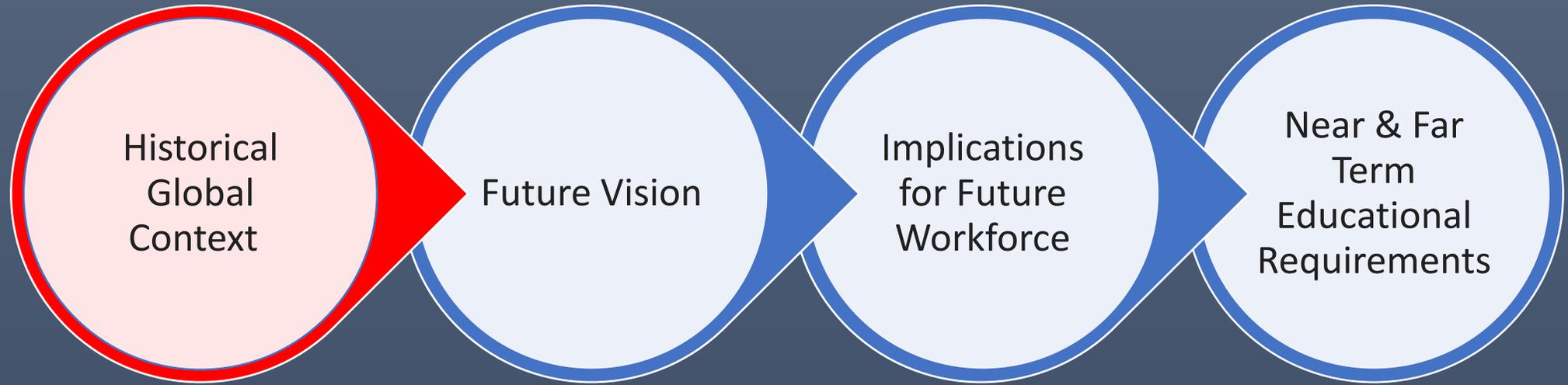# The Frontier for the Future Workforce
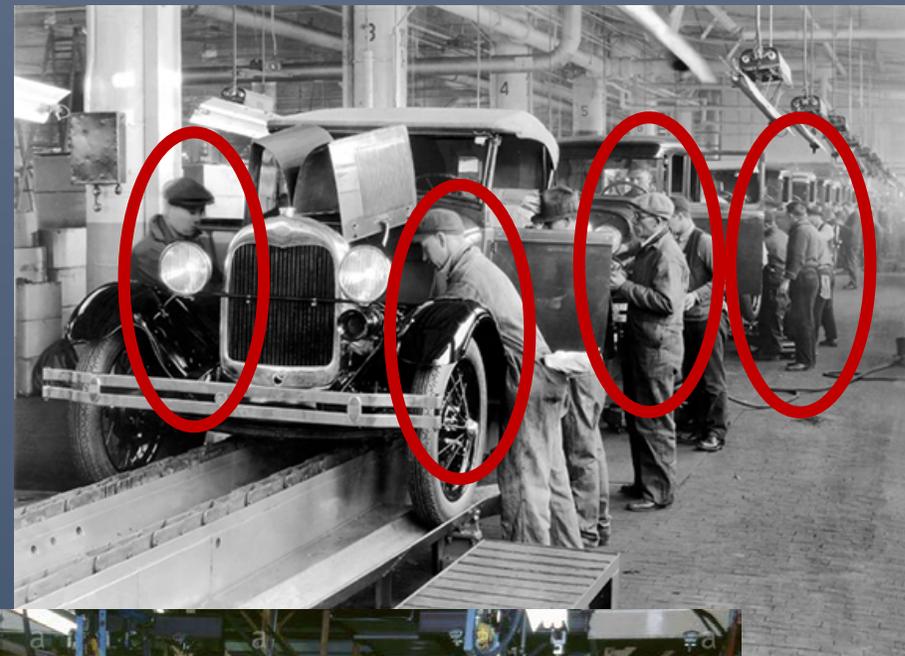
Reginald Brothers, Ph.D.

