



# The Skills for the Post-COVID Economy

*How the Pandemic is Redefining Workforce Needs*

Matt Sigelman

CEO, Burning Glass Technologies

[msigelman@burning-glass.com](mailto:msigelman@burning-glass.com)

Basic Skills in Israel and Around the World Conference

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# Skills are an Economy's DNA

## Encoding Possibilities for Jobs, Careers & the Workforce

- Jobs are defined by skills
- Increasingly, the unit of currency of the job market is skills – not jobs
- Skills express the job market's dynamism
- Skills are the key to unlocking mobility within and between roles
- **Mapping between skills and jobs provides a powerful bridge between education & work**



# What a Billion Jobs Can Tell Us vs. Traditional Labor Market Information



Greater speed,  
granularity  
compared to  
survey-based  
instruments

Because of that  
speed and detail,  
the data are more  
actionable

In addition, job  
postings provide  
insight into real-  
world skill demands

# The Process: Collecting Real-Time Labour Market Data

The effort needed to build a comprehensive data collection structure is significant, as our experience shows.

Visit Online  
Job Sites



Collect &  
Deduplicate  
Job Postings



Laboratory Technician	
Bayer MaterialScience (BMS) is one of the leading producers of polymers and high-performance plastics in North America and is part of the global Bayer MaterialScience business with nearly 14,700 employees at 30 sites around the world. Business activities are focused on the manufacture of high-tech polymer materials and the development of innovative solutions for products used in many areas of daily life. The main segments served are the automotive, electrical and electronics, construction, medical, and sports and leisure industries.	
<b>Job description</b> The primary responsibility of this role is to produce and evaluate foam samples in the laboratory to support flexible foam application development. Bayer MaterialScience (BMS) product quality control, customer technical support, polyol, isocyanate and process research & development programs, and flexible molded and slabstock foam research & development programs.	
<b>The incumbent will:</b>	
<ul style="list-style-type: none"> <li>Producing lab-scale foams, testing of polyols, isocyanates and additives for customer technical programs, process and product research programs and manufacturing support.</li> <li>Troubleshooting and maintaining equipment needed for bench foam production and routine foam processing &amp; property evaluation and supporting machine scale-up work.</li> <li>Maintaining appropriate logbooks and other records including computer documents utilizing Excel, Word and PowerPoint programs to support project work.</li> <li>Provide internet and other information searches as needed for problem solving.</li> <li>Performing stoichiometric calculations for foam production using computer programs or hand-calculations.</li> <li>Understanding and following EHS, SOPs and Responsible Care rules, regulations and guidelines while maintaining good housekeeping and a safe work environment through participation in safety programs.</li> <li>Capable of managing multiple tasks, working effectively with more than one technical supervisor, interfacing with other functions such as manufacturing and research personnel.</li> <li>Interfacing directly with customers if needed, and providing timely foam results to assure the</li> </ul>	

Tagging & Normalising  
Postings to Generate  
Detailed Data

- Job Title & Occupation
- Employer & Industry
- Technical Skills
- Foundational Skills
- Certifications
- Educational Requirements
- Experience Levels
- Salaries

## What it Takes:

# Deep, Multi-Tiered Ontologies for Data Analysis

Actionable insight requires not only comprehensive occupation and skill ontologies – with tens of thousands of nodes – but also advance NLP for coding each posting to them

## Skill Hierarchy Sample: Web and Mobile

## Metadata Elements



- Skill Type
- Description
- Demand
- Projected Growth
- Occupations Hiring
- Average Salary
- Industries Hiring
- Employers Hiring
- Similar Skills

# The Granularity & Responsiveness of Big Data Enables Better Tracking of Emerging Technologies



## Example: Defining AI

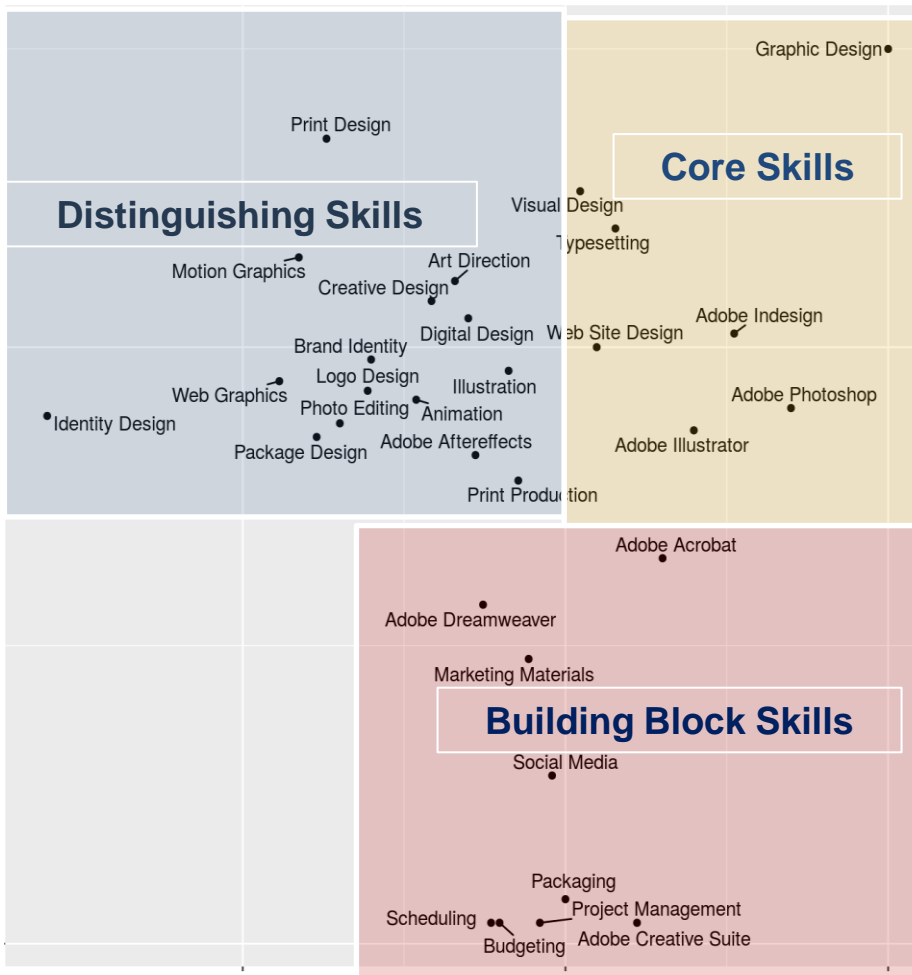
Skill	Skill Cluster
Artificial Intelligence	Artificial Intelligence
Expert System	Artificial Intelligence
IBM Watson	Artificial Intelligence
IPSoft Amelia	Artificial Intelligence
Ithink	Artificial Intelligence
Virtual Agents	Artificial Intelligence
Autonomous Systems	Autonomous Driving
Lidar	Autonomous Driving
OpenCV	Autonomous Driving
Path Planning	Autonomous Driving
Remote Sensing	Autonomous Driving
ANTLR	Natural Language Processing (NLP)
Automatic Speech Recognition (ASR)	Natural Language Processing (NLP)
Chatbot	Natural Language Processing (NLP)
Computational Linguistics	Natural Language Processing (NLP)
Distinguo	Natural Language Processing (NLP)
Latent Dirichlet Allocation	Natural Language Processing (NLP)
Latent Semantic Analysis	Natural Language Processing (NLP)
Lexalytics	Natural Language Processing (NLP)
Lexical Acquisition	Natural Language Processing (NLP)
Lexical Semantics	Natural Language Processing (NLP)
Machine Translation (MT)	Natural Language Processing (NLP)
Modular Audio Recognition Framework (MARF)	Natural Language Processing (NLP)
MoSes	Natural Language Processing (NLP)
Natural Language Processing	Natural Language Processing (NLP)
Natural Language Toolkit (NLTK)	Natural Language Processing (NLP)
Nearest Neighbor Algorithm	Natural Language Processing (NLP)
OpenNLP	Natural Language Processing (NLP)
Sentiment Analysis / Opinion Mining	Natural Language Processing (NLP)
Speech Recognition	Natural Language Processing (NLP)
Text Mining	Natural Language Processing (NLP)
Text to Speech (TTS)	Natural Language Processing (NLP)
Tokenization	Natural Language Processing (NLP)
Word2Vec	Natural Language Processing (NLP)
Caffe Deep Learning Framework	Neural Networks
Convolutional Neural Network (CNN)	Neural Networks
Deep Learning	Neural Networks
Deeplearning4j	Neural Networks
Keras	Neural Networks
Long Short-Term Memory (LSTM)	Neural Networks
MXNet	Neural Networks
Neural Networks	Neural Networks
Recurrent Neural Network (RNN)	Neural Networks
Pybrain	Neural Networks
TensorFlow	Neural Networks

