

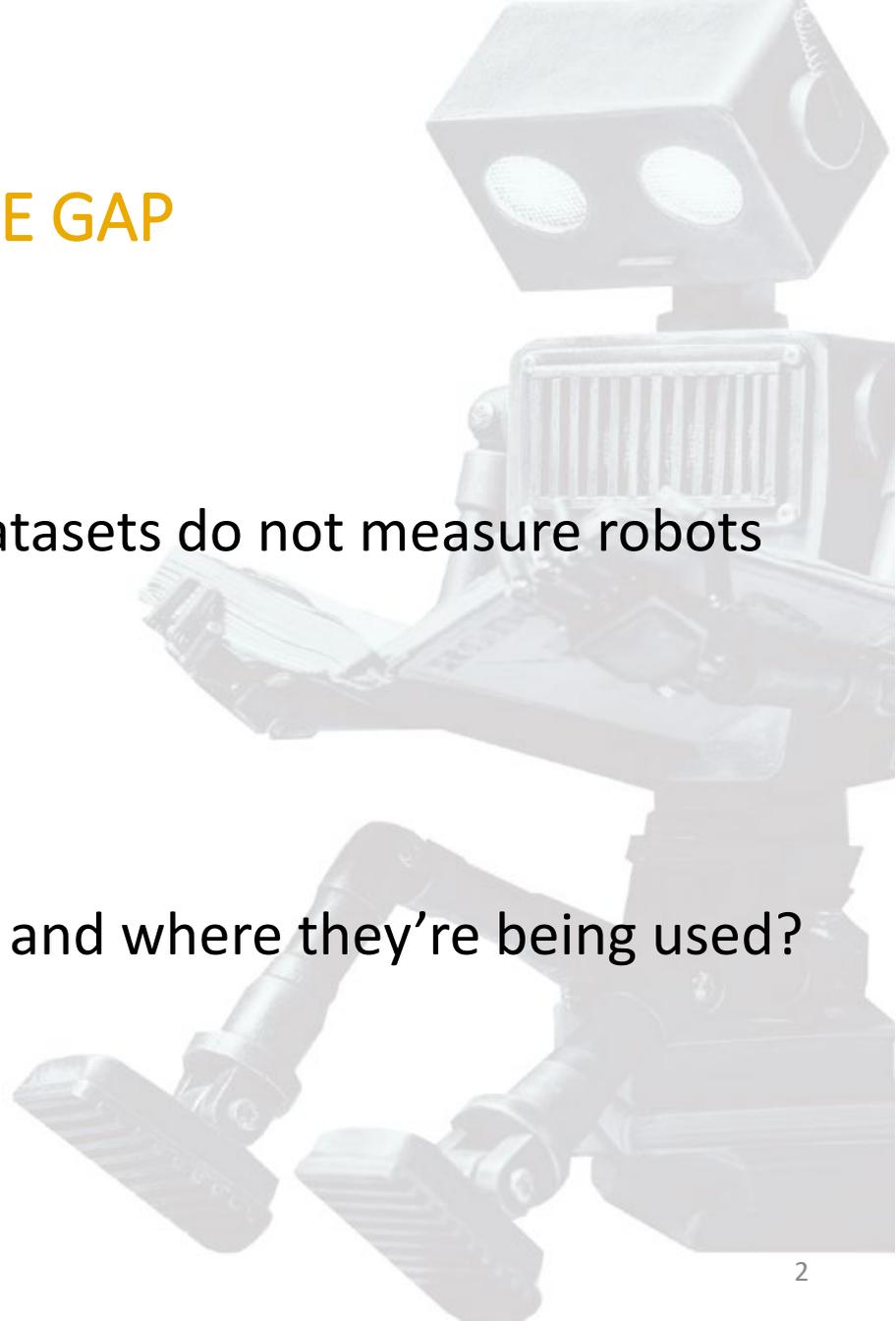


ROBOTS AND CONSTRUCTION

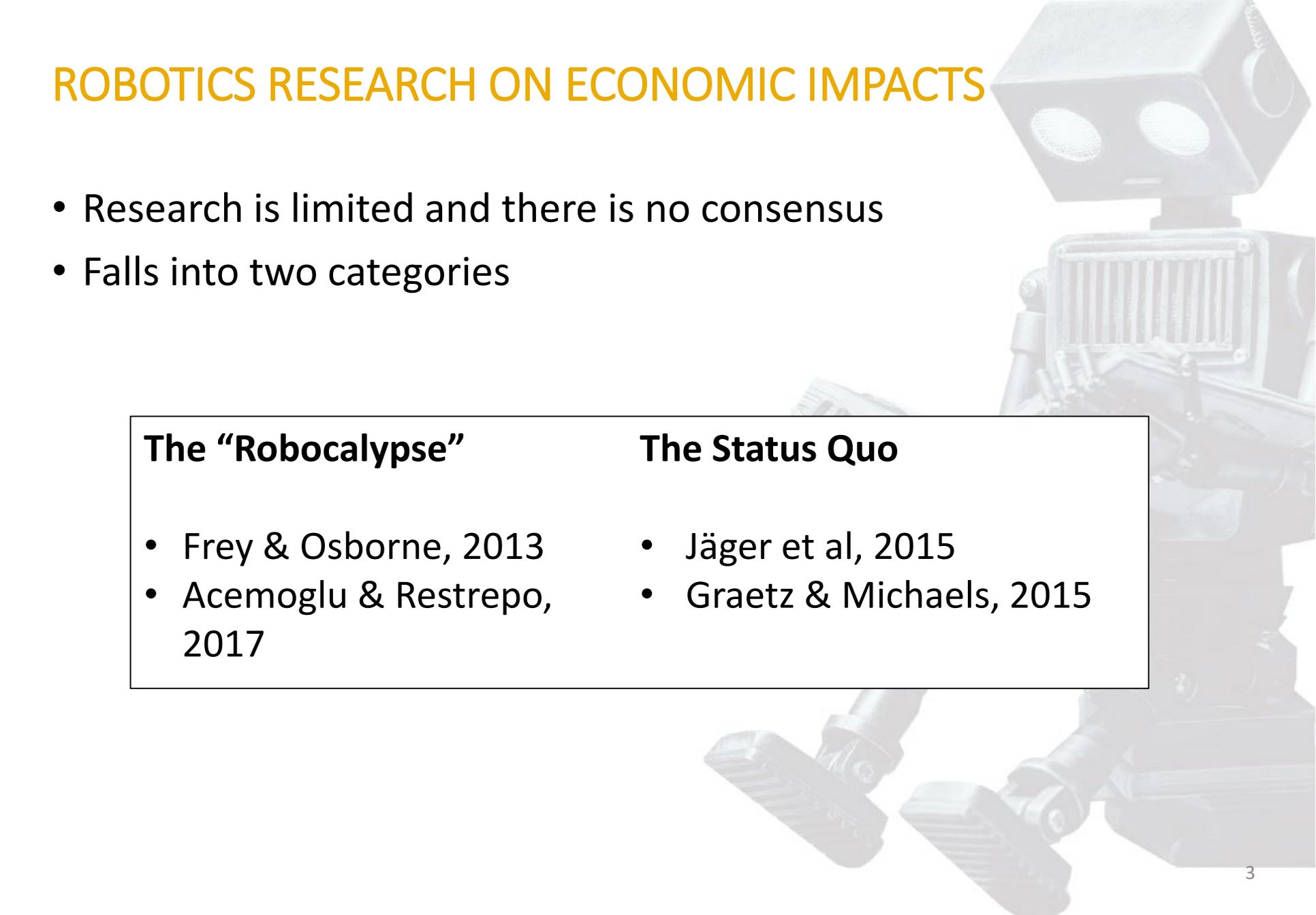
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ROBOTS AND JOBS: KNOWLEDGE GAP

- Standard public socio-economic datasets do not measure robots or robot use.
- Robotics data is highly aggregated.
- How do we know who uses robots and where they're being used?



