
****Source: 10 Auto Industry Jobs that Will Die Due to Automation (moneyinc.com)*

Emerging competencies and skills

LEVEL 1	LEVEL 2	LEVELS 3-5				
Skills & knowledge	Business	Management of personnel				
	Innovation and creativity	Creativity, originality and initiative	Reasoning, complex problem-solving and ideation	Critical thinking and analysis	Analytical thinking and innovation	System analysis and evaluation
	Digital and Technology	Troubleshooting and user experience	Technology use, monitoring and control	Augmented reality	Virtual Reality	
		Technology installation and maintenance	Robotics, data-driven systems and robotic process automation	Digital and advanced engineering skills	Information Technology	
		Artificial Intelligence	Big Data Analysis	Software Programming	Cyber security	
	Industry specialized	STEM (Science, Technology, Engineering, Mathematics)		Electrochemistry	Electrical engineering	Behavior of materials
Attitudes	Working with people	Communication	Human interaction	Consumer-facing skills	Persuasion and negotiation	Team leading
	Self management	Active learning and learning strategies	Attention to detail, trustworthiness	Resilience, stress tolerance and flexibility		

Based on the Skills Taxonomy (https://www.reskillingrevolution2030.org/reskillingrevolution/insights/skills-taxonomy/index.html)

Emerging jobs (1/2)

Key ideas

- **DRIVES project partnership defined 30+ different emerging job roles in the automotive industry** (see next page)
- New professionals will be needed, in particular app developers and artificial intelligence specialists to allow the creation of an entire infotainment offer (audio, communications, entertainment services and satellite navigation) within the passenger compartment
- Computer security experts will also be needed, due to the large amount of data that we will send by car (which will be constantly connected to the network)
- High-skilled job profiles will appear, requiring a growing supply of (post) graduates in science, engineering, mathematics, and information technologies
- Specialized mechanics who can solve electric motor failures will become more and more important
- Software will be the driving force behind the largest revenue stream

Examples of emerging jobs

- Electrical engineers
- Analytics expert
- Interaction designers
- Web programmer
- Autonomous driving engineer
- Customer care experts
- Sustainability integration expert
- Industrial engineer
- 3D printing engineer
- Alternative propulsion engineer

Source: "The Top 10 automotive jobs of the future (2015)" https://www.autocarpro.in/feature/-gm-predicts-automotive-jobs-future-8507

- Data Analysts and Scientists
- Business Development Professionals
- AI and Machine Learning Specialists
- Strategic Advisors
- Materials Engineers
- Management and Organization Analysts
- Digital Transformation Specialists
- Database and Network Professionals
- Environmental Protection Engineers
- Robotics Engineers

Overview of job roles expected to experience an increase in demand over the 2020–2025 period.
Source: World Economic Forum, The Future of Jobs Report 2020, 2020

- Data Analysts and Scientists
- AI and Machine Learning Specialists
- Process Automation Specialists
- Software and Applications Developers and Analysts
- Innovation Professionals
- Sales and Marketing Professionals
- Service and Solutions Designers
- Product Managers
- Industrial and Production Engineers
- Supply chain and Logistics Specialists

Source: World Economic Forum, "The Future of Jobs Report 2018", 2018

- Product Engineer
- Process Engineer
- R&D Engineer/Technician
- Product design and development technician
- Product design and development technician

Source: "The future of work in the automotive industry: The need to invest in people's capabilities and decent and sustainable work - Issues paper for the Technical Meeting on the Future of Work in the Automotive Industry" (Geneva, 15–19 February 2021) – ILO (2021)

Source: publicly available information, references listed on pages 28-30

Emerging jobs (2/2)

DRIVES Emerging Job Roles

Engineering and R&D

- ADAS (Advanced Driver Assistance Systems/ADF Testing and Validation Engineer
- Artificial Intelligence Expert
- Computer Vision Expert
- Machine Learning Expert
- Sensor Fusion Expert
- Automotive Engineering CAD, CAE, CAM
- Practitioner in Automotive SPICE®
- iNTACS/VDA Certified Provisional Assessor Automotive SPICE®
- Connected Vehicles Expert
- Connected Vehicles Technician
- Automotive Cybersecurity Engineer
- Automotive Cybersecurity Manager Strategy Level
- Automotive Cybersecurity Manager Project Level
- Automotive Cybersecurity Tester
- Rubber Technologist - Basic Level
- Advanced Powertrain Engineer
- Functional Safety Manager Strategy Level
- Functional Safety Project Manager
- Functional Safety Engineer
- Highly Automated Drive Engineer
- Automotive Mechatronics Manager - Awareness Level
- Automotive Mechatronics Manager - Basic Level
- Automotive Mechatronics Expert
- Automotive Mechatronics Developer

General

- Automotive Engineer
- Automotive Quality Engineer (AQUA)
- Innovation Agent - Basic Level
- Innovation Agent – Product Innovation
- Innovation Agent – Organizational Innovation
- Innovation Agent – Open Innovation
- Sustainability Manager

Production

- Advanced Manufacturing Press line Set-up
- Automotive Engineer in Quality and Metrology
- Lean Six Sigma Yellow Belt
- Lean Six Sigma Green Belt
- Lean Six Sigma Black Belt
- Robotic Engineer
- Robotic Technician
- Automotive Engineer in Tool and Die Production and Maintenance

Maintenance

- Predictive Maintenance Engineer
- Predictive Maintenance Technician
- Predictive Maintenance Expert

Source: https://www.project-drives.eu/en/driveslearningplatform
For Leaflet, Skills Cards and Skill & Exam Portalfor each job, please access the link above

Reskilling plans and strategies (1/4)

Key findings

- Following the Future of Jobs Survey (2020), the World Economic Forum found an:
  - 44.4% average expected redeployment success rate of displaced worker – employers expect to successfully redeploy 44.4% of their employees with increasingly redundant skillsets within their organization after they have completed their reskilling programme
  - 55.2% average skills instability among workforce – employers expect that 55.2% of the core skills required for employees to perform their roles well will be different in the next four years
- To continue to drive efficiency, the sector must reskill many of its workers to be high performers in a digital and highly connected business environment
- To limit the employment impact, all the participants of the automotive value chain will need to use substantial resources to regularly upskill and retrain staff to ensure their effectiveness.
- Reskilling represents a challenge not only for companies, but also for individual workers
- Skills gaps is the top barrier to adoption of new technology in the automotive industry, according to the Future of Jobs Survey conducted by WEF for development of "Future of Jobs Report 2020"

Source: publicly available information, references listed on pages 28-30

Barriers to adoption of new technologies (according to "The Future of Jobs Report 2020", World Economic Forum)

This bar chart shows the most common barriers companies face when adopting new technologies. It is based on the responses to the following multiple-choice question "What are the top economic and social barriers your organization experiences when introducing new technologies?" from the Future of Jobs Survey. This bar is ranked by frequency of responses by companies surveyed from this industry.

