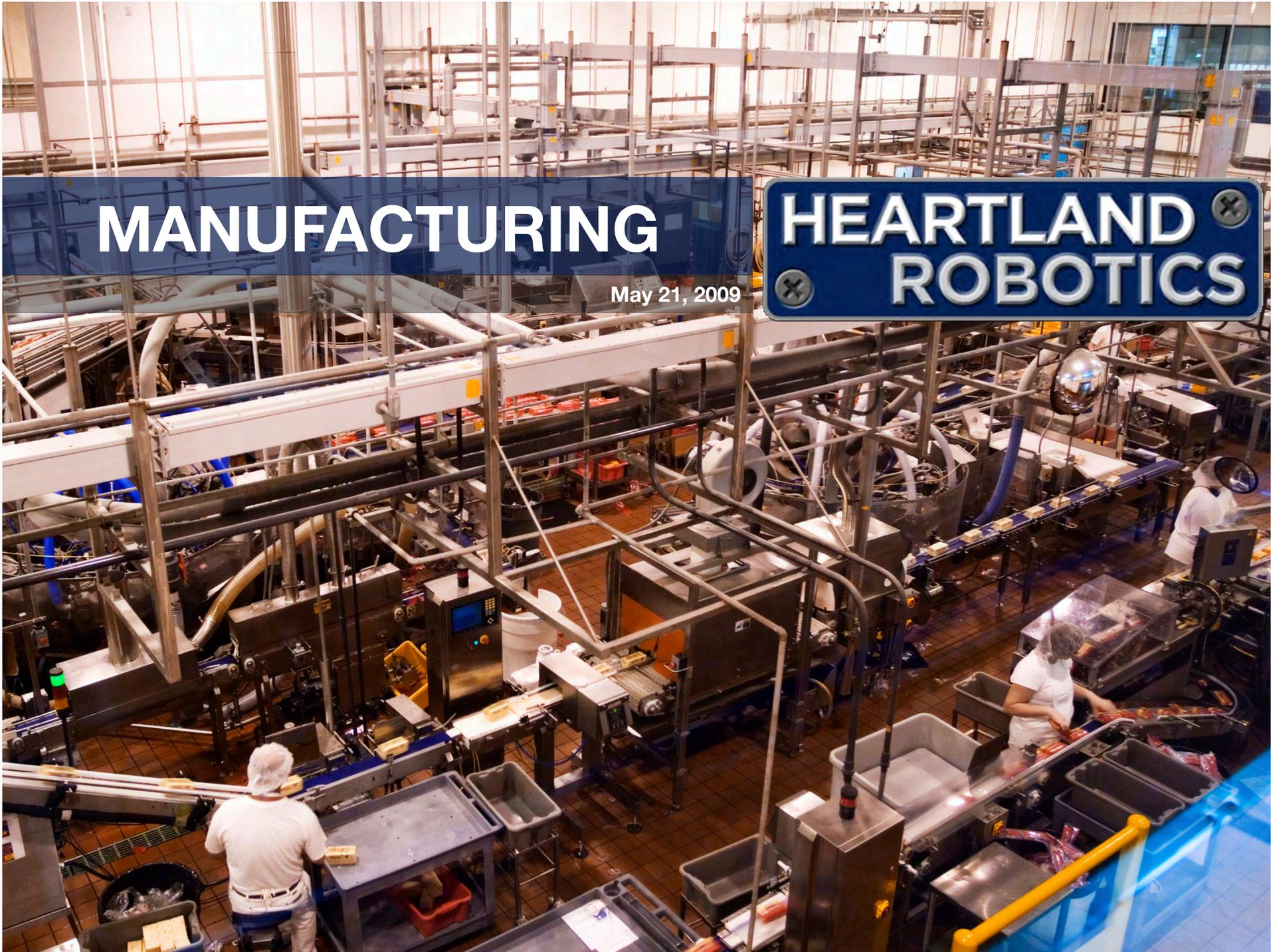
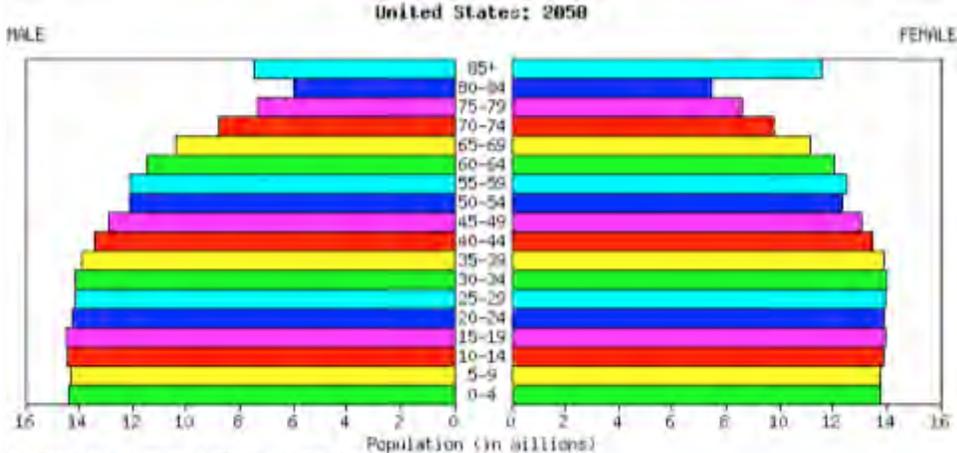
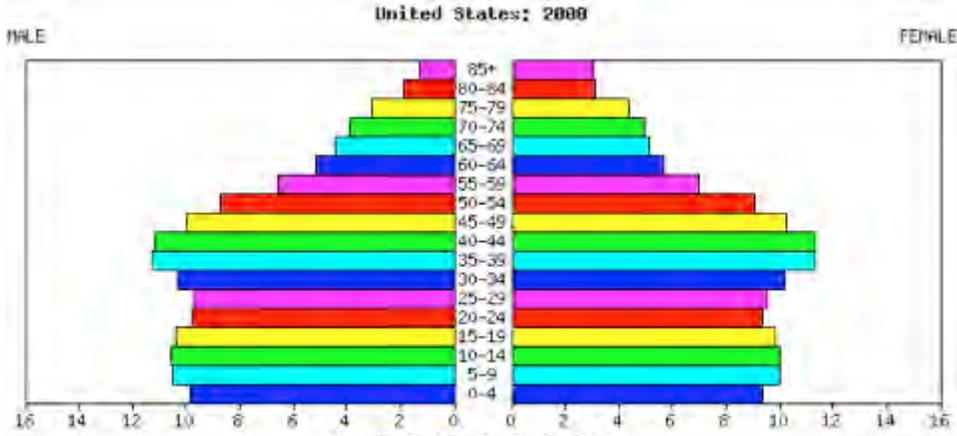
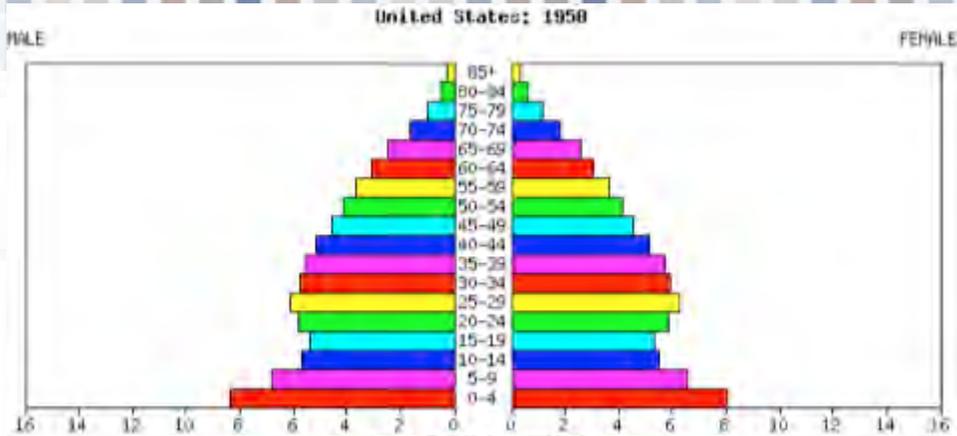


