Jobs and Robots

CS 4002 – Robots and Society

Lots of stories in the press recently

Slide courtesy H. Christensen
I BOUGHT A ROBOT TO REPLACE YOU.

ALL IT DOES IS DRINK COFFEE AND LOOK AT INAPPROPRIATE WEBSITES.

DID I FORGET ANYTHING?

NO. I'M NOT A COMPLICATED MAN.

I BOUGHT A ROBOT TO REPLACE YOU.

ALL IT DOES IS DRINK COFFEE AND LOOK AT INAPPROPRIATE WEBSITES.

DID I FORGET ANYTHING?

NO. I'M NOT A COMPLICATED MAN.

MY 12-YEAR-OLD WANTS TO KNOW WHAT CAREER WOULD PREVENT HIM FROM BEING REPLACED BY A ROBOT.

I'VE MET YOUR SON. AND I'M PRETTY SURE HE COULD BE REPLACED BY A HAMMER.

THIS TOOK AN UGLY TURN.

MAYBE THE ROBOTS CAN USE HIM AS FURNITURE.
Business drivers

- Reduced cost of a system solution
- Agile changes to accommodate product variations
- Higher precision / robustness / speed
- In process inspection
- Simplified programming / deployment
- A connected infrastructure (“industrial internet”)

Slide courtesy H. Christensen

Industrial Robot Update - 2018

Records, records

2017: 381,300 units, +30%
2018: 421,000 units, +10%
2021: 630,000 units, +14% on average per year

AGVs in factories, warehouses, logistic centers, hospitals...

69,000 units installed in 2017, 162% more than in 2016
  - 6,700 units in manufacturing
  - 62,200 units in warehouses, logistic centers, hospitals...

2018:
  115,000 units, 66% higher than in 2017

2019-2021:
  485,000 units, +18% on average per year

IFR Press Conference 2018
Robots are creating jobless recovery, UCLA says

December 7, 2010 | 10:29 am

The state’s economy may begin to pick up next year, according to a forecast released Tuesday by the UCLA Anderson School of Business. But nationally, there are still millions of people whose skills are no longer needed and will have trouble finding work, according to a segment of the forecast written by Edward Leamer, director of the UCLA Anderson Forecast.

"Displaced workers are likely to have a difficult time finding jobs elsewhere partly because the jobs will remain scarce and partly because of a mismatch between the skills and abilities offered and the skills and abilities needed,” he wrote.

The analysis comes as Congress debates provisions that would extend unemployment benefits for millions of Americans, including the long-term unemployed, who have been without work for six months or longer.

One of the reasons for the mismatch, Leamer argues, is that robots have filled positions in manufacturing that in past recessions would have been filled by humans (an issue covered by The Times in October). Jobs that robots can’t do, Leamer says, are being done overseas.

BBC- Feb. 2020

Machines to 'do half of all work tasks by 2025'

© 1 day ago

Coronavirus pandemic

GETTY IMAGES
Industrial Revolution

• Weaving Looms
• Spawned Luddites

3 D’s of Robotics

• Dull
• Dangerous
• Dirty
Advantages to Industry

- Can work 24/7
- Don’t get sick or need leave
- Can be repaired or replaced easily
- Efficient, safe,
- Handle 3Ds – dull, dirty, dangerous
- No health care, benefits or other amenities

Consequences

- Downside
  – Displaces unskilled/low-skilled workers
  – Can lead to long-term unemployment
  – Extending to white collar jobs
- Upside
  – Can generate new jobs and wealth, with new industries
What types of jobs affected?

- Domestic robots
  - Vacuum cleaners
  - Lawn mowers
  - Pool cleaning
  - Window cleaning
- Industrial robots
- Service robots
  - Wheelchairs
  - Refueling
  - Home security
  - Personal transportation
- Entertainment robots
  - Toy robots
  - Entertainment
  - Hobby systems
  - Education and training

More..