Skill	Skill Cluster
AdaBoost algorithm	Machine Learning
Boosting (Machine Learning)	Machine Learning
Chi Square Automatic Interaction Detection (CHAID)	Machine Learning
Classification Algorithms	Machine Learning
Clustering Algorithms	Machine Learning
Decision Trees	Machine Learning
Dimensionality Reduction	Machine Learning
Google Cloud Machine Learning Platform	Machine Learning
Gradient boosting	Machine Learning
H2O (software)	Machine Learning
Libsvm	Machine Learning
Machine Learning	Machine Learning
Madlib	Machine Learning
Mahout	Machine Learning
Microsoft Cognitive Toolkit	Machine Learning
MLPACK (C++ library)	Machine Learning
Mlpy	Machine Learning
Random Forests	Machine Learning
Recommender Systems	Machine Learning
Scikit-learn	Machine Learning
Semi-Supervised Learning	Machine Learning
Supervised Learning (Machine Learning)	Machine Learning
Support Vector Machines (SVM)	Machine Learning
Semantic Driven Subtractive Clustering Method (SDSCM)	Machine Learning
Torch (Machine Learning)	Machine Learning
Unsupervised Learning	Machine Learning
Vowpal	Machine Learning
Xgboost	Machine Learning
Blue Prism	Robotics
Electromechanical Systems	Robotics
Motion Planning	Robotics
Motoman Robot Programming	Robotics
Robot Framework	Robotics
Robotic Systems	Robotics
Robot Operating System (ROS)	Robotics
Robot Programming	Robotics
Servo Drives / Motors	Robotics
Simultaneous Localization and Mapping (SLAM)	Robotics
Computer Vision	Visual Image Recognition
Image Processing	Visual Image Recognition
Image Recognition	Visual Image Recognition
Machine Vision	Visual Image Recognition
Object Recognition	Visual Image Recognition

# Identifying the Skills That Matter

## To Guide Workforce Investment & Education Curricula

### Graphic Designer / Desktop Publisher (BGTOcc)



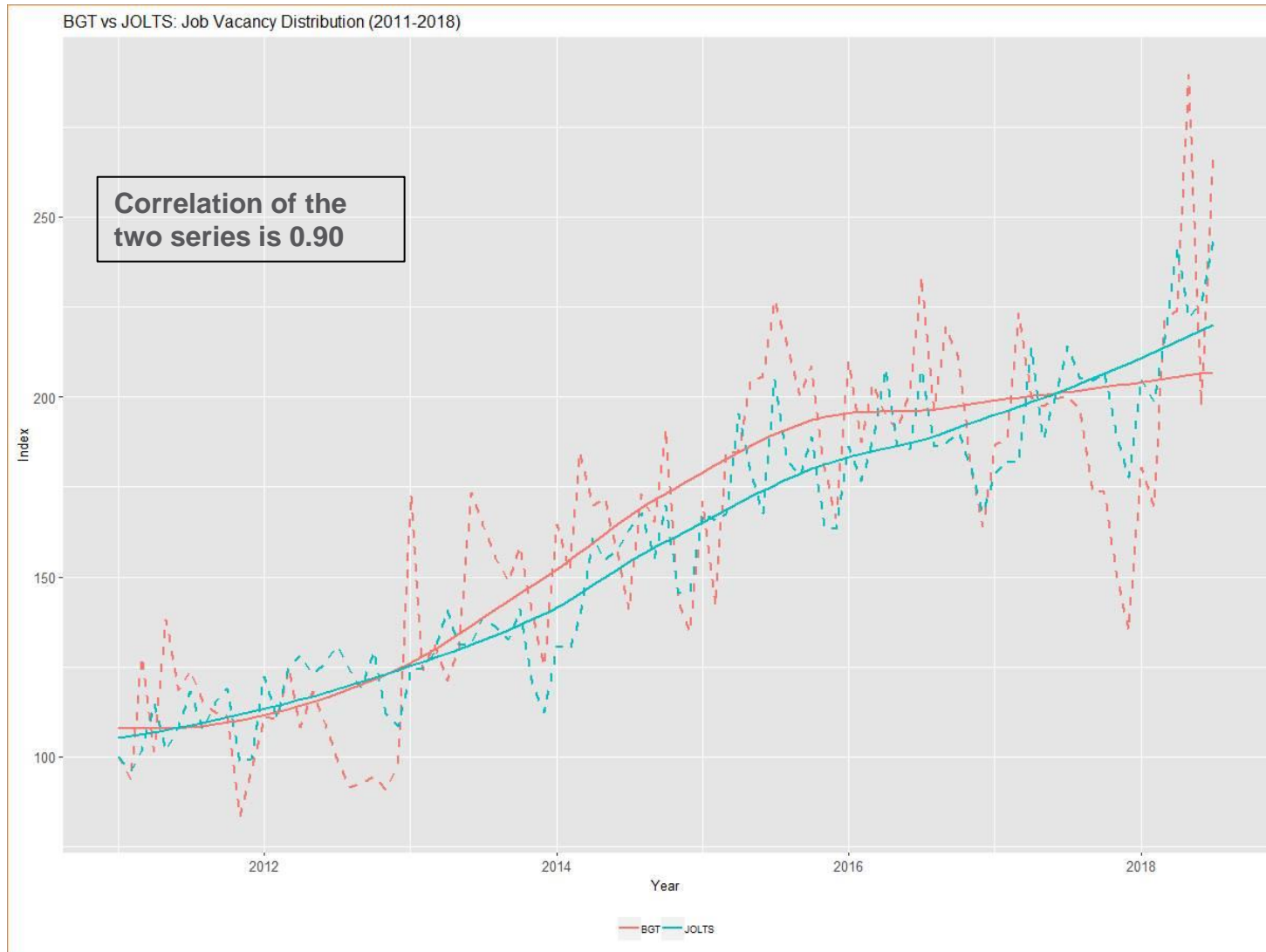
**Core Skills:** Definitional skills to each occupation which students will need in order to contribute

**Building Block Skills:** Although these are required and relevant across many roles, **they aren't always included in curriculum, putting graduates at a disadvantage**

**Distinguishing Skills:** These are emerging, fast-growth skills or core opportunities for specialization that **enable students to differentiate themselves – and often command significant salary premiums**

