Jobs lost, jobs gained: Workforce transitions in a time of automation

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Lessons from history

Automation impact
Throughout history, large-scale sector employment declines have been countered by growth of new sectors that have absorbed workers.
New technologies create many more jobs than they destroy over time, mainly outside the industry itself: Example of PCs

Total net US jobs created and occupations with most jobs created and destroyed by PCs

Thousands of jobs

**Direct—Computer equipment manufacturing**
1970 - 2015

- Assorted managers and administrators: +31
- Computer software developers (in-industry equipment): +27
- Computer scientists: +18
- Office machine manufacturers (typewriters): -61

**Enabled—Computer software and services industries**
1970 - 2015

- Software developers (SW and apps): +768
- Computer scientists: +686
- Managers: +416
- Typewriter repair: -32

**Indirect—Computer suppliers**
1970 - 2015

- Managers: +42
- Semiconductor manufacturing occupations: +31
- Printed circuit assembly occupations: +26
- Typewriter indirect occupations: -79

**Utilizers—Computer utilizing industries**
1980 - 2015

- Customer service reps: +3205
- Computer scientists (not in computer industry): +1873
- Stock and inventory clerks: +1517
- Bookkeepers and auditing clerks: -881
- Secretaries: -823
- Typists: -562

**Jobs created: 19.3M**
**Jobs destroyed: 3.5M**
**Net jobs: 15.8M (≈10% of labor force)**

SOURCE: IPUMS; Moody’s; IMPLAN; US Bureau of Labor Statistics; FRED; McKinsey Global Institute analysis
Automation can stimulate employment by lowering the price of a good and unleashing latent demand: Example of Ford Model T

Ford Model T – Assembly line improved productivity and number of employees as a result of higher sales at lower prices

<table>
<thead>
<tr>
<th>Year</th>
<th># of employees</th>
<th>Productivity, # Model T units produced per employee per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1909</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>1910</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>1911</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>1912</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>1913</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>1914</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>1915</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Model T units shipped</th>
<th>Price, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1909</td>
<td>950</td>
<td>1,780</td>
</tr>
<tr>
<td>1910</td>
<td>780</td>
<td>1,690</td>
</tr>
<tr>
<td>1911</td>
<td>690</td>
<td>1,600</td>
</tr>
<tr>
<td>1912</td>
<td>600</td>
<td>550</td>
</tr>
<tr>
<td>1913</td>
<td>550</td>
<td>490</td>
</tr>
<tr>
<td>1914</td>
<td>490</td>
<td>440</td>
</tr>
<tr>
<td>1915</td>
<td>440</td>
<td>394,788</td>
</tr>
</tbody>
</table>

SOURCE: BLS, FDIC, SNL Hounshell (1984: 224) for the first two columns and Beaudreau (2008: 71), McKinsey Global Institute Analysis
The personal computer and Internet might have reduced employment for information analysts, but instead it has doubled.

**Employment in analyst occupations, US**

Total employment, thousands, 1990-2015

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Total employment, Thousands, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Analysts</td>
<td>31</td>
</tr>
<tr>
<td>Budget Analysts</td>
<td>55</td>
</tr>
<tr>
<td>Financial Analysts</td>
<td>255</td>
</tr>
<tr>
<td>Statisticians</td>
<td>59</td>
</tr>
<tr>
<td>Operations research analyst</td>
<td>159</td>
</tr>
<tr>
<td>Economists, market Researchers and</td>
<td>364</td>
</tr>
<tr>
<td>survey researchers</td>
<td></td>
</tr>
<tr>
<td>Management analyst</td>
<td>985</td>
</tr>
</tbody>
</table>

Total 1.9M

**SOURCE:** IPUMS, McKinsey Global Institute Analysis
Lessons from history

Automation impact
To assess the impact of automation on employment, we focus on the activities within occupations and the capabilities of currently demonstrated technologies.