Source: World Economic Forum, Future of Jobs Report 2020

Reskilling plans and strategies (2/4)

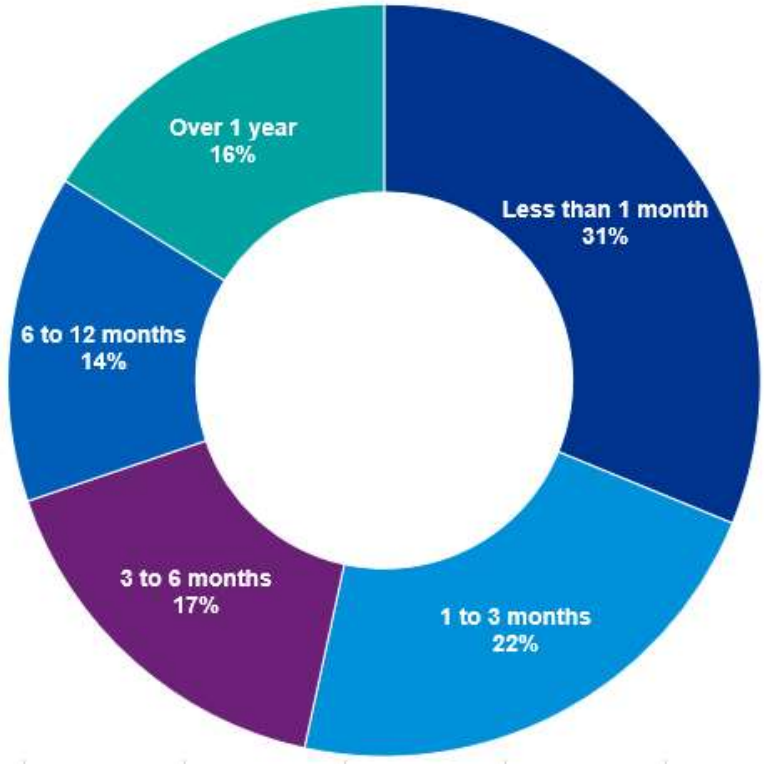
Skills clusters in focus of existing reskilling/upskilling programmes

- Analytical thinking and innovation
- Technology use, monitoring and control
- Active learning and learning strategies
- Reasoning, problem solving and ideation
- Persuasion and negotiation
- Critical thinking and analysis
- Leadership and social influence
- Complex problem-solving
- Quality control and safety awareness
- Management of financial, material resources

The list of skills in focus of existing industry company reskilling/upskilling programmes, based on the responses to the following question “Keeping in mind your current strategic direction, select the top 10 skill clusters that you are currently focusing your reskilling/upskilling efforts on?” from the Future of Jobs Survey.

Source: World Economic Forum, Future of Jobs Report 2020

Share of workforce by duration of reskilling



This chart shows the estimated time needed to reskill each share of the workforce requiring reskilling within the industry. It is based on the responses to the following question “Bearing in mind the evolving skill demand, how long do you expect the reskilling/upskilling of your employees to take?” from the Future of Jobs Survey. Respondents were asked to provide a share of their workforce for each duration of reskilling/upskilling.

Source: World Economic Forum, Future of Jobs Report 2020

Reskilling plans and strategies (3/4)

The articles published under "The challenge of digital transformation in the automotive industry. Jobs, upgrading and the prospects for development" published by European Trade Union Institute (ETUI) (Brussels, 2020) underline a number of key ideas regarding the reskilling/upskilling plans at company and/or national level

- ***Workers' reskilling or upskilling requires comprehensive retraining policies which are not always provided in the workplace or by public institutions***.
- ***The limited recognition of the negative impacts of the introduction of new technologies*** is blocking more critical appraisals and the creation of mitigation strategies at company, regional and national level.
- There seems to be an inclination at the central divisions and strategy levels to think very much ***in terms of processes rather than people***. The overwhelming focus is on getting the technology, and especially the process, right, while work organization or the composition of the workforce are expected to adapt or be adapted to meet the new demands.
- ***There is no effort to prevent structural unemployment* (*at 2019 level),*** because, very few people remain unemployed at the moment and thus the urgency of the need to conduct reskilling programmes is very low. Efficient retraining policies are simply not on the agenda of trade unions and other stakeholders. This comprises a striking question of the prospects for manual workers in the labor markets of the future in which digitalization and automation will be highly developed and where jobs for many manual workers will have diminished. The expected consequence is that these workers will face unemployment with limited likelihoods of finding new jobs. Moreover, the COVID-19 pandemic may accelerate most of these processes.
- ***There is an urgent need to understand the ongoing changes caused by new technologies*** in order to provide relevant policy responses to prevent a deterioration in working conditions for workers in production. Although one of the biggest challenges facing the implementation of Industry 4.0 is the adaptation of workers' skills to new technologies, the policy responses at company, regional and national level are uncoordinated and unsystematic. ***Effective reskilling and retraining policies are costly and require both personal engagement and a plausible institutional framework whose parameters are set by collective bargaining and/or by public institutions***.
- ***Retraining policies are further dependent on the size of company, capital intensity and unionization rate***. In the case of the **automotive sector, an important factor is also the position of the company in the production chain**, with lower tier suppliers having fewer resources to devote to employee training and reskilling than ultimate manufacturers (OEMs). Trade unions, through partnerships with employers, may employ effective policies which help workers reskill. A good example is provided by the employment security councils operated in Sweden by employers and trade unions and which provide redundant workers with assistance in reskilling and employment (Engblom 2019).
- The general concept seems to be of ***a long-term 're-training'*** by having younger workforces – those with a long-term perspective at the plants – rotate through various workstations for stints of several months. Other than recruitment and job rotation strategies, there appeared to be little training taking place specifically for Industry 4.0 applications.

Reskilling plans and strategies (4/4)

The articles published under "The challenge of digital transformation in the automotive industry. Jobs, upgrading and the prospects for development" published by European Trade Union Institute (ETUI) (Brussels, 2020) underline a number of key ideas regarding the reskilling/upskilling plans at company and/or national level

- ***The only way that workers attain the upgrading of their skills lies in self-selection and individual plug-ins into company-level retraining***. However, in the future, if workers are considered redundant, their prospects of reskilling will be determined only by their individual ability to seek retraining and to finance it if no policies at sectoral level, based on cooperation between employers and the involvement of public institutions, have been developed by that point. This might contribute to the further polarisation of job skills, leaving behind older workers, the less flexible and the young and inexperienced who might have difficulties in establishing retraining or reskilling opportunities.
- ***Trade unions have not thus far developed a comprehensive strategy on how to approach new technologies and workers' reskilling***. Up to now, trade unions have applied standard strategies to protect workers which encompass the management of redundancies through retirements and through voluntary leavers and, where involuntary lay-offs are inevitable, they try to apply careful and clear criteria. At the same time, they are paying increased attention to workers' protection in terms of the health and safety aspect of working conditions in the workplace, while paying limited attention to deskilling and retraining strategies at company level.

Reskilling best practices (1/3)

The EASC Report on Automotive Industry* presents a series of innovative tools, national and regional strategies, local initiatives, methods to monitor skills' needs and address skills' mismatches and gaps, aiming at:	
Meeting skills' needs	○ ***EDUCAM*** *was created twenty years ago on the basis of a positive partnership between employers' organizations and trade unions in the car maintenance sector in Belgium.* It is a specialist organization monitoring the different developments in the automobile industry and translating the occupational standards decided upon in different sectoral agreements into training programmes and skills development activities.
	○ ***The Formula Student*** racing project invites engineering students to design, build, test and race a single seater racing car. It takes them out of the classroom and gives them an opportunity to apply their theoretical studies to real work experiences
	○ ***Daimler project "green technology" –*** Daimler offers a flexible green technology qualification concept which ranges from basic information sessions on alternative drive trains to much longer programs and which provides trainees with the technical and safety knowledge required for the production of new Mercedes drive systems. Between 2010 and 2013, with further ongoing activities in 2014 and 2015, more than 84,000 employees were trained in alternative drive train technology and lightweight construction.
Engaging in new forms of learning	○ ***The Advanced Problem Solving programme*** takes the tools from the Six-Sigma (a well-known approach used by the manufacturing sector to reduce productivity defects) and embeds them into whichever problem solving methodology is being applied.
	○ ***A Belgian project*** has been set up to create awareness of the latest developments and innovations in the industry to and provide an accurate knowledge base. Employees within the automotive industry will be able to learn from their own environment and seek acceptance for these new ideas from society by learning through influential models.
	○ ***"Talent-orientated learning & development" process*** is an initiative of BMW, which allows for more flexibility during the vocational training process, thus making it possible for trainees in individual cases to review their options
	○ ***IFOCA'S MOOC on the rubber technology*** focuses on rubber and its physical and chemical characteristics and it is geared, amongst others, to the new employees in the rubber sector as well as to those that are considering starting their studies on the subject.

