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

<table>
<thead>
<tr>
<th>The “Robocalypse”</th>
<th>The Status Quo</th>
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<tbody>
<tr>
<td>• Frey &amp; Osborne, 2013</td>
<td>• Jäger et al., 2015</td>
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<td>• Acemoglu &amp; Restrepo, 2017</td>
<td>• Graetz &amp; Michaels, 2015</td>
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### "ROBOCALYPSE" RESEARCH

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Title</th>
<th>Major Findings</th>
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<tbody>
<tr>
<td>Frey &amp; Osborne</td>
<td>2013</td>
<td>The Future of Employment: How Susceptible are Jobs to Computerization</td>
<td>47% of current occupations are at high risk of automation</td>
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<tr>
<td>Acemoglu &amp; Restrepo</td>
<td>2017</td>
<td>Robots and Jobs: Evidence from U.S. Labor Markets</td>
<td>One robot/thousand workers decreases employment by 3 to 6 workers and aggregate wages by .25 to .75%.</td>
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<td>Graetz &amp; Michaels</td>
<td>2015</td>
<td>Robots at Work</td>
<td>Robots increase labor productivity and value added. No effect on overall number of production hours worked; slight reduction in lower-skill hours.</td>
</tr>
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<td>Jäger et al.</td>
<td>2015</td>
<td>Analysis of the Impact of Robotic Systems on Employment in the EU</td>
<td>Robots increase labor productivity but have no effect on employment. Robot use is associated with decreased likelihood to offshore production.</td>
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## Approaches to Measuring Robot Use

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

*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

McKinsey Global
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

CONSTRUCTION INDUSTRY TRENDS: PUBLIC EMPLOYMENT DATA

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=nKGGHd13NyQ

• Promise of creating better jobs with better compensation
• Increased safety
• Increased productivity
• More affordable residential construction