

Centre for New Economy and Society Insight Report

Towards a Reskilling Revolution

Industry-Led Action for the Future of Work

In collaboration with Boston Consulting Group

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Preface

As the Fourth Industrial Revolution impacts skills, tasks and jobs, there is growing concern that both job displacement and talent shortages will impact business dynamism and societal cohesion. On the one hand, large parts of the labour market will be impacted by intelligent systems and automation, a transformation we can already observe today. On the other hand, technological integration will change the business models of all industries, giving rise to a number of emerging jobs. A proactive and strategic effort is needed on the part of all relevant stakeholders to manage reskilling and upskilling to mitigate against both job losses and talent shortages.

Through the Preparing for the Future of Work project, the World Economic Forum provides a platform for designing and implementing collaboration on the future of work by major industries, the public sector, unions and educators. The output of the project's first phase of work, *Towards a Reskilling Revolution: A Future of Jobs for All*, highlighted a method to identify viable and desirable job transition pathways for disrupted workers, using data from the United States. The project's second phase has focused on two areas of work: 1) extending our previous research to assess the 'business case' for reskilling and establish its magnitude and 2) mobilizing selected industries to address specific future of work challenges and opportunities.

This second report, *Towards a Reskilling Revolution: Industry-Led Action for the Future of Work*, demonstrates the results of this second phase of work. It encompasses the results of the business case research as well as data and proposed actions for five industries—Aerospace; Aviation, Travel and Tourism; Consumer; Financial Services; and Oil and Gas—to support them in their transition to the future of work. It is produced in collaboration with Boston Consulting Group, and with the support of Burning Glass Technologies. It is designed to provide key strategies, innovative frameworks and data-driven tools that can support businesses, governments, educators and civil society in taking proactive and coordinated action to prepare for the future of work.

We find that there is a compelling financial and non-financial 'business case' for companies and governments to reskill at-risk workers. More broadly, we find that companies across all industries should consider a triple

investment today—reskilling at-risk workers, upskilling their broader workforce and building structures for a learning organization—to prepare for both the short-term and long-term future of work.

Human capital is a crucial asset of any business—in fact, in an age of ubiquitous technology, it is human skills, creativity and capability that will form the competitive edge for any organization. Financing and implementing a reskilling revolution must thus be viewed as a critical investment for business, workers and economies alike. It is our hope that this report will both provide the impetus and serve as a practical tool to concerned stakeholders in achieving this goal.

Key Findings

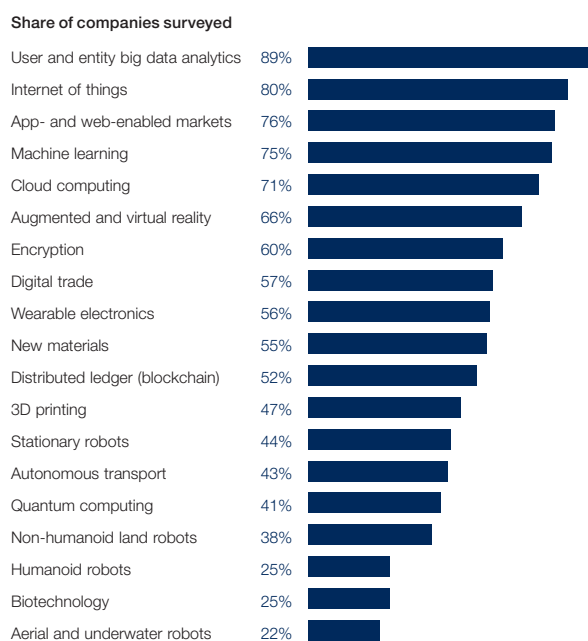
- The World Economic Forum's Preparing for the Future of Work project seeks to provide a platform for collaborative action among industry and other stakeholders to develop futureproof workforce strategies and support at-risk workers with reskilling and upskilling. A key challenge in this regard is that there is currently very limited reliable information about the business case and the return on investment of such efforts. This report aims to demonstrate the existence of a quantifiable business case for a reskilling revolution led by business and government.
- Drawing from average reskilling costs, we find that the 1.37 million workers who are projected to be displaced fully out of their roles in the next decade according to the US Bureau of Labor Statistics, may be reskilled to new viable (similar skillset) and desirable (higher wages) growing roles at a cost of US\$34 billion. On average this would entail US\$24,800 per displaced worker.
- The report contains an innovative quantitative cost-benefit analysis for companies' considerations on whether to reskill current workers or fire and hire different workers. If a company chooses to reskill, the costs incurred include the costs of reskilling, wages and lost productivity while the worker retrain; benefits include post-training gains in productivity. If a company chooses to fire current workers and hire new ones, costs include severance, hiring and wages and benefits include gains in productivity. The report shows that, in the US alone, with an overall investment of US\$4.7 billion, the private sector could reskill 25% of all workers in disrupted jobs with a positive cost-benefit balance. This means that, even without taking into account any further qualitative factors or the significant indirect societal benefits of reskilling, for 25% of at-risk employees, it would be in the financial interest of a company to take on their reskilling.
- We find that this balance sheet could be significantly extended further through public-private collaboration—such as a pooling of resources or combining of similar reskilling efforts, leading to economies of scale and lowering reskilling costs and times, significantly impacting the number of workers who could be reskilled with a positive cost-benefit balance. For example, if industry-led collaboration could reduce reskilling costs and times by 30%, nearly half of the disrupted workforce could be reskilled by employers with a positive cost-benefit balance.
- When it comes to the government perspective, we also find significant evidence of a quantifiable return in addition to broader societal good. For example, with the set of assumptions applied and with an investment of US\$19.9 billion, the US government could reskill 77% of workers expected to be displaced by technology into growing jobs while generating a positive return in the form of taxes and lower welfare payments.
- The report also outlines recommendations and innovative case studies based on more than 60 qualitative in-depth interviews and consultations with industry practitioners and experts participating in the Forum's Preparing for the Future of Work Industry Task Forces. It presents industry-specific adaptation roadmaps to prepare for the future of work, including concrete information related to transition opportunities for displaced workers and options for filling key strategic skills gaps for companies.
- Several insights and solutions outlined in this report will be taken up by the Forum's Preparing for the Future of Work project in the form of a commitment framework and a call to action to industries that seek to pilot collaborative reskilling and upskilling efforts to prepare workers and their organizations for the future of work.

Introduction

The Fourth Industrial Revolution and the rapid development and integration of new technologies in society and industry are currently having an unprecedented impact on the world of work. On the one hand, a variety of manual and cognitive tasks are increasingly being augmented by machines and algorithms, or in some cases even automated completely.¹ On the other hand, the inclusion of these new technologies in business models across different industries is giving rise to numerous new jobs and redefining the tasks of many more.² In combination, these two developments point to the fact that global and regional labour markets will inevitably undergo major transformation in the coming years and decades.

Companies around the world and across all industry sectors are trying to capture the potential for growth and adopt new technologies in their business models, increasing the efficiency of production within their enterprises and ensuring they remain competitive in today's dynamic markets. Looking at US-specific data presented in the World Economic Forum's *Future of Jobs Report 2018*, 89% of US-based companies are planning to adopt user and entity big data analytics by 2022, while more than 70% want to integrate the internet of things, explore web and app-enabled markets, and take advantage of machine learning and cloud computing (Figure 1). There are also technologies that will be explored by a wide range of US companies, but which will be of greatest importance for specific industries. For example, while 60% of all companies plan to adopt new encryption technologies, these will be a specific core focus of the Financial Services industry.³ Similarly, 57% of companies want to further explore digital trade, which already holds a central position in the Consumer industry. Even technologies like quantum computing, which is still many years away

Figure 1: Planned technology adoption by US companies within the next 4 years



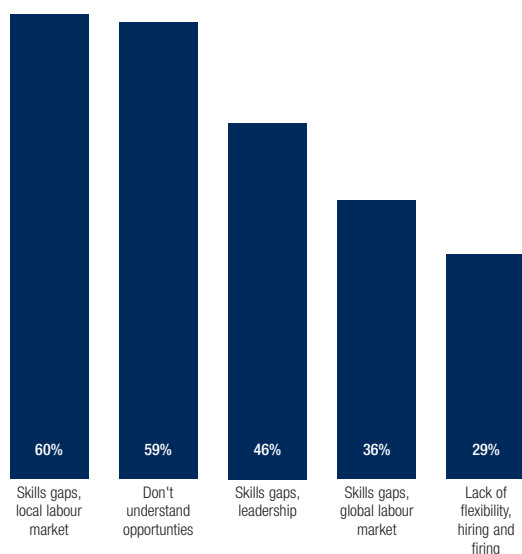
Source: *Future of Jobs Report 2018*.

from commercially viable applications⁴, are generating the interest of business leaders.

Companies are realizing, however, that the adoption and successful integration of these technologies into their business models has significant barriers. The full productivity dividends of technological adoption are often hampered by two main factors: 60% of US-based companies state that skills gaps in local labour markets

Figure 2: Barriers to technology adoption by US companies within the next 4 years

Share of companies surveyed



Source: Data from the Future of Jobs survey 2018.

prevent them from successfully implementing the desired technologies (Figure 2). Fuelled by this as well as skills gaps in leadership—indicated as a problem by 46% of respondents—companies feel that they fail to take advantage of the opportunities which are provided by the technologies. More than one-third of US companies believe that skills gaps are similarly large in global labour markets, intensifying the barriers to technology adoption, given scarcity of skilled talent in the market overall. Companies across industries are trying to expand the part of their workforce that can help them acquire this technological dividend. However, as this type of talent is in high demand—not just in one specific industry, but in all industries at the same time across the world—companies are facing a significant global challenge of mismatch between supply and demand of talent with the skills required.

Data from current job postings across the US, captured by Burning Glass Technologies, is indicative of how companies plan to use these technologies and which roles are increasingly important for their successful integration in companies' business models.⁵ Accordingly, Table 1 shows which jobs across the US are most often linked in recent job postings to specific technologies. For example, companies increasingly require skills around user and entity big data analytics when searching for software developers, database administrators, computer systems engineers, computer and information research scientists and computer systems analysts.

At the same time, they are expecting their marketing managers and sales representatives to have a clear

understanding of the internet of things and web- and app-enabled markets, while medical researchers and research analysts are expected to have skills around machine learning skills. Looking at the top five technologies and the job titles related to them, it becomes apparent that software developers will be more sought after within the next four years. This trend in job postings show that companies expect workers set to fill those job roles to have or quickly develop knowledge and skills around the technologies of the future.

At the other end of the spectrum from a range of entirely new job roles that are increasingly rising in importance, several established job roles are expected to decline in numbers—some of them quite drastically so. Looking at projections from sources such as the United States Bureau of Labor Statistics as well as the results of executive opinion surveys such as the World Economic Forum's *Future of Jobs Report 2018*, there is an expectation across all industries with regard to a big decline in the numbers of secretaries and administrative assistants, team assemblers, tellers and cashiers (Table 2). This trend is far from unproblematic for many companies, which will need to find ways to address the issue, either by reskilling affected parts of their workforce to new jobs relevant to the needs of the future, or by undertaking a series of large-scale redundancy programmes. These programmes are typically accompanied by significant financial, reputational and company/industry knowledge losses. Such losses to the companies are of course only a small part of the story, as large-scale redundancy programmes often cause irreparable damage to the social fabric of local communities.

The adoption of new technologies across various industries will eventually also result in a widespread transformation of almost all currently established job roles. Employees will have to update their skillset to adapt to the needs that are being created, and will need to do so in an iterative way as the 4IR materializes. The constant change of methods and objectives of business will require a flexible and adaptable workforce in terms of skillset, which can only be provided for by creating a culture and setting up mechanisms of lifelong learning and upskilling.

Table 3 shows the skills employers consider most important today, as well as skills expected to be trending or declining by 2022. Digital skills like technology design and programming and systems analysis and evaluation are on the rise, but so are 'human' skills such as creativity, originality and initiative, critical thinking and analysis, leadership, and emotional intelligence, as they are not expected to be automated in the near future. Among the top declining skills are physical skills such as manual dexterity, endurance and precision, which may soon be easily conducted by robots or robotic support systems. Similarly, several mental skills are in decline, such as memory, visual, auditory and speech abilities, as well as quality control and safety awareness, which are expected to

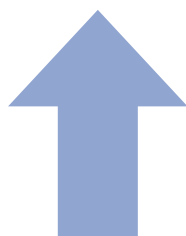
Table 1: Planned technology adoption in relation to job postings

Technology	Top 5 Related Jobs	
User and entity big data analytics	1	Software Developers, Applications
	2	Database Administrators
	3	Computer Systems Engineers/Architects
	4	Computer and Information Research Scientists
	5	Computer Systems Analysts
Internet of things	1	Software Developers, Applications
	2	Computer Systems Engineers/Architects
	3	Marketing Managers
	4	Sales Representatives, Wholesale and Manufacturing, except Technical and Scientific Products
	5	Computer User Support Specialists
App- and web-enabled markets	1	Marketing Managers
	2	Market Research Analysts and Marketing Specialists
	3	Sales Representatives, Wholesale and Manufacturing, except Technical and Scientific Products
	4	Software Developers, Applications
	5	Public Relations Specialists
Machine learning	1	Software Developers, Applications
	2	Computer and Information Research Scientists
	3	Medical Scientists, except Epidemiologists
	4	Computer Systems Engineers/Architects
	5	Operations Research Analysts
Cloud computing	1	Software Developers, Applications
	2	Computer Systems Engineers/Architects
	3	Database Administrators
	4	Network and Computer Systems Administrators
	5	Computer Systems Analysts

Source: Burning Glass Technologies.

Table 2: Top emerging and declining jobs in the US

Top 10 emerging jobs



- 1 Big Data Architects
- 2 Automation Technicians
- 3 Renewable Energy Engineers
- 4 Automation Engineers
- 5 Organisational Development Specialists
- 6 New Technology Specialists
- 7 IT Administrators
- 8 Digital Transformation Specialists
- 9 IT Project Managers
- 10 Data Analysts (General)

Top 10 declining jobs



- 1 Team Assemblers
- 2 Secretaries and Administrative Assistants, except Legal, Medical and Executive
- 3 Inspectors, Testers, Sorters, Samplers and Weighers
- 4 Drilling and Boring Machine Tool Setters, Operators and Tenders, Metal and Plastic
- 5 Electrical and Electronic Equipment Assemblers
- 6 Milling and Planing Machine Setters, Operators and Tenders, Metal and Plastic
- 7 Data Entry Keyers
- 8 Paper Goods Machine Setters, Operators and Tenders
- 9 Bookkeeping, Accounting and Auditing Clerks
- 10 Cashiers

Sources: US Bureau of Labor Statistics and World Economic Forum's *Future of Jobs Report 2018*.

Table 3: Comparing skills demand, 2018 vs. 2022, top ten

Today, 2018	Increasing, 2022	Declining, 2022
Analytical thinking and innovation	Analytical thinking and innovation	Manual dexterity, endurance and precision
Complex problem-solving	Active learning and learning strategies	Memory, verbal, auditory and spatial abilities
Critical thinking and analysis	Creativity, originality and initiative	Management of financial, material resources
Active learning and learning strategies	Technology design and programming	Technology installation and maintenance
Creativity, originality and initiative	Critical thinking and analysis	Reading, writing, math and active listening
Attention to detail, trustworthiness	Complex problem-solving	Management of personnel
Emotional intelligence	Leadership and social influence	Quality control and safety awareness
Reasoning, problem-solving and ideation	Emotional intelligence	Coordination and time management
Leadership and social influence	Reasoning, problem-solving and ideation	Visual, auditory and speech abilities
Coordination and time management	Systems analysis and evaluation	Technology use, monitoring and control

Source: World Economic Forum, *Future of Jobs Report 2018*.

soon be easily provided for by artificial intelligence, machine learning and smart (voice-controlled) support systems.

Employees themselves are increasingly expressing a desire to be given the ability to upskill and reskill in their professional environment. For its Decoding Global Talent 2018 survey, BCG questioned more than 360,000 employees and jobseekers around the world to understand what they value most in their jobs. The results are telling: employees value learning and training opportunities and career development options higher than their job security, financial compensation and the interest they find in their day-to-day job (Table 4).

All these profound transformations—from the changing type and nature of jobs to the rapid change in the type of skills needed—create an imperative for upskilling the workforce and providing targeted reskilling opportunities to those whose jobs will be highly disrupted by automation and other technologies. Many companies provide upskilling and reskilling opportunities to their employees because they understand that the speed of change in

skill requirements necessitates such investment, and because their employees value working for an organization that gives them the opportunity to improve their skillset, improving their future job market prospects.⁶

Globally, however, a large percentage of companies across most industries still have not made significant investments in reskilling and upskilling programmes. In fact, one of the major challenges with up- and reskilling from a company perspective is that there is currently very limited reliable information available about the business case and the return on investment of such efforts. This lack of clarity on where and how much to invest also creates a similar challenge for employees, who don't know how much to invest themselves, and for potential financial supporters of up- and reskilling efforts such as specific government entities and programmes, associations and labour unions.

Upskilling: learning new competencies to stay in current role, due to the change in skills required, or adding certain competencies for career progression.

Reskilling: learning new sets of competencies to transition to a completely new role.

Table 4: Top 10 global work preferences of employees and jobseekers

Rank	Global work preferences
1	Good relationship with colleagues
2	Good work-life balance
3	Good relationship with superior
4	Learning & training opportunities
5	Career development options
6	Financial stability of employer
7	Job security
8	Financial compensation
9	Work being appreciated
10	Interesting work

Source: *Decoding Global Talent 2018*, Boston Consulting Group.

Note: Survey respondents were offered a total of 26 options from which to choose.

The Preparing for the Future of Work Project

The World Economic Forum launched its Preparing for the Future of Work project in 2017 to provide a platform to business leaders and policy-makers to proactively shape the evolving nature of work and workforce needs, moving the narrative around the future of work and employment away from the deterministic predictions that tend to dominate this discussion globally.⁷ The project set out to provide strategies, methodologies and tools that would allow decision-makers to create a working

environment that emphasizes human skills and capabilities, empowering individuals across the world. In January 2018, the Forum published its *Towards a Reskilling Revolution* report in collaboration with the Boston Consulting Group, demonstrating a data-driven approach to how displaced workers could transition into growing jobs and how this method could help decision-makers globally to deal strategically and responsibly with job displacement due to automation. The overwhelmingly positive response to that first report demonstrated the broad willingness of business and policy leaders to apply new methods and to make the right investment in preparing the workforce for the future.

Following this publication, a range of businesses from five World Economic Forum industry groups (Aerospace; Aviation Travel and Tourism; Consumer; Financial Services; and Oil and Gas) have responded to the Forum's call to form specific task forces, bringing together executives from their human resources, strategy and operations departments, and working in tandem with experts from academia, representatives from governments and labour unions. These industry task forces set out to identify and bring to the front the main challenges and opportunities that they are facing in relation to the transformation of their workforces, showcase some of the current strategies and case studies of efforts made to try and address them, and, finally, brainstorm on how industry-led, multistakeholder coalitions could help increase the scale and impact of any effort, while decreasing its cost at the same time. A series of consultations and physical meetings led to the creation of a framework that any company, industry or multistakeholder coalition could use as a guide to start preparing for the future of work. This framework will be presented in detail throughout the publication, along with the evolution of the model presented in the *Towards a Reskilling Revolution* report.

Over the coming months, the recommendations presented here will be translated into a commitment framework and a call to action that is going to be presented on behalf of the task forces to the CEOs of their respective industries for them to review and commit to. Following their commitments, the task forces will take on the design and implementation of pilot programmes in the United States as well as globally.

The Reskilling Revolution Model: Overview and Extensions

The Preparing for the Future of Work project's first report, *Towards a Reskilling Revolution*—published by the World Economic Forum in collaboration with BCG and Burning Glass Technologies in January 2018—presented a data-driven methodology for identifying transition pathways from types of jobs with declining demand to types of jobs with increasing demand, uncovering a range of job profile and skillset similarities that otherwise would not have been immediately apparent. The goal of the report

was to demonstrate that a data-driven approach could be a valuable new tool for workers, companies, and governments to prioritize their decisions and investments with regard to reskilling and upskilling.

Central to our first report was the notion that such job transitions needed to be both *viable* and *desirable* in order for them to be considered an attractive and feasible option.

Viability of a job transition was determined by the similarity of two jobs in terms of their required overall capability profile, assuming that a sufficiently large overlap of required capabilities between two jobs would imply a manageable leap as far as reskilling was concerned. To determine the similarity of the requirements of any two jobs, data from the US Bureau of Labor Statistics, the Occupational Information Network (O*NET) and Burning Glass Technologies was utilized to create a big data approach for calculating objective 'similarity scores' between all 958 jobs. Similarity scores express the overlap between the activities and tasks that need to be performed in a job compared to another job, as well as between additional components of 'job-fit' such as knowledge, skills and experience (see Table 5 for an overview and the Annex: Report Methodology section for technical details on the computation of similarity scores).

Similarity scores are expressed as a numeric value between 0 and 1, with 1 expressing a perfect fit and overlap between the profile of the two jobs in question, and 0 expressing the most remote and imperfect fit. For example, a computer programmer and a web developer are found to have a high 'job-fit', with a similarity score of 0.92, while an office clerk and an aerospace engineering technician have a low job-fit, with a similarity score of 0.81 (see Table 6).

Desirability of a job transition represented its attractiveness from the perspective of the worker and was ascertained by the long-term employment stability of the target job as well as its capacity to financially maintain or improve the current standard of living of the prospective job mover. These two factors were determined on the basis of the projected change in demand for the target job over a ten-year time horizon (stable or increasing job numbers) and projected change in wage (stable or increased wage, compared to the current wage in the starting job). Projections for these two factors were based on official data from the US Bureau of Labor Statistics (see Annex: Report Methodology for technical details).

Based on the official 2016-2026 employment change baseline scenario of the US Bureau of Labor Statistics,⁸ our *Towards a Reskilling Revolution* analysis found that—allowing only transitions to jobs with increased or stable income—95.3% of the 1.44 million individuals in jobs which will undergo a period of disruption until 2026 would be able to find a viable and desirable job transition. However, the average additional work experience and education required for a successful transition was up to two years, indicating that these transitions typically require

Table 5: Components of a job

Content	Aptitudes	Experience
Work activities are the range of tasks that need to be accomplished within a job role.	Knowledge is the body of facts, principles, theories and practices that acts as a foundation for skills. Skills are used to apply knowledge to complete tasks: Cross-functional skills are skills required by a variety of job roles which are transferrable to a broad range of job roles. Specialized skills are particular to an industry or a job role and are not easily transferable (e.g. skills related to the use, design, maintenance and repair of technology). Abilities are the range of physical and cognitive capabilities that are required to perform a job role.	Time spent in education is the duration of time spent gaining knowledge and skills through a formal route of training. Years of work experience are the years spent forming and improving skills to apply a given knowledge through on-the-job practice. Years of job family experience are the years of work experience to date that have been spent within related professions that exhibit similarities in their required skills, knowledge and overall profile.

Source: World Economic Forum, *Towards a Reskilling Revolution*, 2018.

Note: Elaboration based on taxonomies by Burning Glass Technologies and Occupational Information Network (O*NET).

Table 6: Examples of high, medium and low similarity jobs

Starting job	'Job-fit' category	Similarity score	Target job
Office Clerks, General	High	0.92	Municipal Clerks
	Medium	0.87	First-Line Supervisors of Office and Administrative Support Workers
	Low	0.81	Aerospace Engineering and Operations Technicians
Cooks, Fast Food	High	0.93	Dining Room and Cafeteria Attendants and Bartender Helpers
	Medium	0.86	Butchers and Meat Cutters
	Low	0.82	Locksmiths and Safe Repairers
Electrical Engineering Technicians	High	0.91	Electrical and Electronics Repairers, Powerhouse, Substation and Relay
	Medium	0.86	Geothermal Technicians
	Low	0.81	First-Line Supervisors of Agricultural Crop and Horticultural Workers
Computer Programmers	High	0.92	Web Developers
	Medium	0.86	Computer and Information Systems Managers
	Low	0.82	Anthropologists

Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Note: Data in this table presents the approach taken to categorizing the potential transitions between jobs by a similarity score calculated in 2018. An updated calculation model was used in the 2019 edition as well, to identify viable and desirable job transition pathways.

a larger timeframe than normal trainings willingly offered by most employers today.