# Big Datasets Track Other Sources

## High Levels of Correlation with Government Data Series

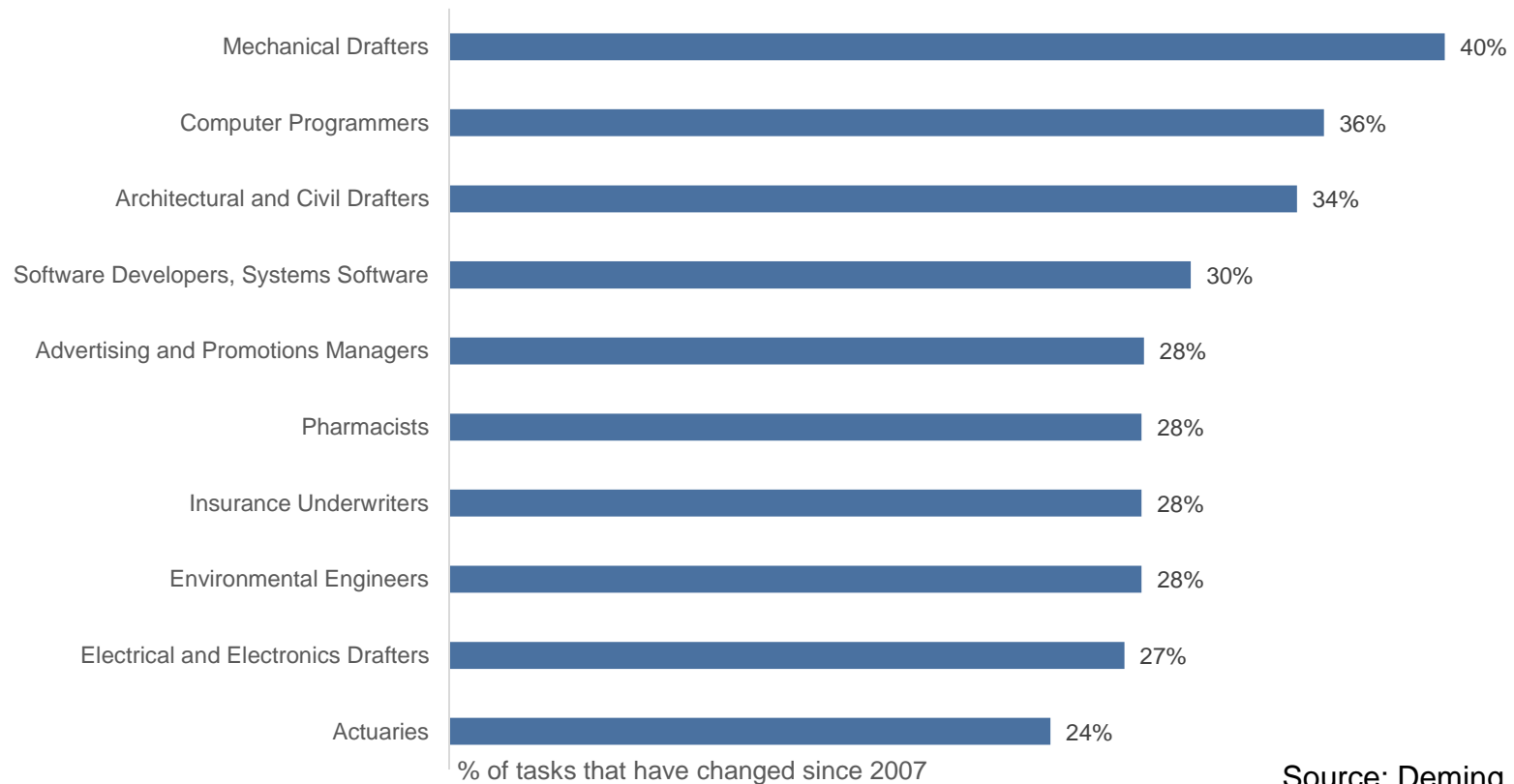




# Existing Occupations

## Can Evolve Faster Than Expert-Driven Definitions

### Fastest-Changing Professional Occupations



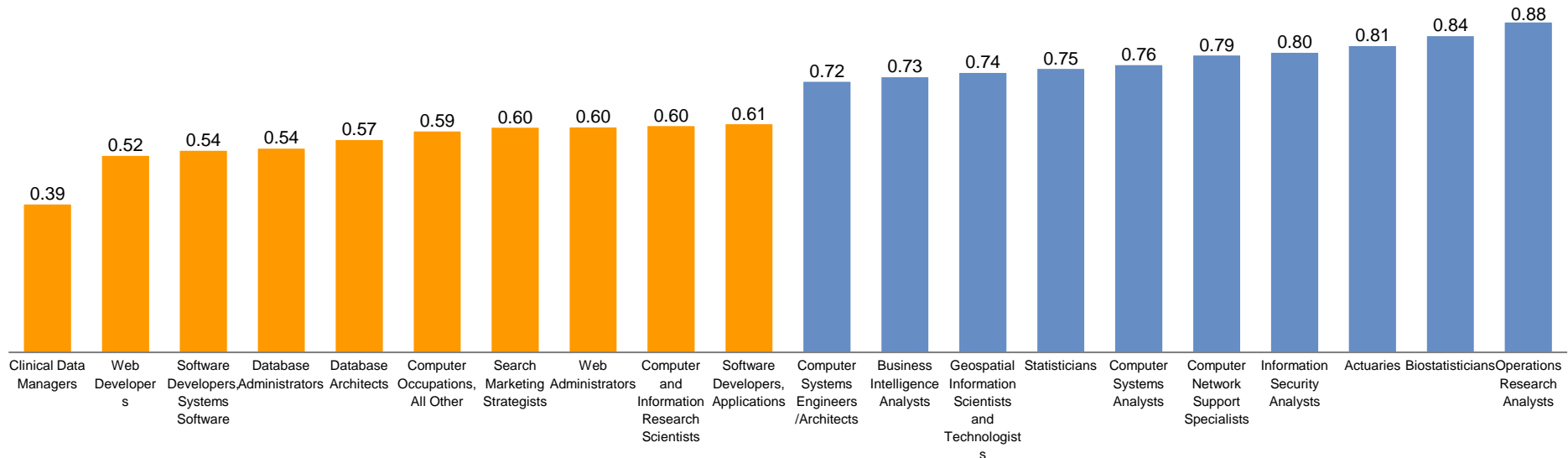
Source: Deming, NBER, 2018, analysing Burning Glass data

# Understanding How Jobs Change Even Among Tech Jobs, Some Change Faster

**Skill Change Score:** The score can take values between 0 and 1 – the smaller it is, the more a job has changed.

Top 10 fastest changing tech / data jobs

Top 10 tech / data jobs changing the least



Note: the job titles follow the ONET taxonomy and only the jobs with more than 10,000 appearances in online postings in 2018 were considered

1. Intra-similarity score: based on the changes in skills, education and experience required to perform a certain job over 2015-2018

2. Changes in skills, education and experience: by % of online postings in which they were required; only skills required in at least 10% of postings in either 2015 or 2018 were included

Source: Burning Glass; BCG analysis


# Clinical Data Managers: More Focus on Data, Less on Bureaucracy

## What skills are rising...



Clinical Research: 109%  
Biologics Industry Knowledge: 85%  
People Management: 40%  
Quality Assurance and Control: 75%  
Scheduling: 142%  
SQL Databases and Programming: 100%

## ...and in decline



Clinical Informatics: -23%  
Project Management: -21%  
Billing and Invoicing: -70%  
Business Process and Analysis: -69%



Are employers raising  
the bar on experience  
and education?

6 to 8 years experience: 85%  
0 to 2 years experience: -25%

# Remixing the DNA of Jobs

## The Emergence of a Hybrid Genome

### Accountant

### Data Scientist

#### ACCOUNTING

Accounting  
Account Reconciliation  
General Ledger  
Financial Statements  
Generally Accepted Accounting Principles  
Financial Reporting  
Balance Sheets

#### SOFT SKILLS

Communication Skills  
Detail-oriented  
Excel



**+23%**

Since 2013



**+598%**

Since 2013

#### PROGRAMMING

Python  
SQL  
Hadoop  
R

#### DATA SKILLS

Data Visualization  
Tableau  
Excel  
MapReduce

#### BUSINESS SKILLS

Predictive Models  
Business Process  
Economics  
Strategic Planning

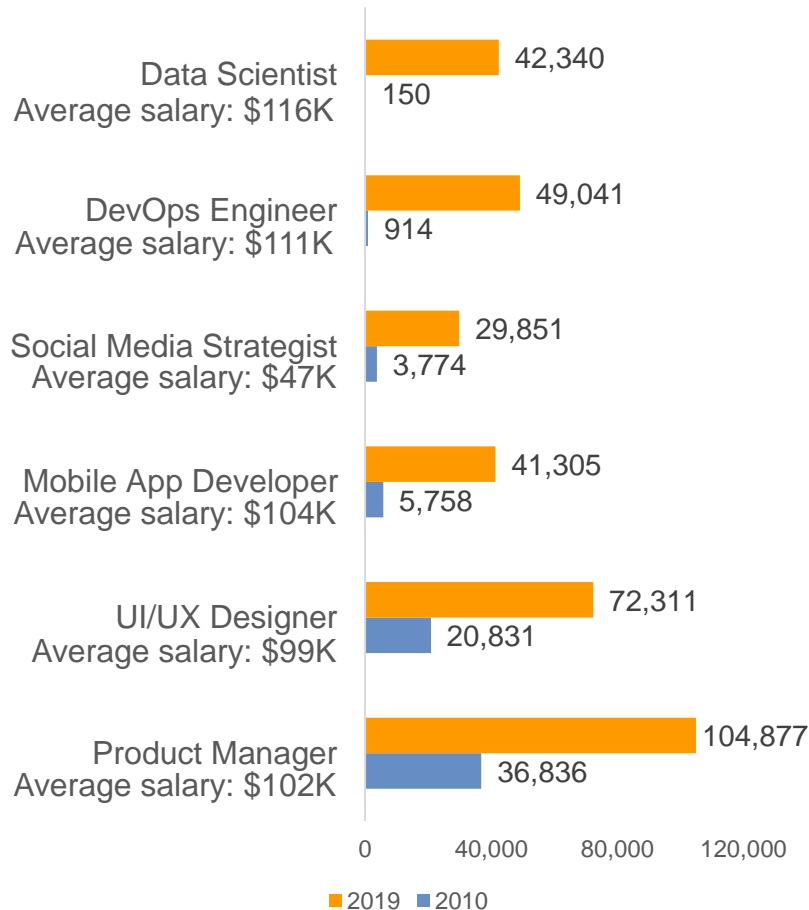
#### SOFT SKILLS

Problem Solving  
Writing  
Teamwork

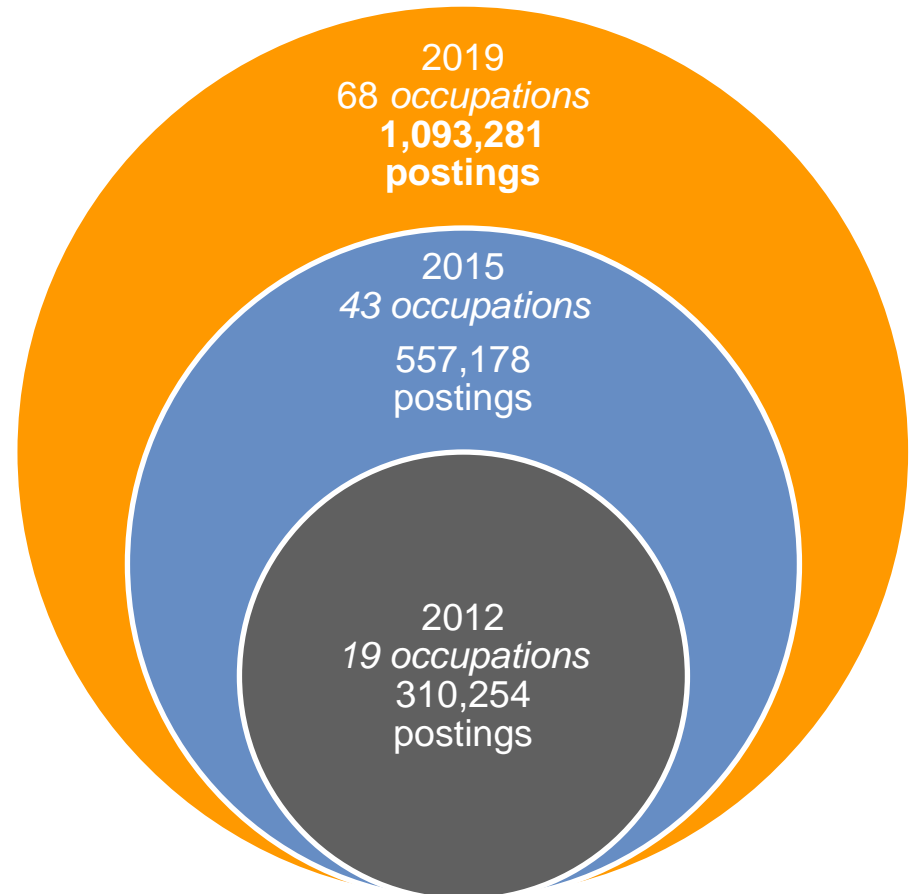
# The Biggest Future Work Transformations