**European Automotive Skills Council (EASC) was an 18-month project funded by the European Commission DG Employment. The European Automotive Skills Council was coordinated by representatives of employers and trade unions in the automotive sector, the European Association of Automotive Suppliers (CLEPA), the European Tyre and Rubber Manufacturers' Association (ETRMA) and Industrial respectively.*

Reskilling best practices (2/3)

The EASC Report on Automotive Industry* presents a series of innovative tools, national and regional strategies, local initiatives, methods to monitor skills' needs and address skills' mismatches and gaps, aiming at:

Developing new qualifications	○ ***Continental launched a three year programme***, aiming at training automotive software developers, with 28 places made available at nine sites cross Germany. The content of the training was geared toward mathematical technical software developers (MATSE) and provided additional training in embedded software development and electronics.
	○ ***Bosch – mechatronics engineering – e-mobility plus:*** Bosch developed a new qualification to train mechatronics engineers in the area of electronic mobility so that it can continue to develop automotive technology in hybrid vehicles and concepts for electro-mobility. It covers basic science subjects, such as mathematics, physics, electrical engineering and technical mechanics, with specializations later in, inter alia, digital technology, information technology, microprocessor technology, electronic design, control technology, software engineering and soft skills.
	○ ***DEIA - postgraduate qualification in automotive engineering:*** The Automotive Intelligence Center (AIC) - a research and training organization set up with the support of Basque provincial government, the University of Deusto in Bilbao and a series of local automotive companies (e.g. Gestamp in Spain) have set up a postgraduate degree in Automotive Engineering, targeted at graduates in Industrial Engineering and experienced persons already working in the industry who want to acquire or expand their specific knowledge of the automotive industry. The success rate is high, and 90% of the students are employed at the end of the programme, in product and process engineering.
	○ ***Advanced apprenticeship in mechatronic engineering:*** The University of Deusto in Bilbao, offers a postgraduate Diploma de Especialización en Ingeniería de Automoción which gives learners an opportunity to demonstrate what they know and what they can do in terms of automotive engineering on the basis of formal education and industrial experience, and another institute of higher education, the Institut des Sciences et Techniques des Yvelines, has set up a 3-year advanced apprenticeship in mechatronic engineering.
Transferring knowledge and skills	○ ***Space Cowboys - Daimler senior experts:*** Retired employees have supported specific departments like production, R&D and IT with their expertise and their skills on a voluntary and temporary basis and pooled their experience so as to contribute to the transfer of knowledge to younger generations.

**European Automotive Skills Council (EASC) was an 18-month project funded by the European Commission DG Employment. The European Automotive Skills Council was coordinated by representatives of employers and trade unions in the automotive sector, the European Association of Automotive Suppliers (CLEPA), the European Tyre and Rubber Manufacturers' Association (ETRMA) and Industrial respectively.*

Reskilling best practices (3/3)

The EASC Report on Automotive Industry* presents a series of innovative tools, national and regional strategies, local initiatives, methods to monitor skills' needs and address skills' mismatches and gaps, aiming at:

Transferring knowledge and skills	○ ***Inter-generational learning:*** In order to meet the increasing demand for tool and die makers, the Mercedes-Benz plant in Bremen has set up a dedicated program to train apprentices alongside experienced production workers. The older employees benefit from young persons' know-how in new technologies and learning styles, and the youngsters get a better understanding of processes and company structures.
Training for apprenticeships	○ ***Training for apprenticeships:*** Jaguar Land Rover (JLR) has set up a scheme to alleviate the problem of imbalance between supply and demand in terms of apprenticeships - a clearing house to match apprentice applicants that have not been able to join JLR with opportunities with companies in the JLR supply chain.
Certifying knowledge, skills and competence	○ ***Certification of vocational training courses in the group:*** In 2010 a French company introduced a corporate method focused on the certification of vocational training curricula, with the aim of identifying the associated technical skills, the target level for each job position and the related training curricula necessary for skills development.
Addressing and closing the skills' gap	○ ***BMW - e-mobility:*** BMW has set up another initiative "e-mobility" which has improved health and safety within the company and improved competence in a range of new technologies: e-mobility, high voltage technology, battery technology, automotive engineering, safety technologies and electrical and electronic engineering. Around 30,000 persons employed in the company have benefited from this program. ○ ***Managing internal redeployment:*** In 2012 a French company launched a scheme "Top Competences" which aimed to help employees who were willing to switch from "at-risk" jobs to "in demand" jobs within the company throughout Europe. It succeeded in developing an effective redeployment scheme designed to develop the skills and competence of employees in 'at-risk' job positions. In this way it helped to manage overstaffing in certain parts of the company and improve measures to improve employability.

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Oil & Gas

Megatrends and drivers of change

The energy transition	○ ***According to McKinsey & Company, the acceleration of certain shifts will affect the industry value chain:*** 1. *Faster uptake of **electric vehicles*** 2. *Efficiency gains and faster uptake of low-emissions fuels for **aviation and marine*** 3. *Accelerated electrification of **residential heat*** 4. *Increasingly rapid electrification of **cooking** in non-OECD countries* 5. *Reduced demand for and increased recycling of **plastics*** 6. *More efficiency gains, recycling, and low emissions feedstock in **iron and steel*** 7. *Increased electrification of EU **industry low- and medium- temperature heat*** 8. *Accelerated cost reduction for **renewables and storage*** ○ ***Both in the medium and the long term the relative weight of employment in the fossil fuel industries is expected to decrease compared to employment in renewables, energy efficiency, and jobs in energy flexibility and grid.***
Increased decarbonization efforts	○ ***Increased societal pressure and regulation continue to drive a shift in the environmental, social, and governance imperative for downstream oil and gas and petrochemicals.*** ○ *Recent legislation, such as **the European Green Deal, seeks to drastically reduce carbon emissions and increase economic sustainability.** Such legislation drives increased investment in non-carbon energy sources and aims to reduce net demand for products derived from fossil fuels. It also incentivizes innovation and technology development. As a result, low-carbon and renewable energy sources are becoming economically feasible and thus more attractive.*
Workforce changes	○ ***The petroleum industry faces the shortage of skilled workers, as a result of several major changes and trends:*** • *The oil price collapse in early 2020 impacted highly experienced knowledge workers with crucial domain expertise* • *Large-scale layoffs in both energy and chemicals took place in 2020* • *Early retirement of older, highly experienced workers has been a trend in the recent years. Retirements cause accumulative loss of knowledge.* • *Cyclical drop in the number of university candidates interested in joining asset-intensive organizations* • *Existing employees having fungible digital skills are at the risk of migrating to other industries (e.g., technology and consulting firms, digital solution providers, etc.) with better career growth prospects.* ○ ***As a consequence, companies look for ways to add capacity and capability not through hiring more people, but through using technology and automation in order to address the scarcity of technically skilled workers.***

