Building a STEM Workforce for the Innovation Economy
## *Understanding & Addressing the STEM Talent Shortage*

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A Misaligned Pipeline of Talent

Falling higher ed enrollments + programs out of sync with demand creates an imperative to do better – both for students & the region

Student enrollments are declining, with new community college enrollments down 15% since the start of the pandemic

21M
20.56M
20M
19M
18M
18.24M
17M
2012 2013 2014 2015 2016 2017 2018 2019 2020
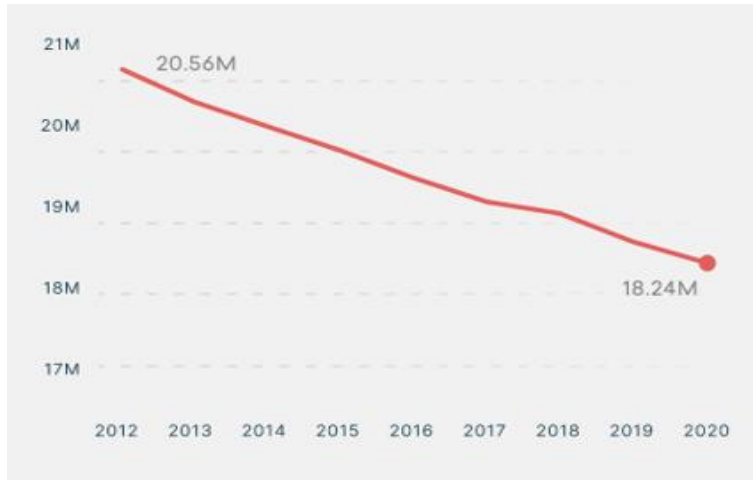
Only 18% of credentials earned in career & tech ed programs are in demand by industry while many needed certs go undersupplied

Rank	Credential	Credential Type	Credentials Earned	Percent Oversupplied	Supply/Demand Category	State Count
1	Microsoft Office Specialist	🖥	129,895	--	⏬	19
2	WISE Financial Literacy Certification	💼	67,208	100%	⏫	7
3	NCCER - Core Curriculum	🏅	60,350	100%	⏫	12
4	Adobe Certified Associate	🖥	52,189	78%	➖	19
5	Virginia Workplace Readiness Skills for the Commonwealth	💼	42,313	100%	⏫	1
6	Basic First Aid	💼	36,102	100%	⏫	11
7	NCCER - Carpentry	🏅	33,392	100%	⏫	14
8	IC3 Certification	💼	22,840	100%	⏫	13
9	Automotive Service Excellence Certification	🏅	22,726	16%	⏬	24
10	ServSafe Certification (Manager/ Food Handler/Allergens/Alcohol)	🏅	21,634	47%	🔽	20

In many critical fields, the number of graduates is insufficient to keep up with rising demand.

10,000
Logistics degrees conferred each year

20,000
Logisticians will exit the workforce each year
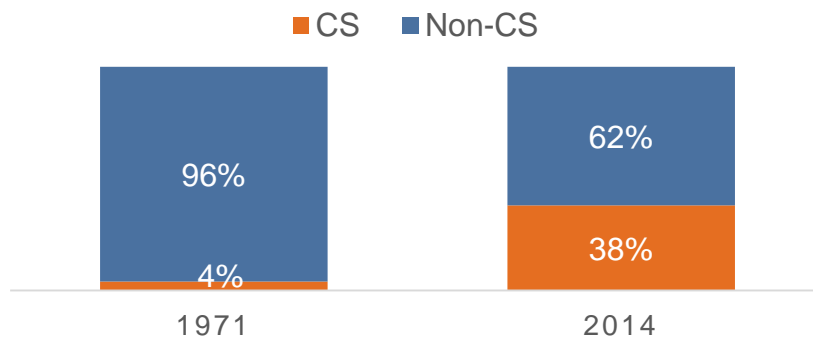
5,600
New logisticians needed per year