## Are Sub-Occupational: The Hybridization of Skills

**Job Postings Growth in New Hybrid Roles**

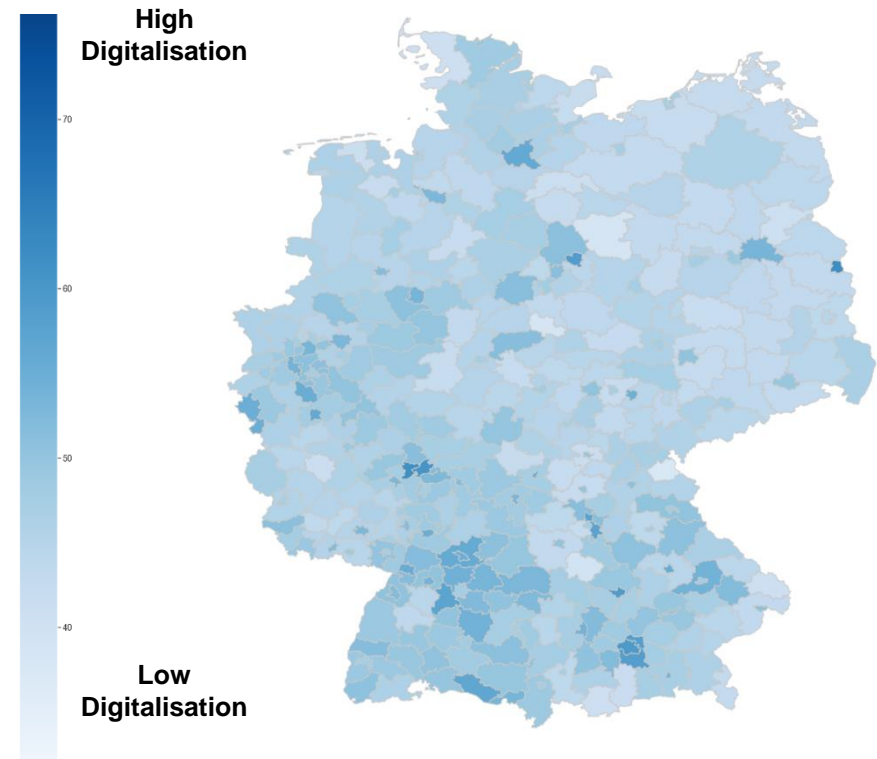
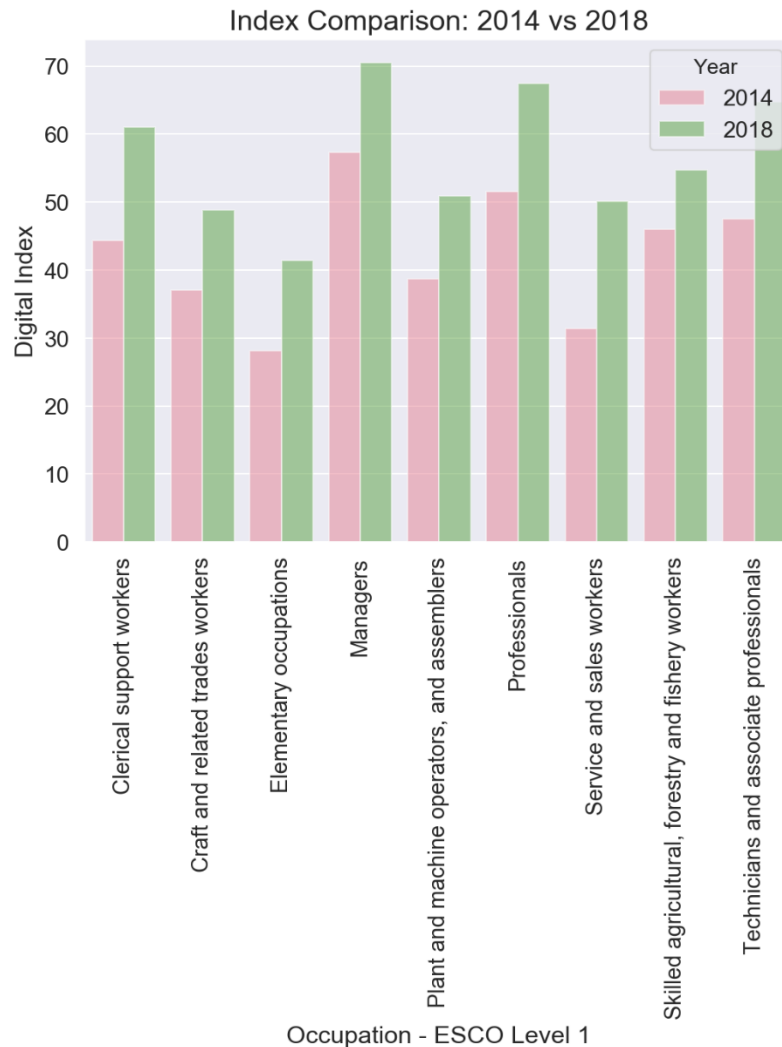


**Occupations with at least 10,000 postings requesting data skills**



# Digitalisation is Rising

Broad Impact Across Occupations & Regions, Including Those That Have Previously Lagged



# Skills of Mass Disruption

## Emerging Skills Rewriting the Tech Workforce

Skill Area	Total Job Openings (last 12 months)	Projected 5-Year Demand Growth
Software Dev Methodologies	634,660	35%
Cloud Technologies	462,963	28%
Proactive Security	373,123	39%
IT Automation	282,380	59%
AI and Machine Learning	197,810	71%
Connected Technologies	68,313	104%
NLP	36,941	41%
Fintech	35,667	96%
Parallel Computing	11,056	17%
Quantum Computing	2,718	135%

# A New Set of Foundational Skills

## Unlock New Economy Opportunity

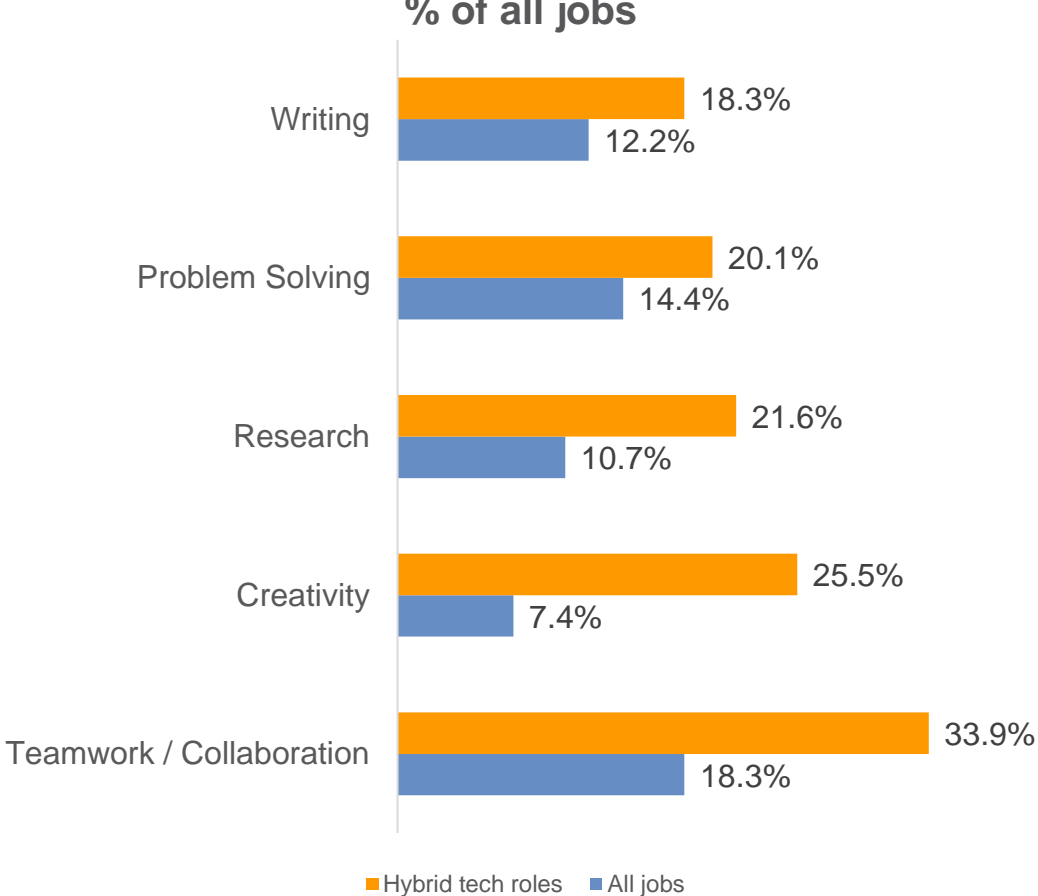
Foundational Skill Group	Foundational Skill Area	Total Openings in Entry-Level Postings in BA-plus SOCs: March 2019 - Feb 2020	Growth in Number of Postings: 2017-2019	Share of Openings Outside IT and Analysis Job Families	Average Salary Premium
Business Enablers	Business Process	370,883	29%	67%	12%
	Project Management	281,999	51%	69%	14%
	Digital Design	152,960	44%	64%	-
	Communicating Data	39,897	101%	34%	27%
Digital Building Blocks	Managing Data	292,817	49%	28%	34%
	Analyzing Data	217,623	48%	55%	21%
	Software Development	263,261	48%	17%	43%
	Computer Programming	203,328	56%	13%	45%
	Digital Security and Privacy	67,879	30%	29%	38%
Human Skills	Communication	1,264,535	48%	81%	-
	Collaboration	595,402	58%	79%	2%
	Critical Thinking	587,966	52%	66%	0%
	Analytical Skills	490,311	44%	76%	1%
	Creativity	276,003	60%	82%	-