For this reason, the present publication extends the initial model utilized in last year's report in two important ways: by incorporating a tool for quantitatively evaluating the costs and benefits of potential job transitions from an employer and government perspective, as well as by providing a holistic guiding framework for making reskilling and upskilling decisions. The central goal of the present report is to both quantitatively demonstrate the existence of

a genuine business case for a reskilling evolution and to showcase how decision-makers may utilize a data-driven approach to turn these abstract opportunities into tangible action.

Our approach this year aims to extend the model presented in last year's *Towards a Reskilling Revolution* report into a more concrete instrument, which decision-makers may use to make better choices regarding job transitions. Through the addition of a cost-benefit component, we aim to show that reskilling is a worthwhile

endeavour for companies, governments and society not only in principle, but that many reskilling efforts for displaced employees are of tangible financial value for companies and governments.⁹ Conversely, it is also of vital importance for companies and potential funding collaborators to know which transitions do *not* offer a positive cost-benefit-balance for individual employers from the outset and might therefore need additional incentives or subsidies to make them possible as well as a broader mindset of social responsibility on the part of business.

The report's holistic framework shows how companies and their broader ecosystem—government entities, industry associations, labour unions and private and public educational institutions—should prepare for the challenges and opportunities that the Fourth Industrial Revolution brings and suggests a concrete approach to taking action through industry-level task forces. Our analysis urges companies to focus on reskilling employees in declining jobs, upskilling large portions of the workforce, attracting and retaining new talent to fill crucial future roles and creating an ecosystem which supports these tasks and facilitates a culture of life-long learning.

The report is structured into two major sections:

Part 1: From Business Case to Action and **Part 2: Industry Roadmaps**. Part 1 first details the business case for reskilling from a company and government perspective through an innovative quantitative cost-benefit analysis building on the model used in our *Towards a Reskilling Revolution* report. It then highlights priority actions to prepare for the future of work based on more than 60 qualitative, in-depth interviews and consultations with industry practitioners and experts participating in the Forum's Preparing for the Future of Work Industry Task Forces. Part 2 contains industry-specific roadmaps to prepare for the future of work, collected through the Forum's bi-annual *Future of Jobs Report* and other complementary research efforts: technologies the industries plan to adopt; the resulting impacts on the workforce; the barriers for adoption and the top declining and emerging jobs. Moreover, based on our Reskilling Revolution model, we offer concrete information related to the transition opportunities for displaced workers and options for filling key strategic skills gaps for the companies from within the existing workforce. Lastly, we suggest key anticipatory actions to be taken by specific industries, following our overarching recommendations.

Part 1

From Business Case to Action

From Business Case to Action

The Business Case for a Reskilling Revolution

One of the major challenges with up- and reskilling from a company perspective is that there is currently very limited reliable information available about the business case and the return on investment of such efforts. This lack of clarity on where and how much to invest also creates a similar challenge for employees, who don't know how much to invest themselves, and for potential financial supporters of up- and reskilling efforts such as specific government entities and programmes, associations and labour unions. Accordingly, a central goal of the present report is to both quantitatively demonstrate the existence of a business case for a reskilling revolution and to show how decision-makers may utilize a data-driven approach to turn these abstract opportunities into tangible action.

Creating an accurate, data-based business case for reskilling is not an easy task. On the one hand, a lot of the benefits of reskilling to individuals, companies, governments and society at large are difficult to capture in a quantitative model. For example, personal growth, increased loyalty to the employer, a more mobile labour market and social cohesion are all possible benefits that derive from ensuring the reskilling of employees that are currently in roles that are destined to be disrupted by new technology integration. On the other hand, even with those variables that are easier to quantify and put in a model, there are so many specific aspects of each labour market, company and region, that the transferability of a model to a different reality can be challenging.

To date, there have been very few independent studies on the costs and benefits of reskilling.¹⁰ Training providers have been among the few stakeholders to publish substantial work on the costs and benefits of reskilling,

typically with a focus on in-house tools. However, the need to create a methodologically sound, objective and easy-to-adopt cost-benefit model for reskilling has been identified as a key to scaling such efforts by companies and policy makers alike.

In light of this, this report seeks to demonstrate that there can be a methodologically sound model that can indicate an initial estimate of the return on investment of any reskilling effort and provide decision makers with a valuable tool to assess the cost-benefit balance of specific reskilling initiatives. Corporate strategic workforce planners and policy-makers may use such a model to plan how to meet the needs of the future labour market and deal strategically with the impact on employees whose jobs are being disrupted. For this publication, we have looked at the labour market of the United States as an example, using data from our partner Burning Glass Technologies, the Bureau of Labor Statistics and specific US government agencies.¹¹

We aim to provide data-driven answers to two central questions:

1. From a company perspective, what are the costs and benefits of reskilling current employees as opposed to going through a firing and hiring process?
2. From a government perspective, what are the costs and benefits of reskilling parts of the at-risk workforce, who might otherwise not find a job for an extended period of time?

As companies and governments consider their options to resolve these questions, they have to take into account the costs and benefits linked to each option (see Figure 3). Reskilling expenditures represent a significant investment, which can only be repaid at a later point in

Figure 3: Two main stakeholder perspectives and questions for the cost-benefit analysis

	Company perspective		Government perspective
Question	What are the costs and benefits of reskilling current employees as opposed to going through a firing and hiring process?	What are the costs and benefits of reskilling parts of the at-risk workforce, who might otherwise not find a job for an extended period of time?	
Option 1	Reskilling the employee within the company.	Reskilling the employee into another company.	
Option 2	Letting the employee go and hiring external talent.	Paying direct and indirect welfare costs.	



Funding reskilling instead of firing and hiring¹

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Reskilling expenditures

Reskilling costs covered by the company for the complete time of the reskilling.

Missed productivity

During the reskilling, the company continues to pay wages to the employee, but does not receive their full productivity.

+

Avoided severance and hiring costs

When reskilling instead of firing and hiring, severance and hiring costs are avoided.

Share of increase in productivity

After reskilling, wage increases for the new position are shared between company and employee.²

Avoided reduced productivity of new employees

Employees new to the company or industry have reduced productivity compared to reskilled internal employees.



Funding reskilling instead of welfare spending³

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Reskilling expenditures

Reskilling costs covered by the government for the complete time of the reskilling.

+

Avoided welfare payments

By reskilling, which enables job transition, government avoids welfare costs.

Gained taxes

By reskilling, which enables job transition, government can collect taxes on employee's future wage.

Sources: World Economic Forum and Boston Consulting Group.

¹ This assumes that the majority of the costs are covered by the company.

² According to efficiency wage theory, as an employee is upskilled his or her productivity increases, and this increase may be distributed between the company and the employee.

³ This assumes that the majority of the costs is covered by the government.

time.¹² Companies know that the benefits not only have to outweigh the direct expenditures, but also the missed productivity during the reskilling. On the other hand, tangible benefits for companies include avoiding severance and hiring costs, sharing in the increase in productivity from the reskilling and avoiding the reduced productivity of new employees. These monetary factors are in reality bolstered by ‘soft’ benefits like positive PR effects, the ability to attract better future candidates, a continued historical knowledge base and an improved motivation of the current workforce (which were not included in our calculations). The government, in addition to potentially reducing unemployment, creates monetary benefits by avoiding welfare payments and gaining future tax payments.

To be able to provide a methodologically sound answer to all of these questions and create a tool that can be useful for decision-makers, we followed a number of steps. At first, we selected all the declining jobs that would necessitate reskilling and transitioning to a new job. Secondly, based on our Towards a Reskilling Revolution model, we identified all viable and desirable job transitions, and then calculated their cost-benefit balance¹³ with regard to reskilling both from a company and a government perspective. These calculations were based on analyzing the costs and benefits to each stakeholder, as described in Figure 3. This allowed us not only to estimate the cost-benefit balance of every reskilling effort, but also to have a high-level overview for companies and governments, identifying how many of the workers in jobs with declining numbers can ultimately benefit from reskilling programmes that have a positive cost-benefit balance for these stakeholders.

The results of the model are displayed in categories which allow companies and the government to rate single transitions on a simple cost-benefit balance scale:

Strongly positive + \$10,000 and above
 Positive.....between \$0 and + \$10,000
 Negative.....between \$0 and –\$10,000
 Strongly negative..... –\$10,000 and below

The **outcomes of the model** described in this report are to be understood as one of many possible scenarios. Changing a single factor or assumption would lead to a different outcome. We urge each stakeholder to use the method and assumptions stated here to create their own model and to reach their own conclusions. The viable and desirable transitions, which were the basis of this model, also depend strongly on the workforce projections which are used.

The company perspective

The macro view for job transitions for company stakeholders is depicted in Figure 4. This view of all possible transitions from all 958 starting job roles (lines) to all 958 target job roles (columns) symbolizes the number of opportunities each employee has, and at the same time illustrates for companies the difficulty of deciding on which employees to financially support for their reskilling. White spaces indicate non-viable and/or non-desirable transitions. Blue indicates a positive cost-benefit balance and grey a negative one. Looking at the matrix it becomes apparent that, even among the viable and desirable transitions, there are more with a negative cost-benefit balance and that within job families, transitions have a higher chance of generating a positive cost-benefit balance. This cost-benefit calculation, or a similar one adjusted to the specifics of the company in question, allows decision-makers to use a breadth of information and analyse the results of any given transition. In the sample ‘zoom-in’ displayed in the figure, the resulting balance for transitions from jobs in Office and Administrative Support functions to jobs in Business and Financial Operations is displayed. Decision-makers in companies face three possible transitions with a positive cost-benefit balance when trying to reskill Freight Forwarders (zoom-in of Figure 4), training them to become 1) Licensing Examiners and Inspectors, 2) Customs Brokers or 3) Title Examiners.

With another perspective, Figure 5 reveals that 25% of all workers in disrupted jobs could be reskilled into a new position with a positive cost-benefit balance for companies, following one of the viable and desirable transitions identified (11% of all available options). This means that without taking into account the significant societal benefits of reskilling the workforce and the company benefits of avoiding a firing and hiring strategy, for 25% of employees in jobs that will be significantly disrupted by automation and additional factors, it would be in the financial interest of a company to take on their reskilling efforts. More specifically, our model shows that, with an investment of US\$4.7 billion, the private sector in the US could reskill 25% of workers expected to be displaced by technology into growing jobs with an overall positive cost-benefit balance. Using this, companies can have a clear incentive and a good starting point in investigating the exact cost-benefit balance of specific job transitions.

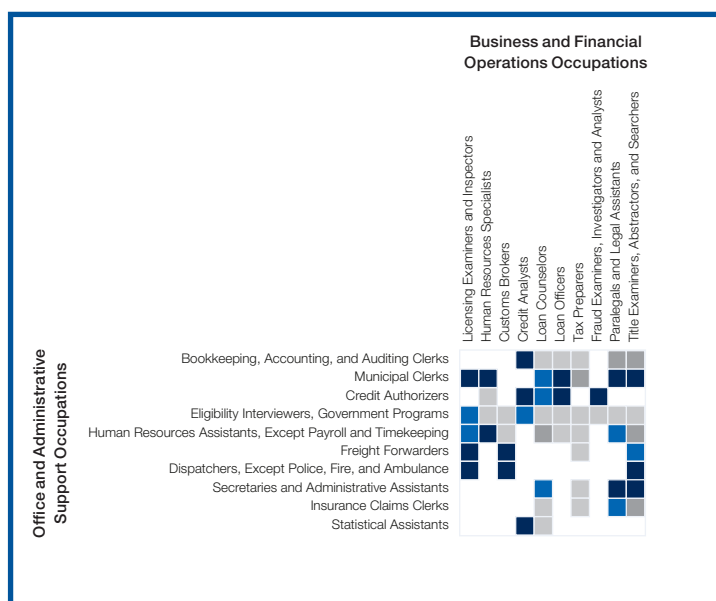
Table 7 highlights a selection of transitions with strongly positive cost-benefit balances from a company perspective. The highest positive results are achieved when the reskilling leads to a large wage increase (which, ultimately, also brings a lot of benefits to the company in terms of productivity gain, but at the same time does not require an unrealistic step change in terms of knowledge and skills). For example, according to BLS projections, Credit Authorizers will undergo a reduction of 2,600 jobs in the next 10 years in the US labour market, but they may be able to become Credit Analysts, which BLS projects to

Figure 4: Macro view for company perspective: Matrix overview of transitions with positive and negative cost-benefit balance



Cost-benefit balance

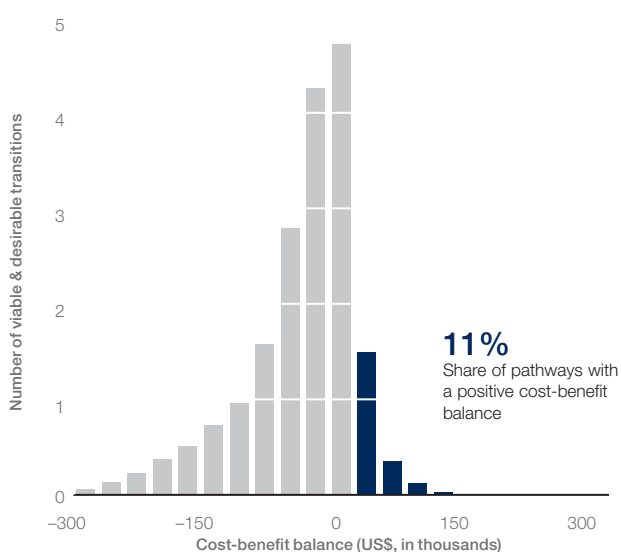
- Strongly positive
- Positive
- Negative
- Strongly negative



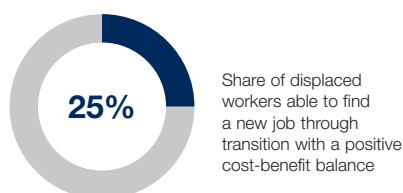
Sources: World Economic Forum, Boston Consulting Group, Burning Glass Technologies, and US Bureau of Labor Statistics.

**Figure 5: Macro view for company perspective:
Histogram of transitions with positive and negative
cost-benefit balance**

Outcomes across job transition pathways



Outcomes for impacted workers



Sources: World Economic Forum, Boston Consulting Group, Burning Glass Technologies and US Bureau of Labor Statistics.

gain 6,100 jobs during the same period. This reskilling will lead to an increase in wages by US\$42,000 per year.

As the assumptions in the model presented here are currently US-specific, the monetary and regulatory barriers to firing employees and hiring new candidates are relatively low compared to some countries and higher than others. Therefore, the business case for reskilling might change significantly across different geographies. In some economies for example, firing an employee is tightly regulated and entails very high costs, making reskilling a more financially attractive alternative for the company. The existing model can be easily adapted to more accurately reflect the situation in other countries, affecting the amount of transitions resulting in a positive cost-benefit balance after these adjustments.

The government perspective

The government has a different quantifiable ‘business case’ or opportunity cost involved: not reskilling someone whose job is disrupted may result in years of welfare payments as well as missed opportunities for taxation—as well as a range of costs that are harder to quantify, such as the effect of job displacement on the families of those displaced and on health. For this reason, many more transitions result in a positive cost-benefit balance when taking this perspective: Figure 6 showcases this effect through a macro view while Figure 7 shows that it would make financial sense to the US government to reskill 77% of all workers in disrupted jobs into a new job, following one of the viable and desirable transitions identified (60% of all available options). Such reskilling efforts not only bring enormous societal benefits,

Table 7: Roles with strongly positive cost-benefit balance (company perspective)

Starting job	Job decline	Target job	Job increase	Wage increase
Purchasing Agents, Except Wholesale	-17,300	Purchasing Managers	4,100	\$53,000
Credit Authorizers	-1,000	Credit Analysts	6,100	\$43,000
New Accounts Clerks	-2,600	Loan Officers	36,500	\$41,000
New Accounts Clerks	-2,600	Sales Agents, Financial Services	22,000	\$60,000
Respiratory Therapy Technicians	-6,100	Diagnostic Medical Sonographers	15,600	\$22,000
Laundry and Dry-Cleaning Workers	-800	Solderers and Brazers	700	\$19,000
Desktop Publishers	-2,000	Film and Video Editors	5,600	\$39,000
Locksmiths and Safe Repairers	-900	Transportation Vehicle, Equipment and Systems Inspectors, except Aviation	1,300	\$31,000
Purchasing Agents, Except Wholesale	-17,300	Compliance Managers	2,500	\$44,000
Textile Bleaching and Dyeing Machine Operators and Tenders	-1,900	Painters, Transportation Equipment	3,900	\$17,000

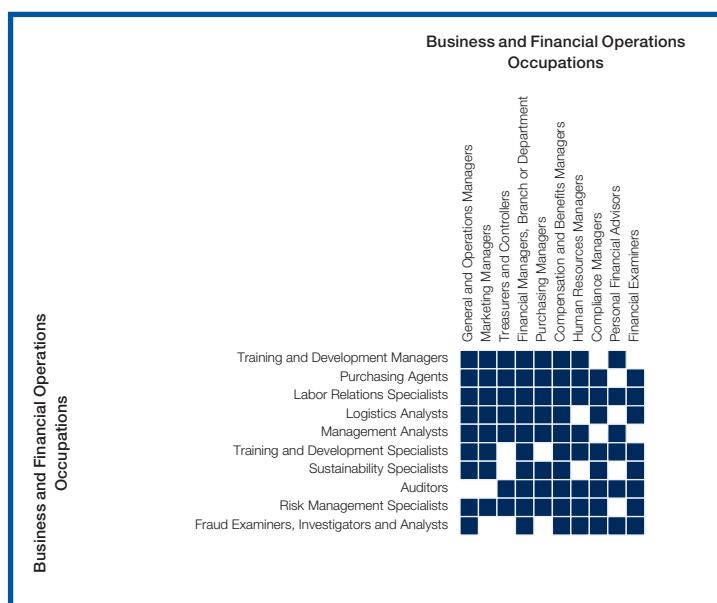
Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Figure 6: Macro view for government perspective: Matrix overview of transitions with positive and negative cost-benefit balance



Cost-benefit balance

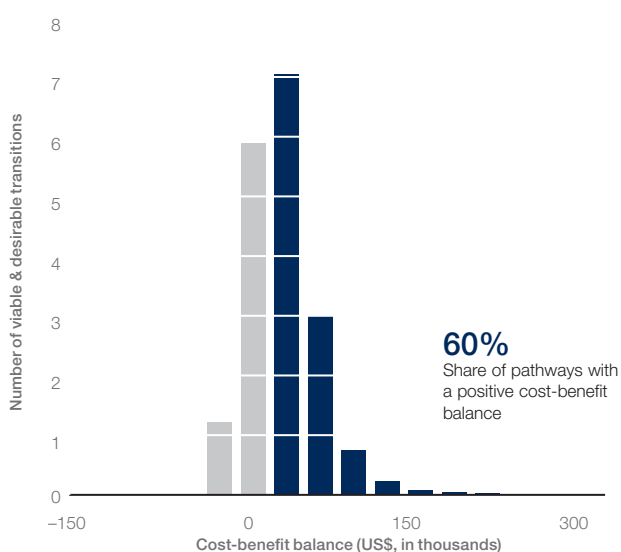
- Strongly positive
- Positive
- Negative
- Strongly negative



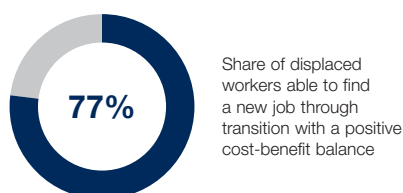
Source: World Economic Forum, Boston Consulting Group, Burning Glass Technologies and US Bureau of Labor Statistics.

**Figure 7: Macro view for government perspective:
Histogram of transitions with positive and negative
cost-benefit balance**

Outcomes across job transition pathways



Outcomes for impacted workers



Sources: World Economic Forum, Boston Consulting Group, Burning Glass Technologies and US Bureau of Labor Statistics.

but may also actually be a financially sounder option for the government, than not taking any action, since it would generate significant gains through additional higher future tax earnings. Our model shows that, with an investment of US\$19.9 billion, the US government could reskill 77% of workers expected to be displaced by technology into growing jobs with a positive cost-benefit balance.

The sample zoom-in for Figure 6 shows that many job transitions with a strongly positive cost-benefit balance exist for workers who want to transition within Business and Financial Operations. For example, Labor Relations Specialists are presented with 10 such highly feasible transitions in this zoom-in alone. Building on this, Table 8 shows selected transitions with a highly positive cost-benefit balance from a government perspective. For example, according to BLS projections, travel agents will see a reduction of 7,400 jobs in the next 10 years in the US and could be reskilled to Sales Agents, which will gain 22,000 jobs. This transition would lead to a wage increase of US\$56,000 per year and thus create a sizable amount of future taxes for the government.

Benefits of industry and multistakeholder collaborative action

As mentioned, there are many variables in our model that, if set at different levels, would have a significant effect on how many of the viable and desirable job transition opportunities would have a positive cost-benefit balance for companies and governments with regard to investment in reskilling efforts.

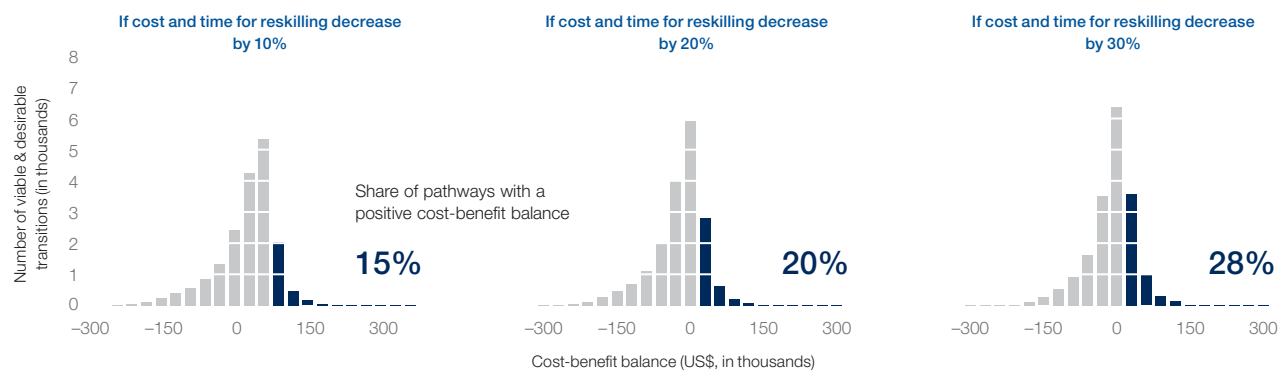
Table 8: Roles with strongly positive cost-benefit balance (government perspective)

Starting job	Job decline	Target job	Job increase	Wage increase
Water and Wastewater Treatment Plant and System Operators	-3,800	Stationary Engineers and Boiler Operators	1,700	\$15,000
Respiratory Therapy Technicians	-6,100	Cardiovascular Technologists and Technicians	5,500	\$6,000
Advertising Sales Agents	-4,300	Sales Representatives, Wholesale and Manufacturing, except Technical and Scientific Products	81,100	\$7,000
Broadcast Technicians	-1,100	Camera Operators, Television, Video and Motion Picture	1,600	\$15,000
Tax Examiners and Collectors, and Revenue Agents	-400	Accountants	107,100	\$19,000
Postmasters and Mail Superintendents	-3,000	Administrative Services Managers	28,400	\$27,000
Radio and Television Announcers	-4,500	Copy Writers	9,100	\$24,000
Tax Examiners and Collectors, and Revenue Agents	-400	Credit Analysts	6,100	\$24,000
Purchasing Agents, Except Wholesale, Retail and Farm Products	-17,300	Financial Examiners	5,100	\$23,000
Travel Agents	-7,400	Sales Agents, Financial Services	22,000	\$56,000

Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

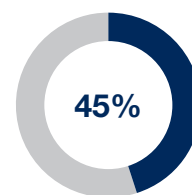
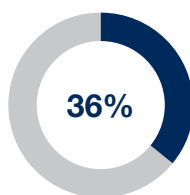
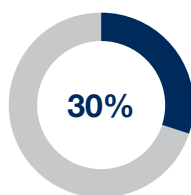
Figure 8: Economies of scale impact on cost-benefit balance (company perspective)

Outcomes across job transition pathways



Outcomes for impacted workers

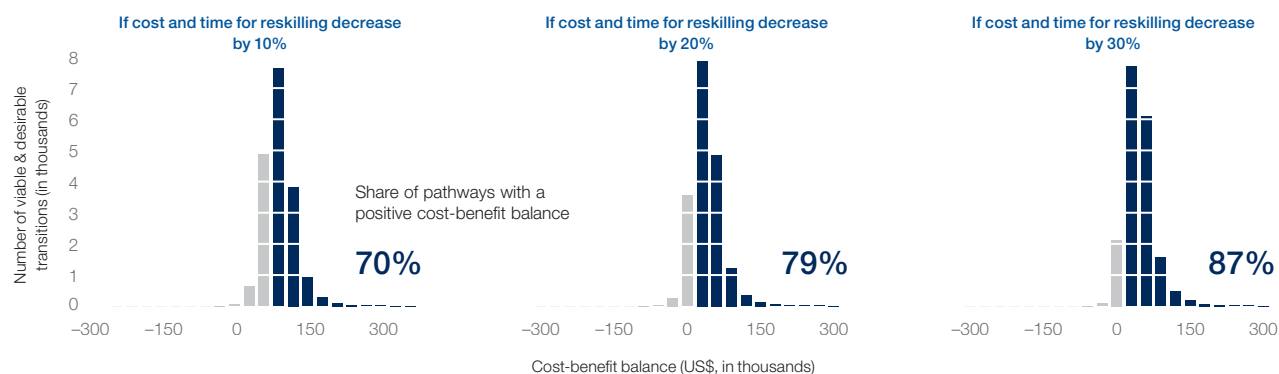
Share of displaced workers able to find a new job through transition with a positive cost-benefit balance



Sources: World Economic Forum, Boston Consulting Group, Burning Glass Technologies and US Bureau of Labor Statistics.