MANUFACTURING

May 21, 2009

HEARTLAND ROBOTICS





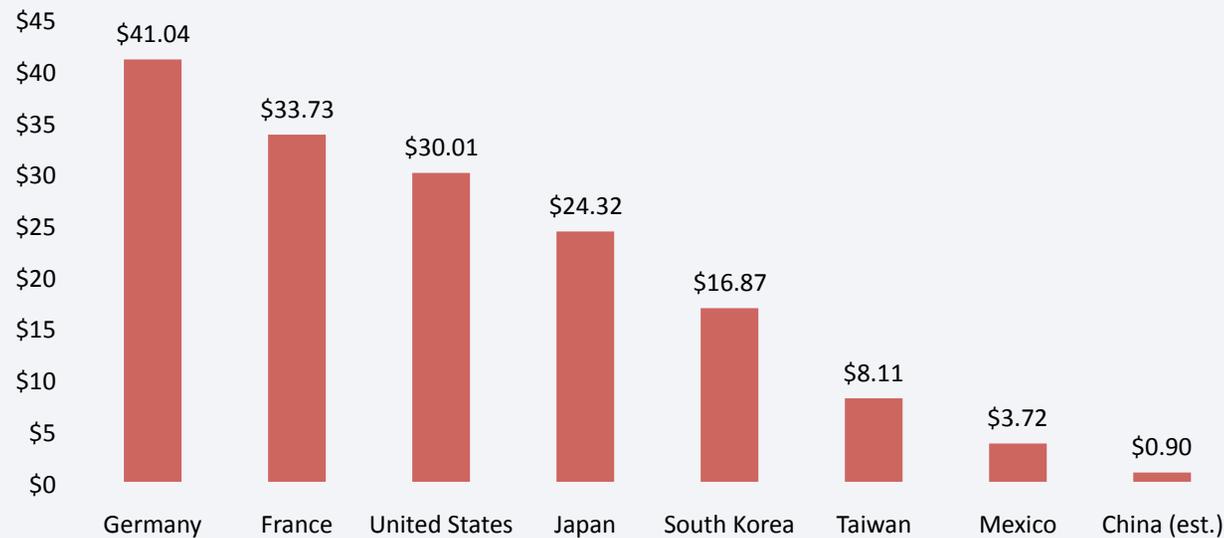
Source: U.S. Census Bureau, International Data Base.

