CCC Robotics Roadmap:

From Internet to Robotics

Henrik I Christensen

KUKA Chair of Robotics, Georgia Tech

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Introduction

- Robotics is a transformative technology
- Objective to define a roadmap for commercial use of robotics in the US
- Robots empower the american workforce

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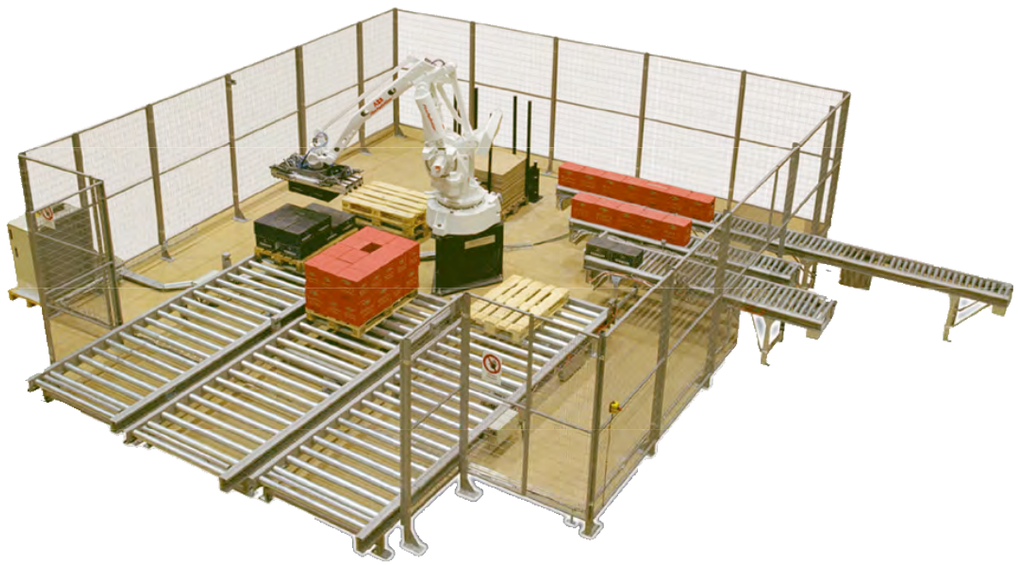
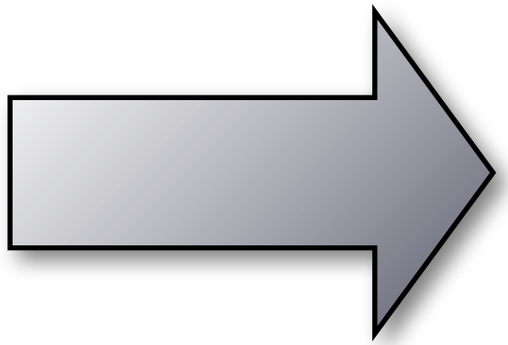
Robotics?





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Objective

- Map out key socio-economic opportunities
- Identify major obstacles to progress
- Identify strategies to overcome obstacles
- Outline a 5, 10 and 15 yr roadmap to progress

4 Key Areas

- Manufacturing & Logistics
  - Organized by Rensselear Polytechnic Institute, Univ. of Pennsylvania, UC Berkeley, Georgia Tech
- Medical & Healthcare
  - Organized by Johns Hopkins Univ., Univ. of Southern California & Georgia Tech
- Service Applications
  - Organized by Univ. of Massachusetts, The Tech Collaborative, Georgia Tech
- Emerging Technologies
  - Organized by Carnegie Mellon, Univ. of Utah, Georgia Tech