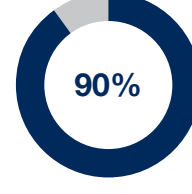
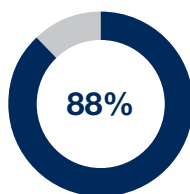
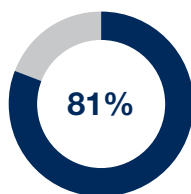
Figure 9: Economies of scale impact on cost-benefit balance (government perspective)

Outcomes across job transition pathways



Outcomes for impacted workers

Share of displaced workers able to find a new job through transition with a positive cost-benefit balance



Sources: World Economic Forum, Boston Consulting Group, Burning Glass Technologies and US Bureau of Labor Statistics.

One such key variable concerns the possible effects of a pooling of resources or combining of similar reskilling efforts, which leads to economies of scale and thus lowers reskilling costs and times, significantly impacting the number of workers who can be reskilled with a positive cost-benefit balance.

For example, some reskilling efforts can serve a large number of workers, while others are similar enough to profit from pooled resources, venues, and training providers. If economies of scale could reduce reskilling costs and time by only 10% through merging classes and targeted training of key skills, 15% of the transitions would already be worthwhile for companies to undertake, meaning 30% of at-risk workers could have the prospect of profitably reskilling within their existing company, as compared to 25% of workers without any collaborative multistakeholder action. And, if industry and multistakeholder collaboration could reduce reskilling costs and times by 30%, nearly half of the disrupted workforce (45%) could be profitably reskilled by the private sector in house (Figure 8).

From the government perspective, a 10% reduction of cost through economies of scale would translate into 70% of viable and desirable job transitions having a positive cost-benefit balance, meaning that the reskilling of 81% of disrupted workers would ultimately cover its own costs—as opposed to 77% without collaborative multistakeholder action—while a 30% cost and time reduction could see the transition of 90% of displaced workers having a positive cost-benefit balance (Figure 9). Therefore, there is a strong case to be made, both for intra-industry collaboration and government-industry collaboration, to reduce the costs and increase the reach of reskilling programmes. A reskilling revolution, bringing together large-scale initiatives from both the government and the private sector in the United States, could see 95% of the workers expected to be displaced by technology reskilled into growing jobs with a positive cost-benefit balance.

Priority Actions to Prepare for the Future of Work

Having outlined the genuine business case for a reskilling revolution and demonstrated how decision-makers could use a data-driven approach to appraise specific reskilling opportunities, this section of the report will outline a range of strategic priority actions that industry players—in collaboration with their broader ecosystem (policy-makers, educational institutions, industry associations and trade unions)—might take to move from these abstract opportunities to tangible action.

The recommendations in this section are the outcome of more than 60 in-depth interviews and consultations with industry practitioners and experts across five industries participating in the Forum's Preparing for the Future of Work Industry Task Forces. They range from business executives leading human resources and strategy departments to

deans of relevant academic departments, and from heads of trade unions and industry associations to key policy-makers.

An analysis of these experts' thoughts on challenges, opportunities and ideas for new solutions for each industry reveals a range of common trends, opportunities and priority actions that are very similar in nature for most industries, pointing to the potential of intensified intra- and cross-industry learning and collaboration. Three key workforce-related areas, in particular, emerged as critical to the continued success of an industry and its ecosystem (see Table 9):

1. Leverage strategic workforce planning
2. Shape the future talent pipeline
3. Optimize talent ecosystem conditions

The remainder of this section outlines these key recommendations and priority actions for companies in any industry to follow to prepare for the future of work.

Leverage strategic workforce planning

Conduct strategic workforce planning

A key challenge companies face in developing, upgrading and upscaling their upskilling, reskilling and recruiting efforts is that they do not have a clear idea of what skills and jobs will be needed in the future. Companies can address this challenge by going through a strategic workforce planning process.¹⁴ At a minimum, such a process should involve the creation or adoption of a job taxonomy and identification of strategic job functions; consideration of workforce attrition and retirement rates and demographic supply side factors; as well as simulation of future talent demand under a range of different strategy and growth assumptions, including technology and productivity developments as well as global and local economic, social, political and demographic trends as driving factors. Ideally, such a process should be scenario-based, combining different configurations of supply and demand side factors to identify possible future employment gaps across strategic job functions. By analysing a range of different scenarios, companies can identify those measures and actions which remain good choices in many of them, increasing the safety of long-term workforce investments, which may then serve as a basis for all future recruiting, outsourcing, upskilling and reskilling initiatives.¹⁵ A range of companies have begun going through such a strategic workforce planning and a range of helpful tools¹⁶ and methodologies exist to support such a process (see Lloyd Banking Group case study). However, for many others, such planning is still in its infancy, remaining overly based on short-term (quarterly or at most annual) time horizons and simple headcount statistics.

Table 9: Overarching recommendations

Leverage strategic workforce planning		Conduct strategic workforce planning Establish strategic skills mapping within jobs Close management knowledge gap
Shape the future talent pipeline		Develop targeted reskilling programmes Upskill on a large scale Homogenize skilling landscape Align educational curricula with skills needs
Optimize talent ecosystem conditions		Rethink organizational structures Transform culture to attract and retain next generation talent Develop a culture of lifelong learning Boost diversity

Sources: World Economic Forum and Boston Consulting Group.

Lloyds Banking Group's strategic workforce planning exercise

Lloyds Banking Group is a UK financial services provider. In 2018 it unveiled its latest strategic phase which focused on meeting changing customer demands in a rapidly evolving external environment. With more than £3 billion of strategic investment over three years, the strategy focused on four pillars—one of which was to transform the way the bank works and to ensure that the bank has the right balance of new skills required in financial services. The bank conducted a strategic workforce planning exercise to identify the roles and skills that would be required in the future. It concluded that the majority of the Group's employees would require new skills over the next three years. It identified 10 skills that would be particularly important including new skills, such as agile project management and artificial intelligence, alongside more traditional customer service, relationship management and leadership skills. As part of its new strategy, the Group has made a public commitment to deliver an additional 4.4 million hours of learning and development for employees to help build these skills over three years, which would be delivered through a range of Group-wide and divisional initiatives. In 2018, the Group launched new online learning hubs, new role-specific development programmes and new capability-led graduate and apprenticeship programmes. Alongside these initiatives, the Group has also launched a campaign to encourage employees to learn based around four common reasons why employees choose to develop: Change, Curiosity, Challenge and Career. This campaign was supported by a network of 300 learning champions (from within the Group), a dedicated social media site and a quarterly magazine.

Establish strategic skills mapping within jobs

In addition to more generalized strategic workforce planning, companies can upgrade their future workforce preparedness by creating or adopting skills taxonomies which will allow an evaluation of their employees' current skills and mapping them against the skills that will be critical for the company in the future. Such skills models should be designed using standardized tools, and employee skills assessment must be carried out through well-defined, iterative processes to ensure usability for companies. By combining the benefits of strategic workforce planning and strategic skills mapping, companies can assess the overall level of the upskilling challenge for existing employees. Skill needs will be at different levels for each job role, and companies will need to determine if basic awareness, intermediate proficiency or advanced mastery is required.

Although companies may implement strategic workforce planning and skills mapping exercises individually, there are clear advantages to taking action on an industry-wide scale, involving multiple stakeholders. At the industry level, companies can cooperate, for example, by creating common anonymized data pools of jobs and skills information, possibly operated by third-party providers. Industry-level skills committees may then discuss the most relevant future skills and ongoing efforts to up- and reskill the workforce in these areas. Such committees can carry out any future scoping tasks much more precisely than individual parties, whether those tasks involve identifying at-risk jobs and missing skills or covering the costs of up- and reskilling. Similarly, collaborating with trade unions may help reach a much larger percentage of the workforce, contribute to the accuracy of the data provided and increase awareness among

employees of emerging skills gaps. Collaborating with local and national government bodies could likewise allow a comprehensive mapping of local, regional and national workforce skills, bringing unprecedented clarity of the reskilling and upskilling needs for all stakeholders involved and allowing targeted smart investments in reskilling and upskilling initiatives. For example, a multistakeholder group in the British oil and gas industry constructed a version of such a platform.

Initiation of the Talent Retention Services platform by a multistakeholder group to support job transitions for oil and gas industry workers

The British oil and gas industry is one of the country's largest economic players and employs a well-trained workforce. Falling oil prices in recent years have had a significant negative impact on the sector, and the number of people employed began to decline. For this reason, the government—in collaboration with leading sector organizations, corporations and universities—set up a portal to take care of both affected individuals at risk of losing their jobs and companies looking to recruit. The Talent Retention Solution (TRS) portal is run and supported by employers and universities. It monitors the attraction, development and retention of an experienced workforce across science, technology, engineering and mathematics sectors in the UK. Furthermore, the TRS portal contains a platform on which individuals may search for new positions and be approached by interested companies. Recruiters have direct access to the individual profiles and CVs of these experienced employees with transferable skills. TRS also operates in the UK Rail, Nuclear and Aerospace Industry.

In addition, based on the strategic workforce planning of several companies and the estimated future industry-wide impact of specific technologies, adaptable tools should be created in cooperation with government and public agencies which would allow for the calculation of changes in sector needs over the long term (five years and more). CyberSeek is an example of such a collaborative approach in the field of cybersecurity.

CyberSeek illustrates the short- and long-term skill gaps for cybersecurity¹⁷

Today's shortage of cybersecurity employees in the United States results in a lack of security for digital privacy and infrastructure. Data reveals that more than 200,000 job postings require cybersecurity-related skills and that employers have difficulty filling these positions. To bridge this cybersecurity skill gap and improve the talent pipeline, CyberSeek was established with the support of the National Initiative for Cybersecurity Education (NICE)

programme of the US government. CyberSeek is an interactive tool that provides detailed data about supply and demand in the cybersecurity labour market. For example, it illustrates skill gaps in the form of a heat map in which regions are coloured according to their demand for cybersecurity workers. In addition, the tool contains career pathways aligned to the NICE Workforce Framework, which allows users to explore common cybersecurity jobs and identify opportunities. CyberSeek can support local employers, educators and career counsellors, students, job seekers and current workers, policy-makers and other stakeholders by identifying the challenges and opportunities which the industry faces.

Close management knowledge gaps

The majority of senior and middle managers have limited knowledge of new digital technologies and their potential uses, and thus have limited understanding of how to leverage these technologies effectively to set a sound strategy for their business units and of how to integrate relevant digital talent in their teams. This makes targeted digital upskilling of management crucial to any effort aimed at creating a workforce that is prepared for the future. Closing such knowledge gaps will enable managers to make more informed decisions regarding whom to recruit at what point in time. Acquiring the talent needed to incorporate new technologies into current business models is a major challenge. Technology professionals such as data scientists, machine learning specialists, robotics technicians and blockchain experts are scarce and sought after by almost every industry. Industries that have management with an understanding of how to use their skillset in a meaningful way will gain a competitive advantage in attracting them. On an industry-wide level, companies should cooperate in creating future technology and skills boot camps for managers, to exchange ideas and good practices on integrating talent with emerging digital skills into their teams and operations. These boot camps can help executives understand current and upcoming technologies, assess consequences for the workforce and adapt their strategy and decision-making early on.

L'Oréal: Enabling leadership to create a digital strategy and prepare the workforce for the future¹⁸

L'Oréal noticed that the company and the workforce needed to grow to be ready for the digital age, and with this in mind created a leadership development programme. The goal of this programme is to provide executives with the knowledge and attitude to prepare L'Oréal for the future changes. The top 1,000 executives took part in a range of events aimed at empowering them to develop digital road maps for their offices and regions, and to create a more open, innovative and agile culture that their office

and workforce need to have to execute this strategy. Furthermore, more than 14,000 employees have completed an upskilling programme consisting of online lessons and workshops developed in collaboration with General Assembly. These learnings include skills such as search engine optimization, digital media allocation and digital analytics in order to design a baseline of digital knowledge for every employee. To stimulate employees to participate in the programme, the company employs a variety of tactics, including gamification, incentives and executive communications. The Digital Transformation Learning Director at L'Oréal strives for a global completion rate of 90% against the recommended track of the upskilling programme.

Shape the future talent pipeline

Develop targeted reskilling programmes

The results of strategic workforce planning may help reveal which job families will be in less demand in the future. Historically, many companies have opted for redundancy plans when concluding that a certain set of job roles will no longer be needed, especially in countries with flexible labour laws such as the United States. However, as demonstrated in this report, reskilling frequently represents a much more sustainable, responsible and even profitable alternative, especially for job transitions where a positive cost-benefit balance can be generated. For example, Amadeus has identified specific transitions for customer service representatives and started a reskilling campaign.

Amadeus is striving to redeploy customer service employees through up- and reskilling

Amadeus, a major Spanish IT provider for the global travel and tourism industry, automated a significant part of its customer service offerings by employing machine-learning algorithms for chatbots and self-service in order to better serve clients, increase response times and availability of service, and improve overall efficiency. This transformation frees up resources in the area of standard support services. Wherever possible, Amadeus shifts affected employees to more complex areas of troubleshooting or departments such as sales support and pre-sales. The company's learning department created a modular training system along specified development paths that prepare employees for the next steps in their careers. A talent assessment of each employee helps Amadeus to identify skill level, skill mismatches and motivation in order to provide individual learning curricula with attention to the complete process rather than single events, thus allowing learners to build knowledge progressively. This approach has been proven to reduce time to full productivity by 30% to 50%.

One additional argument for reskilling is the scarcity of available talent in key roles of the future, such as data analysts and cybersecurity experts. As industry demand outpaces supply from the educational pipeline and will continue to do so significantly, filling these roles externally will become increasingly expensive and challenging for any company. Using a methodology such as the one presented in this report, companies can develop targeted reskilling programmes to create an internal pipeline for this type of talent. A range of companies interviewed for this report recommended using digital experts to work across the whole organization, rotating throughout different project teams and providing on-the-job training to their colleagues. During this process, they may also identify high-potential employees suitable for a combination of targeted reskilling, shadowing and mentoring in order to develop more of this talent internally.

For key job transitions, industry-wide retraining programmes can be piloted in collaboration with public or private learning institutions and training providers. Sharing learning infrastructure between companies significantly increases cost efficiency. Such an approach could also use impact measurement to determine which training is most effective and how it can be improved. A collaboration of the industry with government entities and academic institutions to develop large-scale subsidized programmes addressing local at-risk workforces can lead to the creation of an ecosystem where workforce employability is safeguarded, and societal and business benefits maximized. In the United States, for example, such a model was developed by Cargill and the broader training ecosystem of Columbus, Nebraska.

Multistakeholder collaboration between Cargill and the Columbus training ecosystem to reskill factory workers

In 2015, Cargill decided to upgrade one of its plants in Columbus, Nebraska and close it for nine months. Until December 2015, the plant had employed 240 people processing meat. Around 160 production workers were let go, but the company decided that it was in its—and the broader community's—best interest to ensure that they acquired the skills that would make them employable in the new plant. Most of these employees had limited English language and literacy skills, fewer than half had reliable access to the internet and only 56% had finished a high school education. The company set out to identify the right partners in the broader training ecosystem. A key partner was Columbus' Central Community College, which took a central role in developing the reskilling programmes. A multistakeholder coalition was developed, with local and state labour officials, the Nebraska Department of Education, the Educational Services Unit network, the Columbus Family Resource Center, Platte

Valley Literacy Services, the Cargill team and Central Community College, all pooling resources and developing a detailed reskilling plan. Every employee affected by the plant shutdown had the option to enrol in 36 weeks of classes (five days a week, five hours per day). Production workers could study English, computer skills and financial literacy; managers could learn Spanish and take leadership courses; while those with advanced skills could take college-level courses for credit. For employees staying on, the programme helped develop the skills needed to run high-tech equipment. For those not wanting to stay on, it would simply provide a programme that would help them find a different job. One-hundred sixty-eight workers enrolled in the programme, and when the plant reopened in January 2017, about 90% of those who were laid off returned to the new plant in higher-skilled positions. Overall, employment more than doubled and almost all new positions paid better to reflect the higher skill requirements.

Upskill on a large scale

One emerging key challenge that companies are increasingly faced with in the era of technological disruption is a need for company-wide employee upskilling. Technological change will affect almost all jobs, making both digital literacy and human-centric skills indispensable. A wide range of companies have begun to acknowledge that fundamental changes to their training are essential in order to teach these skills to most of their employees. To meet this large-scale upskilling need, companies should develop customizable training modules focusing on digital disruption that are available to all employees. Alternatively, digital platforms with online training options provide a low-cost entry solution for companies. However, online learning alone is often not effective and a blended training approach,¹⁹ where online training is accompanied by classroom modules, on-the-job training and mentorship programmes, frequently offers the greatest potential for impact. Walmart, for example, introduced an elaborate upskilling programme. Cooperation at an industry-wide level may reduce the cost of these training activities through economies of scale and co-finance the development of technology applications that can also be used by the less digitally-savvy part of the workforce. In cooperation with governments and academic institutions, large-scale, subsidized programmes might address the knowledge gap for basic digital skills among entire communities, and enable the creation of local, regional or national agile labour markets.

Walmart's grand-scale upskilling initiative

Walmart, the American multinational retail corporation, identified the need to transform its operational model and its workforce to meet the changing needs of customers and the new needs created by the integration and use of new technologies. In 2016, Walmart launched the Walmart Academy programme in the U.S. as a dedicated training programme utilizing the sales floor to train associates in areas that include advanced retail skills, leadership and change management. In two years, the U.S. programme has grown to encompass salaried managers and market-level positions, bringing additional training programmes in house and influencing other areas of the business and how they are training their associates. Introducing the use of new technologies as part of the training programme (using smart tablets instead of text books; using virtual reality in training modules, having virtual simulation games as part of the process, etc.), Walmart has succeeded in making its academies a very attractive option for employees. By the end of 2018, more than 720,000 U.S. associates had already gone through an academy programme.

The benefits of upskilling are not always clear to employees, making them sceptical about sacrificing time for learning activities. In some companies and even some industries, continuous learning is not part of the culture, and in some teams, it generally does not take place at all unless necessary for safety or licensing reasons. Companies need to face this challenge head-on by designing effective and attractive upskilling programmes with minimal barriers to entry for employees. This goal may be achieved by utilizing innovative and engaging training practices: micro-learning (small learning units which come in three-to-five-minute sessions and can be strung together at will), nudges (positive reinforcement and indirect suggestions as ways to encourage learning), badges (validated indicators of skill earned in the learning environment) and gamification (use of game elements in learning environments). Companies need to create a sense of urgency by sharing detailed information about declining roles and possible transition opportunities. Strategic workforce planning must be translated into HR practices and shared with all employees, who tend to have still less insight than companies when it comes to future skills needed. Only long-term efforts can generate the desired cultural shift. In close cooperation with any relevant trade unions, companies should strive to make up- and reskilling an integral part of the employee culture and to communicate clearly its urgency and advantages. In Germany, for example, an alliance of several stakeholders goes beyond this recommendation and not only informs employees but also upskills them with the aim of improving regional competitiveness.

Alliance for Industry 4.0 prepares their employees for emerging skills and workplace changes²⁰

The Baden-Württemberg region in Germany, where many world leaders in mechanical engineering and manufacturing are situated, has begun to experience the labour market impact of advanced technology and automation. For this reason, in 2015 a number of companies, associations, educational institutions and unions formed an alliance, the goals of which are to examine the impact of new and emerging technologies and then support employees through specific training programmes conducted jointly by research institutions and companies. Additionally, the German federal government delegates responsibility for ensuring the provision of skilled labour for the regional economy to the states. One of the alliance's primary aims is to avoid significant skills mismatches. Accordingly, it defined several core objectives to address the following issues: improving vocational training and further education; boosting employment of women and older workers; reducing overall unemployment; supporting the integration of migrants into the job market; and increasing employment in engineering fields and building regional alliances.

Harmonize the skilling landscape

As well as identifying key skills of the future, companies should identify certified training courses that confer these skills and ensure the transferability of certifications within the company and industry. However, the global re- and upskilling landscape is highly heterogeneous. Organizations use different names to describe similar skills, while educational institutions and training providers offer certificates that are not benchmarked against one another. Therefore, it is often difficult for companies and employees to understand which certificates match the skills they need and how comparable these are, even in cases where certificates carry similar names. As skill requirements are constantly evolving, the selection and affirmation process will need to be iterative. One step entailing numerous synergies for employers and employees alike is to agree on certification content at an industry-wide or cross-industry level. This need not be done for all skills at once but should first be completed for the most pressing future skills. A possible starting point would be a pilot project for the development of digital skills within a specific job family. For example, Mozilla started Open Badges in 2011, which could be used as a model for industry-wide implementation. Similarly, the World Economic Forum's Shared Vision for Talent initiative provides a shared platform for cooperation between companies, academic institutions, reskilling organizations and others to create a common skills taxonomy.²¹

Mozilla created Open Badges to recognize learning achievements and contributions²²

Mozilla, a free software community promoting exclusively free software and open standards, and the MacArthur Foundation, which makes grants and impact investments to support non-profit organizations, have collaborated on the Open Badges project since 2011 to give individuals an opportunity to develop and grow using the internet. They aspire to create a software platform that will teach people digital skills and represent their progress, especially their mastered skills. Every learner on the platform, regardless of background and age, can acquire skills through a variety of formats, methods and organizations. Once an individual has successfully completed a training, she or he receives a badge containing data on the specific qualification and the issuing organization in a portable image file. This data plus information such as what the individual had to do to earn the badge or when it was issued can be shared and viewed by others. Earned badges can be posted to websites, blogs, job applications, social media and email signatures so that others can learn more about them. Open Badges now collaborates with thousands of partners, has a dedicated and international audience and aims to become the world's recognized skills currency by meeting the demand for an open, homogeneous ecosystem.