How CS Has Swallowed Up Engineering

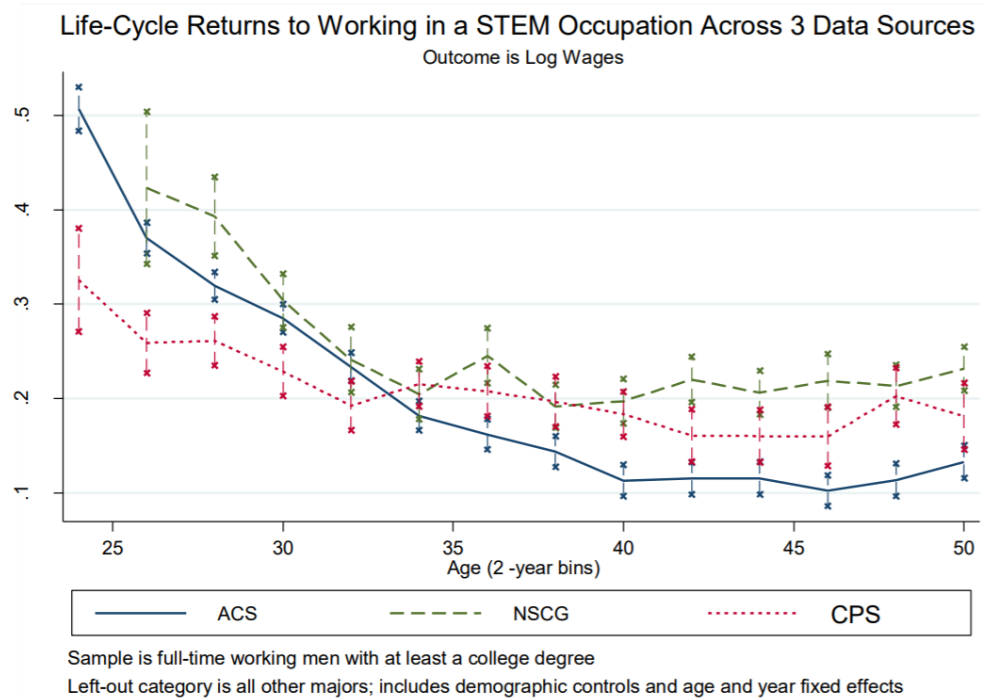**ENGINEERING DEGREES AS A PERCENTAGE OF ALL CONFERRALS**

- While engineering conferrals have grown over the past 50 years, virtually **all this increase can be attributed to Computer Science**

- The rate of **non-CS engineering degrees conferred has decreased** since 1971

- The growth in popularity for computer science has crowded out other disciplines

COMPUTER SCIENCE SHARE OF ENGINEERING DEGREE CONFERRALS

Source: Burning Glass Institute analysis of Natl Center for Education Statistics data: https://nces.ed.gov/programs/digest/d15/tables/dt15_322.10.asp

The STEM Degree Premium Fades Fast
## Driving a high rate of attrition from STEM fields

- A Harvard study found that the **early returns to STEM degrees decline by >50% in the first decade of work**

- The rapid pace of tech change combined with limited opportunity for workers to upskill means that **STEM workers become obsolete**

- Higher ability workers often switch out of STEM and **into fields that value experience**

Life-Cycle Returns to Working in a STEM Occupation Across 3 Data Sources
Outcome is Log Wages

Age (2 -year bins)

ACS — — NSCG .... CPS

Sample is full-time working men with at least a college degree
Left-out category is all other majors; includes demographic controls and age and year fixed effects

Source: Deming, David "STEM Careers & Technological Change", NBER, 2018 using Lightcast data