- Field robots
  - Agriculture
  - Milking
  - Forestry
  - Mining
  - Space
- Professional cleaning
  - Floor cleaning
  - Window and wall cleaning
  - Pipe cleaning
- Inspection robots
  - Sewer robots
  - Tanks, tubes, pipes
  - Electrical wires
- Construction
  - Demolition
  - Construction support
And more…

- Logistic systems
  - Courier robots
  - Mail delivery
  - Factory logistics
- Medical robotics
  - Diagnostic
  - Robot assisted surgery/therapy
  - Rehabilitation
- Defense, rescue, security
  - Demining
  - UAVs
  - Fire fighting
  - Underwater
- Laboratory robots
- Public relation robots
  - Tour guides
  - Hotel and restaurant

Kitting
Material Handling

AGVs
Healthcare

Warehouse Depalletizing
Warehouse Depalletizing

Boston Dynamics Stretch
Agriculture

New Zealand Apple Picking

A Hawkes Bay orchard is using a robotic harvester for an apple harvest.
Weeding Robot

A robot is killing weeds by zapping them with electricity
By Stephanie Bailey, CNN Business
Updated 6:56 AM ET, Wed June 9, 2021

Tom (left) and Dick (right) are farming robots that work together to kill weeds without using
Weed laser robot

Welding
Food Assembly

Mechanical Assembly
Cleaning

Coating
Food Handling/ Quality Control

Bakery

WATCH: A robot safely picking up pastries and cakes
Fast Food

Pizza in Paris
Restaurants

Cowboys?
Japanese Robot Hotel

Robot Job Interviewer
Drones used to deliver post to remote Orkney island

Drone delivers mail to remote Orkney Island

Baxter
International Distribution

Annual installations of industrial robots - World
1,000 units

Annual installations of industrial robots
15 largest markets 2019

Source: World Robotics 2020
### Table 1: Justification for Using Robots as Found in Companies That Are Using Robots, Ranked According to Priority

<table>
<thead>
<tr>
<th>Rank</th>
<th>U.S. Companies</th>
<th>Japanese Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reduced labor cost</td>
<td>Economic advantage</td>
</tr>
<tr>
<td>2</td>
<td>Improved product quality</td>
<td>Increased worker safety</td>
</tr>
<tr>
<td>3</td>
<td>Elimination of dangerous jobs</td>
<td>Universalization of production system</td>
</tr>
<tr>
<td>4</td>
<td>Increased output rate</td>
<td>Stable product quality</td>
</tr>
<tr>
<td>5</td>
<td>Increased product flexibility</td>
<td>Labor shortage</td>
</tr>
<tr>
<td>6</td>
<td>Reduced material waste</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Compliance with OSHA regulations</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Reduced labor turnover</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Reduced capital cost</td>
<td></td>
</tr>
</tbody>
</table>


*Survey in Japan consisted of only five categories.*

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### Table 3: Difficult-to-Quality Benefits of Robotization

<table>
<thead>
<tr>
<th>Robotization Can Improve</th>
<th>Robotization Can Reduce or Eliminate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>Hazardous, tedious jobs</td>
</tr>
<tr>
<td>Plant modernization</td>
<td>Safety violations and accidents</td>
</tr>
<tr>
<td>Labor skills of employees</td>
<td>Personnel costs for training</td>
</tr>
<tr>
<td>Job satisfaction</td>
<td>Clerical costs</td>
</tr>
<tr>
<td>Methods and operations</td>
<td>Cafeteria costs</td>
</tr>
<tr>
<td>Manufacturing productivity capacity</td>
<td>Need for restrooms, need for parking spaces</td>
</tr>
<tr>
<td>Reaction to market fluctuations</td>
<td>Burden, direct, and other overhead costs</td>
</tr>
<tr>
<td>Product quality</td>
<td>Manual material handling</td>
</tr>
<tr>
<td>Business opportunities</td>
<td>Inventory levels</td>
</tr>
<tr>
<td>Share of market</td>
<td>Scrap and errors</td>
</tr>
<tr>
<td>Profitability</td>
<td>New product launch time</td>
</tr>
<tr>
<td>Competitive position</td>
<td></td>
</tr>
<tr>
<td>Growth opportunities</td>
<td></td>
</tr>
<tr>
<td>Handling of short product life cycles</td>
<td></td>
</tr>
<tr>
<td>Handling of potential labor shortages</td>
<td></td>
</tr>
<tr>
<td>Space utility of plant</td>
<td></td>
</tr>
<tr>
<td>Level of management</td>
<td></td>
</tr>
</tbody>
</table>

*Analyzing the amount of change in each of these categories in response to robotization and assigning quantitative values to the intangible factors is necessary if they are to be included in the financial analysis (see Section 2). Otherwise they can only be used as weighting factors when determining the best alternative.*
Determination of Costs and Benefits