Align educational curricula with skills needs

Many corporate HR executives interviewed for this report stated that the curricula of educational institutions—starting with the earliest educational stages—are insufficiently aligned with the current needs of their industry, and even less with the future needs of the 4IR. Expert task force members likewise agreed that this is a major challenge for educational institutions, which—similar to companies—often lack understanding and clarity on future skills needs. Companies could meet this challenge indirectly by creating advanced onboarding trainings that shorten the time to full productivity for new graduates and by focusing on scaling internship and apprenticeship models, which can help teach additional relevant skills faster. One solution that can be explored within an industry ecosystem (and is currently piloted by some large companies individually), is the development of an industry-wide academy focussing on specific new skills key to growth. However, the most sustainable strategy would be to build long-term partnerships with universities and technical and community colleges, which can in turn create adult education courses that are flexible and tailored to the needs of the industry. A multistakeholder approach might involve the creation of industry skill boards at key academic institutions in a region, composed of HR experts from various companies, skills and training experts, trade union representatives and local policy-makers, to enable local educational institutions to collectively adapt their curricula to the needs of the local

labour market and the most important skills that will be needed in the future. In Rhode Island, for example, P-TECH was created with that exact goal in mind.

In Rhode Island, a multistakeholder group created a programme to align curricula and teaching methods with industry needs²³

P-TECH is a nationally recognized programme in Rhode Island based on collaboration between local high schools, community colleges, industry associations and companies in growing industries. The P-TECH initiative aims to prepare and train high school students for the future job market and its requirements. Students enrolled in the programme participate in university-level courses during their high school years, can complete internships with partner companies and are supervised by the company's employees. If the students finish the programme, they graduate with an industry-approved associate degree in addition to their high school diploma and an opportunity for a job offer at one of the partner companies. Business partners are closely involved by designing the training programme to make sure that the curriculum is relevant to the industry's future needs.

Optimize talent ecosystem conditions

Rethink organizational structures

Most of the experts and practitioners interviewed for this report believe that the traditional model of hierarchically-structured companies with function-based silos hampers the implementation of new, flexible ways of working. Companies strive for the introduction of agile ways of working, with modular, multidisciplinary teams consisting of multi-skilled employees working in flatter, more networked structures. To facilitate the successful formation of such teams, which can respond more flexibly to challenges, substantial structural changes to traditional organizational constructs are required. For example, AT&T experimented with more permeable organizational structures since the beginning of the firm's digital transformation. A potential additional benefit is that this might enable companies to attract and retain significantly more next-generation talent, because such employees will prefer the increased job mobility and task diversity that comes with working in agile environments, especially if they offer a variety of learning and development opportunities. As companies attract, retain and develop more employees with new skills and behaviours, this will also indirectly influence the organizational structure in the long term.

AT&T's programme to realize impactful digital transformation with new structures²⁴

In 2013, AT&T, the world's largest telecommunications company, recognized that it lacked talent in the areas of cloud-based computing and data science. Instead of recruiting externally, the company decided to focus on reskilling its current employees, adapting the organizational structure in order to make possible changes in job roles and create a culture of continuous learning. For this reason, AT&T initiated its WF2020 programme. The programme's first task was to identify the skills the company would require in the future and create roadmaps for internal acquisition of those skills. Next, role structures were simplified and standardized to increase job mobility by allowing for more lateral, diagonal, and both ascending and descending moves, giving employees greater control over their own career. This approach, which is often found in start-ups, was combined with the long-term plan to eliminate silos like marketing and finance and instead have small mixed teams work on concrete projects for specific amounts of time.

Another incentive for rethinking organizational structures is the potential for successful integration of platform workers into business models, which enables companies to reap the benefits of a wider labour ecosystem. Although the platform economy currently still faces a number of unresolved questions regarding employment conditions and social security contributions, collaboration among industries, labour unions and governments can help create the working conditions necessary for a truly dynamic and mobile labour market across industries to emerge. At an industry-wide level, a suitable solution would be to standardize processes in supporting functions to make possible common resources (platform workers) to serve the entire industry ecosystem. This strategy requires working with governments and labour unions to create attractive and sustainable working conditions for platform workers.

Transform culture to attract and retain next-generation talent

In addition to traditional hierarchical structures, another obstacle that companies must overcome to attract and retain talent across generations is the existence of traditional working cultures in their companies. Many industries suffer from the fact that younger employees with advanced digital and technology skills do not regard them as appealing work environments. In fact, experts from every single industry interviewed for this report voiced this concern—except for the tech industry. A company's location is often perceived as unattractive for young people, the 9-to-5 mentality is seen as not fitting their lifestyle and the work done is not perceived as meaningful or impactful. Companies in these industries need to make changes to accommodate the desires of the new talent pool. These

changes need to impact all HR policies including employee relations, career and performance management and compensation. Individual branding campaigns to change public perception are neither fruitful nor cost-effective. On an industry-wide level, companies can coordinate their cultural changes and invest in communication activities that slowly change young people's perception of the industry, thereby attracting more of this talent. In geographic regions perceived as insufficiently attractive, collaboration with local governments might help to improve living and working conditions. For example, Invesco pursued this approach in the Maritime Provinces of Canada.

Invesco entered public-private partnerships for regional reskilling and to attract new talent

The current workforce of the Maritime Provinces of Canada is mainly active in fishing and seasonal tourism. A Canadian public-private partnership between Invesco, an American independent investment management company, the province of Prince Edward Island and two local universities was established to attract higher-skilled jobs into the region. The two main goals of this ecosystem are to reskill the local workforce into higher-level positions and to attract additional new talent. The government motivated Invesco to expand into the area by providing incentives including low-cost rent for its buildings. The universities lent support by providing training for the new staff and the up- and reskilling of local employees. For Invesco, this was an opportunity to grow with well-trained people. The company immediately built a transfer agency and has since added IT, HR and operations. Its partnership resulted in a doubling of the initial workforce number, and Invesco is now considered one of the two top employers in the area.

Given that cultural change on such a massive scale is very challenging, it is worth highlighting three innovative approaches to this challenge that emerged out of the report's consultations: industry innovation hubs, collaboration with start-ups and company exchange programmes. Innovation hubs are shared working spaces with a distinct culture and unique working conditions. The hubs themselves could be run by an independent provider. The participating companies rent spaces within these hubs, while their stationed employees cooperate with employees from other companies for learning sessions and problem-solving exercises. A more far-reaching step is the outsourcing of relevant digital functions to start-ups or a separate entity, which can operate under different conditions and create their own culture to attract the desired talent. Finally, cross-company employee rotation programmes can be established, allowing a specific part of the workforce to bring back new ideas and practices to the company. While this might be a difficult endeavour for direct competitors, the programme can focus on

exchanges with companies within the industry's value chain or companies in completely different industries. Procter & Gamble and Google have entered into such a mutually beneficial exchange programme.

Procter & Gamble (P&G) and Google set up an employee exchange programme

In early 2008, P&G, an American multi-national consumer goods corporation, and the technology company Google started swapping talented employees to create a more creative and innovative workplace where employees can take part in the other company's training programmes and establish mutually beneficial relationships. In the first year, 24 employees from the two companies participated in the partner's curricula and business meetings, offering new methods, creative ideas and out-of-the-box thinking. As consumers are globally shifting to online channels, P&G's primary goal is to improve their employees' digital skills. This programme could provide the big consumer company with the knowledge and experience it needs to intensify its Internet marketing initiatives. For Google, on the other hand, the focus is on better understanding fast-moving consumer goods companies in general, becoming better business partners and reaping the potential benefits if P&G increases its internet marketing expenditures. Furthermore, according to the executives consulted, this initiative was a useful way to learn from each other as well as an innovative way of opening up the culture.

Develop a culture of lifelong learning

One of the biggest challenges associated with future workforce management is the speed of change expected due to skill and job disruptions over the coming decade. One-time reskilling and upskilling efforts will not be sufficient to deal with these transformations in the long-term. Companies and their ecosystems need to build a culture of life-long learning²⁵ which allows employees to continuously improve their competencies. Current structures, incentives and the culture in many companies are not conducive to this endeavour. There are a number of steps that may help companies be better prepared. Once a company has developed a suite of training programmes which employees can access, it needs to ensure that there is real buy-in and support from the top of the organization. From communicating the importance of training to actually taking time to train themselves, senior management must signal that learning is a key new part of the company's core culture. These efforts should be accompanied by the creation of learning KPIs and dashboards for the assessment of managers so that learning becomes a key task for both employees and managers. Unilever has taken a number of relevant actions to create a culture of lifelong learning within its workforce. Companies can thereby show that they are serious about the need for all employees to

invest time in upskilling. Measurement and visualization also create transparency for the workforce's current learning efforts. An online platform where employees can exchange ideas and teach one another different skills can also spark a mentality shift toward a culture of lifelong learning. Trade unions can be key partners in facilitating this mentality shift among employees, so companies need to work closely with them to design the right communication and dissemination strategy. Moreover, companies need to work with local governments and other relevant institutions to create ongoing educational opportunities for local communities, to ensure that their skills are iteratively aligned with the needs of the industry.

Unilever ambition for iterative upskilling and life-long learning

Unilever, the British-Dutch transnational consumer goods company, identified six skills for successful transition of the company to the digital age: digital awareness; data and analytics; agile delivery; channel and customer understanding; consumer and shopper connect; and sustainable business. In addition, it also decided to invest in ensuring that everyone can develop a growth mindset and adhere to a life-long learning culture. A critical component of this is purpose—which 30,000 Unilever employees have explored in a “discover your purpose” workshop—and leadership. A new leadership language, based on an individuals' inner game powering their outer game, puts purpose and curiosity at the heart of Unilever leadership. Following the identification of the key skills and behaviours using both internal and external resources the company developed a series of programmes for employees to develop these skills and behaviours. After just four months of the launch of these programmes, more than 15% of Unilever's workforce had engaged in the new learning activities with the ambition that more than 70% engage by the end of 2019. In parallel, deeper expertise programmes are being rolled out generically, and a strategy is in place to make the overall business' skills (including levels) visible to the wider organisation. At the same time, Unilever's Global learning team ensures that all programmes use a common process and framework when defining and measuring skills.

Boost diversity

It is increasingly evident that companies must be able to attract talent from all fields in order to be successful in the world of work of the future. Currently, there remains a vast untapped opportunity for most companies with specific demographic groups—ranging from women, to specific ethnic groups, to people with special needs and others—that can bring a competitive advantage to companies that move fast and in the right direction. All of the companies interviewed for this report stated that they had become more diverse in recent years and had set specific targets

and processes to do so—but most acknowledged that they could and should continue to do more to boost diversity, especially at the leadership level. An essential step for companies is to develop specific mentoring and leadership programmes for under-represented groups and to design processes that remove bias from the recruitment process. The detection and elimination of subconscious biases in the recruiting phase and the creation of an inclusive and respectful environment at work will be key to countering systemic discrimination against under-represented groups. Companies should collaboratively coordinate industry-wide campaigns celebrating diverse role models in order to inspire members of under-represented groups to enter career paths in the industry. In the realm of up- and reskilling, companies should cooperate with governments and associations to support under-represented groups in their journeys from the educational system to their career and professional progress. Best Buy, for example, has initiated several programmes for teens from minority groups.

Best Buy is preparing teens from under-represented communities for tech-related jobs

Best Buy, an American multinational consumer electronics retailer, has set a goal for 2020 of preparing one million teens in under-represented communities every year for technology-related jobs. To this end, the company designed a pathway consisting of three elements. The first component is called the Geek Squad Academy (for ages 12-14), which aims to spark interest in and awareness of technology-related courses and topics in a fun and interactive way. The Geek Squad Academy is a collaboration between local non-profits and organizations and reaches almost 10,000 children every year. The next element is the Best Buy Teen Tech Centres (ages 13-21), a free after-school programme that gives students a platform to explore and acquire technology-related skills that will help them become more employable. Lastly, Career Pathways (ages 17-21) is a training programme developed to help students gain technological skills in high-demand areas, e.g. cybersecurity and coding. The training programme consists of skills training and an internship at a local company. Furthermore, Best Buy designs the curriculum together with local companies and creates meaningful internship placements with the companies. Teens taking part in the programmes gain digital skills, but they will also receive a degree or credential that has real value on the job market so that they will have improved chances of becoming employed and/or receiving further educational and career advancement.

Part 2

Industry Roadmaps

User's Guide: How to Read the Industry Roadmaps

The following section outlines roadmaps for the five industries that piloted industry collaboration through the Preparing for the Future of Work project: Aerospace; Aviation, Travel and Tourism; Consumer; Financial Services; and Oil and Gas. They are created with the aim of providing specific practical information to decision-makers and experts from academia, business, government and civil society.

Each roadmap contains the following three parts:

1. An Industry Scorecard, where the reader can find industry-specific information on:
 - New technologies companies are planning to adopt in the next five years*
 - Barriers to the adoption of these technologies for the industry*
 - Top jobs related to these technologies for the industry†
 - Expected impact of this technology adoption on the workforce*
 - Top emerging and declining jobs for each industry‡
2. **A description of the industry transformation and the recommended focus for action.** In this section, we provide a qualitative profile of each industry based on both the data in its industry scorecard and its job transition pathways, as well as the areas of action that relevant experts in each task force highlighted for both individual companies and the broader ecosystem.
3. A selection of **job transition pathways** for workers in these industries, which outline:
 - Job transition opportunities for workers in declining jobs. We selected for each industry three sample jobs that have been declining and looked at the opportunities for reskilling into new jobs within the industry that are increasing in number and that have a high similarity in terms of skills. Using data from the US Bureau of Labor Statistics (BLS), we indicate how many jobs are expected to be disrupted for each job category selected. Finally, the transitions selected also show the cost-benefit balance of potential reskilling efforts.
 - Job transition options for transferring workers into growing jobs. We selected emerging jobs that have a scarce skillset and are in short supply based on the Future of Jobs Survey 2018 and considered how talent could be moved towards them by training parts of their existing workforce. We selected three sample emerging jobs for each industry and identified jobs within the industry that have a high similarity in terms of skills. The transitions selected also show the cost-benefit balance of potential reskilling efforts.

* Based on the Future of Jobs Survey 2018.

† Based on data from Burning Glass Technologies.

‡ Based on data from the US Bureau of Labor Statistics, Burning Glass Technologies and Future of Jobs Survey 2018.

Industry Roadmap

Aerospace

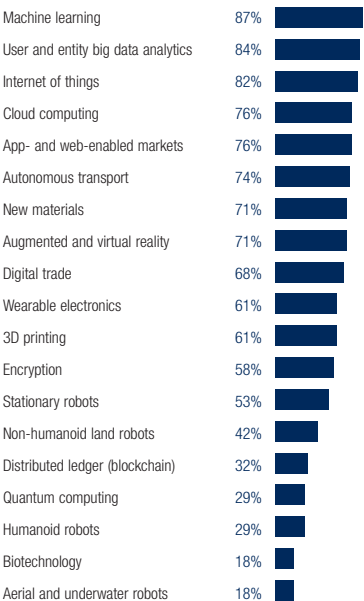


Industry Scorecard

Aerospace

TECHNOLOGY ADOPTION IN INDUSTRY

Share of companies surveyed



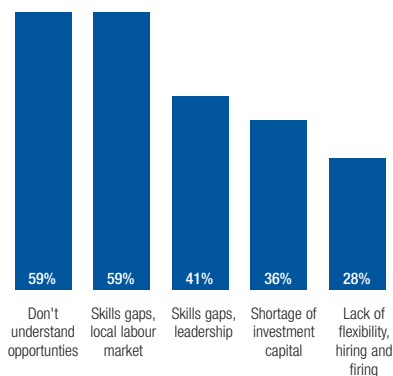
TECHNOLOGY

Machine learning	1	Software Developers, Applications
	2	Computer and Information Research Scientists
	3	Medical Scientists, except Epidemiologists
	4	Computer Systems Engineers/Architects
	5	Operations Research Analysts
User and entity big data analytics	1	Software Developers, Applications
	2	Information Security Analysts
	3	Computer Systems Engineers/Architects
	4	Database Administrators
	5	Network and Computer Systems Administrators
Internet of things	1	Software Developers, Applications
	2	Computer Systems Engineers/Architects
	3	Information Security Analysts
	4	First-Line Supervisors of Retail Sales Workers
	5	Computer Systems Analysts
Cloud computing	1	Software Developers, Applications
	2	Computer Systems Engineers/Architects
	3	Network and Computer Systems Administrators
	4	Database Administrators
	5	Computer Systems Analysts
App- and web-enabled markets	1	Software Developers, Applications
	2	Retail Salespersons
	3	Sales Representatives, Wholesale and Manufacturing
	4	Operations Research Analysts
	5	Market Research Analysts and Marketing Specialists

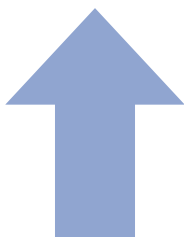
TOP 5 RELATED JOBS

BARRIERS TO NEW TECH ADOPTION

Share of companies surveyed

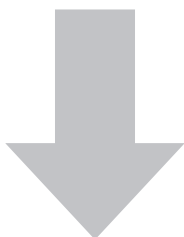


TOP 10 EMERGING JOBS



- 1 Data Analysts (General)
- 2 AI and Machine Learning Specialists
- 3 Automation Technicians
- 4 Application Developers / Engineers
- 5 Innovation Professionals
- 6 Sales and Marketing Specialists
- 7 Service and Solutions Designers
- 8 Product Managers
- 9 Industrial Engineers
- 10 Supply Chain Specialists

TOP 10 DECLINING JOBS



- 1 Team Assemblers
- 2 Secretaries and Administrative Assistants, Except Legal, Medical and Executive
- 3 Inspectors, Testers, Sorters, Samplers and Weighers
- 4 Electrical and Electronic Equipment Assemblers
- 5 Executive Secretaries and Executive Administrative Assistants
- 6 Molding, Coremaking and Casting Mach. Setters, Operators and Tndrs, Metal and Plastic
- 7 Data Entry Keyers
- 8 Purchasing Agents, except Wholesale, Retail and Farm Products
- 9 Office Clerks, General
- 10 Driver/Sales Workers

EXPECTED IMPACT ON WORKFORCE

Share of companies surveyed



Overview

Automation has had a limited level of penetration in the Aerospace industry compared to other manufacturing industries, in terms of substituting large parts of its workforce. There are several reasons for this: production volumes are much smaller, while the life expectancy of the products is much higher, which leads to a higher level of required quality. Assembly parts are heavy, and many assembly steps require a higher degree of specificity and detail to be performed and rechecked in accordance with the quality goals. While sophistication in robotics and intelligent machines has been increasing progressively in the last decades, it has not yet reached the level required to substitute the expertise and skills of the human workforce. These reasons have made the value proposition of automation for the industry relatively weak.²⁶ When it comes to digital technology, too, until recently aerospace companies have not been at the forefront of adoption. But investment of aerospace companies into digital technologies have significantly increased during the last decade and nearly all companies reported positive results from their digital investments.²⁷ Companies know that if they want to continue in this direction, finding talent for all stages of the digital journey is going to be a challenge, and there is an acute need for cultural change to be able to attract and retain this new talent while helping existing talent transition to new roles.

The five main technologies that most companies in the Aerospace industry (more than 75%) aim to adopt in the next four years, are all situated in the digital space: machine learning, big data analytics, internet of things, cloud computing and app- and web-enabled markets. The perceived urgency to adopt these technologies goes even beyond production- and logistics-related technologies, like new materials, 3D printing and autonomous transportation.

Most companies (82%) expect that adopting these new technologies will modify their value chain. Half (50%) expect an expansion of their workforce in general, nearly half (48%) expect their workforce will have to be reduced due to automation, and one-fifth (20%) think that it will have to be expanded due to automation. These percentages are not mutually exclusive: a reduction in highly specialized jobs can happen in tandem with a reduction of less qualified employees.

The main barriers to technology adoption for the industry are the skills gaps that exist in local labour

markets (59%) and in the existing leadership of the companies (41%). Another key barrier is posed by the knowledge gap that leads to an inability to understand the related opportunities (59%). All these barriers lead to the need for a workforce with additional skills, and thus to the need for significant reskilling and upskilling of the existing employees as well as the recruitment of new talent.

In their current job postings, we can see that Aerospace companies are looking to Software Developers for Applications to fill part of the skills gap—a job that tops the list for all five technologies that the industry is aiming to adopt. Two other jobs that are also key to unlocking the potential of these technologies for the industry are Computer Systems Engineers/Architects and Information Security experts.

Looking to the future, the top projected emerging jobs mirror this trend: digitalization is represented by Data Analysts, AI and Machine Learning Specialists and Application Developer/Engineers. An additional focus, which stems from the adoption of all technologies, is added by the need for Automation Engineers. The fact that the companies themselves need to understand the opportunities and challenges—and in some cases need to change their structures to be able to adopt the technologies in a meaningful way—is taken into account by the high position of Innovation Professionals on the list. The declining roles point to the increase in changes from automation, with Team Assemblers, Secretaries and Inspectors leading the top of the list.

When considering the strategic opportunities of reskilling to deal with this transformation, we can see how Secretaries, Molders and Data Entry Keyers (Figure 15) working in Aerospace can be transitioned within the industry and to other industries—to roles in increasing numbers such as Paralegals, Transportation Inspectors and Medical Records Technicians. In Figure 16, we show how the industry can develop programmes that can provide them with an agile internal pipeline for the talent they are most looking to integrate into their operations, such as Data Analysts, Automation Technicians and Industrial Engineers, by reskilling existing employees such as Marketing Specialists, Production Technicians and Customer Service Representatives. According to our model, these reskilling efforts will mostly have a positive cost-benefit balance for companies.

Recommendations for action

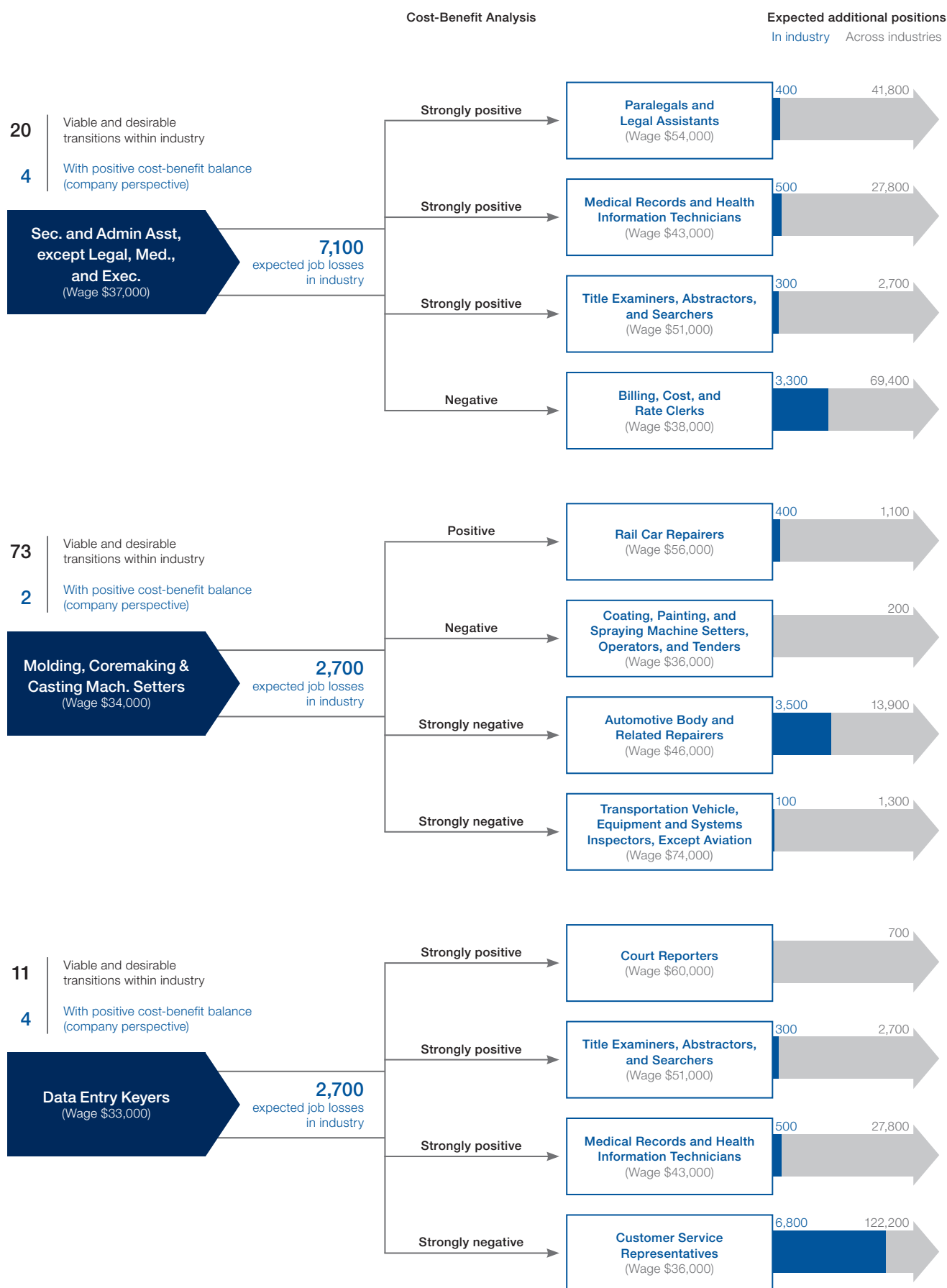
There were four main points that emerged from our discussions with the Aerospace Industry Task Force. The first regards the relatively high growth of the industry; the challenge of declining jobs and dealing strategically and responsibly with a large part of the workforce will be lower in scale compared to other industries. For the Aerospace industry, jobs will mainly be transforming jobs rather than declining. The focus should therefore be on building the right lifelong learning culture and making upskilling widely available to employees so that they can dynamically evolve their skillset according to changing needs.