Artificial Constraints
Degree inflation for STEM roles chokes supply

STEM DEGREE INFLATION

■ 2012 ■ 2021

60%
44%
48%
56%

ALL JOB POSTINGS   COMPUTER/MATH
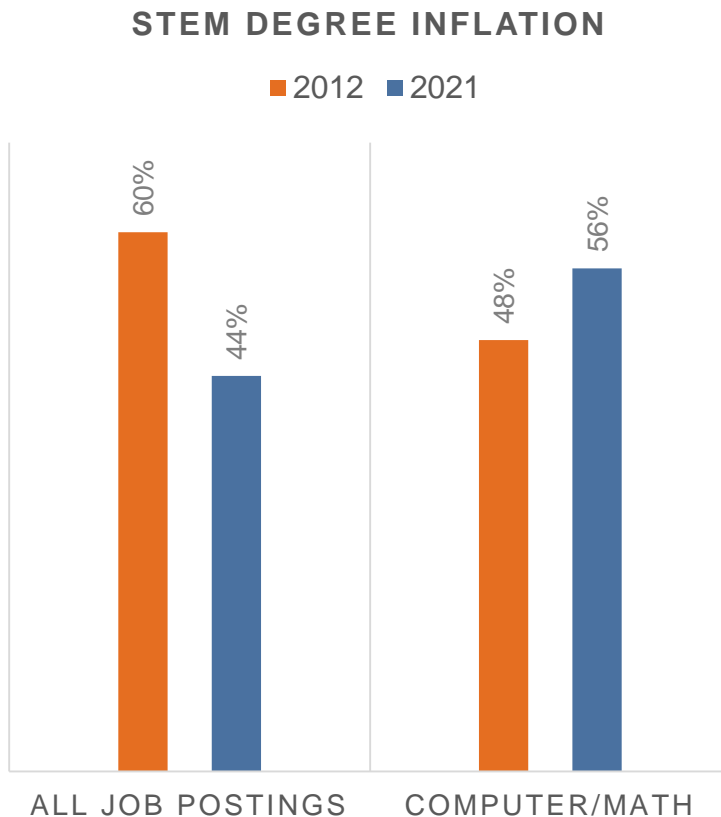
- Contrary to the rest of the market, degree inflation is on the rise in STEM fields, leaving no path up for non-degreed workers.

- **The percentage of Computer/ Math occupations requiring a degree has increased 17%** over the past decade

- This runs counter to broader market embrace of skills-based hiring, with **the percentage of all job postings requiring a degree down 27% (in the same time period**

Source: Burning Glass Institute analysis of online jobs postings data, 2012-Present

Emerging Technologies Redefine Talent Needs
Rapid growth in disruptive skills drives the possibility of mismatch