ROBOTICS RESEARCH ON ECONOMIC IMPACTS



- Research is limited and there is no consensus
- Falls into two categories

The “Robocalypse”

- Frey & Osborne, 2013
- Acemoglu & Restrepo, 2017

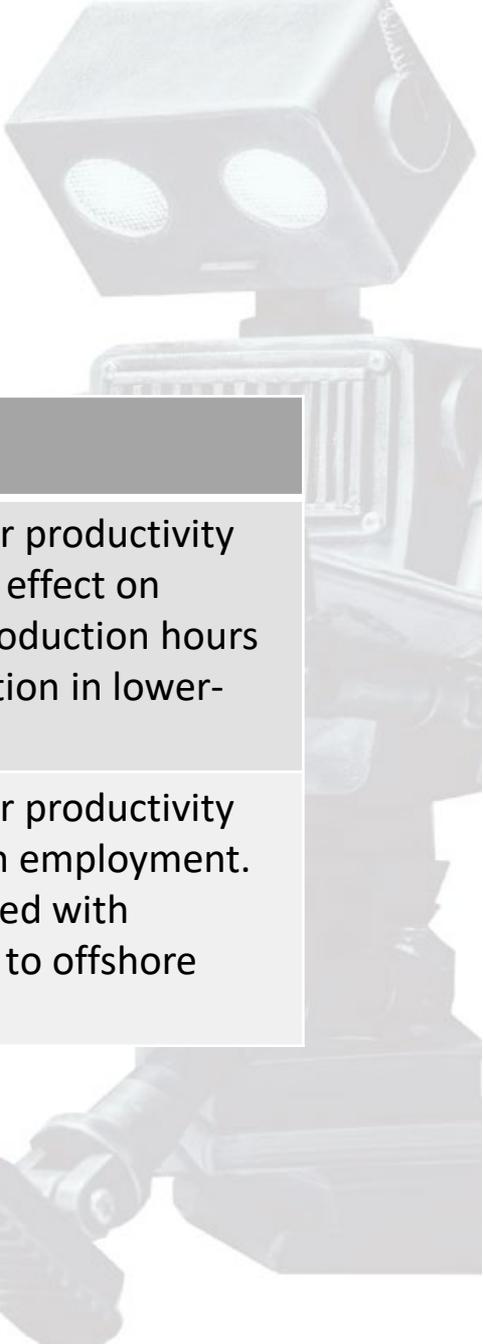
The Status Quo

- Jäger et al, 2015
- Graetz & Michaels, 2015

“ROBOCALYPSE” RESEARCH

Authors	Year	Title	Major Findings
Frey & Osborne	2013	The Future of Employment: How Susceptible are Jobs to Computerization	47% of current occupations are at high risk of automation
Acemoglu & Restrepo	2017	Robots and Jobs: Evidence from U.S. Labor Markets	One robot/thousand workers decreases employment by 3 to 6 workers and aggregate wages by .25 to .75%.

STATUS QUO RESEARCH



Authors	Year	Title	Major Findings
Graetz & Michaels	2015	Robots at Work	Robots increase labor productivity and value added. No effect on overall number of production hours worked; slight reduction in lower-skill hours.
Jäger et al.	2015	Analysis of the Impact of Robotic Systems on Employment in the EU	Robots increase labor productivity but have no effect on employment. Robot use is associated with decreased likelihood to offshore production.

APPROACHES TO MEASURING ROBOT USE

Author	Name of Measure	Operationalization	Data Source
Jäger et al.	Intensity of Robot Use	Qualitative scale: High, Medium, or Low	European Manufacturing Survey 2009
Graetz & Michaels	Robot Density	# of Robots/Thousand Workers (by Country)	International Federation of Robotics' Robot Stocks Data
Acemoglu & Restrepo	Robot Exposure	# of Robots/Thousands of Workers (by Commuting Zone)*	International Federation of Robotics' Robot Stocks Data

*Robot exposure in commuting zones is an inferred statistic, derived by summing, over industries, the local fraction of the workforce in each industry times the national penetration of robots into that industry.

LIMITATIONS OF CURRENT RESEARCH

- Data problems
 - No direct quantitative measure of robot use exists (IFR robot stocks are inferred from sales).
 - Existing IFR data is coarse-grained, aggregated by country and industry.
 - US studies' data panels end at 2007 (prior to Great Recession).
- Conceptual problems
 - Simple models with substantial assumptions.
 - Ignores robotics integration.
 - Ignores subnational variations in robotics diffusion, knowledge, and potential effects (Leigh & Kraft [2017] show that it is substantial in U.S.).