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Open Process

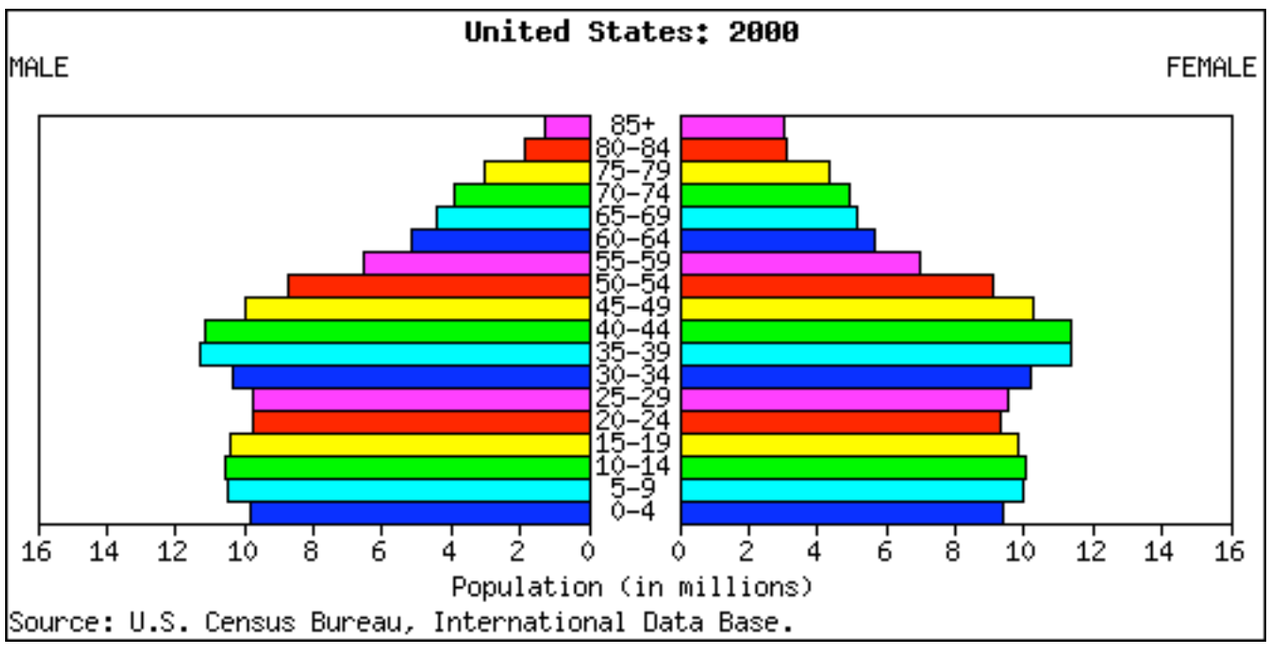
1. Open Call for Participation
2. Selected Workshop Participation
   40% Industry/60% Academia
3. Draft Report
4. Community Feedback
5. Final Report

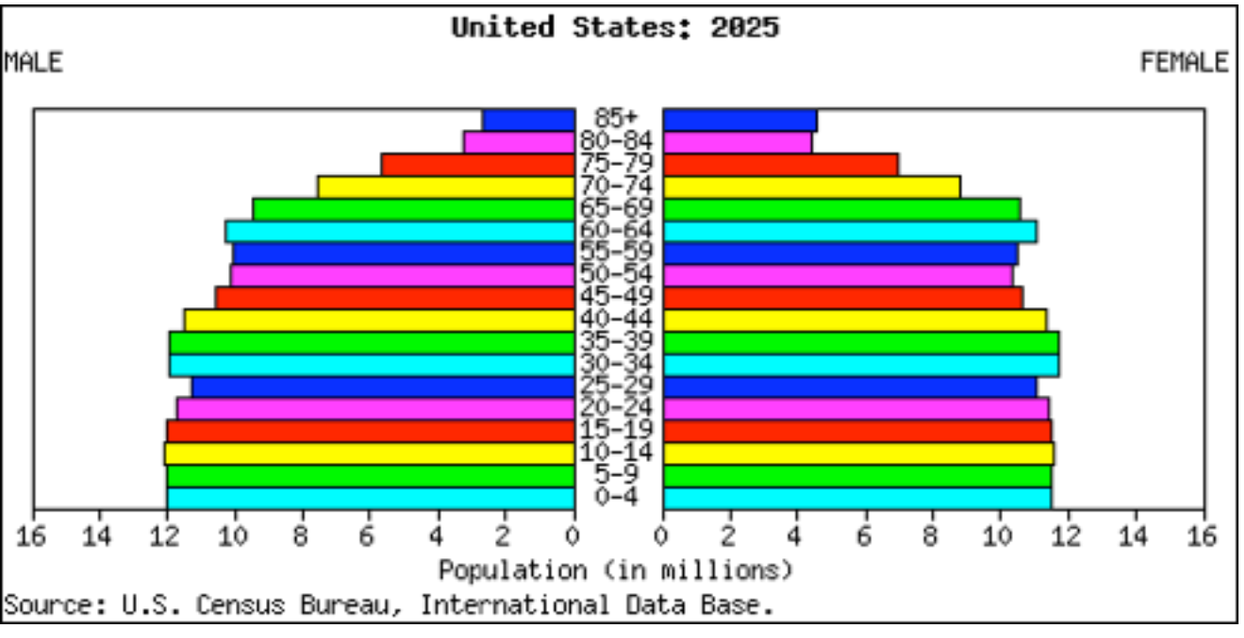
- Involvement of a broad set of companies and institutions across US