Source: publicly available information, references listed on pages 50-51

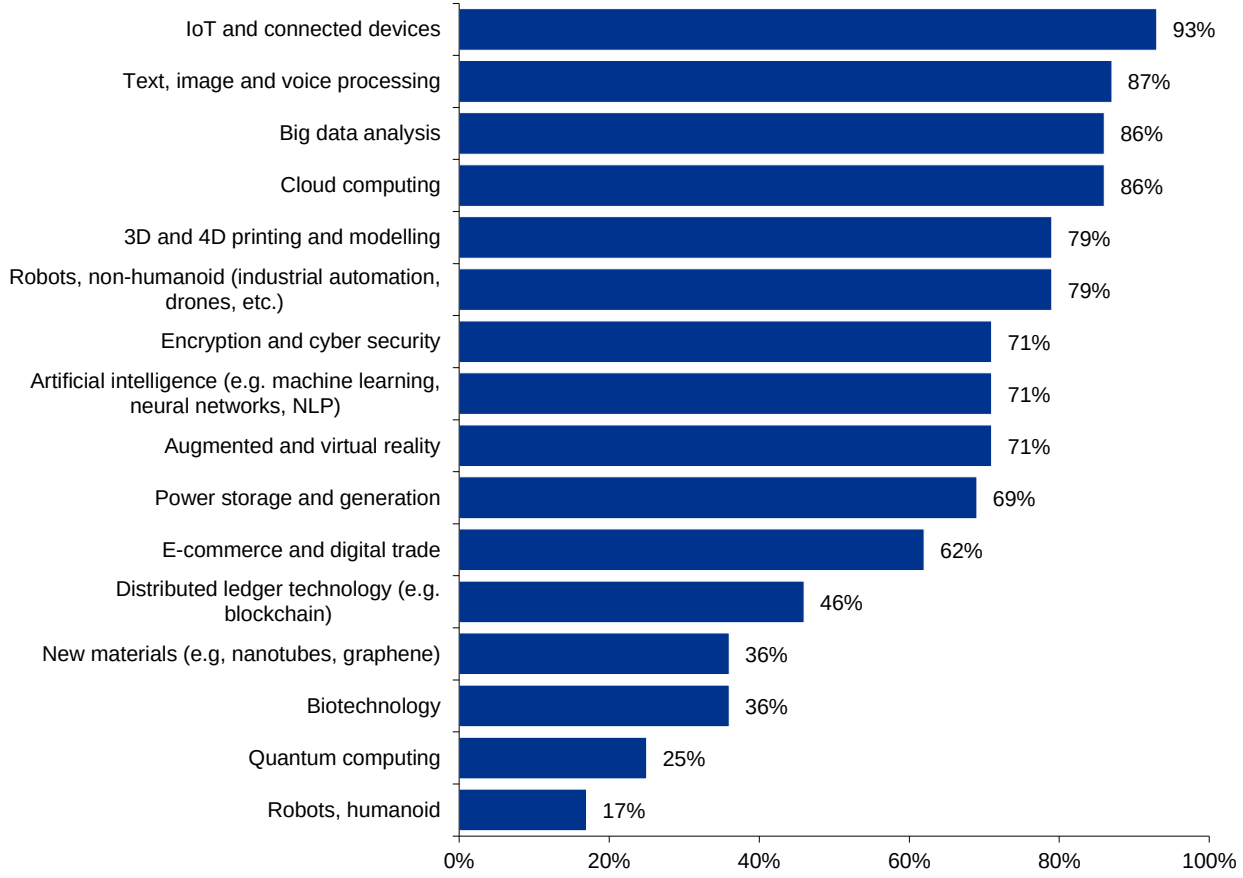
Megatrends and drivers of change

Accelerated technological innovation	○ ***The energy sector's rate of adoption of digital technologies continue to increase**, as technologies continue to evolve and become more affordable and easier to deploy.* ○ *With advancements in industry 4.0 innovations, the oil & gas industry is exploring ways to efficiently and competitively digitize, automate, and solve complex sub-surface engineering challenges. The use of artificial intelligence (AI) algorithms, in addition to providing a competitive edge, also enables oil & gas companies to increase field or well productivity* ○ *The gradual adoption of advanced robotics and data management practices invigorates scientists to develop novel practices that accelerate the processing times and reduce human labor* ○ *Recent infrastructure upgrades, such as secure 5G site-level networks, have changed data-management capabilities and reduced cybersecurity risks, allowing for integrated, automated solutions to be deployed.* ○ *According to the Gartner 2021 CIO Survey, 87% of CIOs expect their digital programs to increase or stay the same in 2021, 85% of CIOs in the oil and gas industry have assumed responsibility for creating a change-enabling technical platform and 79% are working to build a stronger change leadership culture in IT.*
Change in Prices	○ ***There is volatility in prices, due to geopolitical and civil conflicts, change in demand and supply, besides the climate change, and technological advancement.***
COVID-19 impact	○ *COVID-19 **challenges the way work is done in the industry**, such as tracking of new manufacturing tasks and regulations, moving of roles, schedules, inspections, and practices from human-operated fields to digitally powered remote operations centers. It also **degraded the investment climate and investors' appetite for fossil fuels**, and put an emphasis on the need for energy transition.* ○ *The COVID-19 pandemic **led to the slowdown of the economy and the resulting oil price crash**. Spending has been significantly reduced among upstream oil and gas organizations. Operating expenditures and non-essential capital projects have been cut in order to reduce costs across the industry, impacting especially technology projects, and slowing the short-term implementation and adoption of automation and AI, and leading to the fastest layoffs in the industry.* ○ *The COVID-19 pandemic **created a greater urgency in accelerating digitization efforts**. Although virtual and remote projects were being implemented before 2020, the pandemic accelerated the urgency to mitigate health, safety, and environment exposure for both off- and on-field employees without disrupting operations. Technologies and solutions such as cloud platforms to help experts working from home analyze and visualize operations, edge analytics to analyze the data, and augmented wearables for the onsite workforce have become the bare minimums. This brings up the need to upskill the existing workforce and recruit new employees as more skilled field employees approached retirement.*

Source: publicly available information, references listed on pages 50-51

Technologies in the Oil & Gas industry (1/5)

Technology adoption in Oil & Gas industry (according to "The Future of Jobs Report 2020", World Economic Forum)



This bar chart represents the share of survey respondents from companies operating in the Oil&Gas industry who indicated that, by 2025, their company was "likely" or "very likely" (on a 5-point scale) to have adopted the stated technology as part of its growth strategy.
Source: World Economic Forum, Future of Jobs Report 2020

Technologies in the Oil & Gas industry (2/5)

Automation	○ **Automation focuses on automating systems and enables machines to follow programmed orders or instructions without human intervention.** ○ **Automation is used for:** ○ Daily Drilling Operations: Automating manual portions of that process, like pipe handling and pressure drilling, can significantly reduce safety risks, and speed up the overall drilling process. ○ Diagnostics and Inspections: Underwater drones and unmanned submersibles can help monitor when equipment needs repairs, and can also aid in the inspection process. These vehicles can be controlled remotely, eliminating the need for skilled pilots, and can even broadcast live video feeds and data back to a central location. ○ Weather Monitoring Systems: Some energy companies have begun using automated weather sensors to detect changes in seismic activity, as well as ocean and atmospheric levels. This can help predict when conditions are right for major natural weather events, such as earthquakes and hurricanes, thereby enabling oil and gas companies to take the proper safety precautions in real-time. ○ Pressure and Flow: Installing smart sensors which connect to centralized monitoring software, allow pressure, flow, and level of oil to be reported remotely from the field, without the need for on-site crew. Upon receiving this information, rig crews can monitor and adjust settings as needed.
Robotics	○ Robotics solutions **increase workplace safety and speed of operations, reduce the manpower requirement**, reduce cost, thus increasing efficiency and reducing human-induced errors. ○ **Examples:** roughneck, underwater, aerial and snake bots, robotic processes that increase the service life of oilfield equipment, robotic gas stations, wearable robots for heavy lifting (exoskeletons); wearable safety technology that alarms a crew member if they come too close to the drilling equipment.; cybernetic blow-out preventer (BOP) service; ○ **Robots are useful for:** surveying, industrial automation in oil rigs and refineries, drilling, in inspection, maintenance and repair (IMR) operations (mostly for subsea IMR activities, but also for topsides).
Artificial Intelligence	○ **AI focuses on intelligent machines and is a collection of technologies that includes machine learning, natural language processing and robotics that allow machines to sense, interpret, act and learn from data to aid decision-making.** ○ The oil & gas industry increasingly applies AI and data science to solve complex problems in upstream, midstream, and downstream operations. ○ AI-enabled platforms support decision-making with insights from predictive, prescriptive, and cognitive analytics. In this way, AI helps petroleum engineers and oil & gas industry managers discover and implement new exploration & production ideas on the field to increase ROI. AI is use in locating new areas for drilling