US Demographics

- Ratio of working age to older Americans is decreasing
- Working Americans will need to become more productive in all sectors, including manufacturing

Production Labor Cost is the Top Challenge for Manufacturers in Industrialized Countries

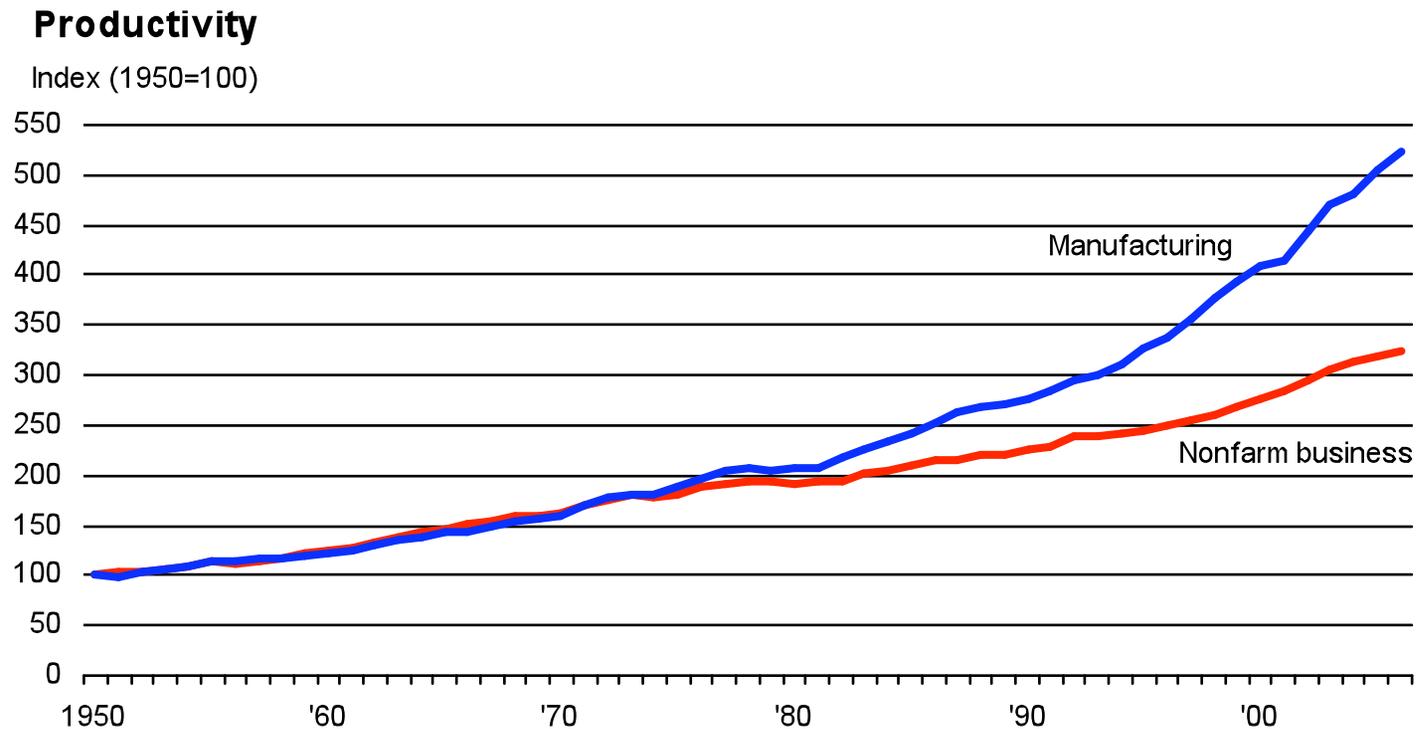
2006 Hourly Manufacturing Compensation Cost,
all NAICS ex. Petro/Coal, US\$



To be competitive, US industry and workers must be more productive; and they have been and are!