SHARE OF POSTINGS MENTIONING SELECTED SKILLS
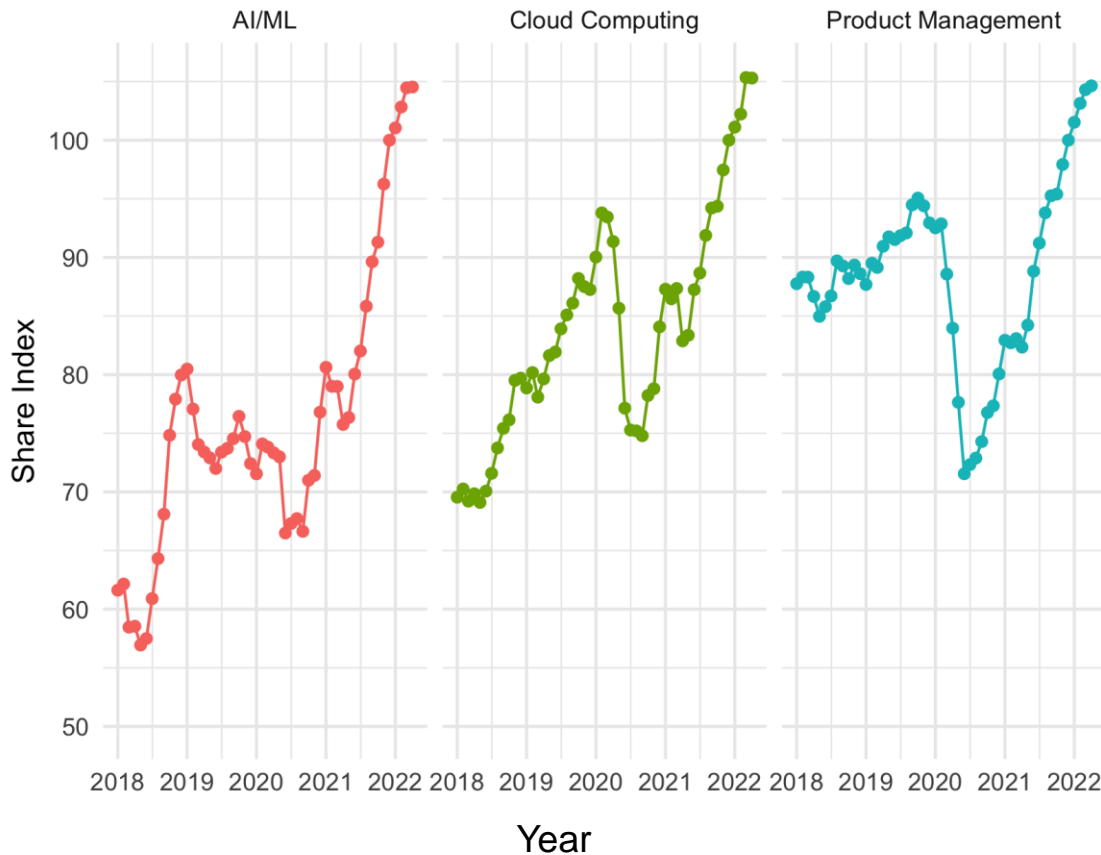
Note: Share index of "100" set at beginning of 2022 value

Source: Burning Glass Institute analysis of online jobs postings data, 2018-Present

- AI/ML, Cloud Computing, and Product Management have all seen dramatic demand growth in past 5 years

- Occupation-level demand data does not capture the rapid growth need of certain skills