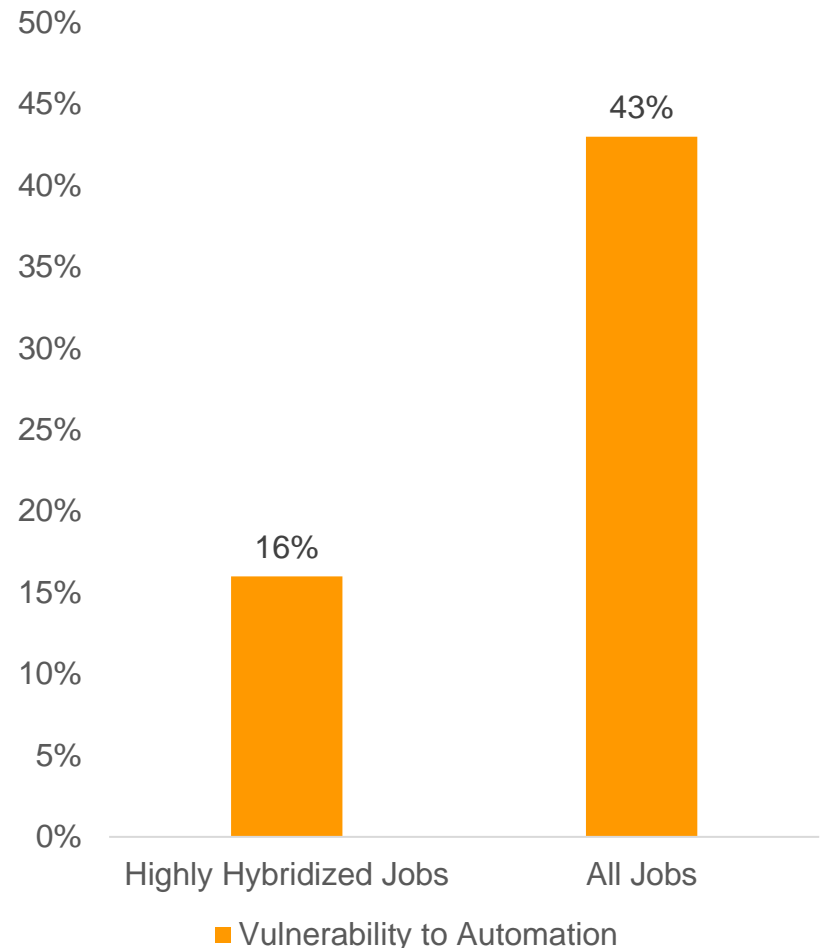
# High Value Work Demands Foundational Skill

## The New Foundational Skills are Central to New Economy Opportunity

% of hybrid jobs requesting key soft skills vs. % of all jobs



Vulnerability to Automation

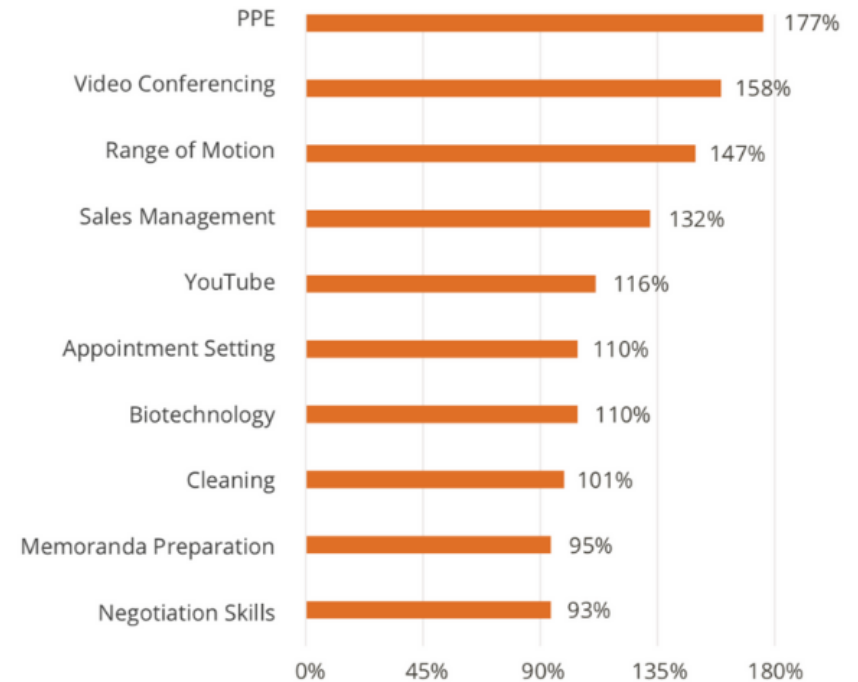


# The Pandemic is Accelerating Skill Change

Largest Relative Shift in Skill Demand  
2010-2020



Largest Relative Shift in Skill Demand  
2019-2020



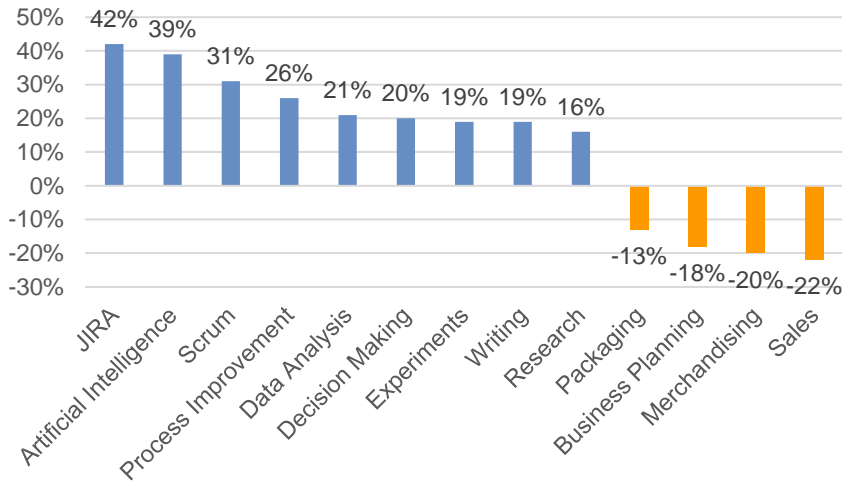
# The Roles They Are a-Changin’



## Just Since the Start of the Pandemic, Many Roles Demand New Skills

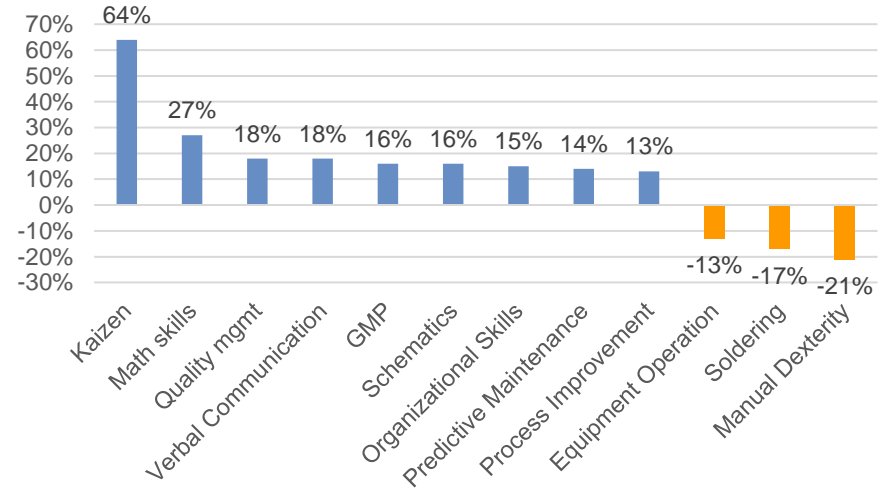
### Key Changes in Product Manager Skills

Change in relative demand, last 30 days vs. 2019



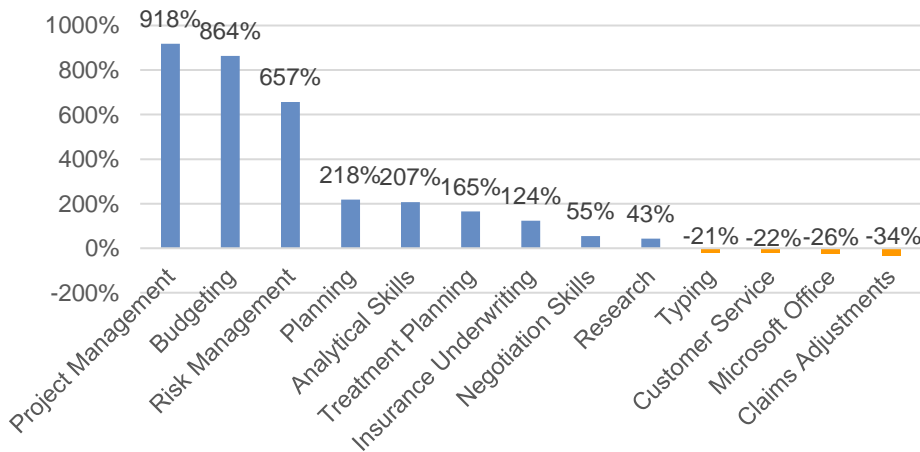
### Key Changes in Production Technician Skills