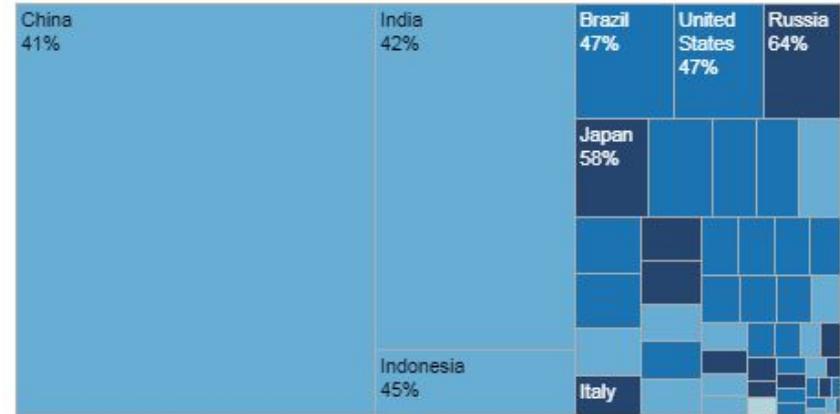
CONSTRUCTION AND ROBOTICS LOW UPTAKE

- From Robotic Industrial Association
 - Construction hard to automate
 - Robots function best with repetitive tasks in controlled environment
 - Building Construction on site is dynamic
- View from an robotics firm manager of engineering operations:
 - Currently work best in a pre-engineered environment
 - Problems building robots that can exposed to variable weather conditions



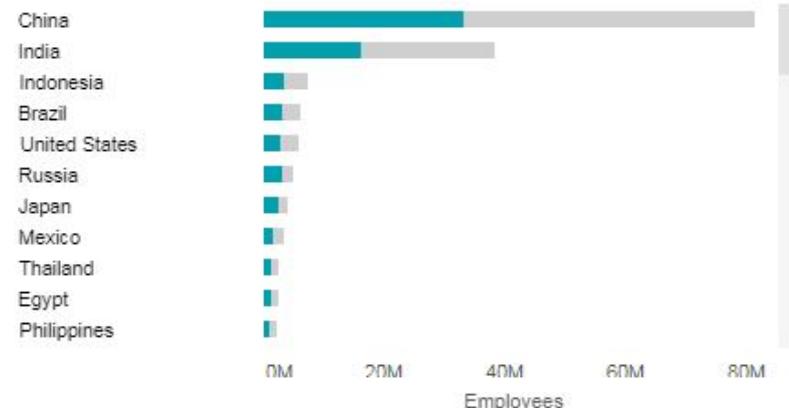
CONSTRUCTION INDUSTRY AUTOMATION POTENTIAL

Worldwide potential for automation: Employees
Sector(s): **Construction**



McKinsey Global
<https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet>

Worldwide potential for automation: Employees
Sector(s): **Construction**



CONSTRUCTION AND TRADES ROBOTICS

- Horizontal Construction
 - Earth moving, grading, site prep
 - Tunneling
 - Remote controlled vehicles
 - Adopted from remote mining applications
- Vertical Construction
 - Masonry
 - Brick laying
 - Materials handling (MULE)
 - Digital construction using 3D printing
- Demolition
- Human Assist – robotic?
 - Exoskeleton devices



ROBOTIC DIGITAL FABRICATION

- Emerging technology
- Using computer-controlled technologies to create structures and buildings in nontraditional configurations
- Potential to:
 - streamline design and utility of structures,
 - inspire new forms of architectural expression.
 - make better use of building materials, reduce labor-intensive processes, and increase productivity and sustainability.”