2. Will the robotic system expand the sales volume?
3. Will the plan decrease the production cost?
4. Will the robotic system decrease the initial investment amount?
5. Will the robotic system reduce lead time for products?
6. Can manufacturing costs be reduced?
7. Can inventory costs be reduced?
8. Will robotic system reduce direct and indirect labor costs or just shift workers’ skills?
9. Can the burden (overhead) rate be reduced?
10. Will the robot be fully utilized?
11. Will setup time and costs be reduced?
12. Can material-handling costs be reduced?
13. Will damage and scrap costs be reduced?
World Robotics 2020

Personal/Domestic Service Robots

Value of Sales:
2019: USD 5.7bn, +20%
2020: USD 6.5bn, +15%
2023: USD 12.1bn, +23% (CAGR)

Unit Sales:
2019: 23.2 million units, +34%
2020: 26.7 million units, +15%
2023: 55.3 million units, +27% (CAGR)

Vacuuming and floor cleaning: a task for robots

Service robots for personal/domestic use.
Unit sales 2018 and 2019, potential development 2020-2023

millions of units

Robots for domestic tasks

<table>
<thead>
<tr>
<th>Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>13.2</td>
</tr>
<tr>
<td>2019</td>
<td>18.6</td>
</tr>
<tr>
<td>2020</td>
<td>21.6</td>
</tr>
<tr>
<td>2021</td>
<td>31.2</td>
</tr>
<tr>
<td>2022</td>
<td>39.0</td>
</tr>
<tr>
<td>2023</td>
<td>48.6</td>
</tr>
</tbody>
</table>

Entertainment robots

<table>
<thead>
<tr>
<th>Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>4.6</td>
</tr>
<tr>
<td>2019</td>
<td>4.6</td>
</tr>
<tr>
<td>2020</td>
<td>6.1</td>
</tr>
<tr>
<td>2021</td>
<td>5.6</td>
</tr>
<tr>
<td>2022</td>
<td>6.1</td>
</tr>
<tr>
<td>2023</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Source: World Robotics 2020
Social Issues (U.S. Workshop)

- Productivity and Capital formation
- Labor
  - Will the US experience a long-term rise in unemployment? Effects by region, social class, education level, race, gender?
  - What is employment penalty of not automating?
  - Will robots create displacement effects? Regarding industry class, geography, job types
  - Quality of working environment? 3Ds of robotics

Social Issues - 2

- Education and Training
  - Shortage of trained people exists
  - Technologically literate population less likely to resist robot deployment
- International Impacts
  - Differential utilization
  - Create wider trade/culture/economic gaps?
<table>
<thead>
<tr>
<th>FIVE POLICY STRATEGIES FOR ADJUSTING TO AUTOMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Embrace growth and technology</strong></td>
</tr>
<tr>
<td>- Run a full-employment economy, both nationally and regionally</td>
</tr>
<tr>
<td>- Embrace transformative technology to power growth</td>
</tr>
<tr>
<td><strong>Promote a constant learning mindset</strong></td>
</tr>
<tr>
<td>- Invest in retraining incumbent workers</td>
</tr>
<tr>
<td>- Expand accelerated learning and certification</td>
</tr>
<tr>
<td>- Make skill development more financially accessible</td>
</tr>
<tr>
<td>- Align and expand traditional education</td>
</tr>
<tr>
<td>- Foster uniquely human qualities</td>
</tr>
<tr>
<td><strong>Facilitate smoother adjustment</strong></td>
</tr>
<tr>
<td>- Create a Universal Adjustment Benefit to support all displaced workers</td>
</tr>
<tr>
<td>- Maximize hiring through a subsidized employment program</td>
</tr>
<tr>
<td><strong>Induce hardships for workers who are struggling</strong></td>
</tr>
<tr>
<td>- Reform and expand income supports for workers in low-paying jobs</td>
</tr>
<tr>
<td>- Reduce financial volatility for workers in low-wage jobs</td>
</tr>
<tr>
<td><strong>Mitigate harsh local impacts</strong></td>
</tr>
<tr>
<td>- Future-proof vulnerable regional economies</td>
</tr>
<tr>
<td>- Expand support for community adjustment</td>
</tr>
</tbody>
</table>

Source: Metropolitan Policy Program at Brookings