Change in relative demand, last 30 days vs. 2019



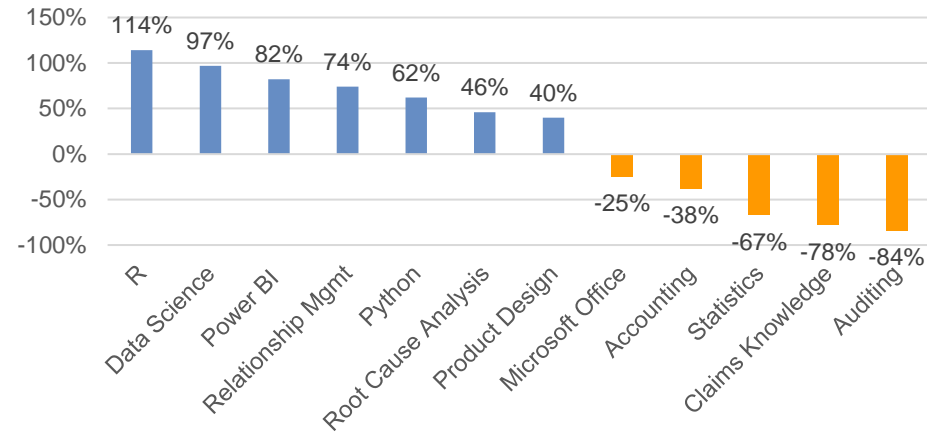
### Key Changes in Insurance Claims Clerk Skills

Change in relative demand, last 30 days vs. 2019



### Key Changes in Actuary Skills

Change in relative demand, last 30 days vs. 2019



## Looking Ahead to Anticipate

# The Jobs That Will Drive the Recovery

### The Readiness Economy

- COVID-19 has revealed how ill-prepared we all are – the “black elephant” we’ve been ignoring. Preparedness will **boost demand in healthcare, infrastructure, cybersecurity, environmental tech, insurance**, etc.

### The Remote Economy

- As more work gets performed remotely, there will be **growing dependence on the data and software** that are the key underpinnings of the remote economy.

### The Logistics Economy

- Manufacturers can see the **vulnerability of supply chains**, etc. **Reshoring** some industries will put greater focus on **advanced manufacturing**. Similarly, there will be greater need for **logistics expertise**.

### The Automated Economy

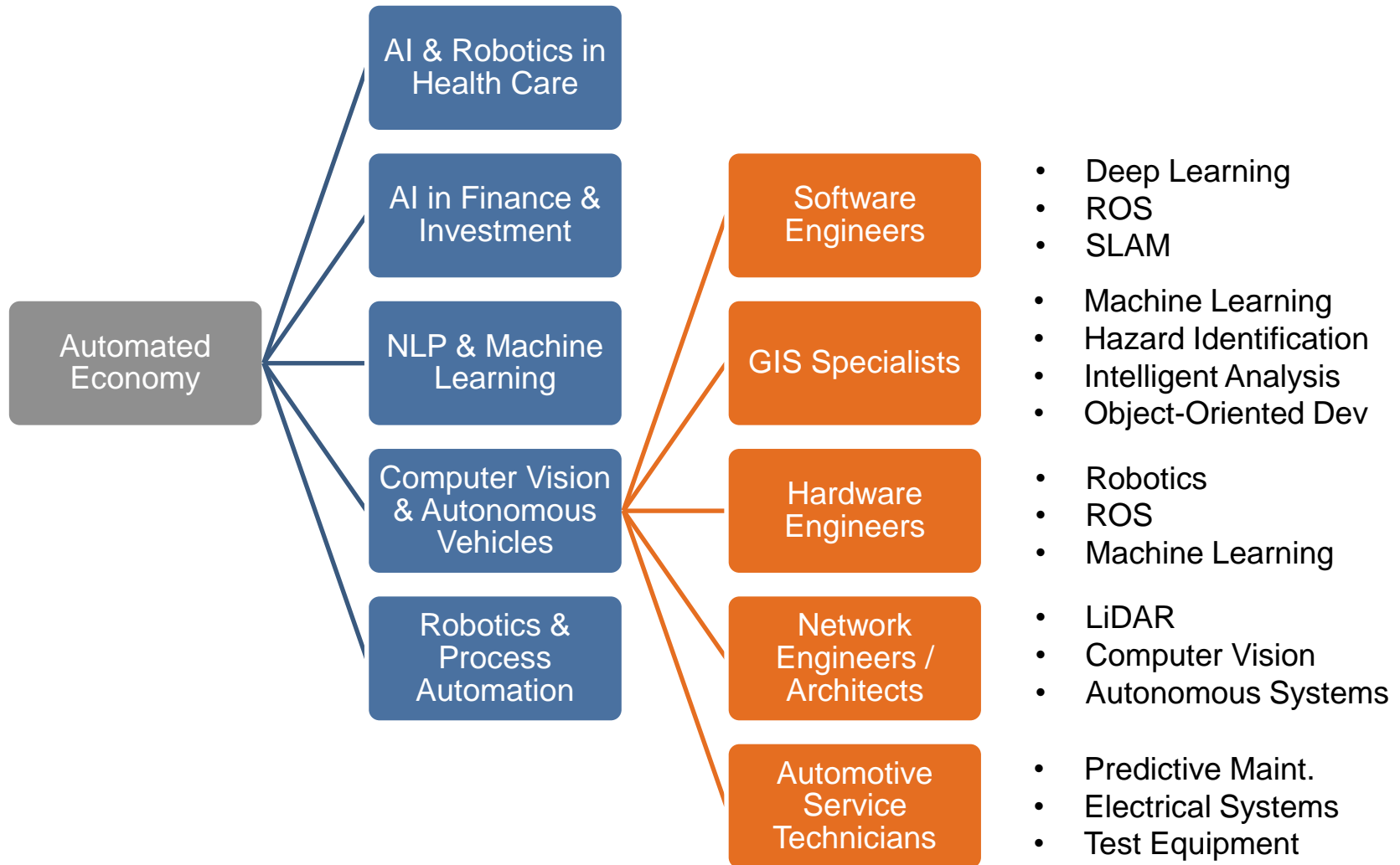
- Employers will prioritize automation over hiring back low-value workers. **Jobs driving automation will thrive**.