Source: RIA

2019 SURVEY: ASSOCIATED GENERAL CONTRACTORS OF AMERICA

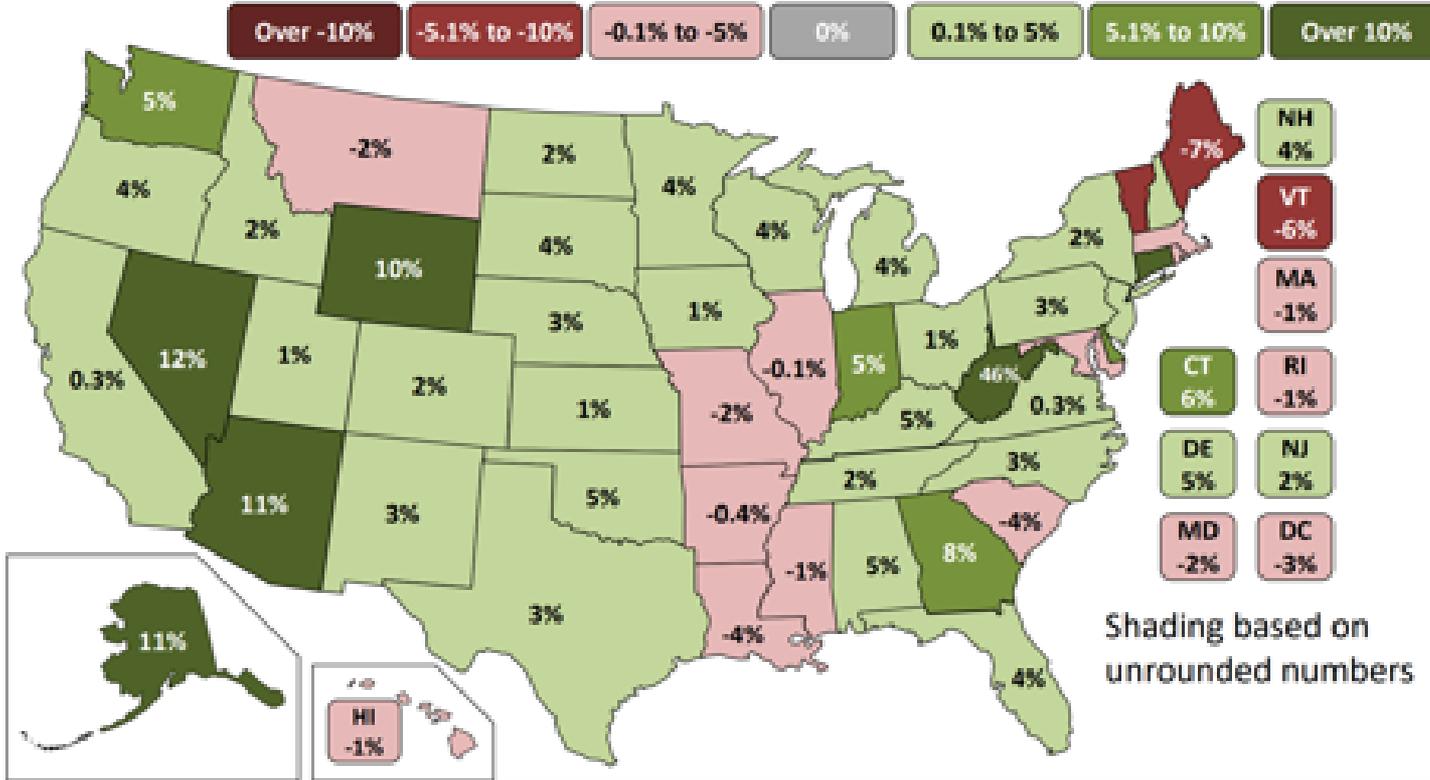
- 78% of construction firms report difficulty filling salaried & hourly craft positions
- +50% plan to invest more in training & development in 2019
- Nearly half expect to increase investment in IT
- +25% are using methods to reduce onsite worktime with
 - Building information modeling (BIM)
 - offsite fabrication
 - labor-saving equipment: drones, robots, laser- or GPS-guided machinery

Source: <https://www.accordantco.com/content/2019-construction-survey/>

CONSTRUCTION LABOR SHORTAGE AND GROWTH PRESSURE

State construction employment change (U.S.: 3.1%)