The second point regards the particular opportunity for building talent with a currently scarce skillset in the market through training within the industry. Given that the industry has a relatively large share of high-skilled and tech-savvy labour, building the right reskilling programmes based on a model such as the one introduced in this report will allow Aerospace companies to have a competitive advantage by leveraging talent with a high digital skillset, while still having strong inherent knowledge of the industry.

The third point that companies felt puts Aerospace in a position of advantage compared to other industries is that, historically, companies have always had to find ways to collaborate on processes that other industries see as extremely competitive. That will permit them to more easily find areas of collaboration for dealing collectively with workforce-related challenges than other industries. The initial focus would be to set up a mechanism that iteratively identifies the emerging skills needs for the industry and the jobs of the future.

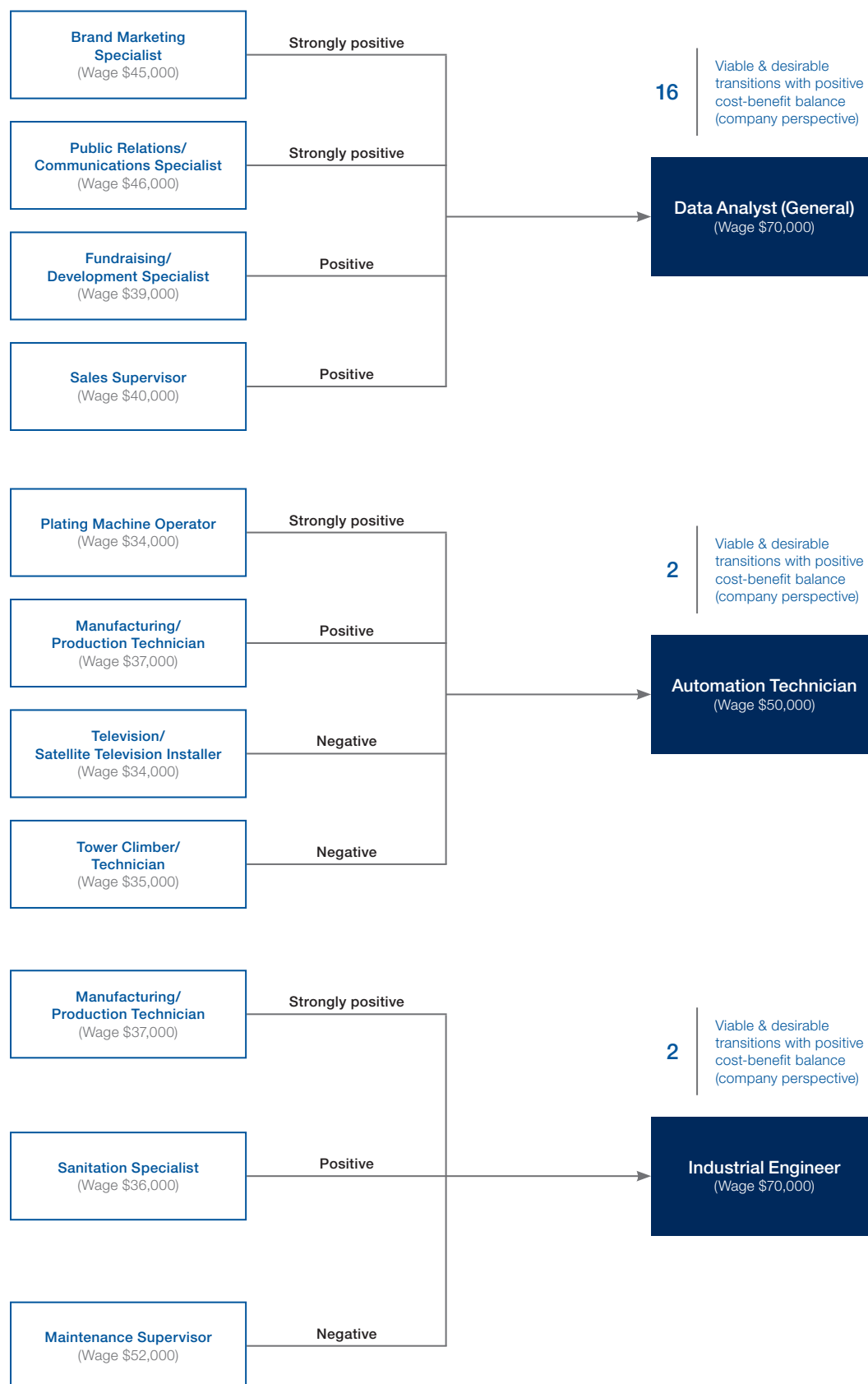
Finally, the emphasis on building the right culture is one that companies in the industry felt they needed to focus on urgently. The industry must integrate new technologies and new talent, while keeping its strength and expertise in technology and equipment that dates many generations already and which are still crucial to its operation. Hence, it is important to create a culture that can support a multi-generational workforce that works on multi-generational products.

Figure 15: Finding opportunities for displaced workers in Aerospace



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Figure 16: Filling the skills gaps for emerging jobs in Aerospace



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Industry Roadmap

Aviation, Travel and Tourism

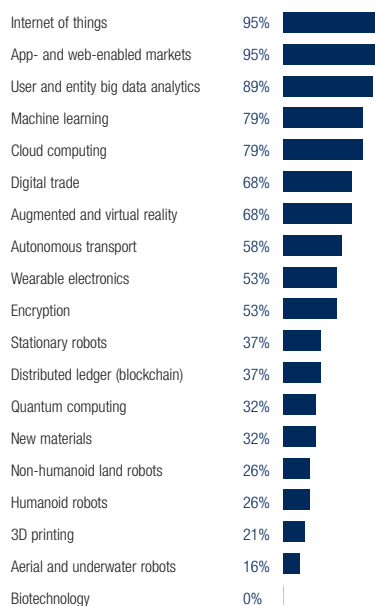


Industry Scorecard

Aviation, Travel and Tourism

TECHNOLOGY ADOPTION IN INDUSTRY

Share of companies surveyed



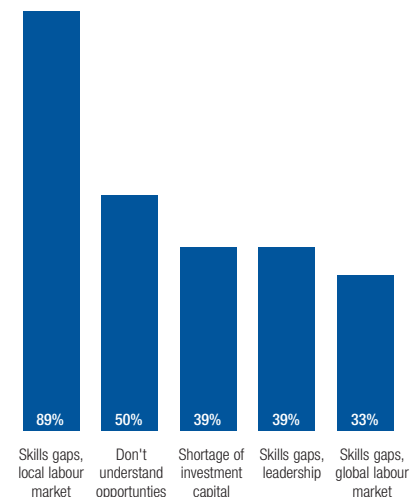
TECHNOLOGY

Internet of things	1	Software Developers, Applications
	2	Computer Systems Analysts
	3	Computer Systems Engineers/Architects
	4	Computer Programmers
	5	Marketing Managers
App- and web-enabled markets	1	Marketing Managers
	2	Market Research Analysts and Marketing Specialists
	3	Software Developers, Applications
	4	Lodging Managers
	5	Sales Managers
User and entity big data analytics	1	Software Developers, Applications
	2	Database Administrators
	3	Computer Systems Analysts
	4	Computer Programmers
	5	Computer Systems Engineers/Architects
Machine learning	1	Software Developers, Applications
	2	Computer and Information Research Scientists
	3	Medical Scientists, except Epidemiologists
	4	Database Administrators
	5	Computer Systems Engineers/Architects
Cloud computing	1	Software Developers, Applications
	2	Database Administrators
	3	Network and Computer Systems Administrators
	4	Computer Systems Engineers/Architects
	5	Computer Network Architects

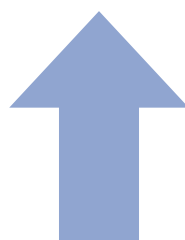
TOP 5 RELATED JOBS

BARRIERS TO NEW TECH ADOPTION

Share of companies surveyed



TOP 10 EMERGING JOBS



- 1 General Managers
- 2 Data Analysts (General)
- 3 User Experience (UX) Designers
- 4 AI and Machine Learning Specialists
- 5 Software Developers / Engineers
- 6 Sales and Marketing Specialists
- 7 Product Managers
- 8 Innovation Professionals
- 9 Cyber Security Analysts
- 10 Brand Marketing Specialists

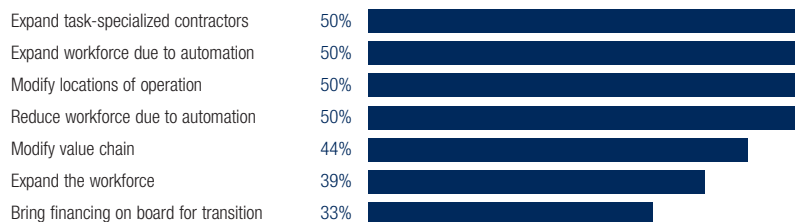
TOP 10 DECLINING JOBS



- 1 Purchasing Agents, except Wholesale, Retail and Farm Products
- 2 Data Entry Keyers
- 3 Inspectors, Testers, Sorters, Samplers and Weighers
- 4 Office Clerks, General
- 5 Bookkeeping, Accounting and Auditing Clerks
- 6 Driver/Sales Workers
- 7 Switchboard Operators, including Answering Service
- 8 Cashiers
- 9 Secretaries and Administrative Assistants, except Legal, Medical and Executive
- 10 Cooks, Fast Food

EXPECTED IMPACT ON WORKFORCE

Share of companies surveyed



Aviation, Travel and Tourism

Overview

The Aviation, Travel and Tourism Industry is one of the largest employers in the world, accounting for one in every 10 jobs worldwide, while also creating one in every five new jobs.²⁸ Moreover, a significant proportion of the industry's employees are low-skilled, while the industry has a much more diverse setup than others, with women accounting for 60% of the workforce. Even though there are major players, both in the Hospitality and Aviation sectors, most of the industry is made up of small and medium-sized enterprises that lack the economies of scale to respond effectively to major changes in skills needs and the integration of new technologies. The industry has experienced significant disruption over the past decade, primarily through the introduction of online travel aggregators, travel service platforms and accommodation delivery platforms, while automation is now impacting many customer-centric roles such as hotel and airport clerks.

The top five technologies, which almost 80% of all companies in Aviation, Travel and Tourism intend to use within the next four years, show a continued digitalization of the industry: internet of things, app- and web-enabled markets, user and entity big data analytics, machine learning and cloud computing will all be key to improving the operations of businesses and the enhancing user experience, leading to an extended era of growth.

Half of the companies (50%) expect their workforce be reduced due to automation, and the same percentage (50%) believe it will have to be expanded due to automation. These percentages are not mutually exclusive: a reduction in highly specialized jobs can happen in tandem with a reduction of less qualified employees. More than one-third of companies predict a general expansion of their workforce.

The barriers currently hindering the adoption of these technologies are related to skills gaps, with almost all companies (89%) considering skills in local labour markets to be the biggest obstacle. Half of the companies surveyed also believe that they lack the knowledge to understand the opportunities offered by new technologies. All of these barriers lead to the need for a workforce with additional skills and thus point to the need for significant re- and upskilling of existing employees as well as the acquisition of new types of talent.

In their job postings, companies particularly turn to software specialists in order to overcome some of these barriers. In fact, Software Developers for Applications are among the top five occupations searched for in connection with the top five technologies. Occupations that do not belong to the IT job family, such as Marketing and Sales Managers, are also expected to be able to leverage these technologies, including the internet of things and app- and web-enabled markets. Innovation Professionals are also needed by the industry to take advantage of new technologies and reform the business models of the industry accordingly.

Looking to the future, it is obvious that at the same time that highly skilled jobs such as Data Analysts, Cybersecurity Specialists and User Experience designers will rise in numbers, professions with low qualifications will be particularly vulnerable to the integration of new technologies and automation processes: Purchasing Agents are expected to be reduced in number by the advances in machine learning, and Data Entry Keyers by advanced scanning software and app integration.

When considering the strategic opportunities of reskilling to deal with this transformation, we can see how Cashiers, Secretaries and Cooks working in Aviation, Travel and Tourism can be transitioned within the industry and across other industries to roles in increasing numbers such as Manicurists, Paralegals and Cafeteria Attendants (Figure 17). In Figure 18, we show how the industry can develop programmes that provide them with an agile internal pipeline for the talent they are most looking to integrate into their operations, such as Data Analysts, User Experience Designers and Cybersecurity Analysts, by reskilling existing employees such as Sales Professionals, Graphic Designers and Network Support Technicians. According to our model, these reskilling efforts will mostly have positive cost-benefit balance for companies.

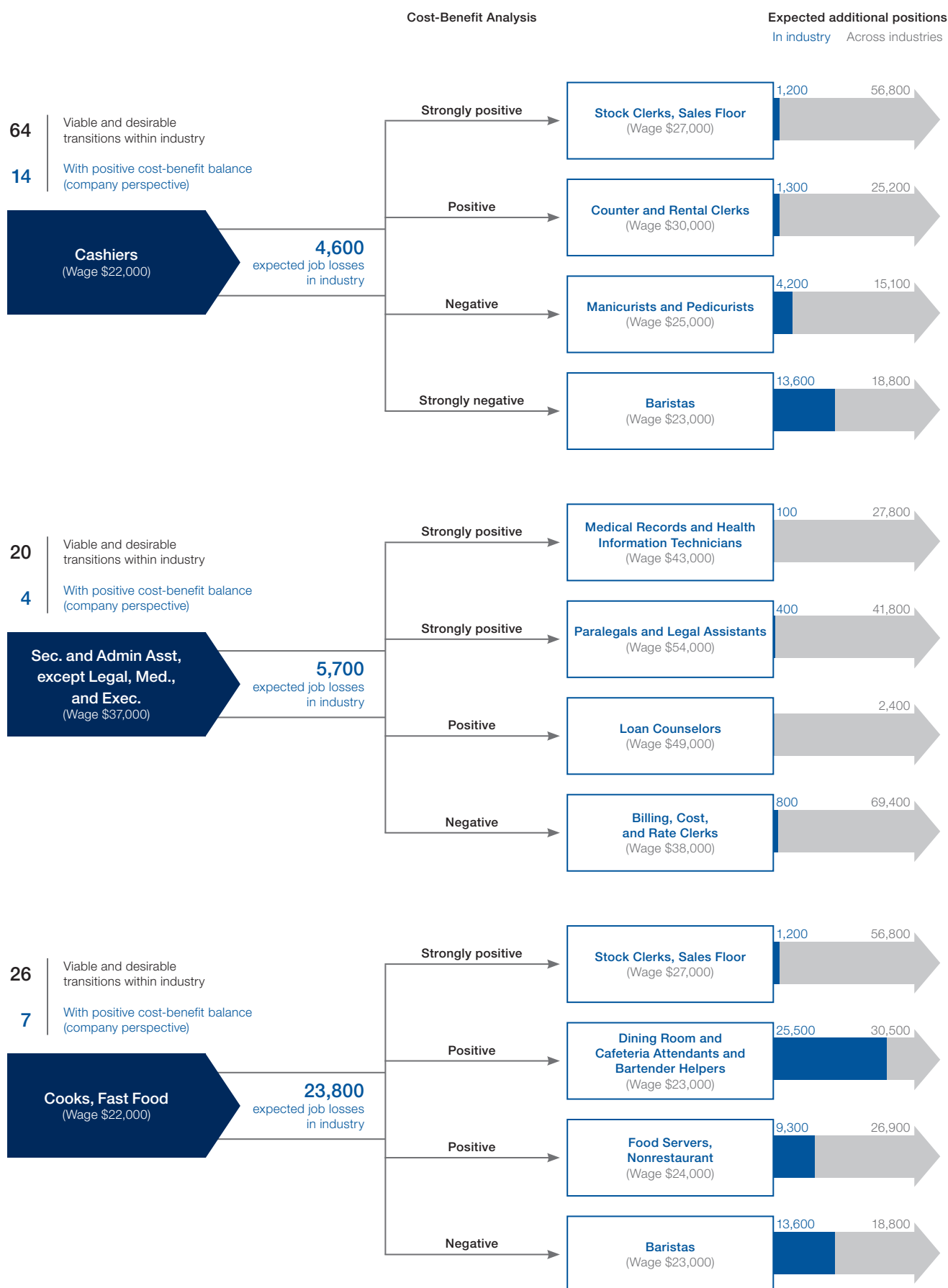
Recommendations for action

Our discussions with the Aviation, Travel and Tourism Task Force and other relevant experts focused on three points. First, we touched on the need to develop a mechanism that anticipates the impact of automation on workers on an iterative basis, and that profits from the knowledge and expertise of the broader industry ecosystem. Skills mapping exercises can be much more accurate and powerful if done in collaboration across the wide spectrum of job functions covered by the industry. This will also ensure that more retraining opportunities for affected workers are found in collaboration with the wider industry ecosystem, which can massively increase the scale and decrease the cost of such efforts.

Second, given the make-up of the industry, which consists of many small and medium-sized enterprises, it will be important for the key players of the industry—but also governments and academic institutions—to collaborate in supporting them in the transformation process and allowing them to proactively address the impact of technological integration and automation.

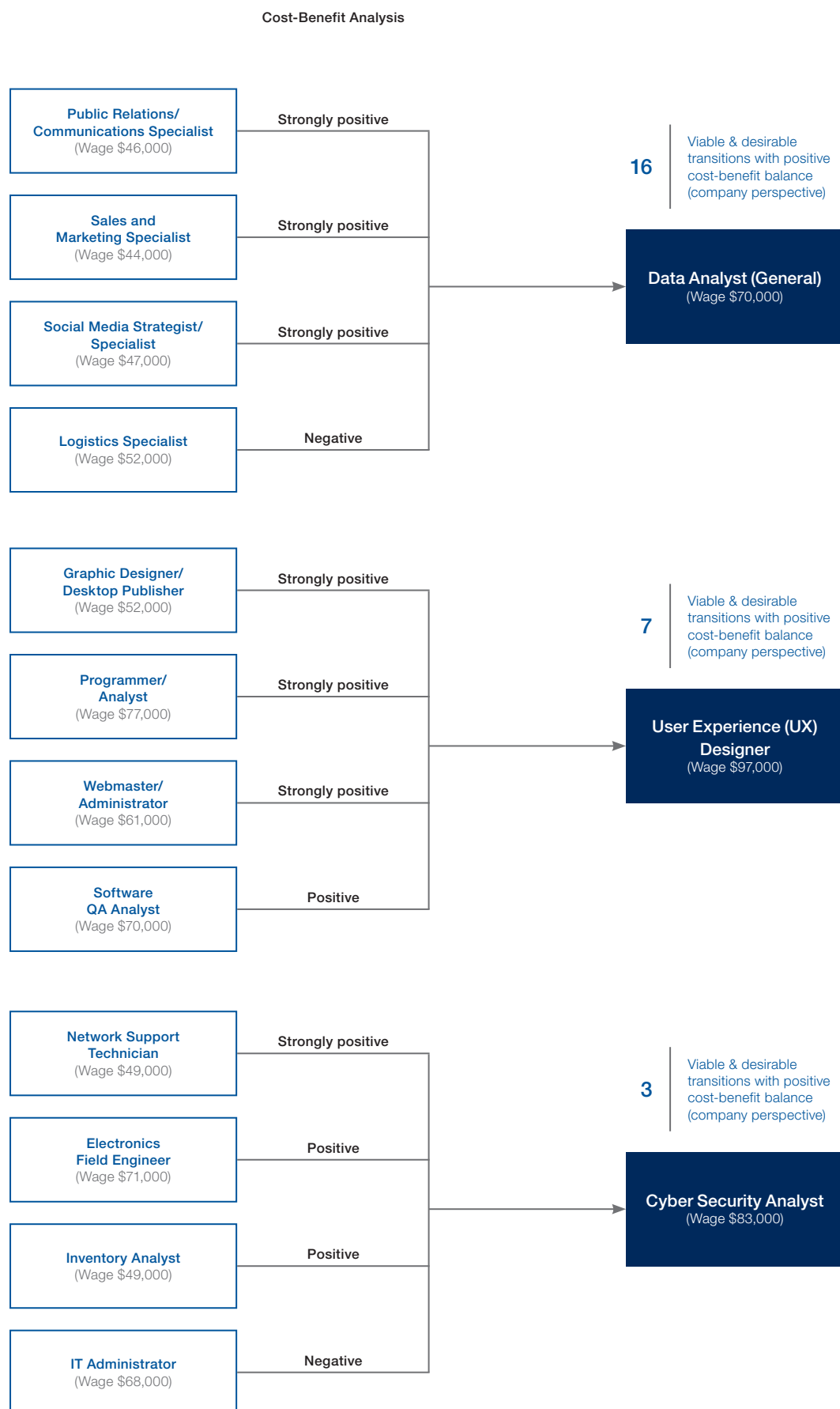
Finally, the Aviation, Travel and Tourism Task Force identified the diversity of the sub-industries as an opportunity for creating ecosystem-wide programmes for knowledge exchange and other workforce-related initiatives. In this environment, large industry-related coalitions can be created without raising concerns of competition, if the involved parties are carefully selected. One such example would be creating workforce-related coalitions of airlines, hotels, airports and technology platforms.

