Positive-Sum Automation
GM Automated Line, 1990s – courtesy King Rose Archives
“The objective: highly flexible, individualized and resource-friendly mass production. That is the vision for the Fourth Industrial Revolution.” – Siemens, 2013
Tradeoff: productivity for jobs?

Robots could take over 20 million jobs by 2030, study claims

A study finds nearly half of jobs are vulnerable to automation

UP FRONT
Four cures for automation anxiety

The Robots Are Coming. Prepare for Trouble.
However: automation -> productivity + jobs

Robots could take over 20 million jobs by 2030, study claims

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Firm-Level Automation: Evidence from the Netherlands

New Evidence on the Effect of Technology on Employment and Skill Demand*

The Employment Consequences of Robots: Firm-level Evidence

Don’t Fear the Robots, and Other Lessons From a Study of the Digital Economy

A task force assembled by M.I.T. examined how technology has changed, and will change, the work force.

Four cures for automation anxiety

The Robots Are Coming. Prepare for Trouble.
## Challenge: too little automation

<table>
<thead>
<tr>
<th>Technology in Manufacturing</th>
<th>Digital skill requirements</th>
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<td>Robots: 10% of firms</td>
<td><strong>Production: 18.6% of new jobs</strong></td>
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<td>Cloud applications: 29%</td>
<td>Maintenance / repair: 14.6%</td>
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<td>Specialized equipment: 39%</td>
<td>Administrative support: 46%</td>
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<td>Specialized software: 42%</td>
<td>Business operations: 58.7%</td>
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Source: U.S. Census (2018), Burning Glass (Q4 2019)
Challenge: too little automation

Challenge: too little automation

Source: Annual Surveys of Manufacturers
Challenge: too little automation

Source: JOLTS BLS Data
Ohio manufacturing owner / operator:

1. We can’t find workers to meet demand.
2. We need to offer higher wages.
3. But we can’t offer higher wages unless we automate.
“Humans are underrated.” – Elon Musk, after failing to develop a “lights-out” Model 3 Tesla factory

“We have tried to make robots assemble components, but robots often break delicate and expensive components. From the process, I have realized that the human body is magic.” – Anonymous Chinese electronics executive, quoted by Ya-Wen Lei

“Why would I want a lights-out factory? A factory without people is a factory not innovating?” – Manufacturing executive
Why is automation so hard?

1. Hard to adapt to changes in environment
2. Needs specific skills to operate / repair
3. “Black box” systems
How can automation deliver productivity gains while also improving flexibility and generating innovation?
## Path to Flexible Automation

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<th>Positive-sum investments</th>
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**Example:**

- Robot collaborating with technician to assemble scientific equipment
- Robot manipulates heavy assembly, human performs dexterous work to install sensors
- The potential is for more productive assembly that improves job quality.
- Robot remains unused because it’s not easily reprogrammed to worker specifications.
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Example:

- Hospital system automating administrative tasks with robotic process automation (RPA)
- Without internal software expertise, need to rely on consultants to set up and optimize software tools
- But a bottom-up approach that trains internal personnel who know the tasks to program the software can provide flexibility and labor hours saved
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**Example:**

- High-mix, low-volume factory adopts automation across its machines
- Skill requirements for production workers goes up, so do wages ($30/hr minimum wage)
- Bonuses linked to overall machining hours from automated cells – incentives to lower switching costs and deliver process improvement
How to think about flexible automation?

1. Automation is for repetitive, high-volume tasks
2. Automation can solve labor shortages and workforce challenges
3. Automation is to deliver high-quality products to customers
4. Automation is to grow and innovate in new products and processes

Robots as more productive workers
Robots as tools to make teams better – productivity, quality, innovation