Source: publicly available information, references listed on pages 50-51

Technologies in the Oil & Gas industry (3/5)

Internet of Things (IoT)	○ **The Internet of Things (IoT) in the oil & gas industry is the network of physical objects connected to the Internet**. Things like wearable devices, drones, equipment, buildings can be embedded with electronics, software, sensors, and network connectivity. The ability to transfer data without any human interaction enables previously unprecedented amounts of data to be collected and exchanged with other devices, or through a centralized platform. ○ **Oil & gas organizations are focusing their IoT initiatives on underlying sensors, and devices while also developing bold approaches for managing data, building an IoT infrastructure, and subsequently developing new business models**. ○ The oil and gas industry utilizes IoT to **improve production, optimize equipment, ensure worker safety, and monitor remote areas**. Sensors placed inside wells, blowout preventers (BOP), and choke valves enable real-time data collection. Using this data, O&G companies identify faulty equipment quickly, helping field engineers predict and react quickly. **IoT solutions allow oil and gas facilities to minimize maintenance costs and gain detailed visibility into their equipment or processes**.
Reality technologies	○ Immersive technology includes **augmented reality (AR), virtual reality (VR), mixed reality (MR), and extended reality (XR).** ○ In the oil and gas industry, **AR/VR animations boost efficiency and reduce errors by showing real-time information about equipment, tools, and parts**. For example, exploration & production (E&P) companies use reality solutions for remote monitoring, downhole imaging, and virtual training. Further, startups combine real and virtual environments to enable human-machine interactions using wearables and smartphone alerts.
Cloud computing	○ **Cloud computing is capable of storing and processing data on remote servers,** freeing up expensive local memory and computing capacities. **The oil and gas industry generates enormous amounts of data in its daily activities. Using cloud technology and software applications boosts oil & gas efficiency, security, scalability, and eases digital transformation. Cloud-native tools, such as 'as-a-service' platforms – platform, storage, infrastructure, data, and more – enable advanced analytics, informative visual dashboards, and remotely accessible real-time insights.** ○ Cloud enables many other technologies such as blockchain, mobility apps and autonomy, and opens up the possibilities new business models
Manufacturing Execution Systems (MES)	○ MES integrates manufacturing facilities, operational technologies, such as supervisory control and data acquisition (SCADA), and computing systems, to control the production process. ○ **MES offers intelligent architecture for manufacturing systems with integrated control for the oil and gas industry that ensures faster, safer, and reliable oilfield production systems.**

Technologies in the Oil & Gas industry (4/5)

Predictive maintenance	○ ***Predictive maintenance and operations include gathering data from sensors in field installations and integrating them with machine learning algorithms. This enables engineers to quickly assess equipment conditions and offer timely maintenance solutions. Predictive operations, coupled with software platforms, further enable granular part visualizations, allowing oil and gas operators to predict potential failures.*** ○ ***Predictive maintenance is applied across all upstream, midstream, and downstream operations. These solutions improve safety, extend the life of installations, and reduce costs associated with operations and maintenance.*** ○ *By utilizing IoT and creating a predictive maintenance process, operators can now track deterioration and corrosion of assets and equipment with the ability to diagnose a problem remotely. The way this works is the collection of data from the sensors is fed to the cloud, giving management access to real-time data from the field.* ○ *Predictive maintenance allows companies to decrease maintenance costs by as much as 13%.*
Blockchain	○ ***Smart contracts provide much-needed security and transparency of oil & gas documents and operations***. ○ *Distributed ledgers verify contractors, employees, and maintain smart contracts.* ○ *Blockchain allows oil and gas companies to automate invoices, post-trade settlements, and joint venture accounting.* ○ *Blockchain is also useful for hydrocarbon fleet tracking, trading, retail B2C, intragroup billing.*
Unmanned Aerial Systems (Drones)	○ ***The main advantages of UAS technology are efficient maintenance, safer inspections,*** *high-quality aerial data. Through a reduction in costs, time efficiency and data collecting abilities, drones are replacing the standard operating practices in the oil & gas industry* ○ *Oil & Gas industry benefits greatly from harnessing aerial insights received through applications such as surveying and mapping, inspection, & security and emergency response applications. Automated drones have greatly improved productivity, efficiency, and safety in such industries.*
Asset Tracking & Management	○ ***Asset tracking and management make production more predictable, optimizing production and improving productivity*** *and became the most widely adopted wireless sensor network application in the sector. Due to the dramatic price volatility oil can face, companies need to analyze their operations and assets to see where reductions can take place while maximizing the utility of assets.* ○ *With asset tracking, all assets are integrated into one platform to allow the monitoring of multiple wells or sites. Through IoT sensors, companies can also monitor key pipeline equipment more accurately and cost-effectively. It can allow teams to survey potential drilling sites and find a specific location for a pump. Additionally, the use of wireless sensors will give oil companies the ability to monitor their inventory and shipments in real time.*

Technologies in the Oil & Gas industry (5/5)

3D Modeling and Visualisation	○ ***3D modeling & high-quality visualizations help create realistic representations of subsurface reservoirs and other O&G equipment**. In combination with historical production data, 3D modeling simulates the production and injection phases during a reservoir's lifecycle.* ○ *This helps to predict risks that impact the safety of the reservoir. Based on the data, **oil & gas engineers optimize the production and operations planning**.* ○ *3D modeling and visualization **lowers costs and reduces risks while increasing performance for the oil and gas assets**.*
Digital Twin & Digital Thread	○ ***A digital twin is a virtual representation that serves as the real-time digital counterpart of a physical object or process.*** ○ ***Digital twins can deliver value across the business via the increased integration of internal systems, human activity and external ecosystems**.* ○ *Digital twins improve the performance of business assets, improve operational efficiency, prevent downtime, reduce maintenance and maintenance costs, and allow for more effective collaboration between experts and operators.*
Big Data & Data Analytics	○ *Everyday operations in the oil & gas industry generate large volumes of unstructured data. **Big data platforms help the industry's data analysts draw insights from production and performance data**. This is also useful for engineers looking to optimize production and ensure the safety of reservoirs.* ○ *Historical data of previous operations better train and test AI-driven algorithms and models. By using big data analytics, the oil and gas industry derives more value from everyday decisions to reduce operational costs and the industry's carbon emissions.*
3D printing	○ ***Additive manufacturing optimizes asset maintenance** in multiple ways. Through quick turnarounds, suppliers and maintenance providers all achieve faster repairs and improved design quality. AM also reduces the need to maintain a large inventory of spare parts through on-demand printing.* ○ *Probably the most practical use would be the **creation of small, cost-effective models** that can assist for maintenance and execution. Engineers can test new or replacement products to ensure size and fit* ○ ***3D printing accelerates product development**. With 3D printings capacity for rapid prototyping, companies are able to develop, design and validate their prototypes faster, which in turn accelerates the manufacturing process and from a grander scale allows organizations to implement unique solutions in various market opportunities.*