Figure 17: Finding opportunities for displaced workers in Aviation, Travel and Tourism



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Figure 18: Filling the skills gaps for emerging jobs in Aviation, Travel and Tourism



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Industry Roadmap

Consumer

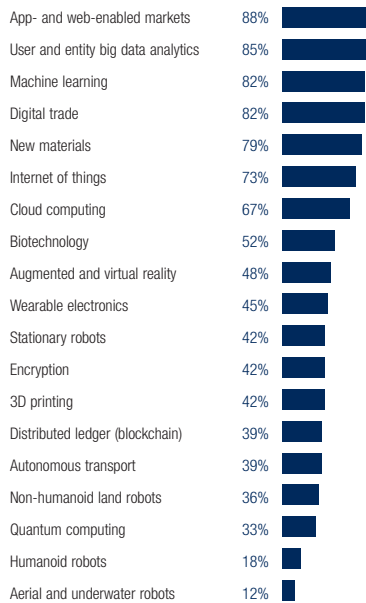


Industry Scorecard

Consumer

TECHNOLOGY ADOPTION IN INDUSTRY

Share of companies surveyed

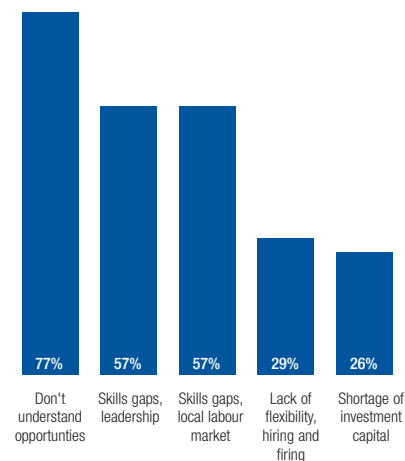


TECHNOLOGY

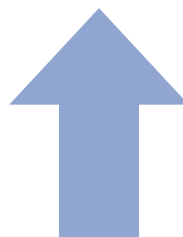
TECHNOLOGY		TOP 5 RELATED JOBS
App- and web-enabled markets	1 2 3 4 5	1 First-Line Supervisors of Retail Sales Workers 2 Marketing Managers 3 Software Developers, Applications 4 Retail Salespersons 5 Sales Representatives, Wholesale and Manufacturing
User and entity big data analytics	1 2 3 4 5	1 Software Developers, Applications 2 Computer Systems Engineers/Architects 3 Database Administrators 4 Computer and Information Research Scientists 5 Computer User Support Specialists
Machine learning	1 2 3 4 5	1 Software Developers, Applications 2 Computer and Information Research Scientists 3 Medical Scientists, except Epidemiologists 4 Computer Systems Engineers/Architects 5 Marketing Managers
Digital trade	1 2 3 4 5	1 First-Line Supervisors of Retail Sales Workers 2 Financial Analysts 3 Sales Managers 4 Financial Managers, Branch or Department 5 Cargo and Freight Agents
Internet of things	1 2 3 4 5	1 Software Developers, Applications 2 Farm and Home Management Advisors 3 Computer Systems Engineers/Architects 4 Marketing Managers 5 Sales Managers

BARRIERS TO NEW TECH ADOPTION

Share of companies surveyed

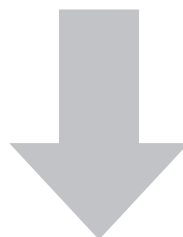


TOP 10 EMERGING JOBS



- 1 Data Analysts (General)
- 2 Sales and Marketing Specialists
- 3 AI and Machine Learning Specialists
- 4 Training and Development Specialists
- 5 General Managers
- 6 Digital Marketing Specialists
- 7 Organisational Development Specialists
- 8 New Technology Specialists
- 9 IT Administrators
- 10 User Experience (UX) Designers

TOP 10 DECLINING JOBS



- 1 Team Assemblers
- 2 Cashiers
- 3 Secretaries and Administrative Assistants, except Legal, Medical and Executive
- 4 Inspectors, Testers, Sorters, Samplers and Weighers
- 5 Sewing Machine Operators
- 6 Molding, Coremaking and Casting Mach. Setters, Operators and Tndrs, Metal and Plastic
- 7 Data Entry Keyers
- 8 Purchasing Agents, except Wholesale, Retail and Farm Products
- 9 Bookkeeping, Accounting and Auditing Clerks
- 10 Postal Service Mail Carriers

EXPECTED IMPACT ON WORKFORCE

Share of companies surveyed



Overview

The Consumer industry, and in particular the retail sector—which accounts for 6% of US GDP and about 10% of total employment²⁹—has long been at the forefront of technology change disruption. While the introduction of self-checkout kiosks in the early 1990s revolutionized customer facing interactions, which was adopted widely in the same decade—and still continues to grow in impact—RFID tagging technology changed the logistical processes in warehouses and all throughout the supply chain during the same time period. Yet this change was mostly invisible to end-user customers. However, these developments were surpassed by the increase in e-commerce market share, which now accounts for more than 11% of total US retail sales and is expected to grow to 18% in 2021.³⁰ The need for their employees to be constantly up- and reskilled is therefore old news to companies in Consumer industries, but the degree of disruption we are expecting makes the challenge for the executives we have spoken to still a matter for top management.

Most companies (more than 80%) in the Consumer Goods industry indicate that four of the five new top technologies they want to adopt within the next four years are related to digitalization: app- and web-enabled markets, user and entity big data market analytics, machine learning and digital markets. New materials (79%) also rank among the top five technologies, but are also followed by further digital technologies, such as the internet of things (73%) and cloud computing (67%).

Most companies (83%) expect that the biggest impact of adopting these new technologies will be on their value chain. More than half (57%) project that their workforce will have to be reduced due to automation and one-fourth (23%) think that it will have to be expanded due to automation. As with other industries, we are expecting a reduction in highly specialized jobs happening in tandem with a reduction in the need of less qualified employees.

The biggest barrier to technology adoption (77%) is perceived to be the lack of understanding of the opportunities offered by the introduction of new technologies. Following that, skills gaps in the local labour market (57%) and in the leadership of the companies themselves (57%) are hindering the smooth integration of these technologies. These barriers indicate a need for a workforce with additional skills, requiring significant

reskilling and upskilling efforts for existing employees and intensifying recruitment efforts for new talent.

Software Developers for Applications are among the most sought-after occupations in the industry related to these new technologies, especially in app- and web-enabled markets, user and entity big data analytics, machine learning and internet of things. We also see that Marketing and Sales Managers are also expected to understand the possibilities of these technologies and leverage technologies the internet of things and app- and web-enabled markets.

The trend within the entire top emerging roles results reflects these developments: AI and Machine Learning Specialists, Digital Marketing Specialists and User Experience Designers are in demand to advance digitization in customer-oriented areas, while Training and Development Specialists and Organizational Development Specialists are required to transform the companies' culture and organizational structures. Among declining roles, the impact of automation is reflected strongly: a large number of Assemblers, Cashiers, Secretaries and Sewing Machine Operators are expected to be replaced by AI and robotics in the near future.

When considering the strategic opportunities of reskilling to deal with this transformation, we can see how team assemblers, cashiers and sewing machine operators working in consumer goods and retail industry can be transitioned within the industry and across other industries to roles in increasing numbers such as painters, rental clerks and stock clerks (Figure 19). In Figure 20, we show how the industry could build an agile internal pipeline for the talent they are most looking to integrate into their operations—such as Data Analysts, User Experience Designers and General Managers—by reskilling existing employees such as Social Media Strategists, Purchasing Agents and Data Centre Technicians. According to our model, these reskilling efforts will mostly have positive cost-benefit balance for companies.

Recommendations for action

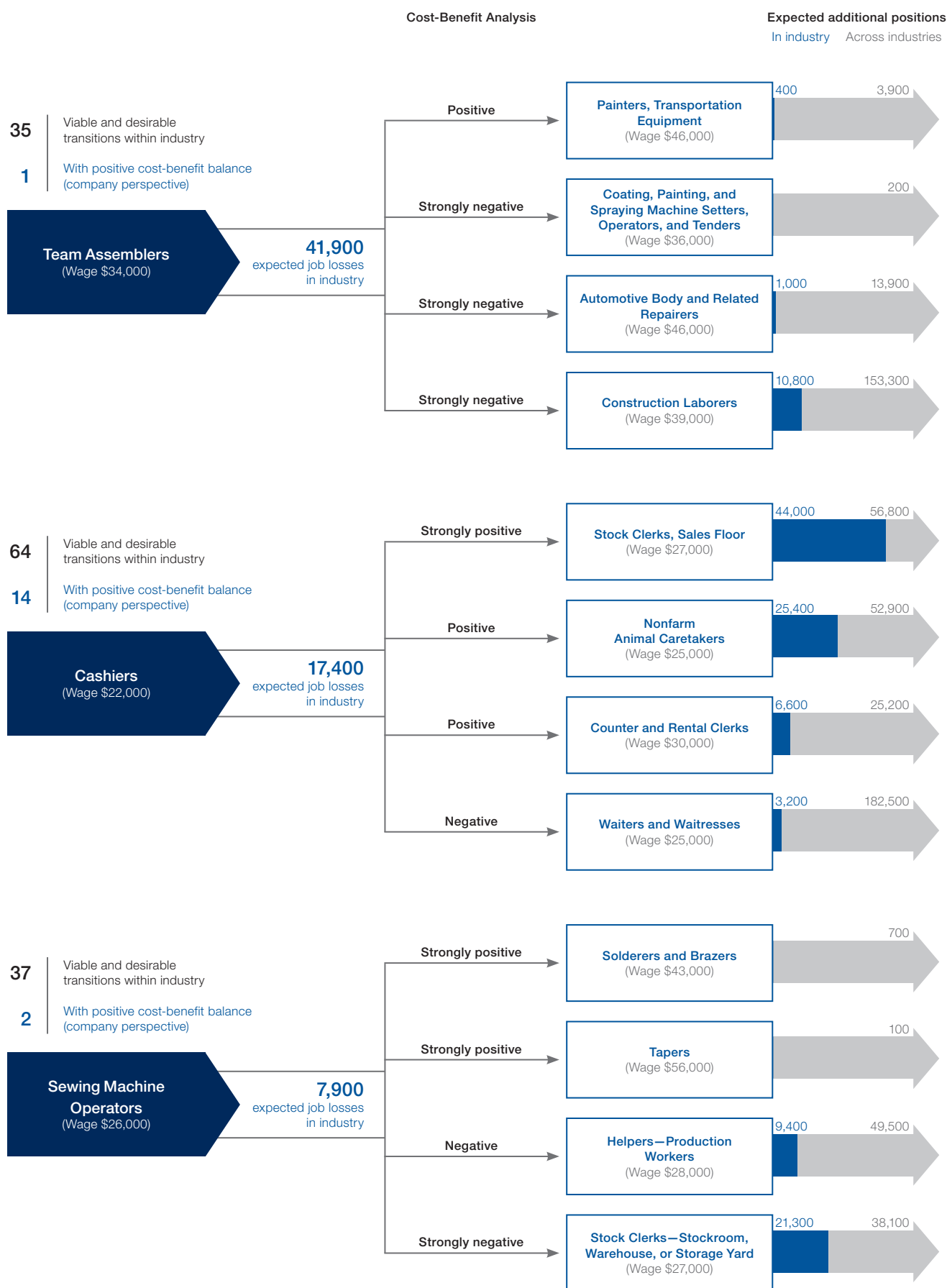
In our discussions with the Consumer Task Force and relevant experts, three clear focal points for action were outlined.

First, the importance of going through a strategic workforce planning exercise was emphasized as an important building block for developing common action. Task force members agreed that more ongoing collaborative efforts are needed to be able to accurately track the evolving nature of skills and adapt the direction required in an agile way. There was consensus that an industry-wide aggregation of relevant data and knowledge could lead to a better common understanding on the future of jobs and skills.

The second area of focus was upskilling the current workforce, not only on digital skills, such as data analysis and cybersecurity, but also on human skills such as empathy, communication and creativity. Targeted reskilling programmes ensuring that those parts of the workforce that are already heavily impacted by technological integration and automation can stay productive and employable in the future are needed urgently. Task force members identified a big opportunity to undertake such programmes in an industry coalition and in collaboration with the public sector and relevant academic institutions.

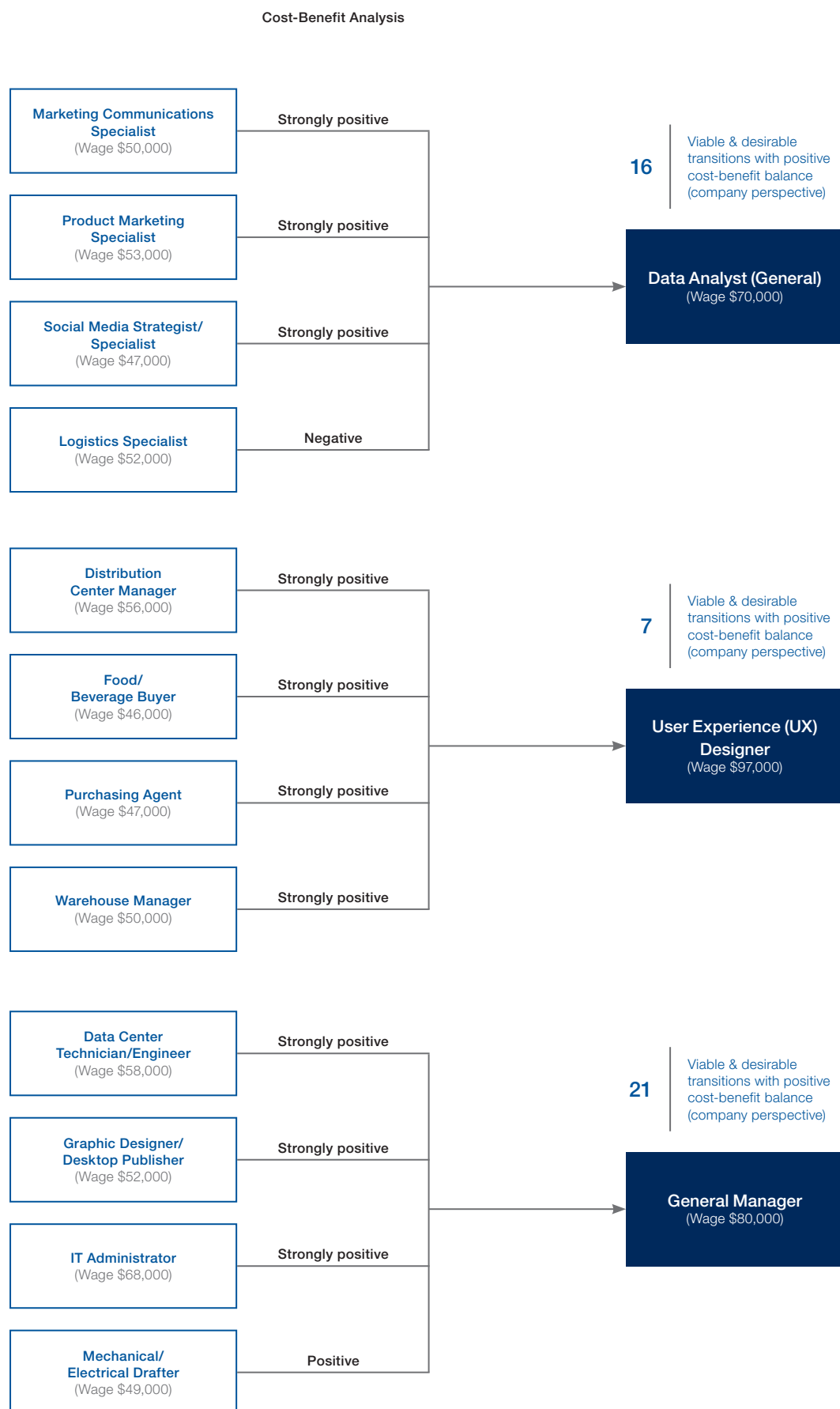
The third area of focus was on the creation of certifications for key skills for the industry, in a way that would allow them to be transferrable across the industry. Such efforts would allow for increased labour mobility throughout the industry and enable the creation of a vibrant industry talent ecosystem. By coupling all the above efforts with the right incentive structure, leadership example and communication strategy around reskilling and upskilling, the industry can be confident in succeeding in establishing a lifelong learning culture among the workforce.

Figure 19: Finding opportunities for displaced workers in Consumer Industries



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Figure 20: Filling the skills gaps for emerging jobs in Consumer Industries



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Industry Roadmap

Financial Services

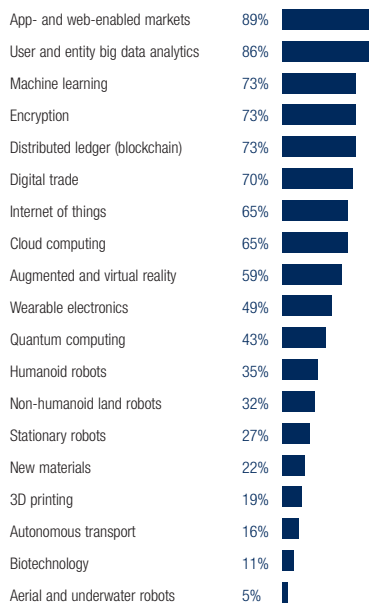


Industry Scorecard

Financial Services

TECHNOLOGY ADOPTION IN INDUSTRY

Share of companies surveyed



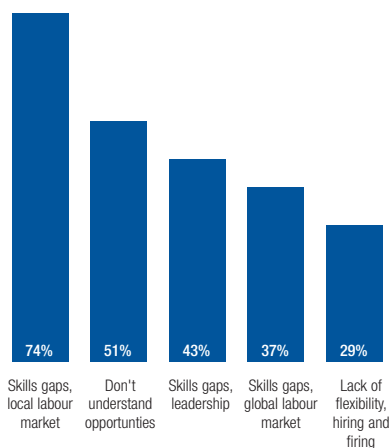
TECHNOLOGY

App- and web-enabled markets	1	Sales Representatives, Wholesale and Manufacturing
	2	Marketing Managers
	3	Market Research Analysts and Marketing Specialists
	4	Software Developers, Applications
	5	First-Line Supervisors of Non-Retail Sales Workers
User and entity big data analytics	1	Software Developers, Applications
	2	Database Administrators
	3	Computer Systems Analysts
	4	Computer Systems Engineers/Architects
	5	Business Intelligence Analysts
Machine learning	1	Computer and Information Research Scientists
	2	Software Developers, Applications
	3	Medical Scientists, except Epidemiologists
	4	Database Administrators
	5	Business Intelligence Analysts
Encryption	1	Information Security Analysts
	2	Software Developers, Applications
	3	Computer User Support Specialists
	4	Computer Systems Engineers/Architects
	5	Computer Systems Analysts
Distributed ledger (blockchain)	1	Software Developers, Applications
	2	Marketing Managers
	3	Information Security Analysts
	4	Financial Analysts
	5	Architectural and Engineering Managers

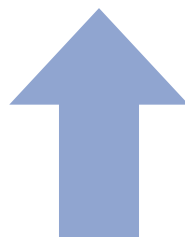
TOP 5 RELATED JOBS

BARRIERS TO NEW TECH ADOPTION

Share of companies surveyed



TOP 10 EMERGING JOBS



- 1 AI and Machine Learning Specialists
- 2 User Experience (UX) Designers
- 3 Digital Transformation Specialists
- 4 Sales and Marketing Specialists
- 5 Client Information and Customer Service Workers
- 6 Innovation Professionals
- 7 IT Administrators
- 8 Cyber Security Analysts
- 9 General Managers
- 10 Data Analysts (Financial)

TOP 10 DECLINING JOBS



- 1 Secretaries and Administrative Assistants, except Legal, Medical and Executive
- 2 Insurance Underwriters
- 3 Word Processors and Typists
- 4 Data Entry Keyers
- 5 Bookkeeping, Accounting and Auditing Clerks
- 6 Computer Programmers
- 7 Inspectors, Testers, Sorters, Samplers and Weighers
- 8 Claims Examiners, Property and Casualty Insurance
- 9 Postal Service Mail Sorters, Processors and Processing Machine Operators
- 10 Tellers

EXPECTED IMPACT ON WORKFORCE

Share of companies surveyed



Financial Services

Overview

The Financial Services industry saw the beginning of the first major disruption through automation of services in 1967, when the first automated teller machine (ATM) was installed. Its widespread proliferation led to a drastic decrease in the number of tellers and a relative uptake of jobs with more complex human tasks only followed in the 1990s.³¹ Since the start of the new millennium, robotic process automation (RPA) has transformed many middle- and back-office functions inside the financial institutions and in the insurance industry in operations, information technology, risk management and human resources, and will continue to do so for many more and increasingly complex mental tasks.³² One of the major technologies creating job growth opportunities in the finance sector is cybersecurity. Many of our task force members highlighted the growing need for experts in this field but also the need for a widespread basic awareness of cybersecurity principles across the industry.

Every technology featured at the top of the Financial Services companies' list for adoption in the next four years is within the digital technology realm: app- and web-enabled markets (89%), user and entity big data analytics (86%) and machine learning (73%). Two specific technologies speak to the growing need for improved security measures in the digital world of Financial Services: encryption (73%) and distributed ledgers via blockchain (73%).

More than half of the companies (56%) expect that their workforce will have to be reduced due to automation and one-fourth (25%) think that it will have to be expanded due to automation. At the same time, more than one-third of companies predict an expansion of their workforce due to new technologies in general. As seen across industries, a reduction in highly specialized jobs can happen in tandem with a reduction of less qualified employees.

The top barrier companies face when trying to adopt these technologies are related to skills gaps, both in local labour markets (74%) and in the companies' leadership teams (43%). Another significant barrier is the lack of understanding for the opportunities that the new technologies pose (51%). All these barriers point to the need for a workforce with additional skills and thus to the need for significant reskilling and upskilling efforts of the existing employees, as well as an intensification of the recruiting efforts for new talent.

The job profiles to which the companies turn for help with the adoption of these new technologies vary, but Software Developers for Applications are in the top five positions linked to all top five technologies. Classical roles in Financial Services like Marketing Managers and Financial Analysts are also now expected now to leverage these technologies and be able to use app- and web enabled markets and encryption in some capacity.

Looking at the top emerging jobs, they are in line with the global digitalization trend: AI and Machine Learning Specialists and User Experience Designers will be needed in great numbers to leverage the new technologies required for numerous customer-facing touchpoints, while Digital Transformation Specialists and Innovation Professionals will be key to help companies adapt their internal structures and business models. Cyber Security Analysts and Data Analysts will be in high demand for the industry to ensure the security of data and to enable companies to derive strategical decisions from its analysis. As for the declining roles, the impact of the new wave of automation is clearly already here: Secretaries, Insurance Underwriters and Tellers are expected to be replaced by AI and machine learning capabilities in the near future.