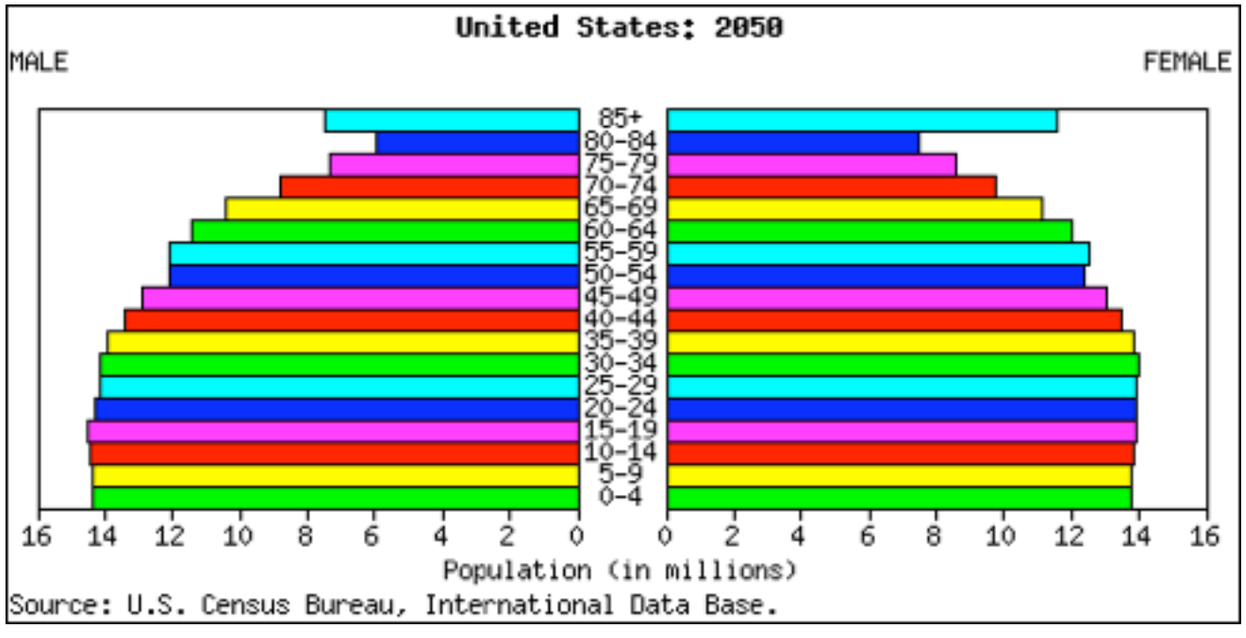
Main Results

- Manufacturing & Logistics
- Medical Robotics
- Healthcare Applications
- Professional Service Applications
- Domestic Services
- Emerging Technologies

Population Statistics







Important consideration for the future

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Manufacturing

- ~11% of GDP (significant overall impact)
- Focus has been on large scale manufacturing
- Bring manufacturing home
- Empower small and medium sized companies
- Simplified use, added flexibility & versatility

Logistics

- All consumer goods are on a truck at least once!
- < 15% of process has been automated
- The transport cost could be reduced by 20-30% or ~5% of final cost and energy
- Flexible palletizing. Ease of programming, small series delivery tasks, ...

Mapping $ to Science

Technologies

- Architecture and representations
- Control and planning
- Formal methods
- Learning and adaptation
- Modeling, simulation and analysis
- Novel mechanisms and high-performance actuators
- Perception
- Physical human-robot Interaction
- Robust, high-fidelity sensors
- Socially-interactive robots

Critical Capabilities

- Perception to enable operation in unstructured environments
- Human-like dexterous manipulation
- Adaptable and reconfigurable assembly
- Robots working with humans
- Autonomous navigation
- Rapid deployment of assembly lines
- Green manufacturing
- Model-based integration and design of supply chain
- Interoperability of component technologies
- Nano manufacturing (next-generation products)

Manufacturing Domains

- Mining
- Processing
- Discrete-part manufacture
- Assembly
- Logistics (transportation, distribution)

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Medical Robotics

- Aging of society is seriously challenging the healthcare system
- Medical robotics facilitate faster, better and cheaper intervention
- Early results demonstrated for prostate and cardiac procedures.
- Need to develop and transition technologies from bench to bedside
- Where electronic patient record meets intervention

Healthcare Robotics

- Baby boomers/wounded veterans require services/ quality of life
- Significant benefits to home-care services
- Freedom and personalized assistance
- New generation of flexible systems, ease of use, tied to home services

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Professional Services

- Empower Field Applications
- Automate Farms, Forestry, Mining….
- Significant opportunities for automation

Domestic Services

- Assist people in homes
- Automate chores
- Add time for leisure
- Enhance independence for elderly and disabled

Education

- Developing the workforce
- Engaging students in STEM
- Educational outreach

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International investments

- European Union
  - Cognitive Systems & Robotics (600M€)
- Korea
  - 21th Century Frontier Program (1.25B$)
- Japan
  - Service Robotics (100M$)
- USA
  - The industry was born here, but ...

Summary

- Robotics is a transformative technology
- Major opportunities to facilitate economic growth
  - Bring manufacturing home
  - Medical procedures cheaper, faster, better
  - Enhanced quality of life
  - Cheaper, greener, ... production
  - Enables energy independence
  - Leverages new R&D technology such as nano ...
- A roadmap for how to grow new opportunities

Speakers

- Manufacturing:
  - Rodney Brooks, Founder Heartland Robotics
- Medical Robotics:
  - Dan Jones, Director Ext. Affairs., Intuitive Surgical
- Service Applications:
  - Eric Close, CEO RedZone Robotics