Impact on jobs (1/4)

Key ideas

- Virtually every type of job will change as a result of automation, from corporate functions such as Finance and IT, to field work such as maintenance and facility operations
- Automation will not only impact on low-skilled, low-wage employees, but increasingly parts of some of the highest paid occupations.
- Many jobs and processes will need to be redefined to take advantage of the potential that automation offers.
- According to the survey applied by the World Economic Forum Report to develop the Future of Jobs (2020 edition), in order to deliver the current growth strategy of the company in the next four years:
    - 42.9% of surveyed companies should reduce their current workforce due to technological integration or automation
    - 28.6% of surveyed companies should expand their current workforce
- The same report found that in response to current outbreak of Covid-19:
    - 77.8% of surveyed companies plan to accelerate the digitalization of work processes
    - 66.7% of surveyed companies plan to provide more opportunities to work remotely
    - 50% of the companies plan to temporarily reduce workforce
    - 44.4% of companies plan to accelerate the digitalization of upskilling/reskilling (e.g. education technology providers)
    - 33.3% of companies plan to accelerate automation of tasks
    - 33.3% of companies plan to accelerate the implementation of upskilling/reskilling programmes
- Despite the huge potential of robotics, operators should be aware that the savings brought by automation and digitalization will be partially offset by the considerable investments required for the adoption of these solutions, which may vary depending on the cost structure and whether the robots are owned or leased
- Job cuts due to robotics are likely to be met with some resistance from labor organizations, and robotized work processes may also need to pass regulatory requirements

Source: publicly available information, references listed on pages 50-51

Impact on jobs (2/4)

Key ideas

- **Impact of automation on various aspects of job:**
  - **Labor productivity** - Productivity tends to increase over time with automation and technological breakthroughs.
  - **Job roles** - job roles that require interpersonal skills, and creativity will be challenging to automate while the ones which require data collection, monitoring and analysis will be easier to automate.
  - **Job polarization** - Physical labor and some white-collar jobs have been replaced with automated processes and better software and computing power.
  - **Hazardous work** - Dangerous jobs in oil rigs have been automated or in the process of automation. This is done to ensure safer work conditions. However, it also implies lower compensation rates for workers as the risk factors get mitigated. Thus, automation deployed in offshore will reduce physical labor on rigs but will also open opportunities for more engineering jobs in control rooms.

- **Activities that have been impacted by automation:**
  - Diagnostics and monitoring- Inspection process of underwater equipment for repair and upgrade can be easily monitored by underwater drones and unmanned submersibles. This will **eliminate the need for skilled pilots, but will increase the need for skilled auditor/analysts** to analyze and monitor data
  - Weather monitoring system - The system predicts natural calamities like earthquake, hurricanes and so on so that precautionary plan and safety measures can be activated. **The automation here ensures job opportunity in the respective arena**.
  - Drilling operations - Automating the manual activities like pipe handling and pressure drilling can enhance the overall drilling process by reducing safety hazards and speeding up the process. **The labor force involved in these activities have a risk of losing job**. However if the workforce is trained well, they can be absorbed in some other tasks involving upgraded skillsets.
  - Measurement and monitoring pressure and flow - Smart sensors are installed to measure the pressure and flow of oil. This **eliminates the requirement for an on-site crew**. Only a few experts are hired to monitor and measure the pressure and flow and take the required action.
  - Rig management and monitoring - There are sensors that are installed on oil rigs at the various levels which produces data on a continuous basis. **The managerial and labor force required to manage rig goes down** and **new roles to comprehend data into meaningful strategies pop up**.
  - Hiring and training - For training and development of the workforce, simulation and augmented reality have made it easier to train candidate from any location. From job perspective, job roles have changed but has certainly not declined.

Impact on jobs (3/4)

Job losses

- According to World Economic Forum, on average, **14.2% of workers in Oil&Gas industry are at risk of displacement** (proportion of global workforce likely to become increasingly redundant in the next four years in organizations participating at WEF Future of Jobs Survey)
- Robotic drilling systems can potentially reduce the number of roughnecks required on a drilling rig by 20% to 30%, in both offshore and onshore drilling crews, bringing cost savings of more than $7 billion in wages in the US alone, based on present wage levels, according to Rystad Energy estimates.
- Overall, Rystad Energy believes that at least 20% of the jobs in segments such as drilling, operational support, and maintenance could in theory get automated in the next 10 years.

Job creation

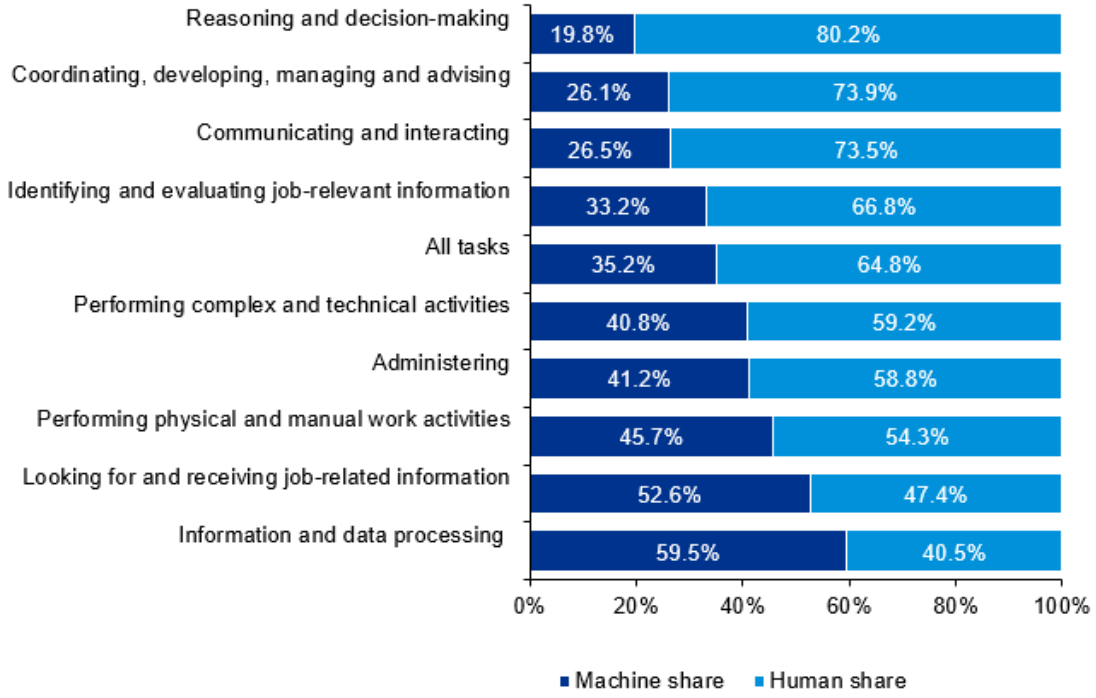
- According to the UKCS Skills Landscape report, over 40,000 new people are likely to be required to join the industry in the next 20 years, of which around 10,000 people will need to be recruited into roles that do not currently exist.
- According to the same report, with the low-carbon economy expected to grow 11% year on year through to 2030, 100,000 new energy jobs are expected by 2025 in all sectors of the energy industry, with 25,000 new jobs in UK oil and gas– and 4,500 in new roles 'that do not currently exist'.
- The use of advanced technologies could help increase the appeal to the upcoming tech-savvy workforce.