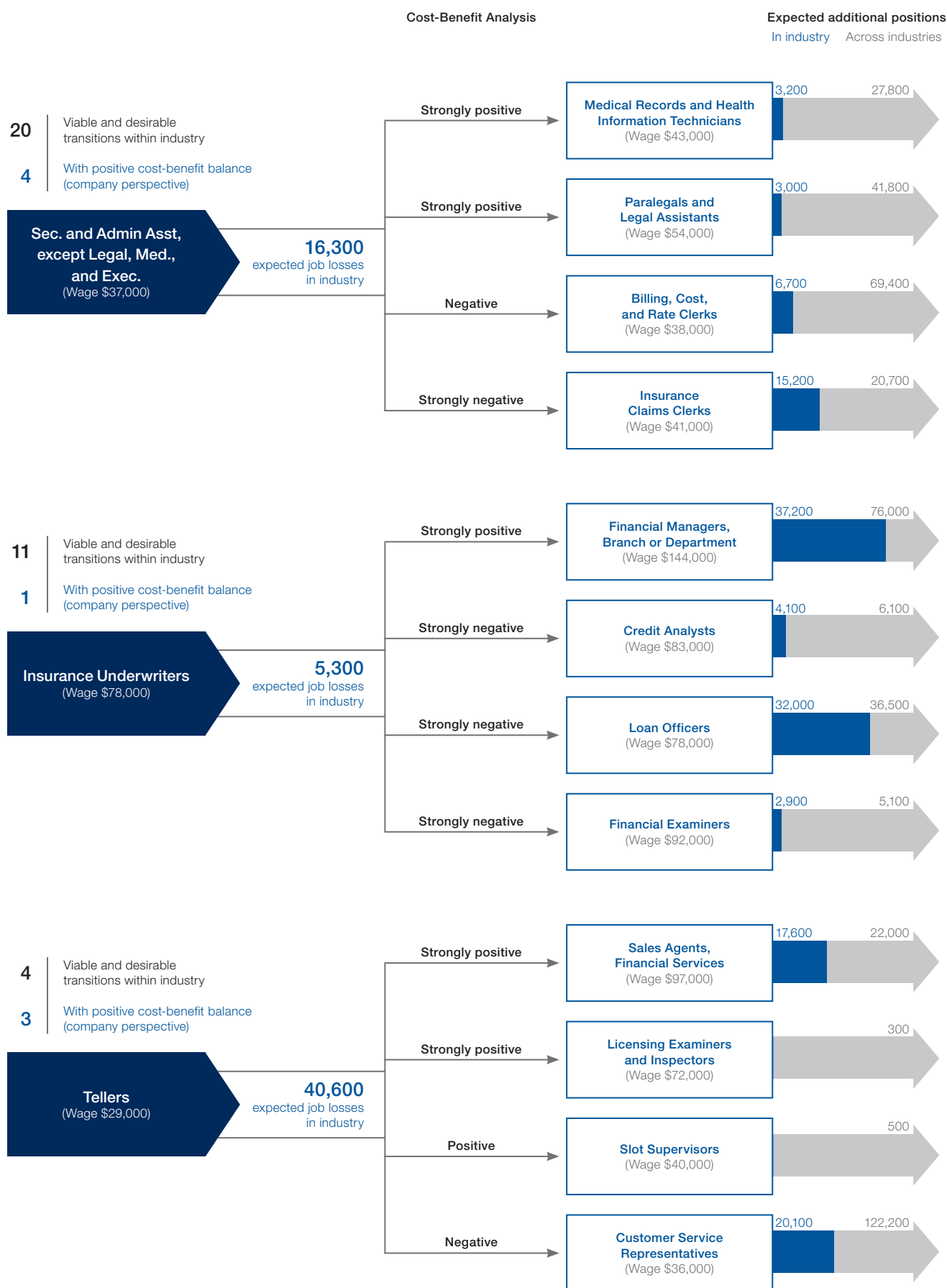
When considering the strategic opportunities of reskilling to deal with this transformation, we can see how Secretaries, Insurance Underwriters and Tellers working in Financial Services can be transitioned within the industry and across other industries to roles in increasing numbers, such as Insurance Claim Clerks, Loan Officers and Sales Representatives (Figure 21). In Figure 22, we show how the industry can develop programmes that provide companies with an agile internal pipeline for the talent they are most looking to integrate into their operations, such as Data Analysts, User Experience Designers and Cybersecurity Analysts, by reskilling existing employees such as Web Administrators, Inventory Analysts and Marketing Campaign Analysts. According to our model, these reskilling efforts will mostly have positive cost-benefit balance for companies.

Recommendations for action

In our discussions with the task force and relevant experts, the upskilling challenge of the current workforce came out as the most pressing issue to be tackled by the Financial Services industry. More specifically, upskilling a large part of the workforce on digital skills in cybersecurity and data analysis were identified as crucial for the sustainable growth of the industry. The task force identified a great opportunity for companies all across the industry to join forces in developing industry-wide upskilling programmes that will create economies of scale, increasing the impact and decreasing the cost and time of these initiatives.

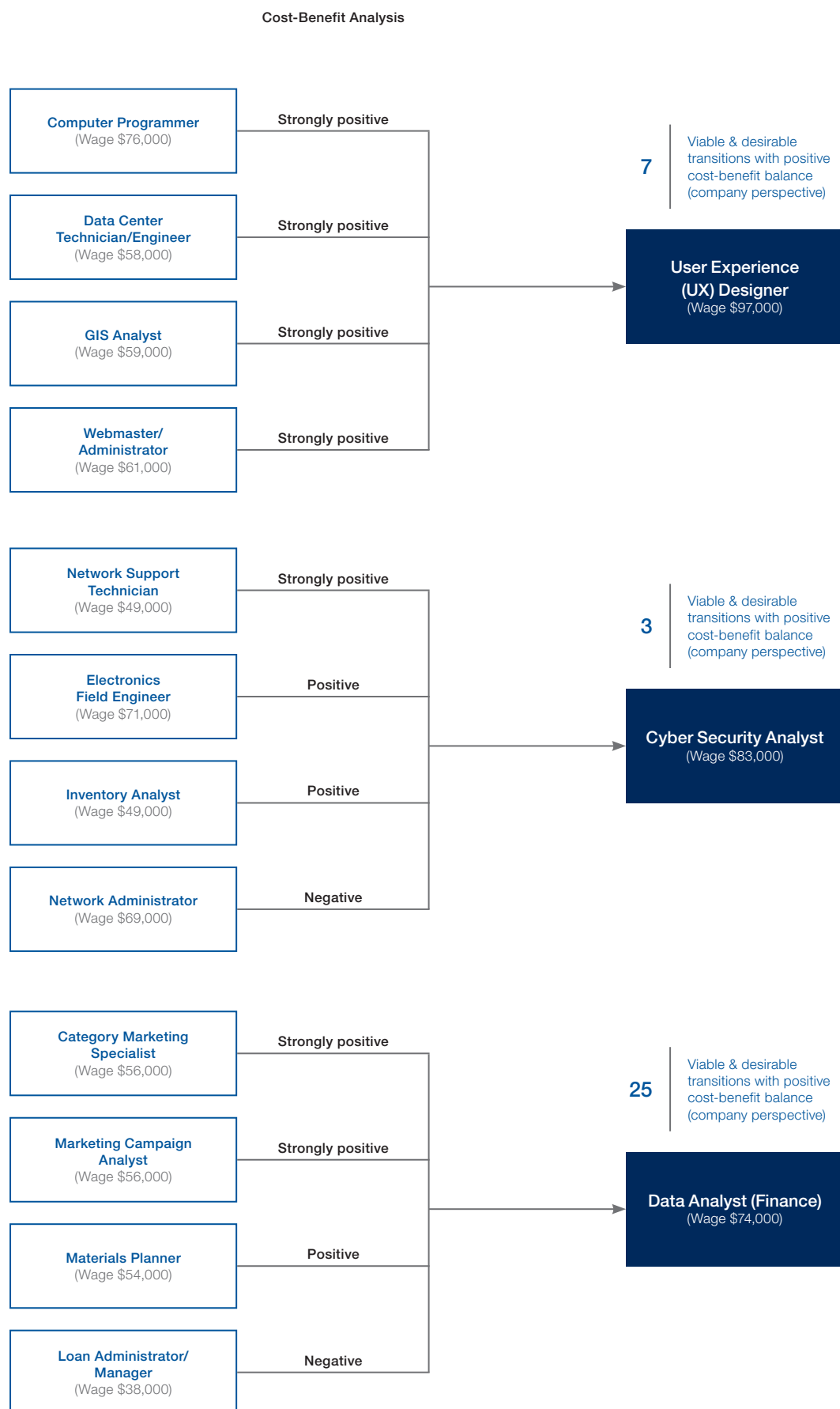
Another action priority identified by the Financial Services Task Force was the creation of commonly accepted certifications for these skills, which would be provided by digital technology companies that would work across the industry, enabling employees and companies to have a common understanding of the skills map, both on an individual level as well as on a company, industry or regional level. These commonly accepted certificates would also assist companies in their strategic workforce planning, allowing them to know what type of skills they will need in the future. At the same time, employees will know where to focus their own upskilling efforts to match the upcoming needs of companies, empowering their overall career progression.

Figure 21: Finding opportunities for displaced workers in Financial Services



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Figure 22: Filling the skills gaps for emerging jobs in Financial Services



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Industry Roadmap

Oil & Gas

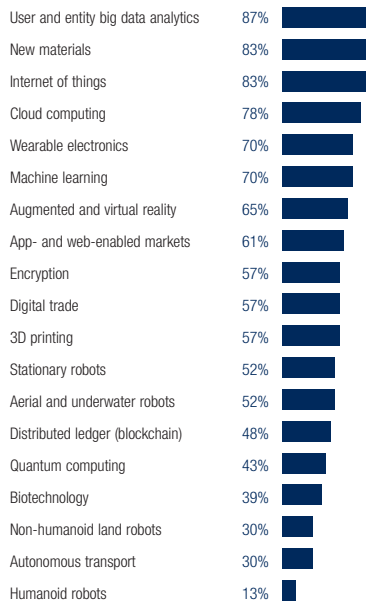


Industry Scorecard

Oil & Gas

TECHNOLOGY ADOPTION IN INDUSTRY

Share of companies surveyed



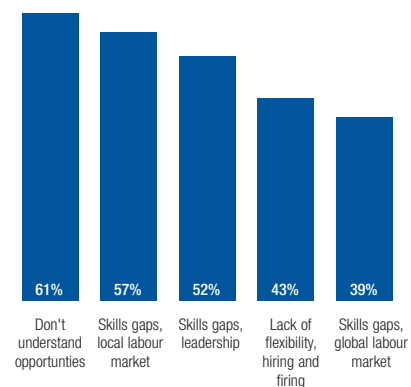
TECHNOLOGY

User and entity big data analytics	1	Software Developers, Applications
	2	Database Administrators
	3	Business Intelligence Analysts
	4	Computer User Support Specialists
	5	Computer and Information Research Scientists
Internet of things	1	Information Technology Project Managers
	2	Software Developers, Applications
	3	Computer Systems Engineers/Architects
	4	Video Game Designers
	5	Computer User Support Specialists
Cloud computing	1	Software Developers, Applications
	2	Computer Systems Analysts
	3	Computer User Support Specialists
	4	Database Administrators
	5	Computer Systems Engineers/Architects
Wearable electronics	1	Information Technology Project Managers
	2	Software Developers, Applications
	3	Computer Systems Engineers/Architects
	4	Video Game Designers
	5	Computer User Support Specialists
Machine learning	1	Computer and Information Research Scientists
	2	Medical Scientists, except Epidemiologists
	3	Software Developers, Applications
	4	Petroleum Engineers
	5	Civil Engineers

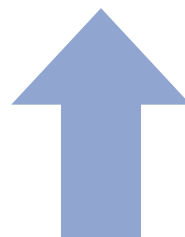
TOP 5 RELATED JOBS

BARRIERS TO NEW TECH ADOPTION

Share of companies surveyed



TOP 10 EMERGING JOBS



- 1 Big Data Architects
- 2 Automation Technicians
- 3 Renewable Energy Engineers
- 4 Automation Engineers
- 5 Organisational Development Specialists
- 6 New Technology Specialists
- 7 IT Administrators
- 8 Digital Transformation Specialists
- 9 IT Project Managers
- 10 Data Analysts (General)

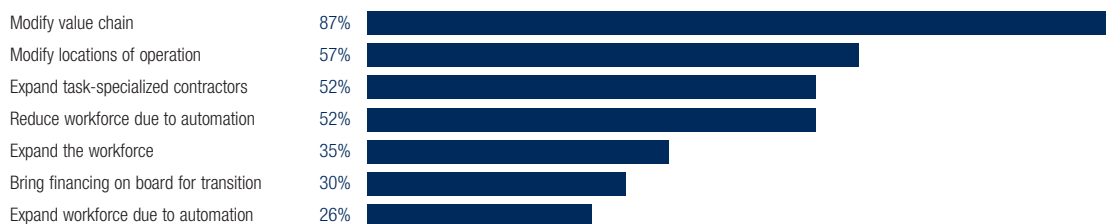
TOP 10 DECLINING JOBS



- 1 Team Assemblers
- 2 Secretaries and Administrative Assistants, except Legal, Medical and Executive
- 3 Inspectors, Testers, Sorters, Samplers and Weighers
- 4 Drilling and Boring Machine Tool Setters, Operators and Tenders, Metal and Plastic
- 5 Electrical and Electronic Equipment Assemblers
- 6 Milling and Planing Machine Setters, Operators and Tenders, Metal and Plastic
- 7 Data Entry Keyers
- 8 Paper Goods Machine Setters, Operators and Tenders
- 9 Bookkeeping, Accounting and Auditing Clerks
- 10 Cashiers

EXPECTED IMPACT ON WORKFORCE

Share of companies surveyed



Oil and Gas

Overview

The Oil and Gas Industry has experienced the impact of digital technologies and automation on offshore facilities for a number of years now: it has led to an increase in efficiency (through the use of predictive maintenance, for example), the exploration of new opportunities (through automated drilling, where it was previously too expensive or too dangerous) and a rise in safety for the workers on the rigs (i.e. through the use of drones for inspection and even basic maintenance). Yet despite the long-established use of technology, many companies in Oil and Gas have been slower than other industries to embrace the full spectrum of possible digital solutions.³³ The extreme volatility in oil prices during the last decade has led to a search for a new operating model that will enable quick adjustments based on changes in supply, demand and price. Many players in the industry realize that such an adoption can only be performed with the help of a workforce that possesses these new skills, but also has the industry-specific knowledge.³⁴

The top technologies that most Oil and Gas companies plan to adopt within the next four years are situated primarily in the digital space: user and entity big data analytics (87% planned adoption), internet of things (83%) and cloud computing (78%). On the intersection between digital and physical lie wearable electronics (70%). At the same time, nearly all companies throughout the industry want to explore new materials (83%).

Two-thirds of companies expect that the biggest impact of this technology adoption will be the change in the locations of operation. Many companies in the Oil and Gas industry have told us that this shift is mostly due to automation and the increase in remote operations, which will allow for central monitoring of drilling and processing in inhospitable locations. Half of companies (56%) expect that their workforce will have to be reduced due to automation and one-fourth (25%) think that it will have to be expanded due to automation, while about one-third (31%) project a general expansion of their workforce thanks to these new technologies. As seen across other industries, a reduction in highly specialized jobs can happen in tandem with a reduction in the number of lower-skilled employees.

For most companies the biggest barrier to the adoption of these technologies industry-wide, is the lack of understanding of the opportunities that they can offer

(61%). Skills gaps in local labour markets (57%) and in the leadership within the companies (52%) follow close behind. All these barriers point to the need for a workforce with additional skills, and thus for significant reskilling and upskilling efforts in the existing workforce, as well as an intensification in the recruitment efforts for new talent.

In their job postings, Oil and Gas companies have turned to a specific selection of job roles to help them solve the need for corresponding talent. For example, Software Developers for Applications are on the list as a must-have role for the top five technologies. At the same time, machine learning is already becoming a skill of central importance for Petroleum Engineers.

Future projections indicate this trend will continue: digitalization is represented by Big Data Architects, Automation Technicians and Engineers and IT Project Managers in the top ten emerging jobs. The fact that the companies themselves need to understand the opportunities and challenges—and in some cases need to change their structures to be able to adopt the technologies in a meaningful way—is reflected by the high ranking of the Organizational Development Specialists and Digital Transformation Specialists on the list. The top declining roles point to extensive disruptive automation and technological integration that will lead to more lower-skilled jobs: Team Assemblers, Secretaries and Inspectors are expected to drop in significant numbers.

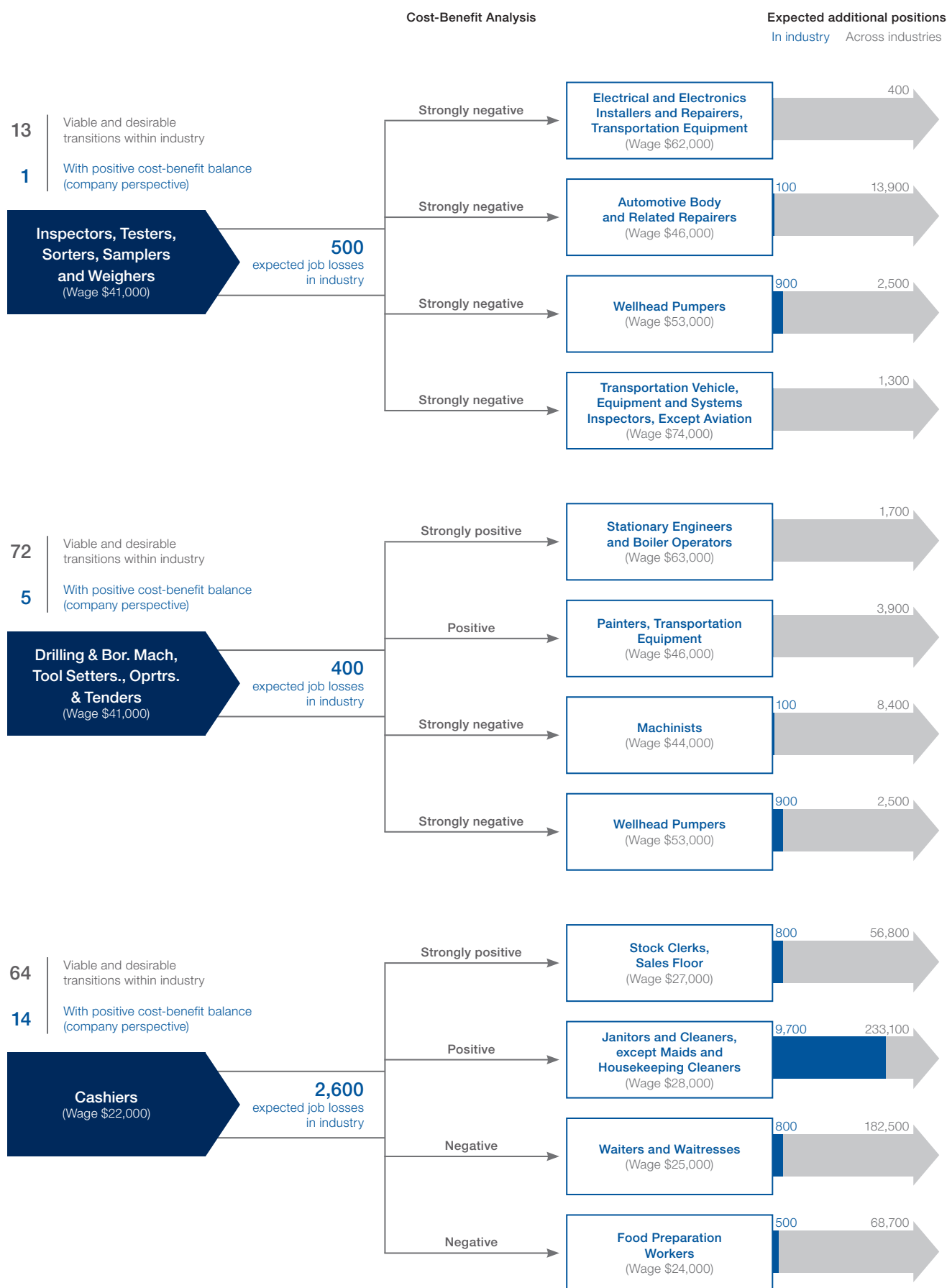
When considering the strategic opportunities of reskilling to deal with this transformation, we can see how Inspectors, Drillers and Cashiers working in Oil and Gas can be transitioned within the industry and to other industries into roles in increasing numbers, such as Wellhead Pumpers, Machinists and Janitors (Figure 23). In Figure 24, we show how the industry can develop programmes that provide companies with an agile internal pipeline for the talent they are most looking to integrate into their operations, such as Big Data Architects, Automation Technicians and IT Project Managers, by reskilling existing employees such as Storage Engineers, Plating Machine Operators and Procurement Specialists.³⁵ According to our model, these reskilling efforts will result in a positive cost-benefit balance for companies.

Recommendations for action

Like others, the Oil and Gas Industry sees the lack of clarity about current and future skills as the most pressing issue. The first step in addressing this should thus consist in building a strategic workforce planning entity within each company. The idea of sharing our findings about upcoming trends and their impact on the workforce and skills demand found wide acceptance among task force members. 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. It's notable that for jobs in security an equivalent training model with a jointly funded training institute does already exist.³⁶

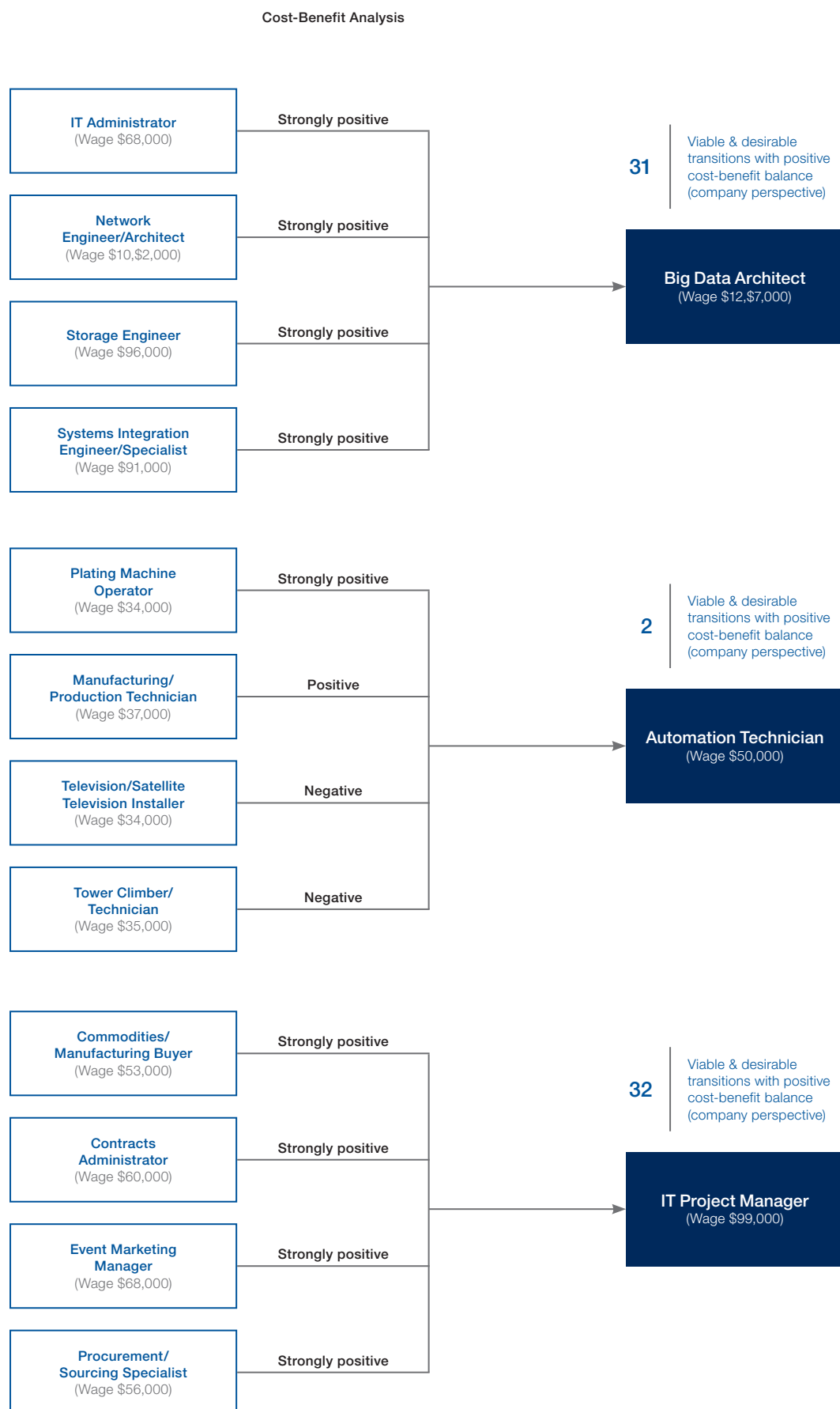
Further, a specific focus should be placed on digital and data science skills on the one hand, and on the introduction of agile (in the sense of scrum) ways of working on the other hand. This would allow multi-skilled talent to quickly form into new teams according to the emerging needs of the company. 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.

Figure 23: Finding opportunities for displaced workers in Oil and Gas



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Figure 24: Filling the skills gaps for emerging jobs in Oil and Gas



Sources: Burning Glass Technologies and US Bureau of Labor Statistics.

Annex:

Report Methodology

The Reskilling Revolution Model

Data Sources

*Occupational Information Network (O*NET)*

The Occupational Information Network (O*NET) database is the primary source of occupational information in the United States, developed under the sponsorship of the US Department of Labor/Employment and Training Administration. The database groups individual jobs into clusters of related professions, or 'job families', and is continually updated by surveying a broad range of workers from each job. Its use in our work is providing both a standardized list of almost one thousand job types, covering the entire US economy, and job-specific descriptors (e.g. required skills and knowledge) on these jobs.