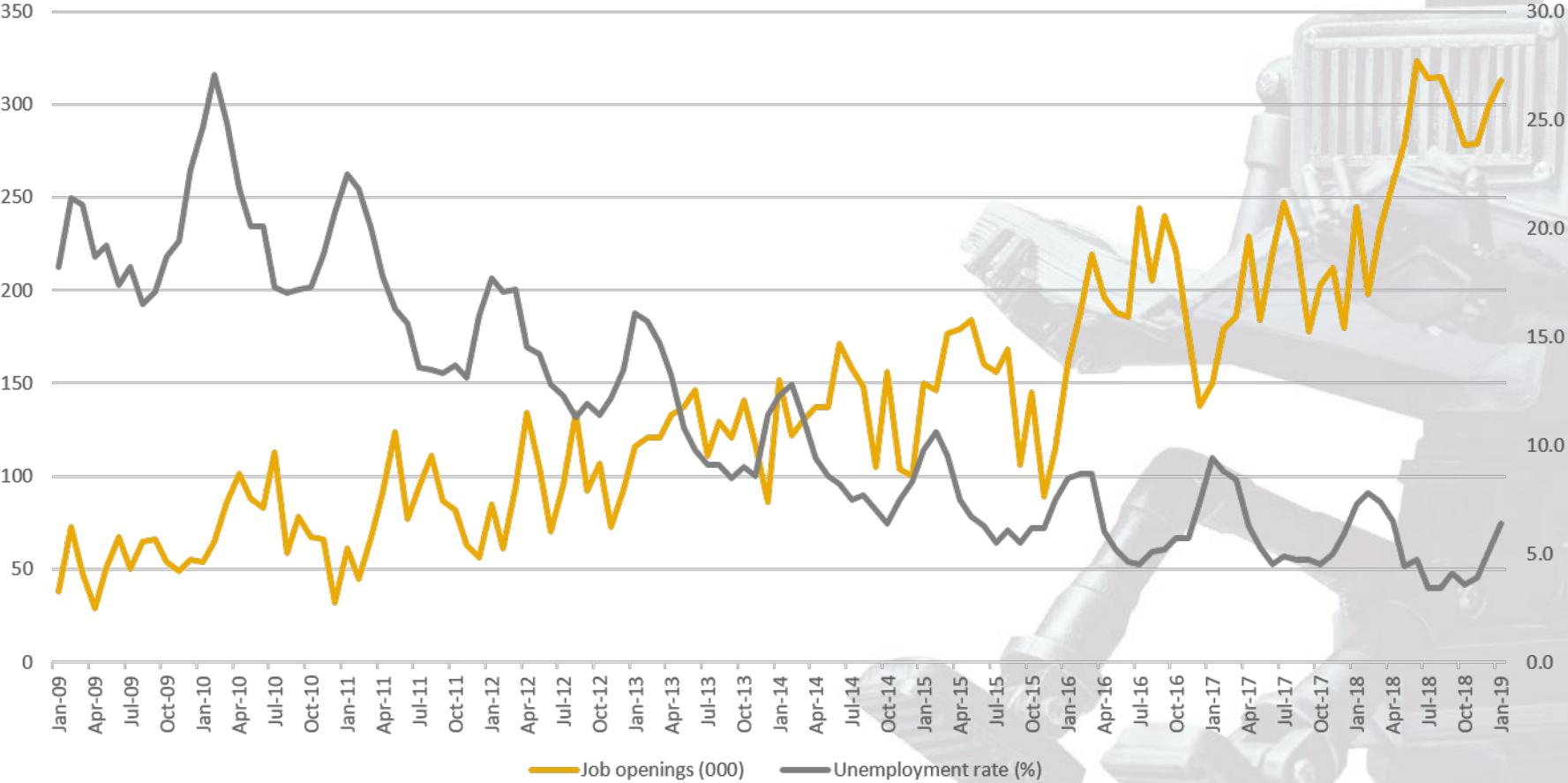
2/18 to 2/19: 44 states **up**, 6 states and DC **down**