Job transformation

- Using algorithms to enhance learning, the more workers will be able to perform their duties with enhanced safety, efficiency, sophistication and less training. This will create new opportunities for more workers. Instead of being replaced, the “role of the human operator changes. They will be responsible for making sure they feed clean, relevant data into the algorithms”

Impact on jobs (4/4)

Augmentation of key job tasks by 2024 (according to "The Future of Jobs Report 2020", World Economic Forum)



The bar chart depicts the share of time that will be performed by humans compared to machines by 2024 for each task. It is based on the responses to the following question "Currently, what proportion of time spent doing tasks in your organization is spent by your employees performing the work?" from the Future of Jobs Survey. This stacked bar chart is ranked by share of time spent doing tasks by humans.
Source: World Economic Forum, Future of Jobs Report 2020

Declining skills and jobs

Examples of declining jobs		
Administrative and Executive Secretaries**	Accountants and Auditors**	Mining and Petroleum Plant Operators***
Assembly and factory workers**	Mining and Petroleum Extraction Workers**	Printing and Related Trade Workers***
Data entry clerks**	Client Information and Customer Service Workers**	ICT Operations and User Support Technicians***
Accounting, Bookkeeping and Payroll Clerks**	Legal Secretaries**	Derrick Operators (0.8 probability)****
Mechanics and Machinery Repairers**	Petroleum and Natural Gas Refining Plant Operators***	Roustabouts (0.68 probability)****
Material-Recording and Stock-Keeping Clerks**	Power Production Plant Operators***	Rotary Drill Operators (0.53 probability)****

***Source: "The Future of Jobs Report 2020", World Economic Forum, 2020*
****Source: "The Future of Jobs Report 2018", World Economic Forum, 2018*
*****Source: Frey C.B., Osborne M. (2013): "The future of employment: how susceptible are jobs to computerisation?"*

Emerging competencies and skills

LEVEL 1	LEVEL 2	LEVELS 3-5					
Skills & knowledge	Business	Management of personnel	Multi-tasking	Project Management	Change Management	Control of change	
	Innovation and creativity	Creativity, originality and initiative	Complex problem-solving	Critical thinking and analysis	Analytical thinking and innovation	Reasoning, problem solving and ideation	System analysis and evaluation
	Digital and Technology	Troubleshooting and user experience	Technology use, monitoring and control	Technology installation and maintenance	Technology design and programming		
		Artificial Intelligence	Robotics, data-driven systems and robotic process automation	Augmented reality	Virtual Reality	Digital and advanced engineering skills	Machine learning
		Information Technology	Data Science	Big Data Analysis	Cyber security	Software Programming	Remote operations
	Industry specialized	Low carbon energy	Material science	Petroleum engineering	Chemical engineering	Mechanical engineering	Civil Engineering
		Astrophysics	Aeronautical engineering	Earth Sciences	Mathematics	Quality control and safety awareness	
Attitudes	Working with people	Communication	Human interaction	Leadership and social influence	Service orientation	Collaboration and teamwork	
	Self management	Active learning and learning strategies	Emotional intelligence	Resilience, stress tolerance and flexibility			

Based on the Skills Taxonomy (https://www.reskillingrevolution2030.org/reskillingrevolution/insights/skills-taxonomy/index.html)

Emerging jobs

Examples of emerging jobs

- Virtual Reality Trainer
- Underwater Drone Supervisor
- Data Cleaner
- Haptic Engineer
- 3D Graphics Designer
- Robotics Manager
- Biotech Installer

Source: “7 Oil & Gas jobs that will exist in the future” (https://www.ge.com/news/reports/dan-jackson-7-oil-gas-jobs-that-will-exist-in-the-future)

- Renewable Energy Engineers
- Sheet and Structural Metal Workers, Moulders and Welders
- Robotics Engineer
- Process Automation Specialists
- Internet of Things Specialists
- ICT Operations and User Support Technicians
- Data Analysts and Scientists
- Big Data Specialists
- AI and Machine Learning Specialists

Overview of job roles expected to experience an increase in demand over the 2020–2025 period.
Source: World Economic Forum, The Future of Jobs Report 2020, 2020

- Data Analysts and Scientists
- Big Data Specialists
- Robotics Specialists and Engineers
- Renewable Energy Engineers
- Process Automation Specialists
- Organizational Development Specialists
- New Technology Specialists
- Information Technology Services
- Digital Transformation Specialists
- Scrum Masters

Source: World Economic Forum, “The Future of Jobs Report 2018”, 2018

- Software engineers
- Digital security specialists
- Machine learners
- Technical engineers

Source: The Future of Oil and Gas Jobs and Required Skills (https://codovia.com/oil-gas/oil-and-gas-jobs-required-skills)

Reskilling plans and strategies (1/2)

Key findings

- Following the Future of Jobs Survey (2020), the World Economic Forum found an:
  - **48.1% average expected redeployment success rate of displaced worker** – employers expect to successfully redeploy 48.1% of their employees with increasingly redundant skillsets within their organization after they have completed their reskilling programme
  - **42.6% average skills instability among workforce** – employers expect that 42.6% of the core skills required for employees to perform their roles well will be different in the next four years
- The Oil & Gas industry is confronted with a **major skills gap** (the difference between the number of highly-skilled workers that employers need and the number of such workers available), due to **four specific factors**:
  - an aging workforce that takes critical skills and experience with at retirement
  - new technologies transform the industry
  - the industry is less attractive for graduates than other industries
  - the industry has unique training challenge
- More than **half of professionals in the industry across the globe believe that a growing skills shortage is by the biggest challenge** the industry faces both now and in the future.

Barriers to adoption of new technologies (according to "The Future of Jobs Report 2020", World Economic Forum)

This bar chart shows the most common barriers companies face when adopting new technologies. It is based on the responses to the following multiple-choice question "What are the top economic and social barriers your organization experiences when introducing new technologies?" from the Future of Jobs Survey. This bar is ranked by frequency of responses by companies surveyed from this industry.

Source: World Economic Forum, Future of Jobs Report 2020

Source: publicly available information, references listed on pages 50-51

Reskilling plans and strategies (2/2)

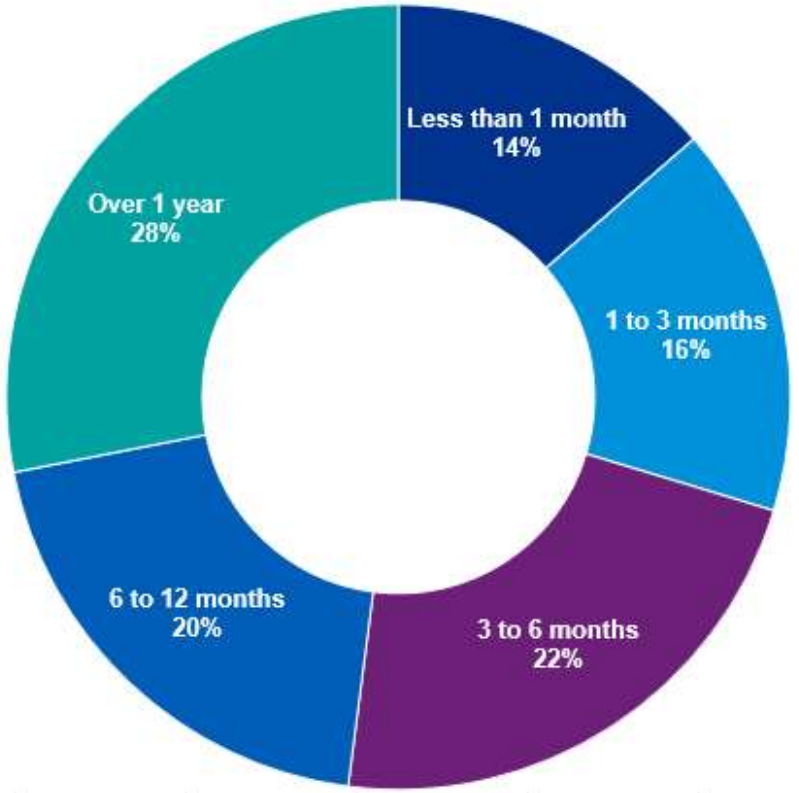
Skills clusters in focus of existing reskilling/upskilling programmes

Technology design and programming	Analytical thinking and innovation
Quality control and safety awareness	Leadership and social influence
Complex problem-solving	Critical thinking and analysis
Technology use, monitoring and control	Troubleshooting and user experience
Technology installation and maintenance	Resilience, stress tolerance and flexibility

The list of skills in focus of existing industry company reskilling/upskilling programmes, based on the responses to the following question "Keeping in mind your current strategic direction, select the top 10 skill clusters that you are currently focusing your reskilling/upskilling efforts on?" from the Future of Jobs Survey.