New Growth, New Skills

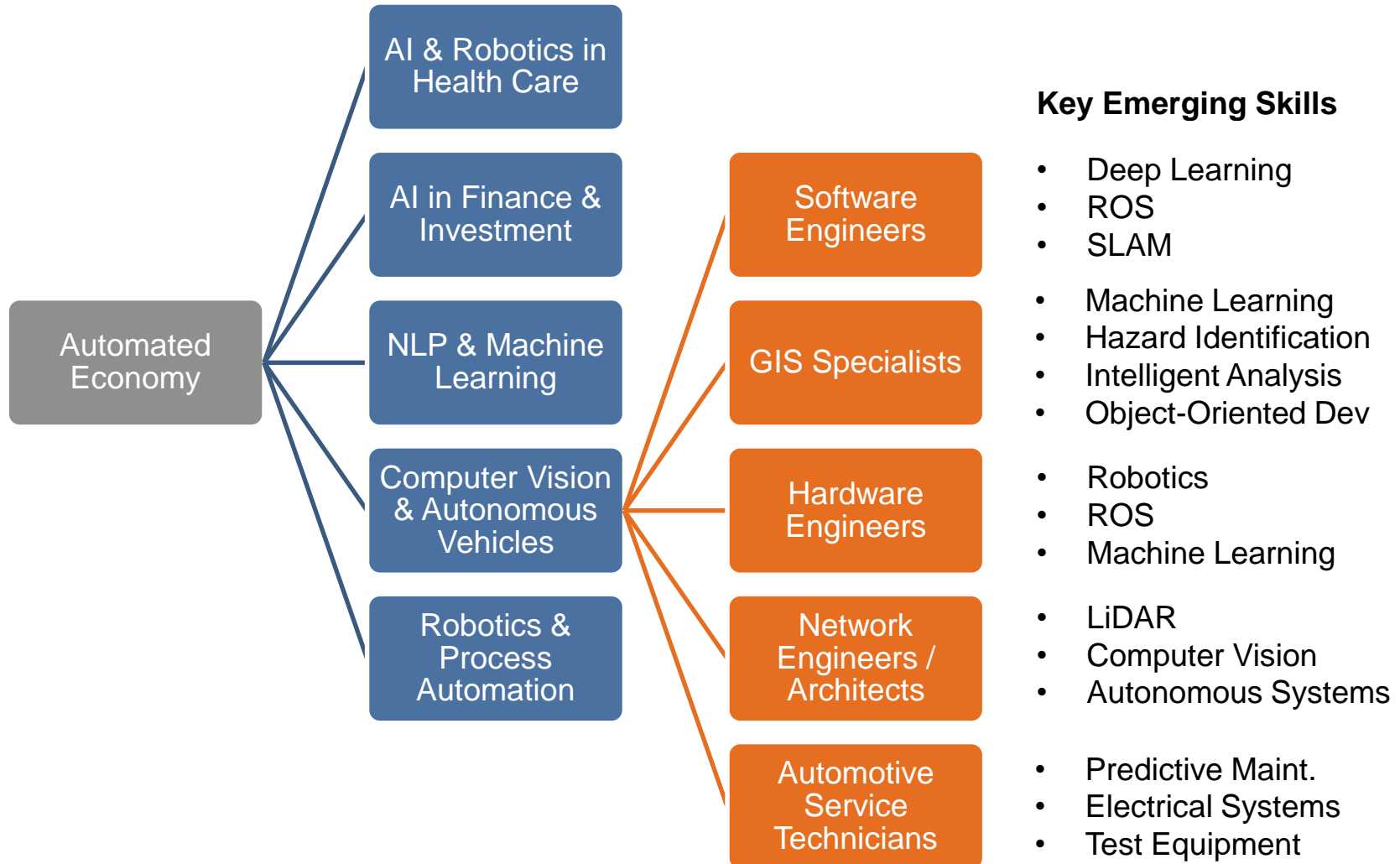**Five emerging economies will create millions of new jobs in the next five years – but many will require new skills, exacerbating gaps**