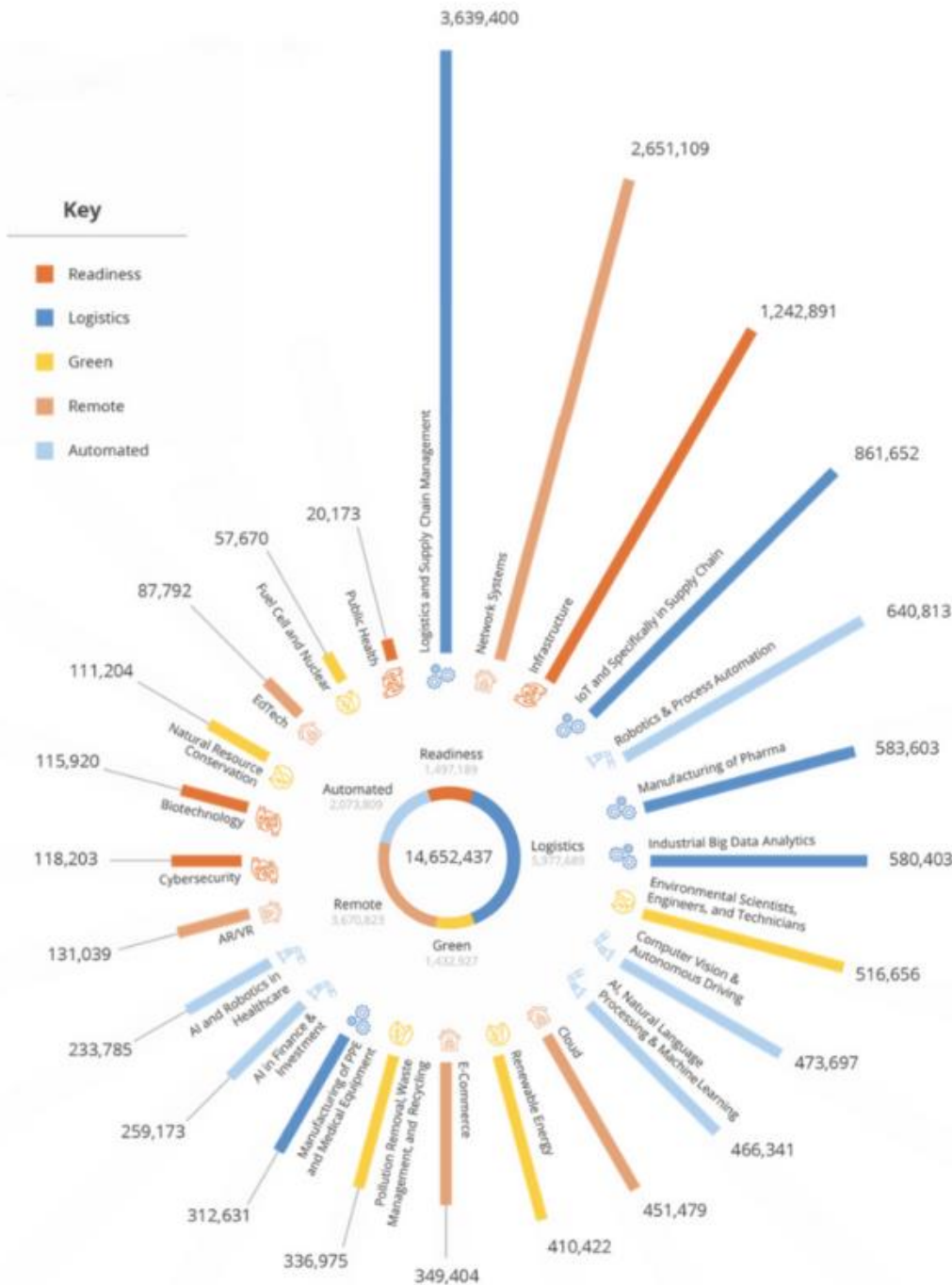
### The Green Economy

- As the U.S. invests more in changing its energy infrastructure and in ways of fighting climate change, there will be demand for **clean energy expertise**.

# Build a Supply Chain of Talent

## For the Jobs & Skills Powering Each Sector's Growth





These Five Economies Will Drive Up Demand in a Broad Array of Jobs  
**Many Will Require New Skills**

# As New Technologies Intersect Familiar Roles Workers May Need Radically Different Skills

## Mechanical Engineers

<b>Traditional Mechanical Engineer</b>
<b>Top Specialized Skills</b>
Mechanical Engineering
Project Management
Mechanical Design
SolidWorks
AutoCAD
Budgeting
Scheduling
Product Development
HVAC
Repair

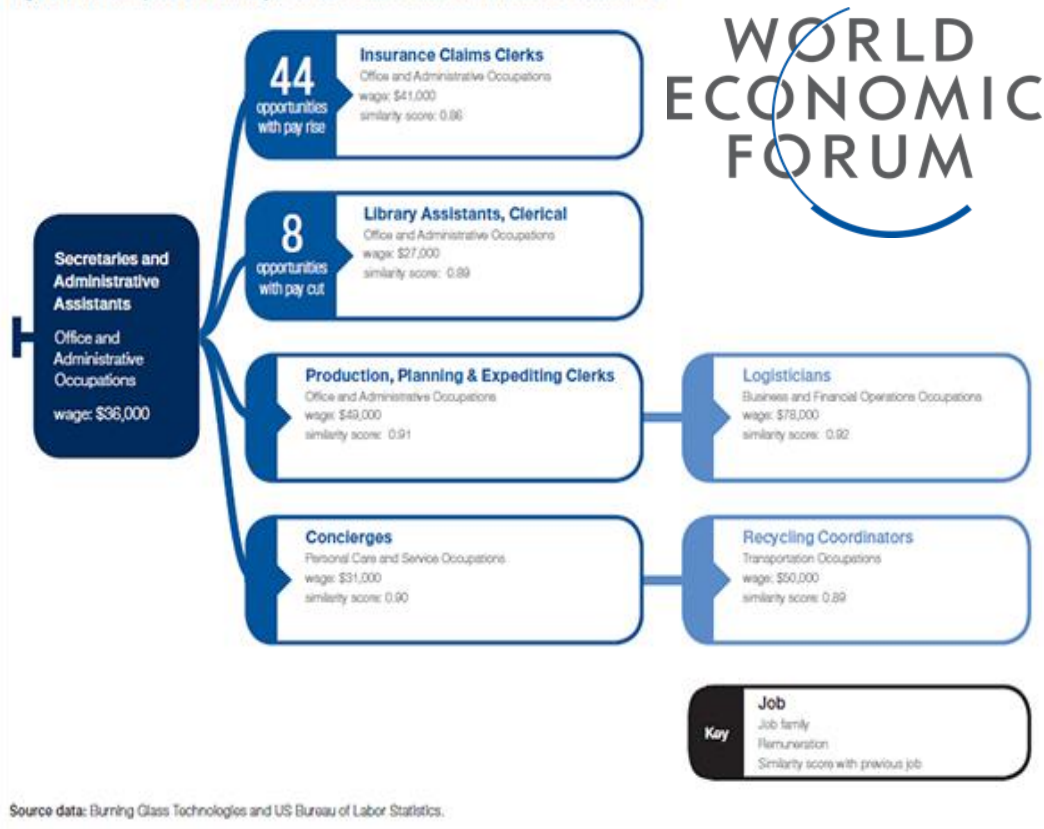
<b>Vehicle-to-Infrastructure Specialist</b>
<b>Top Specialized Skills</b>
Transportation Systems
C++
Global Positioning System (GPS)
Business Development
Civil Engineering
Hardware & Software Configuration
Lidar
Simulation
Traffic Management
Linux

<b>Autonomous Systems Specialist</b>
<b>Top Specialized Skills</b>
Autonomous Systems
Mechanical Engineering
Robotics
Simulation
Python
C++
Systems Engineering
MATLAB
Machine Learning
Electromechanical Systems

# Managing Transitions

## Reskilling to Survive Automation

Figure B1: Examples of Pathways for Secretaries and Administrative Assistants



With reskilling, at-risk workers could **expand their options fivefold**, and could **increase income by up to \$15,000**.

Without reskilling, one in four workers would see their **income drop by \$8,600**.



# To Grow Workforce Value, Build the Skills That Close Gaps & Drive Mobility

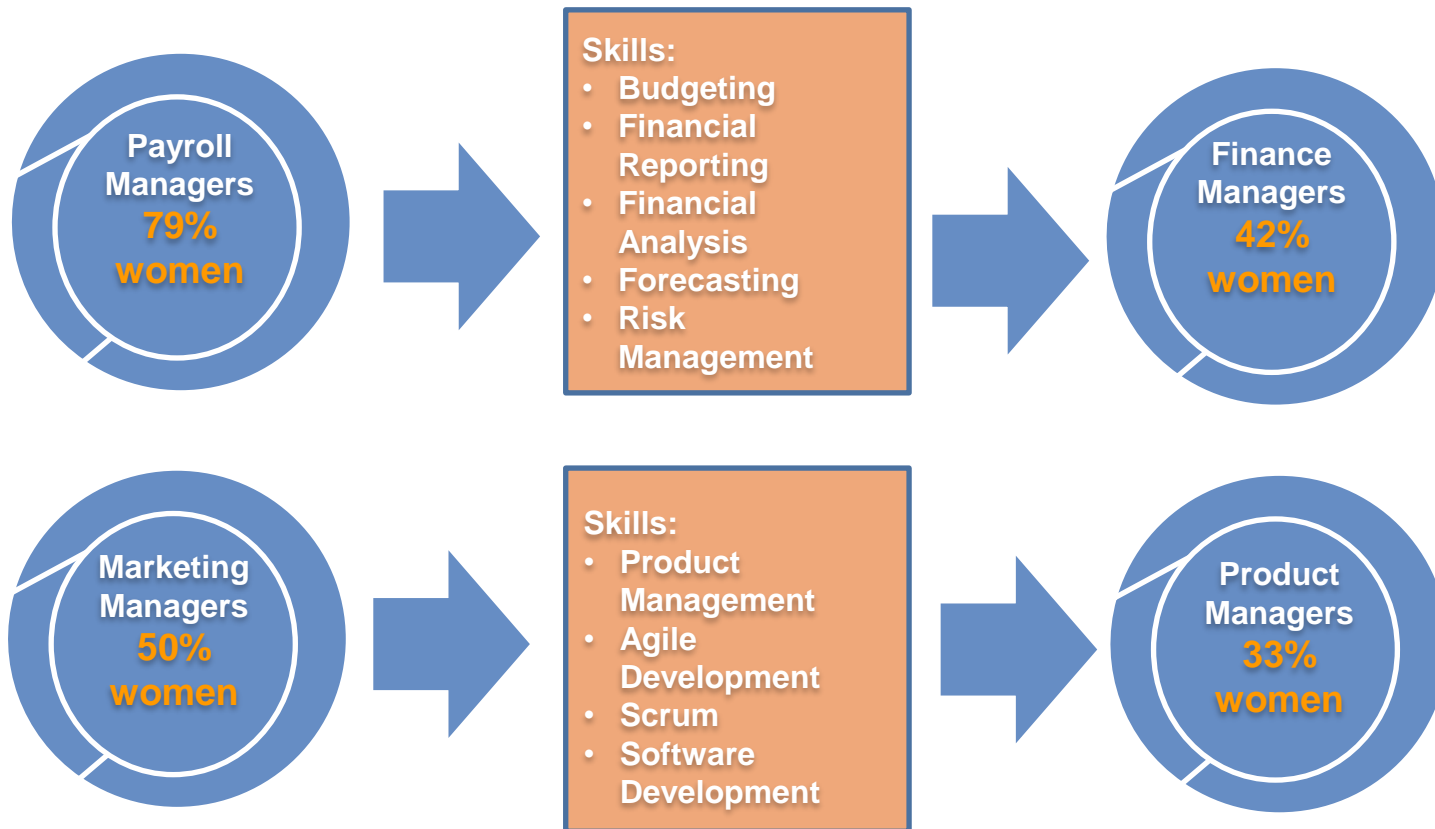
Skills Gaps for Top Transitions from Lower-Wage to Opportunity Occupations



Note: The share of destinations requesting a skill is weighted by the employment of the destination occupations. The y-axis reflects the share of top transitions for which the skill ranks among the destination occupation's top 25 skills but not the origin's.