Burning Glass Technologies (BGT)

The dataset compiled by Burning Glass Technologies (BGT) for this report is based on online job postings. This information is sourced by 'scraping' detailed data for a job from various online sources (e.g. job boards, employer sites). The data set encompasses detailed information on 958 jobs within the United States. Jobs in the data set are based on standardized job codes and job titles from O*NET. The data set provided for this report is based on approximately 50 million job postings over a two-year period from 2016 to 2018, covering approximately 40,000 unique data sources in the United States.

The BGT analysis of each job posting results in an accumulation of detailed information on required skills in each job. This information is categorized into more than 18,000 individual skills within approximately 650 skill clusters (categorized into baseline, specialized and

software skills). Information is also captured on the education and experience required for a job as well as average wages. Additionally, the BGT data set includes supplementary information on the employment gender distribution of each job covered from the American Community Survey (ACS).

US Bureau of Labor Statistics (BLS)

The 2016–2026 National Industry-Occupation Employment Matrix is developed by the US Bureau of Labor Statistics in the course of its ongoing Employment Projections programme. The 2016 matrix was developed primarily from the Occupational Employment Statistics (OES) survey, the Current Employment Statistics (CES) survey and the Current Population Survey (CPS). The 2016–26 National Employment Matrix encompasses data for approximately 800 jobs in the US and contains information on employment in 2016, as well as projections for expected employment in 2026 on an individual job basis.

The information on jobs in the 2016–2026 National Industry-Occupation Employment Matrix is based on Standard Occupational Classification (SOC) codes. The data set of 958 jobs used in this study captures about 96% of total employment in the 2016–2026 National Industry-Occupation Employment Matrix. Projections of employment per job were developed in a series of six interrelated steps, each based on a different procedure or model and related assumptions: labour force, aggregate economy, final demand (GDP) by consuming sector and product, industry output, employment by industry, and employment by occupation. The results produced by each step are key inputs to following steps, and the sequence may be repeated multiple times to allow feedback and to ensure consistency.

Future of Jobs Survey

The World Economic Forum's 2018 survey on the Future of Jobs contains 313 unique responses by global companies, collectively representing more than 15 million employees. The survey consisted of three interrelated parts. Part I mapped the trends that are set to positively and negatively impact business growth, the technologies that are likely to play a part in that expansion, the rationale and barriers related to this technology expansion, employers' preferred ecosystem for support, and the workforce shifts that will be needed to effect those changes. Part II mapped three interlocking pillars of the labour market—occupations, skills and tasks—and provided employers with an opportunity to share the jobs that are set to experience stable, declining and rising demand. Part III also asked employers to estimate the current and future composition of their workforce, and the division of labour between humans, machines and algorithms. Part III gave survey respondents an opportunity to share their current plans for the period up to 2022 as they pertain to closing key skills gaps in their enterprises. In particular, the survey asked employers to rate the likelihood of employing a variety of strategies aimed at ensuring their businesses have the right talent to grow, to give specificity to the scale of their future reskilling needs, and to share a range of detailed information about their current and future reskilling provision.

Use of Sources, Taxonomies and Levels of Data

We used a combination of the above sources, and their corresponding taxonomies, as well as relevant levels of data to ensure we have the highest possible accuracy in highlighting emerging and declining jobs, and to identify viable and desirable job transition pathways.

1. **Identification of top declining jobs** is based fully on forecasts from the US Bureau of Labor Statistics (BLS). BLS uses a number of analyses to assess which jobs will drop in numbers by 2026, and provides an industry breakdown of the number of workers employed in each job. The granularity of BLS' analysis of existing jobs in the US made it the most reliable source for declining jobs and was used throughout the report where possible.
2. **Identification of the top emerging jobs** was done by reviewing three sources: the Future of Jobs Executive Opinion Survey conducted by the World Economic Forum, Burning Glass Technology (BGT) forecasts and BLS projections. This was done to reflect the strengths of each data set: We used the Future of Jobs survey projections as a basis for our emerging jobs, as they reflect more accurately what businesses see coming up in the near future as the most important jobs for their operations; we then used data from BGT, which most accurately captures near-term dynamic trends in company job demands through big-data analysis job posting and their frequency.

3. **Creating a translation engine:** A number of responses to the *Future of Jobs Report 2018* were provided by businesses in a free text box, in particular entries for emerging technologies that might be too new to be already categorized. To standardize the job titles a manual lookup for the top emerging roles identified by executives answering the report was performed within the BGT taxonomy of occupations. Burning Glass Technologies has started to standardize some of the newest jobs titles emerging in the labour market as part of their real-time monitoring of the labour market. More importantly BGT has already provided a mapping of how those titles correspond to O*NET occupational titles. In essence, the Burning Glass Technology taxonomy provided a translation engine between O*NET occupational categories, BLS occupational categories and Future of Jobs occupational categories. This allocation was then used to map those jobs to ONET occupations. At all times, the underlying data used was on the aggregation level corresponding to ONET taxonomy of occupations which is aggregated to a higher level.
4. **Creating viable and desirable transitions:** We used BLS projection data to identify both the number of potential job losses associated with different roles as well as potential job gains. ONET data was used to filter jobs with too high jumps in job experience or educational requirements. BGT similarity scores were used to identify roles which had high levels of similarity according to the methodology described in the following sections. In all cases BGT similarity scores are calculated for data which corresponds to occupations at the ONET level of aggregation. Emerging role names have been displayed using the BGT taxonomy, but the underlying data corresponds to the ONET level of aggregation.

Viable and Desirable Job Transitions: Methodology

As this report builds on the results of *Towards a Reskilling Revolution: A Future of Jobs for All*, that report's key concept of viable and desirable job transitions has also been carried over. The calculation process is described in detail in the original report (http://www3.weforum.org/docs/WEF_FOW_Reskilling_Revolution.pdf) and is thus not repeated here. Figure A1 shows the four conditions for viable and desirable conditions and the use of the data sources for their calculation.

To assess the similarity between the requirements of two jobs, Burning Glass Technologies has developed a distinctive approach to measuring 'similarity scores' for jobs.

Burning Glass Technologies (BGT) combines data that the company gathers and processes from online job

Figure A1: Conditions of viable and desirable job transitions

Viable job transitions	
Condition	Main source data
1. Similarity scores between jobs are sufficiently high	BGT, O*NET
2. Transition does not require huge leaps in education and experience	BGT, O*NET

Desirable job transitions	
Condition	Main source data
3. Transition involves moving to jobs where numbers are forecast not to decline	BLS, O*NET
4. Transition leads to a level of wage continuity that allows individuals to maintain their standard of living	BGT

Source: World Economic Forum, *Towards a Reskilling Revolution*, 2018.

postings with data from the O*NET database described above. The fusion of these datasets is necessary to harness both the advantages of standardized job descriptors and of real-time labour market information.

Individual similarity scores for Burning Glass Technologies data and O*NET data are computed by calculating the similarity of requirement profiles for each separate pair of jobs. The features of every job can be expressed in the form of a vector, which consists of the skill demand frequency, education and experience requirements for the roles in question. Two jobs can then be compared by calculating the similarity score between their respective vectors. An identical pair of jobs would have identical vectors of features, and hence a similarity score of 1. The more different a pair of jobs, the closer their similarity score is to 0.

For each of the two data sources used, BGT calculates individual similarity scores, namely a 'BGT data similarity scores' and an 'O*NET data similarity scores'. The job similarity score is a weighted average between the BGT data similarity score and O*NET data similarity score.

Across the calculations detailed below, a vector comparison technique known as Euclidean distance is used. Each Euclidean distance score is transformed into z-scores in order to account for differences in the distribution of scores based on different factors.

1. **Calculating O*NET data similarity score:** First, the similarity score is calculated for a vector of Knowledge, Skills, and Abilities (KSA) for each occupation. Second, the similarity score is calculated for a vector of Work Activities and Education/Training/Experience for each occupation. Third, the scores are transformed into z-scores to account for differences in the distribution of scores across these categories. Fourth, a weighted average of similarity scores for KSA, Work Activities and Education/Training/Experience is calculated. (See Table A1)
2. **Calculating BGT data similarity score:** First, the similarity score is calculated for the vector of Skill Clusters (including Baseline, Specialized and Software skills) that makes up an occupation. Second, the similarity score is calculated for vectors of 'Experience' and Education. Third, the scores are transformed into z-scores to account for differences in the distribution of scores across these categories. Finally, a weighted average of similarity scores for measures for experience, education, and skills is calculated. (See Table A1)

Cost-Benefit Analysis

The cost-benefit analysis used in this report has been designed to provide guidance in the decision-making process faced by businesses and governments in the context of reskilling. The key questions which we wanted to answer from these two perspectives are:

1. Company perspective: What are the costs and benefits of reskilling current employees as opposed to going through a firing and hiring process?
2. Government perspective: What are the costs and benefits of reskilling parts of the workforce at risk, who might otherwise not find a job for an extended period of time?

Therefore, we consider the following options:

1. Company:
 - **C-reskill:** An employee who occupies job A is reskilled internally to job B
 - **C-hire/fire:** The employee who occupies job A is let go and an external candidate for job B is hired from the labour market
2. Government:
 - **G-reskill:** The government takes on the reskilling costs to help a worker transition to another job
 - **G-welfare:** The worker spends a set time unemployed and transitions to a lower-paying job afterwards

Table A1: Detailed information on scaling and weighting of inputs for calculation of similarity scores

		Input	Definition	Type of information for scaling	Scaling	Weighting for similarity score
O*NET data	KSA measure	Knowledge	Skills learned through education/training/experience	Level	0–7	1
		Skills	Learning acquired through practice and experience, practice used to facilitate knowledge acquisition	Level	0–7	
		Abilities	Similar job activities and behaviors which underlie the work functions	Level	0–7	
	Work Activities		Tasks required to perform the role	Level	0–7	1
	Education, Training and Experience		Requirements for each occupation by education and work experience	Distribution	0–100	1
BGT data	Skills measure	Baseline skills	Common, non-specialized skills required by job applicants to be considered for the role (applicable to broad categories of jobs)	Percent of job postings containing skill name	0–100	1
		Specialized skills	Skills particular to industry or occupation, not easily transferable	Percent of job postings containing skill name	0–100	
		Software skills	Skills related to the use, design, maintenance and repair of software	Percent of job postings containing skill name	0–100	
	Education x Experience	Experience	Year of experience required for the role	Percent of job postings containing experience requirement	0–100	1
		Education	Years of education (and type: AA, BA, MA, PhD) required for the role	Percent of job postings containing educational requirement	0–100	

Source: World Economic Forum, *Towards a Reskilling Revolution*, 2018.

Note: Categories of work experience are measured in time ranges and include: On-Site of In-Plant Training, On-the-Job Training, Related Work Experience and Required Level of Education. Required Level of Education is measured in types of educational qualifications, including high school diploma, associate's degree, bachelor's degree and others. The final measure here indicates the occupation's distribution across joint time and education/experience requirements for each occupation by either educational requirement-type (for example, Required Level of Education-Bachelor's Degree) or work experience type-time requirement (for example, On-the-Job Training-over 6 months, up to and including 1 year).

For each viable and desirable transition, we evaluate the difference in costs and benefits of each option for the relevant stakeholder.

Cost-Benefit Balance

For each viable and desirable transition, the costs and benefits of the four options are determined to calculate their Net Present Value (NPV). Figure A2 illustrates the cost (grey) and benefit (blue) for all options and their corresponding point in time. The percentage of transitions where the NPV of the reskilling option C-reskill and G-reskill is higher than the NPV for C-hire/fire, G-welfare, respectively, is referred to as share of pathways with positive cost-benefit balance.

The share of displaced workers able to find a new job is determined by an optimization model that only allows transitions through pathways with positive cost-benefit balance and maximizes the number of people able to transition. The boundary conditions to the linear programme are shown in Table A2.

Base assumptions

To assess the financial impact of the decision to pursue an option, we determined its Net Present Value (NPV) by discounting and subsequently summing up all future payments. Then, by comparing the NPV of each option, we identified the Net Present Value Difference (NPVD), which is our indicator of whether the cost-benefit balance for reskilling is positive or negative. The calculation of these cash flows requires a number of basic assumptions, which are described in Table A3; specifically, the column "Relevance for options" indicates in which of the above options the assumption is used.

Reskilling time

The time it takes a worker to bring their competencies to the required level of the job they want to do in the future is determined by the difference between the competencies required for their current and future job.

Figure A2: Timeline of cost-benefit payments for four options

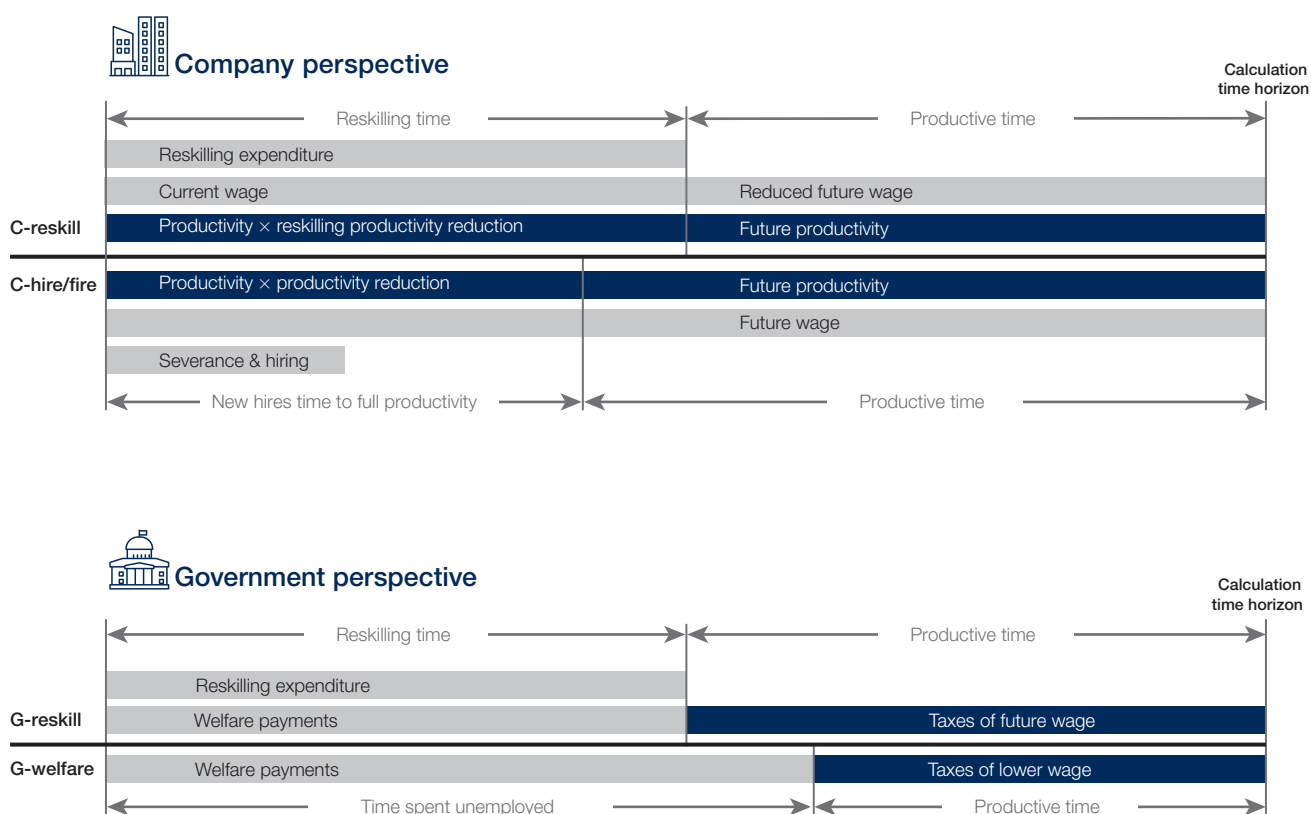


Table A2: Optimization conditions for Job Transition Model

Utility function	Constraints
The sum of job transitions where each job transition has a weight equal to 1	There are no job transitions to jobs with lower wages.
	There are only job transitions from jobs where expected employment in 2026 is lower than in 2016.
	There are no job transitions to jobs where expected employment in 2026 is lower than in 2016.
	There are no job transitions from jobs in job zone 5 (this is because job zone 5 comprises jobs such as CEOs, managers and scientists, where simulation of job transitions yield unlikely results).
	There are no job transitions with a similarity score of less than 0.85.
	Only job transitions to jobs in one job zone lower, equal or one job zone higher are feasible.
	Employment per job is smaller than or equal to projected future employment in 2026.
	Only job transitions that have a positive cost-benefit-balance are feasible.

Sources: World Economic Forum and Boston Consulting Group.

Table A3: Base assumptions of cost-benefit analysis

	Description	Relevance for options
Calculation time horizon including productive time	BLS data was used to determine the time span of the cost-benefit analysis: the time employees stay in a job (productive time) is 4.2 years on average. Additionally, a loyalty boost can be expected for reskilled employees. The reskilling time is added to the productive time, up to a calculation time of 8.4 years.	All
Discount rate	We have averaged a very conservative discount rate of 2%.	All
Tax rate	We used values based on the Internal Revenue Bulletin, published by the Internal Revenue Service, to determine the tax rates for the different income brackets.	All
Severance costs	The type of position and duration of employment determines the cost of firing. Based on the <i>Severance & Separation Benefits 2017–2018</i> report by Lee Harrison the average severance time paid for is 1.7 weeks, which amounts to 3% of the annual wage.	C-hire/fire
Hiring costs	The cost of hiring, including all activities undertaken in the hiring process, as recruiting events, advertising, etc., was estimated at \$ 4,425 per new hire based on our research.	C-hire/fire
New hires time to full productivity	We accounted for an average productivity reduction of 50% for the first months of employments for new hires, while they learn the company and industry-specific processes and skills.	C-hire/fire
Productivity	Wages were used as the indicator of productivity that an employee generates for the company.	C-hire/fire C-reskill
Future wage	Wage for new hires, as well as for new jobs after the reskilling. Based on BLS data per job, it is paid fully in option C-hire/fire, while for the C-reskill option it is calculated as the current wage plus 50% of the difference between current and future wage for the employee, with the company keeping 50% of the difference to cover the costs of reskilling, in line with efficiency wage theory. ³⁷	C-hire/fire C-reskill G-reskill
Reskilling productivity reduction	Used to determine an employee's productivity reduction during reskilling: it is assumed that the employee will have to first focus 100% of efforts on reskilling and reduce this focus throughout the complete reskilling time gradually until it reaches 0% in the end. Thus, an average of 50% productivity reduction is assumed. ³⁸	C-reskill
Reskilling expenditure	Used to determine the direct costs for the training and courses the employee takes. Based on the average cost between a 2-year public college and the costs of instructor and training rooms for about 12 people, the reskilling costs are calculated at \$90 per day and person, assuming reskilling employees can effectively attend classes 170 days per year (two semesters or 34 weeks).	C-reskill G-reskill
Reskilling time	Used to determine how long an employee stays in training. Based on O*NET data, the time necessary to close the competency gap between the average competencies of two jobs. For further explanation please refer to the "Reskilling time" and "Closing the competency gap" sections of this Annex.	C-reskill G-reskill
Current wage	We use the average wage for each job description, based on BLS data, it is paid for the currently disrupted job.	C-reskill G-reskill G-welfare
Time spent unemployed	Based on BLS data the average time spent in unemployment to find new job is 25 weeks.	G-reskill G-welfare
Welfare payments	Based on US government spending statistics, the average welfare benefits in the US equal \$391/week. They are received until a new job is found or reskilling takes place, with a maximum time of 99 weeks.	G-reskill G-welfare
Lower wage	After 99 weeks of unemployment, we assume that without reskilling a worker will need to accept a job that pays 70% of the current wage.	G-welfare

Sources: World Economic Forum and Boston Consulting Group.

Table A4: Competencies

Competencies	Feature	Use	Example
Knowledge	Learnable	Competency Gap between two jobs	Sales and Marketing
Skill	Learnable		Troubleshooting
Ability	Innate	Moderator for learning speed	Inductive reasoning

Sources: World Economic Forum and Boston Consulting Group.

Competencies

The term competency covers the three O*NET categories: Knowledge, Skill and Ability (see Table A4). Each category contains specific dimensions such as psychological knowledge, mathematical skills or logical reasoning ability.

The categories Knowledge and Skill contain dimensions that can be learned. To reach a certain level in one dimension, re/up-skilling must take place. The category Ability is considered innate and hence does not benefit from reskilling. The average Ability level for a job is used as a proxy for learning speed by multiplying the reskilling time with a moderating factor depending on the average ability.

The competencies required for all jobs are determined by O*NET and provided in numerical values. Competency gaps are the differences between the levels in each dimension. In a transition from job A to job B, reskilling closes the competency gap for every dimension in which job B has a higher requirement than job A. For the categories Knowledge and Skill, the levels of each dimension are translated into a timespan necessary to reach that competency level. The reskilling time for one dimension then is the difference between these timespans. Ability acts as a moderating factor for the time needed to bridge these gaps.

Closing the competency gap

The cognitive abilities determine how fast individuals can learn, thus, how long they need for reskilling. It is assumed that individuals from jobs with high average ability levels can learn faster. Thus, their reskilling time is multiplied by a moderating factor that is determined by their Ability.

Clustering all competencies across the categories through common factor analysis, using Spearman correlation coefficients³⁹ and thus empirically determining which competencies are likely to co-occur, led to the following realization: competencies that appear together in job requirements are likely to be taught together when undertaking reskilling. For example: math skill and math knowledge appear as a closely correlated cluster. For this reason, an iterative procedure is used to calculate the overall needed reskilling time. We assume that by learning one competency, the knowledge and skills acquired will partly close the gap for highly correlated competencies.

The amount of transferability between two competencies is determined by their Spearman correlation coefficient. In this manner training is continued until all competency gaps are closed. The overall learning time is used as reskilling time for a transition between two jobs. The reskilling costs are the product of reskilling time in years and cost of training per day.

Notes

- 1 World Economic Forum, 2018b; Frey and Osborne, 2013.
- 2 World Economic Forum, 2018b.
- 3 Fallon et al, 2015.
- 4 Gerbert and Ruess, 2018.
- 5 Burning Glass Technologies is a big data labour market analysis provider which has provided a unique data set aggregating insights from more than 50 million online job postings in the United States over a two-year period. The combined dataset covers 958 unique job types, as defined by the Occupational Information Network (O*NET).
- 6 Strack, et al, 2018.
- 7 For more information, see: <https://www.weforum.org/projects/future-of-work>.
- 8 While the projections utilized for the central scenario in *Towards a Reskilling Revolution* are based on figures for the US labour market from the US Bureau of Labor Statistics, the methodology developed by the report and further elaborated in this present publication is fully compatible with other data sets or alternative projections.
- 9 Schultz, 1961.
- 10 Jacobson, et al, 2005.
- 11 For specific data sources, please refer to Annex: Report Methodology.
- 12 Deming and Kahn, 2018.
- 13 For a methodologically sound calculation of the cost-benefit balance, we used the principle of the Net Present Value Difference (NPVD), which can give us a clear picture of the costs and benefits of any reskilling effort versus the relevant opportunity costs. For each perspective the NPVD between option 1 and option 2 (see figure 3) was calculated for each transition and will be referred to as cost-benefit balance. For details of how to calculate the NPVD, please refer to Annex: Report Methodology.
- 14 ILO, 2015.
- 15 Strack, et al, 2008.
- 16 Like vendors who produce real-time data about the labor market. See Reamer, 2013.
- 17 <https://www.cyberseek.org/>.
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- 19 For a definition of blended learning see McGee and Reis, 2012.
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To learn more about the System Initiative, please refer to the System Initiative website: <https://www.weforum.org/system-initiatives/shaping-the-future-of-education-gender-and-work>.

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