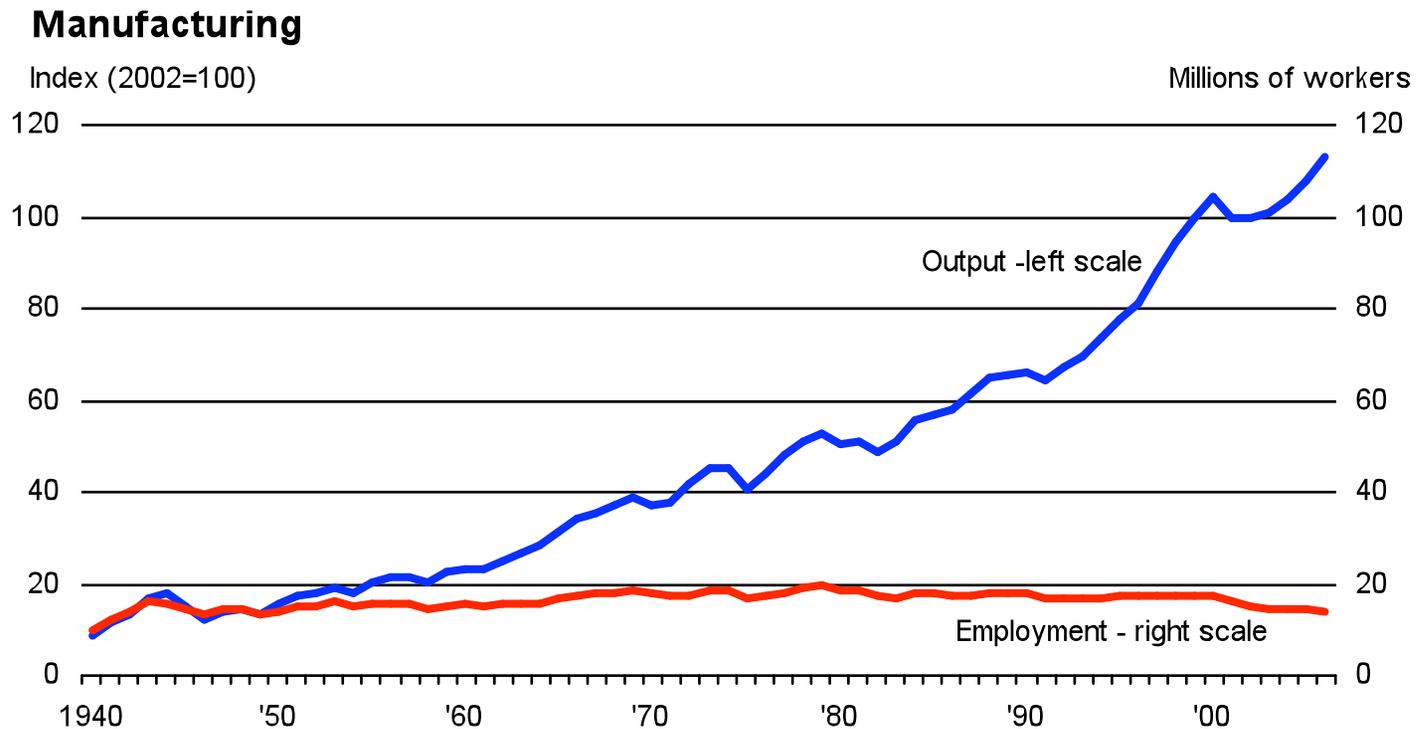
Sources: U.S. Bureau of Labor Statistics; China est. from Lett and Banister, U.S. BLS, "Labor Costs of Manufacturing Employees in China: an Update to 2003-04"; Deloitte & Touche survey of North American manufacturers