Source: Federal Reserve Banks of Cleveland and Philadelphia based on Burning Glass data

# A Strategy for Broad Diversity and Inclusion



# Build a Skills Strategy for Your Community

**Table 13:** Ratio of Projected Openings: Supply for Key Occupation Families

Occupation Family	Employment	Annual Openings, 2016-2026	Total Completions, 2015	Sub-BA Openings: Demand/Supply Ratio	BA Openings: Demand/Supply Ratio	Graduate Openings: Demand/Supply Ratio	Percent of Completers who Remain
<b>Supply Gaps</b>							
Computer and Mathematical	12,070	927	433	2.0	6.4	0.3	63%
Architecture and Engineering	7,338	586	885	0.3	1.9	0.3	73%
Production*	32,195	4,020	75	4.2	N/A	N/A	59%
Business and Financial Operations	24,040	2,309	2,310	1.2	2.1	0.2	67%
<b>Misalignment with Industry</b>							
Life, Physical, and Social Science	2,682	282	609	N/A	0.5	0.7	62%
<b>Misalignment with Credentials</b>							
Practitioners and Technical	42,177	2,948	4,176	1.7	1.5	0.3	60%

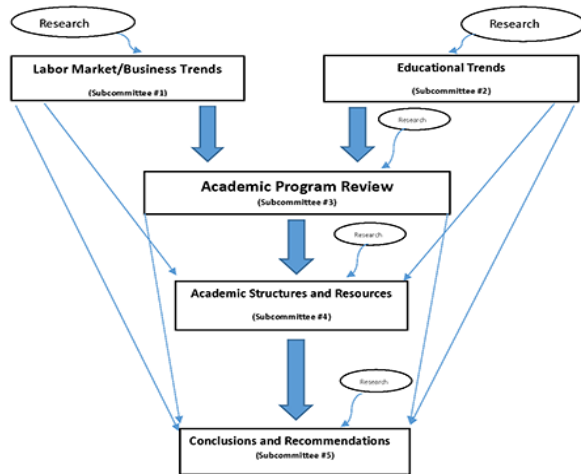
\*Note: Production Sub-BA demand considers only those roles that regularly request a post-secondary credential, such as Inspectors.



Birmingham, AL, found itself struggling to compete with nearby cities like Memphis. Using LMI, the Broad Goals coalition **identified the educational assets and current strengths** of the Central Alabama workforce.

That data is at the center of a **coordinated campaign to upgrade Birmingham's workforce with the skills and degrees to compete internationally.**

# Build a Skills Strategy for Education



As part of its Academic Master Plan process, BCC reviewed 60+ programs for alignment with high-value careers

The college identified areas for additional educational pathways.

The analysis also recommended closing programs aimed at careers that aren't in demand or that lead to low-wage jobs



WESTERN GOVERNORS UNIVERSITY



Data Science Occupations

Skill Name	Percent of Job Postings Calling for Skill
Data Science	75%
Python	72%
Machine Learning	62%
SQL	47%
Apache Hadoop	36%
Big Data	34%
Java	34%
R	24%
Data Analysis	24%
Data Mining	22%
Apache Hive	20%
SAS	20%
Predictive Models	20%
Scala	18%
C++	17%



Data Analysis Occupations

Skill Name	Percent of Job Postings Calling for Skill
Data Analysis	53%
SQL	46%
SAS	34%
Python	30%
Statistics	25%
Data Science	23%
Economics	20%
Tableau	20%
Statistical Analysis	19%
Project Management	18%
R	18%
Machine Learning	16%
Data Management	15%
Data Mining	12%
Data Visualization	12%

**Legend**

**Bubble Shading**

Alignment with labor-market skill demand: the more in-demand skills taught by the MA in Data Analytics program, the darker the bubble shading. The shading therefore reflects the number of skills in bold in the list of top skills beneath each occupation group.

**Skill %**

A skill is in bold if it is mapped to the Competencies

**Skill %**

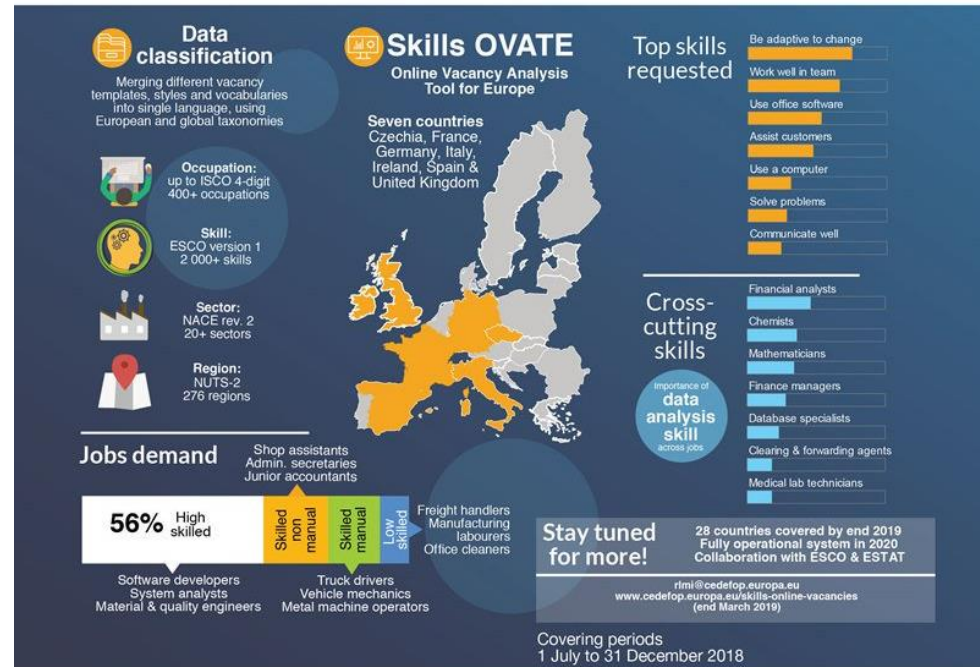
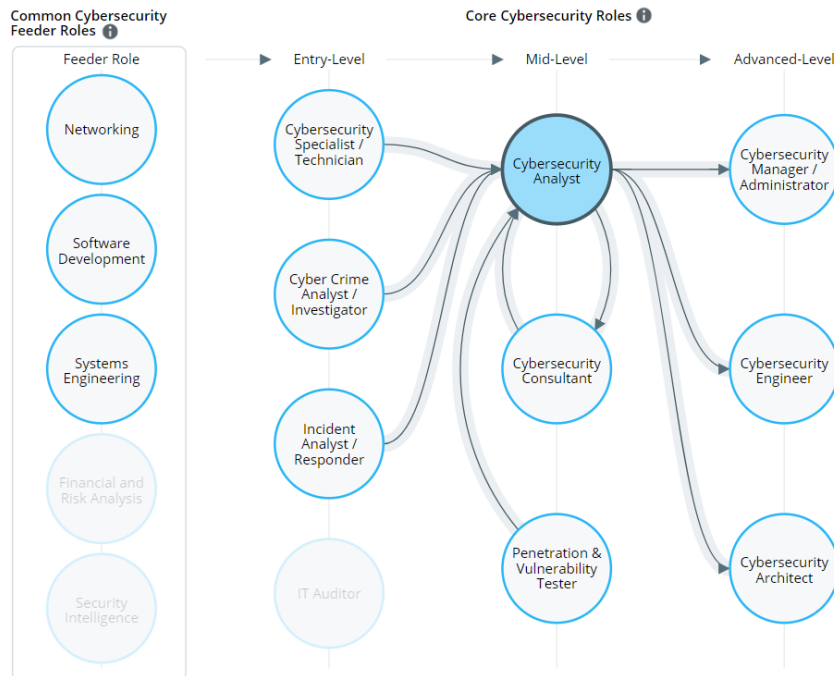
A skill is grayed out if it represents a gap between labor market demand and the MA in Data Analytics (skill not mapped to WGU competencies)

This >100K student public online university built from the ground up for working learners is using postings data to assess the alignment between the skills taught in their programs and the skills employers require of students and identify curricular blind spots

# Build a Skills Strategy for the Public



Cyberseek.org tracks cybersecurity demand in the United States and Australia, providing interactive career pathways for jobseekers and students.



# Keeping Up with Rapid Change

A diagram consisting of three large circles connected by thick lines. The leftmost circle is blue and contains the text "The post-COVID economy is going to be different". It is connected to a smaller orange circle above and to the right, which contains the text "Millions worldwide will be affected by this new labor market". This orange circle is then connected to a larger yellow circle on the right, which contains the text "Nations need to use every tool possible to ensure prosperity for their citizens".

The post-COVID economy is going to be different

Millions worldwide will be affected by this new labor market

Nations need to use every tool possible to ensure prosperity for their citizens

**Matt Sigelman, CEO**  
msigelman@burning-glass.com  
@mattsigelman