Source: Associated General Contractors of America

CONSTRUCTION LABOR SHORTAGE

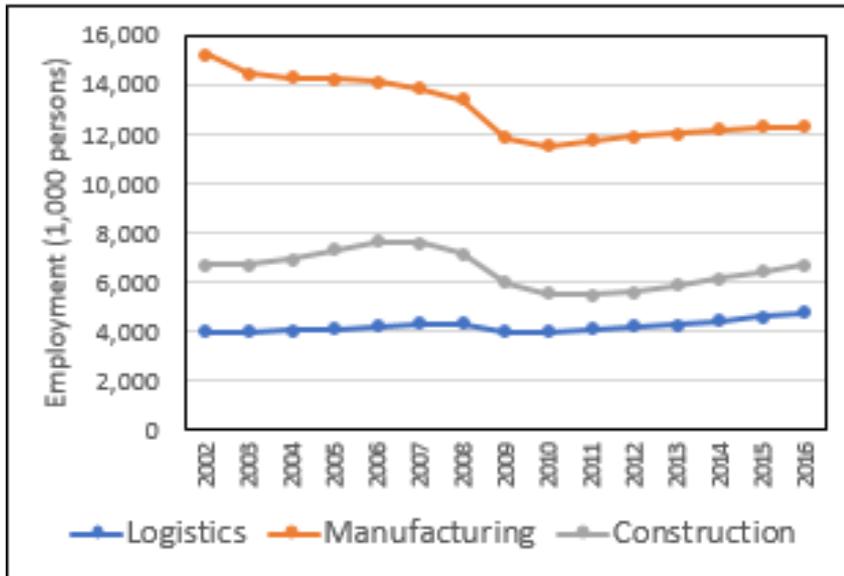
Construction Labor 2009 - 2019
Job Openings and Unemployment rate



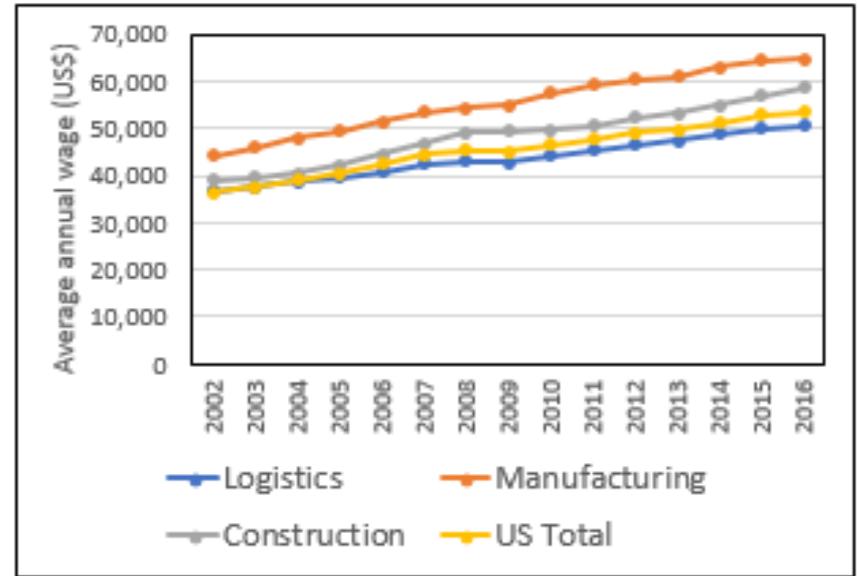
Source: Bureau of Labor Statistics: Job Openings and Labor Turnover Survey and Labor Force Statistics from Current Population Survey

CONSTRUCTION INDUSTRY TRENDS: PUBLIC EMPLOYMENT DATA

Employment, 2002-2016



Average Annual Wage, 2002-2016



Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages (QCEW)

- Logistics: NAICS 48-49 / Manufacturing: NAICS 31-33 / Construction: NAICS 23

CAN ROBOTS IMPROVE CONSTRUCTION WORK?

- 1/3 of construction jobs are contingent or alternative arrangement jobs.
 - Includes temporary, seasonal, independent contract workers
 - No health insurance or retirement benefits
 - One of highest rates of contingency and no benefits of any industry sector.
- Injuries and fatalities
 - Highest rate of all industries
- Robots can reduce both of these negative trends

CAN ROBOTS IMPROVE CONSTRUCTION INDUSTRY PERFORMANCE?

- From BM1
 - <https://www.youtube.com/watch?v=nKGGHdl3NyQ>
- Promise of creating better jobs with better compensation
- Increased safety
- Increased productivity
- More affordable residential construction



THE END
DISCUSSION