US Manufacturing Productivity Has Increased Faster Than Other Productivity



Source: Federal Reserve Bank of Chicago, Oct. 2007

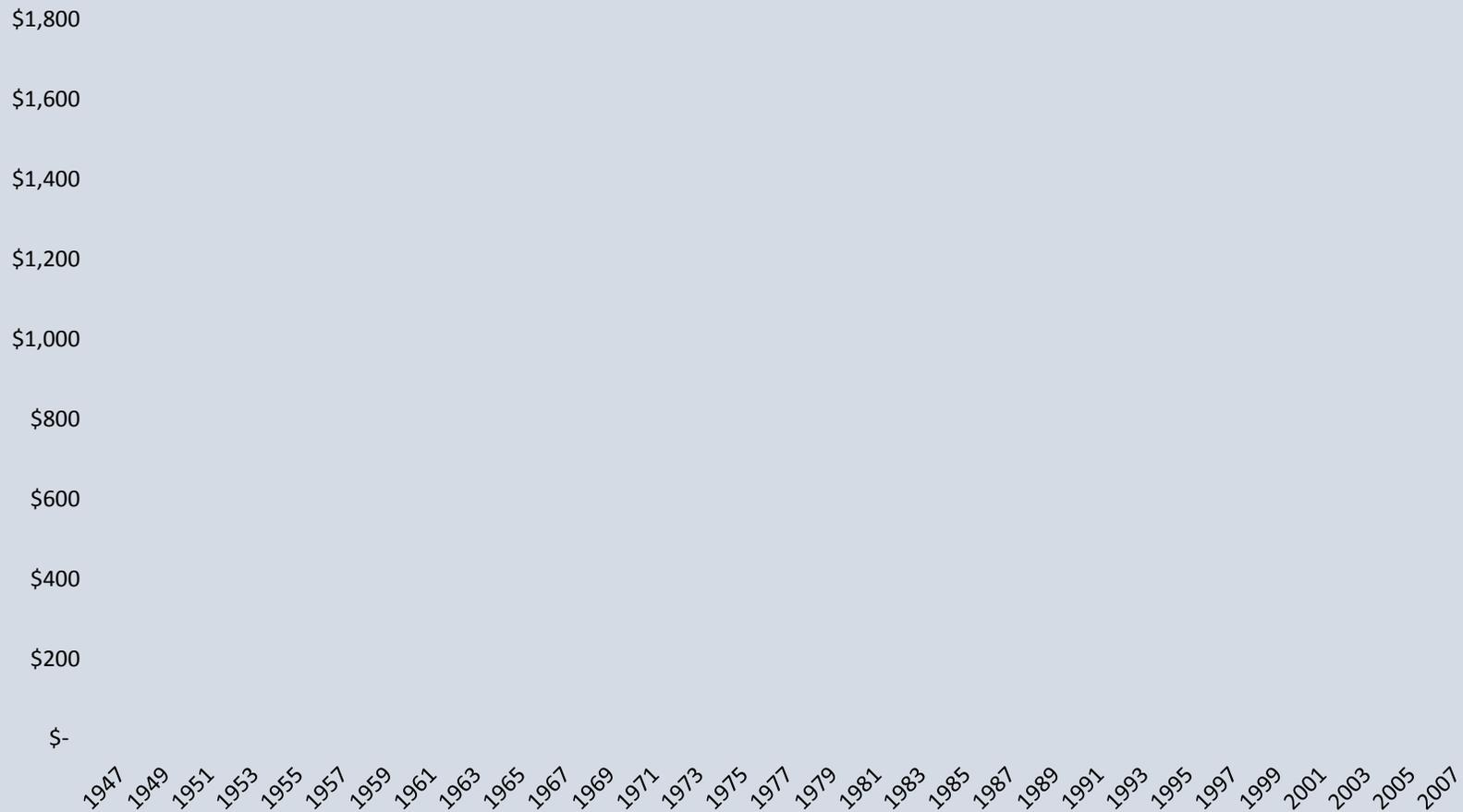
US Manufacturing Output Increased 3.7% per Year with 60 Year Mostly Flat Employment