<table>
<thead>
<tr>
<th>Occupations</th>
<th>Activities</th>
<th>Capabilities required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail salespeople</td>
<td>Greet customers</td>
<td>1 Social</td>
</tr>
<tr>
<td>Food and beverage service workers</td>
<td>Answer questions about products and services</td>
<td>2 Linguistic</td>
</tr>
<tr>
<td>Teachers</td>
<td>Clean and maintain work areas</td>
<td>3 Cognitive</td>
</tr>
<tr>
<td>Health practitioners</td>
<td>Demonstrate product features</td>
<td>4 Sensory perception</td>
</tr>
<tr>
<td></td>
<td>Process sales and transactions</td>
<td>5 Physical</td>
</tr>
</tbody>
</table>

~800 occupations

~2,000 activities assessed across all occupations

18 capabilities utilized within each activity

SOURCE: McKinsey Global Institute analysis
Three categories of activities have higher technical automation potential

**Time spent on activities that can be automated by adapting currently demonstrated technology -- US %**

<table>
<thead>
<tr>
<th>Time spent in all occupations</th>
<th>Manage</th>
<th>Expertise</th>
<th>Interface</th>
<th>Unpredictable physical</th>
<th>Collect data</th>
<th>Process data</th>
<th>Predictable physical</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>14</td>
<td>16</td>
<td>12</td>
<td>17</td>
<td>64</td>
<td>69</td>
<td>81</td>
</tr>
</tbody>
</table>

| Total wages in US, 2014 $ billion | 596 | 1,190 | 896 | 504 | 103 0 | 931 | 766 |

**Most susceptible activities**

- 51% of US economy
- $2.7 trillion in wages

1 Managing and developing people.
2 Applying expertise to decision making, planning, and creative tasks.
3 Interfacing with stakeholders.
4 Performing physical activities and operating machinery in unpredictable environments.
5 Performing physical activities and operating machinery in predictable environments.

**SOURCE:** US Bureau of Labor Statistics; McKinsey Global Institute analysis
While few occupations are fully automatable, over 60 percent of all occupations have at least 30 percent technically automatable activities.

Automation potential based on demonstrated technology of occupation titles in the US (cumulative)

Example occupations:
- Sewing machine operators
- Graders and sorters of agricultural products
- Stock clerks
- Travel agents
- Watch repairers
- Chemical technicians, Nursing assistants
- Web developers
- Fashion designers, Chief executives
- Statisticians
- Psychiatrist
- Legislators

Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis
Technical potential for automation across sectors varies depending on mix of activity types

Size of bubble indicates % of time spent in US occupations

Ability to automate (%)  
0 50 100

Sectors by activity type

- Accommodation and food services
- Manufacturing
- Transportation and warehousing
- Agriculture
- Retail trade
- Mining
- Other services
- Construction
- Utilities
- Wholesale trade
- Finance and insurance
- Arts, entertainment, and recreation
- Real estate
- Administrative
- Health care and social assistances
- Information
- Professionals
- Management
- Educational services

Automation potential %

- 73
- 60
- 60
- 57
- 53
- 51
- 49
- 47
- 44
- 44
- 43
- 41
- 40
- 39
- 36
- 36
- 35
- 35
- 27

Occupations requiring higher levels of education and experience have lower automation potential.

Technical automation potential of work activities by job zone in the US

<table>
<thead>
<tr>
<th>Job Zone</th>
<th>Automatable</th>
<th>Non-automatable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than high school</td>
<td>64%</td>
<td>36%</td>
</tr>
<tr>
<td>High school or some experience</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td>Some post-secondary education</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>Bachelor and graduate degree</td>
<td>22%</td>
<td>78%</td>
</tr>
</tbody>
</table>

Example occupations:
- Less than high school:
  - Logging equipment operators
  - Taxi drivers
- High school or some experience:
  - Stock clerks
  - Travel agents
  - Dental lab technicians
  - Fire fighters
- Some post-secondary education:
  - Nursing assistants
  - Web developers
  - Electricians
  - Legal secretaries
- Bachelor and graduate degree:
  - Lawyer
  - Doctors
  - Teacher
  - Statisticians
  - Chief executives

SOURCE: BLS 2014; O*Net; Global Automation Impact Model; McKinsey analysis
By 2030, automation has the potential to replace up to 47 percent of work hours in the US in the earliest adoption scenario

Projected impact to total employment in earliest automation scenario
Share of 2014 FTE hours with potential to be automated, 2016-2030

By 2030, automation has the potential to replace up to 47 percent of work hours in the US in the earliest adoption scenario.
Thank you

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