Economy	50% Increase Scenario	
	Growth Rate	**5-Year Openings Projection**
Readiness	12.10%	1,756,874
Logistics	4.83%	4,549,046
Green	12.79%	866,902
Remote	16.67%	6,282,331
Automated	28.82%	4,548,798
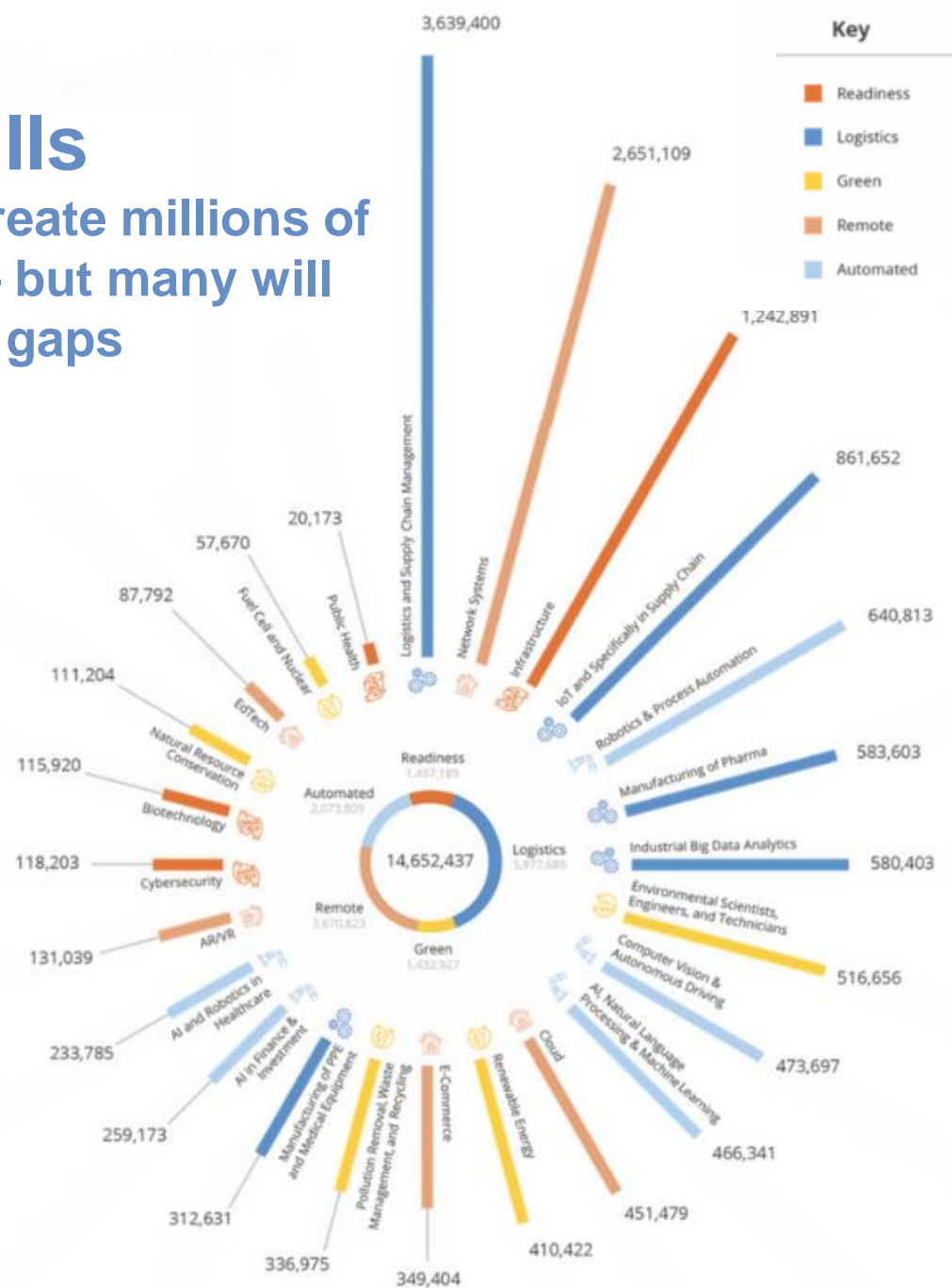
Emerging Sectors Demand a Curriculum Rethink
Build talent for the jobs & skills powering each key sector's growth

```
Automated Economy
├── AI & Robotics in Health Care
├── AI in Finance & Investment
├── NLP & Machine Learning
├── Computer Vision & Autonomous Vehicles
│   ├── Software Engineers
│   ├── GIS Specialists
│   ├── Hardware Engineers
│   ├── Network Engineers / Architects
│   └── Automotive Service Technicians
└── Robotics & Process Automation
```

Key Emerging Skills

- Software Engineers
  - Deep Learning
  - ROS
  - SLAM

- GIS Specialists
  - Machine Learning
  - Hazard Identification
  - Intelligent Analysis
  - Object-Oriented Dev

- Hardware Engineers
  - Robotics
  - ROS
  - Machine Learning

- Network Engineers / Architects
  - LiDAR
  - Computer Vision
  - Autonomous Systems

- Automotive Service Technicians
  - Predictive Maint.
  - Electrical Systems
  - Test Equipment

Talent Shortage or Skills Shortage?