Source: Federal Reserve Bank of Chicago, Oct. 2007

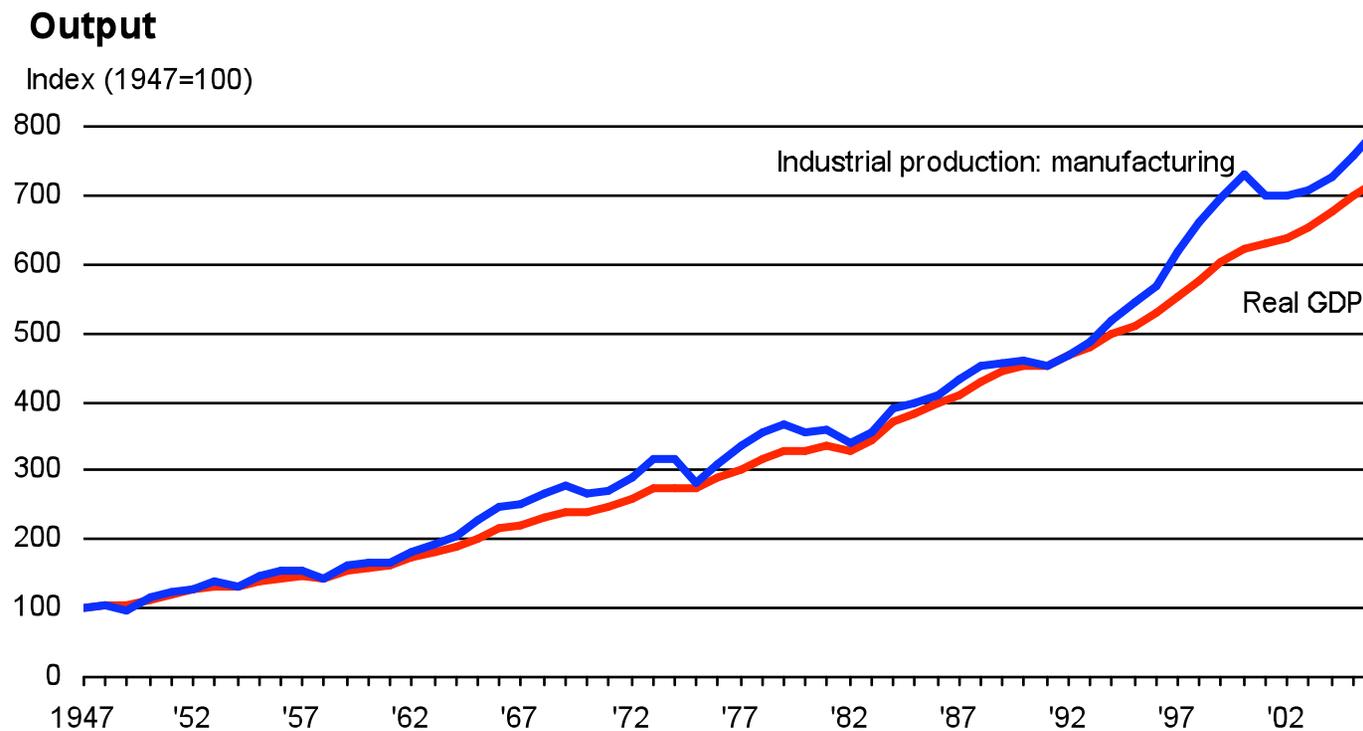
U.S. Manufacturing Value Added Remains World's Largest, But Growing Slowly

U.S. Manufacturing Value Added, \$B



Source: U.S. Bureau of Economic Analysis

Manufacturing Revenues in the U.S. Grow Faster than GDP...



Source: Federal Reserve Bank of Chicago, Oct. 2007

A New Vision For American Manufacturing

Smart and productive:

- skilled workers producing **both** high value and mass market products
- robots take over the simple cases of the simple tasks freeing workers to be smart
- robotics and STEM education intertwine to support each other

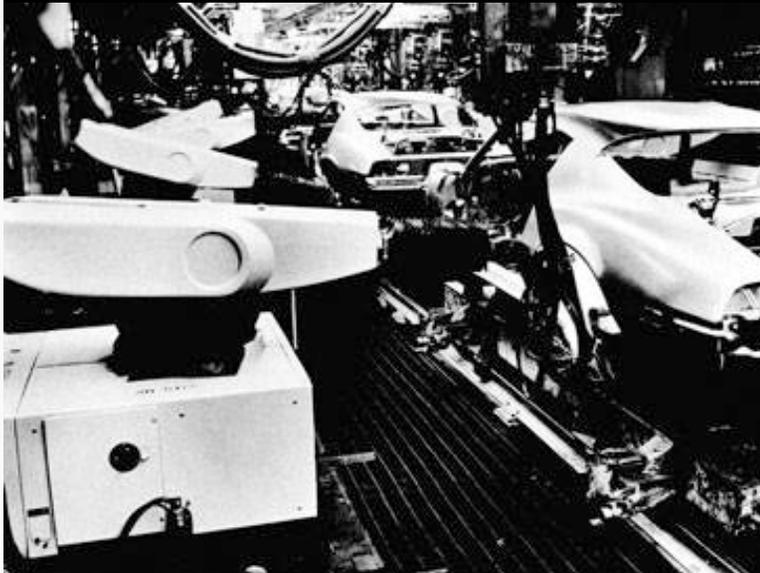
Industrial revolutions:

1. muscles replaced by mechanically distributed power (UK - 1780)
2. electrical power allowing redistribution (USA - 1900)
3. computational intelligence between workers and work (USA?? – 2010)