Source: World Economic Forum, Future of Jobs Report 2020

Share of workforce by duration of reskilling



This chart shows the estimated time needed to reskill each share of the workforce requiring reskilling within the industry. It is based on the responses to the following question "Bearing in mind the evolving skill demand, how long do you expect the reskilling/upskilling of your employees to take?" from the Future of Jobs Survey. Respondents were asked to provide a share of their workforce for each duration of reskilling/upskilling.

Source: World Economic Forum, Future of Jobs Report 2020

Reskilling best practices (1/2)

Companies applying reskilling and upskilling programmes

- ***Royal Dutch Shell is collaborating with Udacity to digitally train its workers in artificial intelligence.***
  - This began long before the coronavirus pandemic and the company continues to use this training method.
  - The digital workforce skilling platform may become the training method of choice for a growing number of companies who need to keep employees up to speed in the weeks and months ahead.
  - The program now under way at Shell with Udacity will help the Anglo-Dutch oil company build its AI skills at scale.
  - Shell says about 2,000 of its 82,000 employees worldwide have either expressed interest in the AI offerings or have been approached by their managers about taking the courses on everything from Python programming to training neural networks.
  - Shell says the training is completely voluntary.
  - Through their initiatives, Shell ensure that their "employees get abundant opportunities to enhance their skill set, receive the requisite training, and undertake complex technology forward projects"
  - Other initiatives: Proactive Technical Monitoring (PTM) system is the early detection of threats or opportunities through structured monitoring of data language; the lubricants business unveiled its latest B2B services portfolio which builds on data analysis and new technologies such as AI, machine learning and GPS tracking.

- ***Other oil and gas companies, including ExxonMobil, Chevron and BP, have also leveraged AI to help them improve operations and reduce costs.***

World Economic Forum recommendations

- To encourage the upskilling and reskilling efforts of the Oil and Gas workforce, **industry-wide certifications and close collaborations with academic institutions** that teach the underlying skills and issue these certifications should be increased.
- Further, a specific focus should be placed on **digital and data science skills on the one hand, and on the introduction of agile (in the sense of scrum) ways of working** on the other hand. This would allow multi-skilled talent to quickly form into new teams according to the emerging needs of the company. For this approach to succeed, the workforce will need to be convinced of the urgency for the adoption of new skills. Perhaps this is why the task force emphasized the need for companies to complement all skilling efforts with an engaging communication campaign. To make the learning experience as effective and lasting as possible, the **concept of cross-industry employee rotational programmes with tech** companies was considered to be an innovative process going forward.

Source: "Towards a Reskilling Revolution Industry-Led Action for the Future of Work", Centre for New Economy and Society Insight Report, World Economic Forum, 2019

Source: publicly available information, references listed on pages 50-51

Reskilling best practices (2/2)

OPITO (Offshore Petroleum Industry Training Organisation)

- OPITO is the global, not-for-profit, skills body for the energy industry, established in 1977 by the UK government.
- It sets industry standards in emergency response, industry training and competence. Standards are developed by oil and gas work groups, made up of industry representatives, training providers and trade associations. Training standards are reviewed by OPITO and industry partners.
- Its portfolio includes standards associated with scoping and development, construction, operations and maintenance activities, basic offshore safety and emergency response, crisis management, and helicopter operations.
- The industry-owned organization also works with governments, national oil companies, operators and contractors, offering a range of services and products to meet international skills needs and support workforce development.
- OPITO provides open learning courses to the industry, through Petroleum Open Learning courses. OPITO also have an e-LEARNING programme - “Introduction to Oil and Gas”. More than 375,000 people are trained to OPITO Standards every year in more than 50 countries through 230 accredited Centers.
- It has operation hubs in four regions - UK and Europe, Middle East and Africa, Asia Pacific and the Americas
- OPITO’s objective is to develop a safe and skilled energy workforce, by:
  - Driving global standards and qualifications
  - Creating workforce development solutions
  - Leading dialogue with industries and governments.
- Involved in **two Energy Transition** instruments:
  - **The Energy Skills Alliance** is a cross-industry group led by OPITO, bringing together leaders from across the oil and gas, renewables, nuclear and refining industries, as well as representation from within regulators, governments and trade unions. The key programmes of work the Energy Skills Alliance have set out aim to develop an all-energy workforce for the future (Programmes: Future Energy Skills Demand and Supply, Integrated STEM programme, All Energy Apprenticeships, All Energy Training and Standards)
  - **The North Sea Transition Deal**, which was announced in March 2021, supports the industry’s transition to clean, green energy and a secure future for skilled oil and gas workers and the supply chain. OPITO is proud to be leading the development of an integrated people and skills plan to support the UK Government’s North Sea Transition Deal’s rollout, and to assist with the transition of expertise across the energy industry

Analysis of documents available in the public domain (1/2)

- "The Future of Jobs Report 2020", World Economic Forum, 2020
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- Top 10 Oil & Gas Industry Trends & Innovations in 2021 - https://www.startus-insights.com/innovators-guide/top-10-oil-gas-industry-trends-innovations-in-2021/
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- Technology's Impact on Oil and Gas (http://davidgrislis.com/technologys-impact-on-oil-and-gas/)
- How Technology Is Changing the Oil and Gas Industry (https://www.thomasnet.com/insights/how-technology-is-changing-the-oil-and-gas-industry/)
- Robots could replace hundreds of thousands of oil and gas jobs, save billions in drilling costs by 2030 https://www.rystadenergy.com/newsevents/news/press-releases/robots-could-replace-hundreds-of-thousands-of-oil-and-gas-jobs-save-billions-in-drilling-costs-by-2030/
- The Top 10 Oil and Gas Trends to Watch (https://www.gartner.com/smarterwithgartner/10-oil-and-gas-trends-to-watch-in-2021)
- Impact of Automation on Oil and Gas sector jobs (https://www.nrgedge.net/article/1541260235-impact-of-automation-on-oil-and-gas-sector-jobs)
- Important Soft Skills Needed In the Oil & Gas Industry (https://www.opuskinetic.com/2017/09/important-soft-skills-needed-in-the-oil-gas-industry/)

Analysis of documents available in the public domain (2/2)

- 7 Oil & Gas jobs that will exist in the future (https://www.ge.com/news/reports/dan-jackson-7-oil-gas-jobs-that-will-exist-in-the-future)
- 10 ways to change careers from oil and gas to another industry (https://canadian-resume-service.com/job-search/ways-change-careers-from-oil-and-gas-to-another-industry/)
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- Four Factors Contributing to the Oil and Gas Industry Skills Gap (https://www.bayporttechnical.com/four-factors-contributing-to-the-oil-and-gas-industry-skills-gap/)
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Thank you!