37% of the skills of the average US job have been replaced over the past five years. What does it take to keep up?
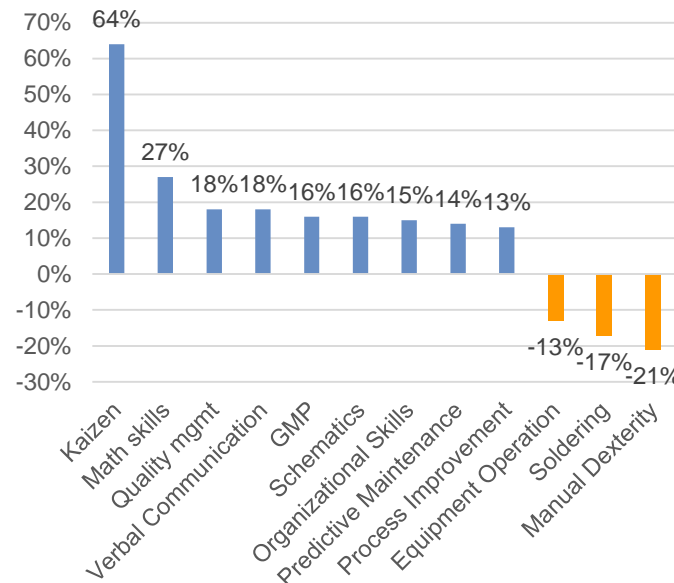
Nearly all of the jobs with the highest levels of skill change are in STEM…

The Skill Disruption Index by Occupation

Occupation	Skill Disruption Index	Occupation	Skill Disruption Index
Data engineer	100	Biomedical engineer	78
Data scientist	95	Director of rehabilitation	78
Web developer	94	Accounting supervisor	78
Validation engineer	90	Sustainability specialist	78
Network engineer/architect	88	Medical transcriptionist	78
Business intelligence architect/developer	88	Business intelligence analyst	78
Database architect	88	IT project manager	78
Industrial designer	87	Sales engineer	77
Software developer/engineer	86	Interior designer	77
Computer systems engineer/architect	83	Mechatronics engineer	77
Advertising/promotions manager	83	Chief information officer/director of information technology	76
Computer programmer	83	Marketing assistant/associate	76
Robotics engineer	83	Quality inspector/technician	76
UI/UX designer/developer	83	Web designer	76
Mobile applications developer	82	Customer service manager	75
Industrial-organizational psychologist	82	Product manager	75
Database administrator	82	Test technician	75
Financial quantitative analyst	82	Mathematician	75
Data/data mining analyst	81	Aerospace engineer	75
Computer scientist	81	Technology consultant	75
Webmaster/administrator	81	Solar sales representative	75
Data warehousing specialist	80	Community health worker	74
Printer/copier/scanner operator	79	Fitness/wellness manager	74
Cyber/information security engineer/analyst	79	Product development engineer	74
Biostatistician	79	Multimedia designer/animator	74
Statistician	79	Market research analyst	74
Engineering manager	79	Network/systems support specialist	74
Marketing specialist	79	Network/systems administrator	74
Solar engineer	79	Ergonomist	73
Technical sales representative	78	E-commerce analyst	73

…And the pandemic has accelerated the pace of change dramatically

Key Changes in Skills for Production Techs
Change in relative demand vs 2019

- Kaizen: 64%
- Math skills: 27%
- Quality mgmt: 18%
- Verbal Communication: 18%
- GMP: 16%
- Schematics: 16%
- Organizational Skills: 15%
- Predictive Maintenance: 14%
- Process Improvement: 13%
- Equipment Operation: -13%
- Soldering: -17%
- Manual Dexterity: -21%

Skills of mass disruption: Emerging technologies are transforming work

Skill Area	Postings (last 12 mos)	Projected 5-Year Growth
Software Dev Methodologies	634,660	35%
Cloud Technologies	462,963	28%
Proactive Security	373,123	39%
IT Automation	282,380	59%
AI & ML	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%

As New Technologies Intersect Familiar Roles, Workers May Need Radically Different Skills
Deliver the Learning to Help Them Stay Relevant and Valuable