World's First Industrial Robot

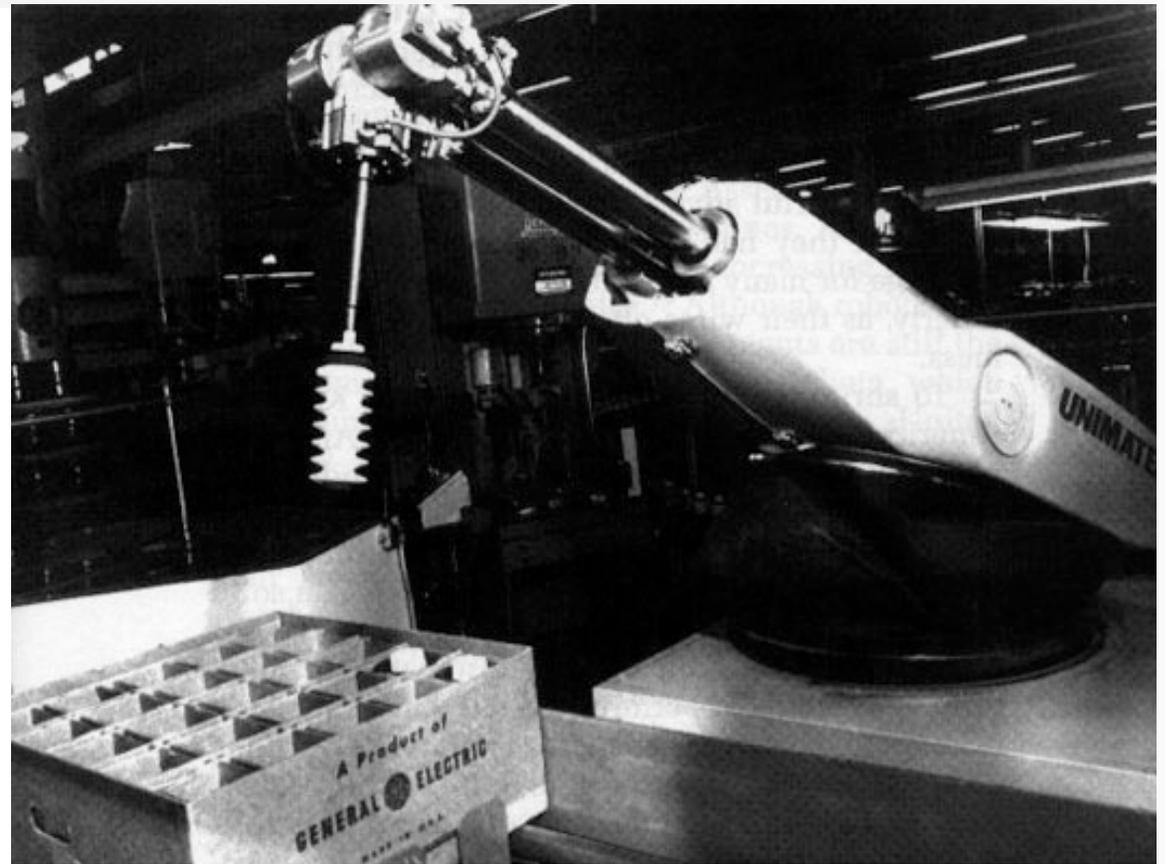


- The Unimate (Unimation)
 - by Joe Engelberger
- First installed in a GM factory
 - 1961
- Later bought by Westinghouse
 - then sold to Kawasaki



Computation and Sensing Expensive

- No computer
- No sensors
- Same motions repetitively
- Cost of systems integration is 10 times robot cost



Today's industrial robots are much the same; they have not yet exploited the microprocessor/network revolution

Today's Manufacturing Robots



- Unsafe for people to be around
- Engineered to be precise and repeatable, not adaptable
- Can only operate in very structured environments
- Their application is limited

Originally Ordinary People Couldn't Touch Computers



Now
they
can



What if ordinary people
could touch robots?