Mechanical Engineers

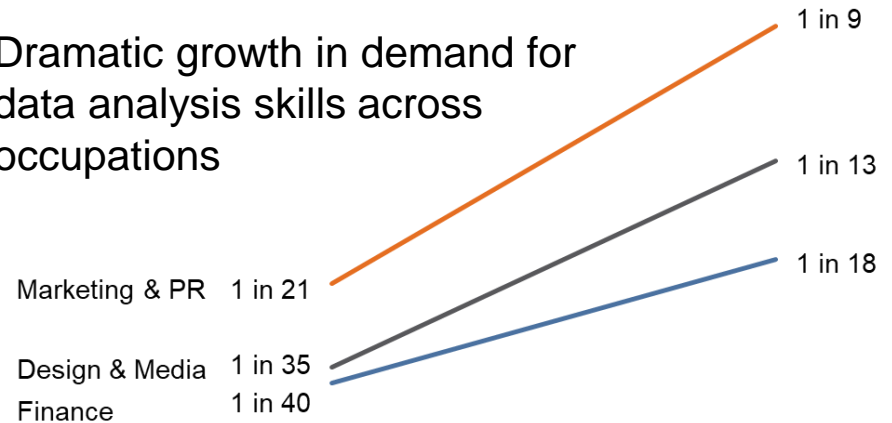| Traditional Mechanical Engineer	Vehicle-to-Infrastructure Specialist	Autonomous Systems Specialist
Top Specialized Skills	**Top Specialized Skills**	**Top Specialized Skills**
Mechanical Engineering	Transportation Systems	Autonomous Systems
Project Management	C++	Mechanical Engineering
Mechanical Design	Global Positioning System (GPS)	Robotics
SolidWorks	Business Development	Simulation
AutoCAD	Civil Engineering	Python
Budgeting	Hardware & Software Configuration	C++
Scheduling	LiDAR	Systems Engineering
Product Development	Simulation	MATLAB
HVAC	Traffic Management	Machine Learning
Repair	Linux	Electromechanical Systems

STEM Talent Demand is Greater Than You Think
Jobs Across All Fields Increasingly Demand STEM Skills

Skills Not Jobs: Data science skills aren't just for data scientists

**Occupations with at least 3K postings requiring data science / analytics/ mining**

2021
81 occupations
1,195,000 postings

2016
46 occupations
597,000 postings

2011
17 occupations
294,000 postings

Dramatic growth in demand for data analysis skills across occupations

1 in 9

1 in 13

1 in 18

Marketing & PR   1 in 21

Design & Media   1 in 35
Finance   1 in 40

2012   2021

Not Just for Professionals: STEM skills are now a minimum ticket to ride in middle skill jobs as well

78%
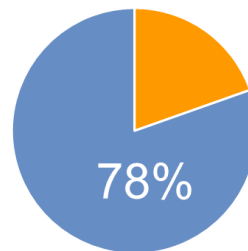
Of middle-skill jobs require digital skills

2X
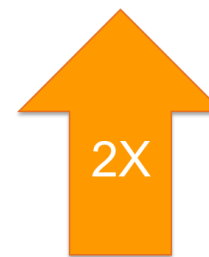
Digitally intensive jobs are growing twice as fast as other middle-skill jobs

Digitally intensive jobs are twice as likely to pay a living wage

STEM Skills Are Foundational
For New Economy Opportunity

Foundational Skill Group	Foundational Skill Area	Growth in Number of Postings: 2017-2019	Share of Openings Outside IT and Analysis Job Families	Average Salary Premium
Business Enablers	Business Process	29%	67%	12%
	Project Management	51%	69%	14%
	Digital Design	44%	64%	-
	Communicating Data	101%	34%	27%
Digital Building Blocks	Managing Data	49%	28%	34%
	Analyzing Data	48%	55%	21%
	Software Development	48%	17%	43%
	Computer Programming	56%	13%	45%
	Digital Security and Privacy	30%	29%	38%
Human Skills	Communication	48%	81%	-
	Collaboration	58%	79%	2%
	Critical Thinking	52%	66%	0%
	Analytical Skills	44%	76%	1%
	Creativity	60%	82%	-

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