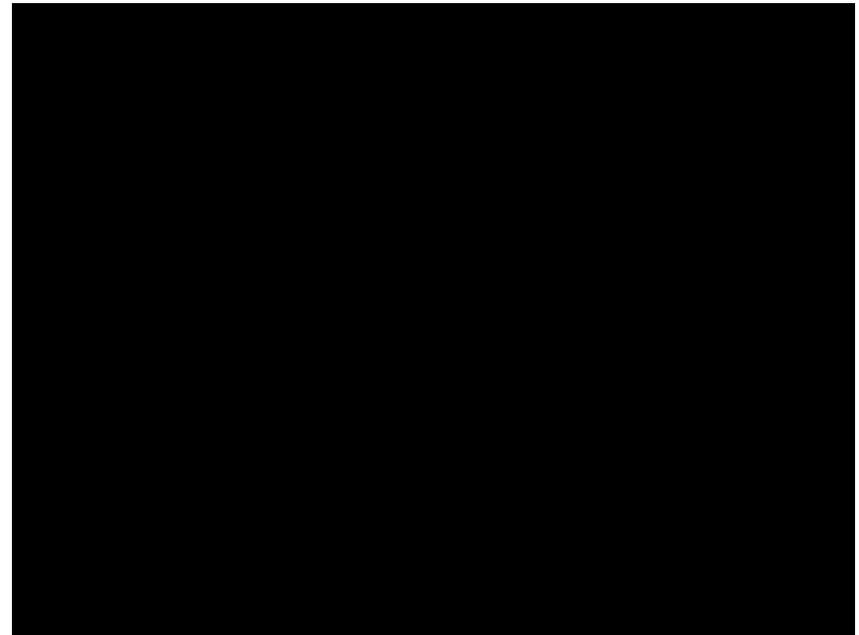


Now They Can



Technologically Ripe Research Areas

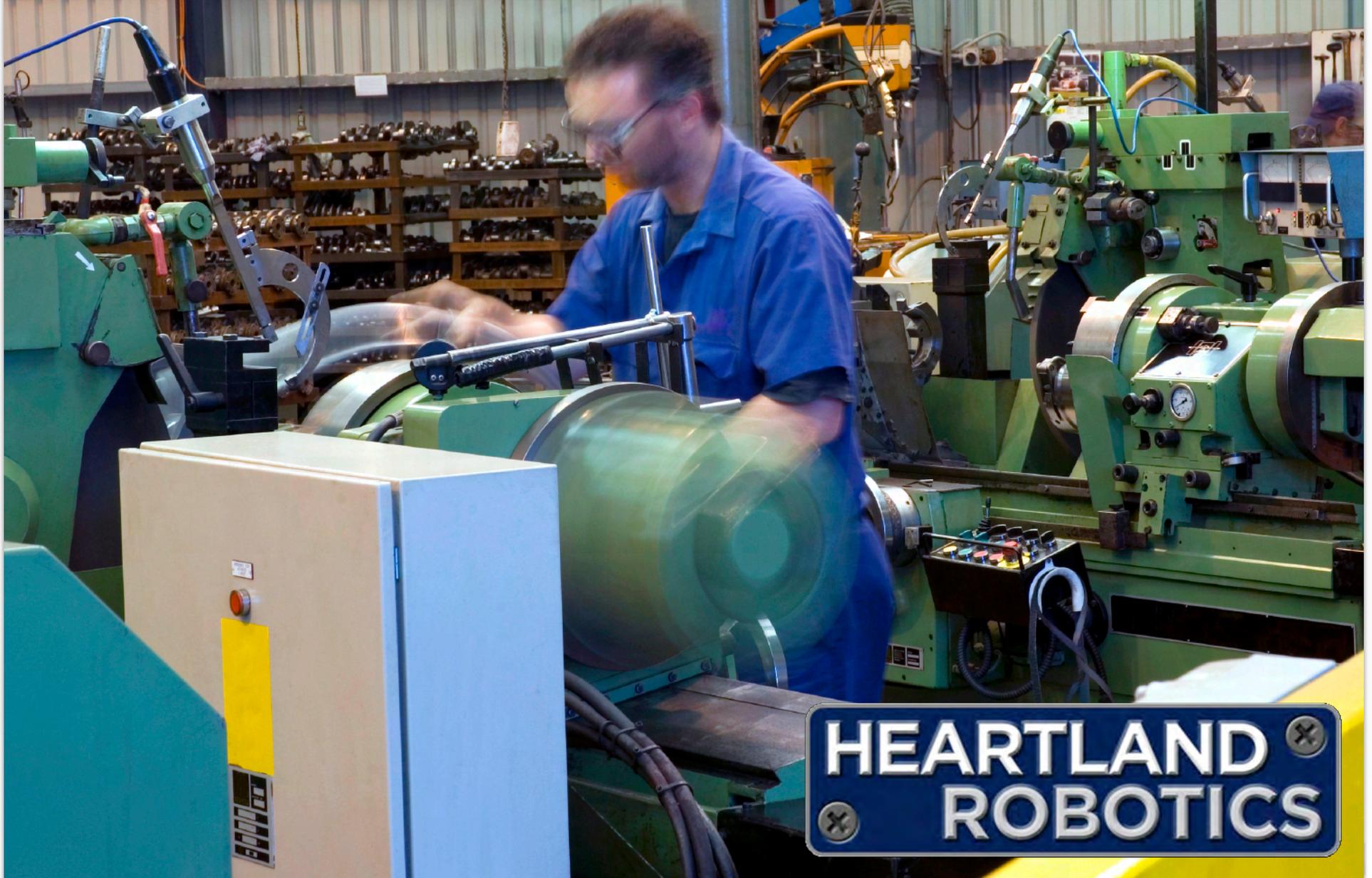
- Visual object recognition
- Manipulation
- New sensors
- New materials
- Networked robots
- Awareness of people
- Social interaction



What US Manufacturing Needs

- A new class of dexterous robots
- Safe for people and robots to share workspace
- Empower workers by being flexible assistants
- Carry out the simple cases of simple tasks
- Decrease systems integration costs
- Increase worker productivity and American competitiveness

ROBOTS TO EMPOWER AMERICAN WORKERS



**HEARTLAND
ROBOTICS**