Ashley Gierlach, M.A.

I. Historical Global Context: Industrial Revolutions

Ford Factory 1927
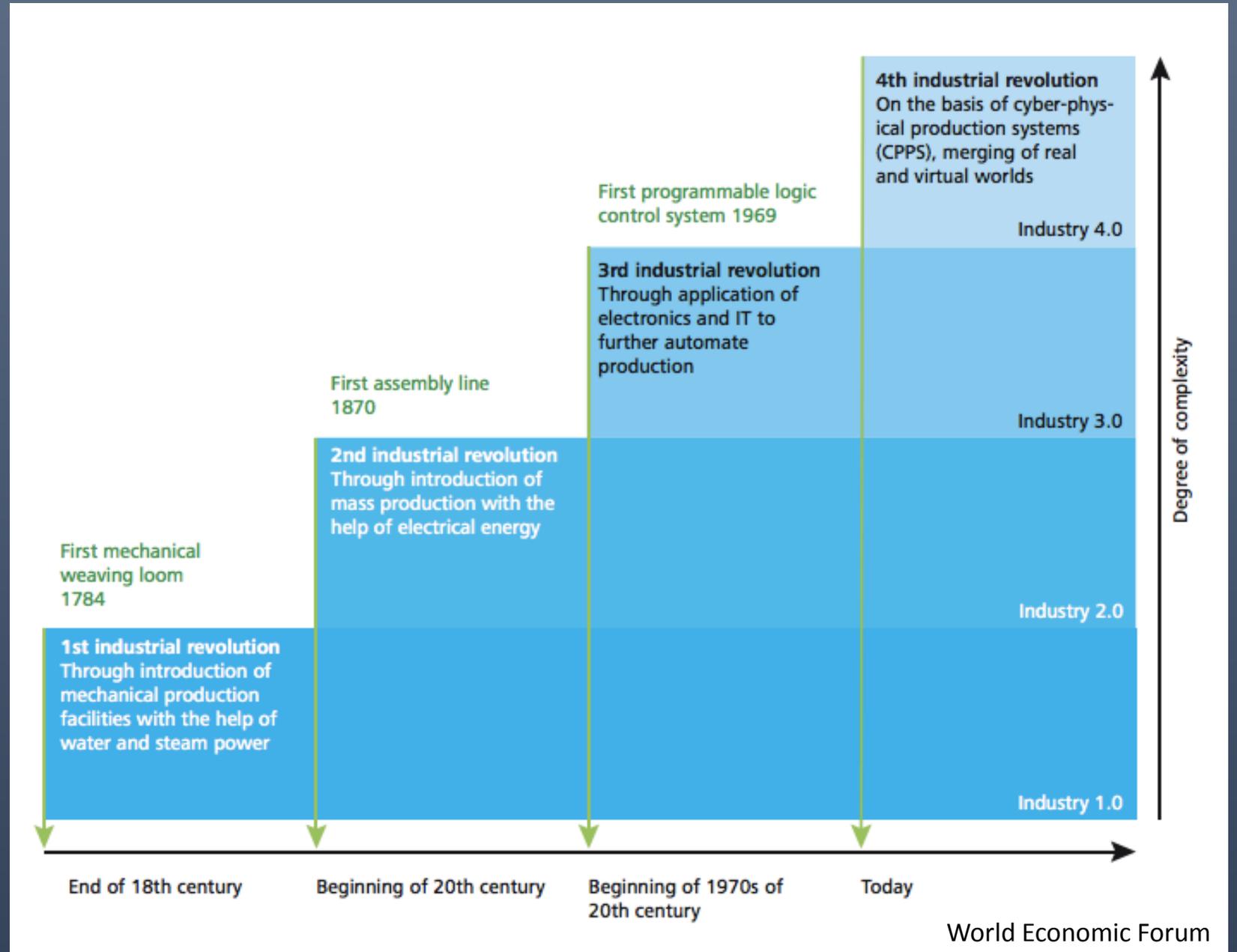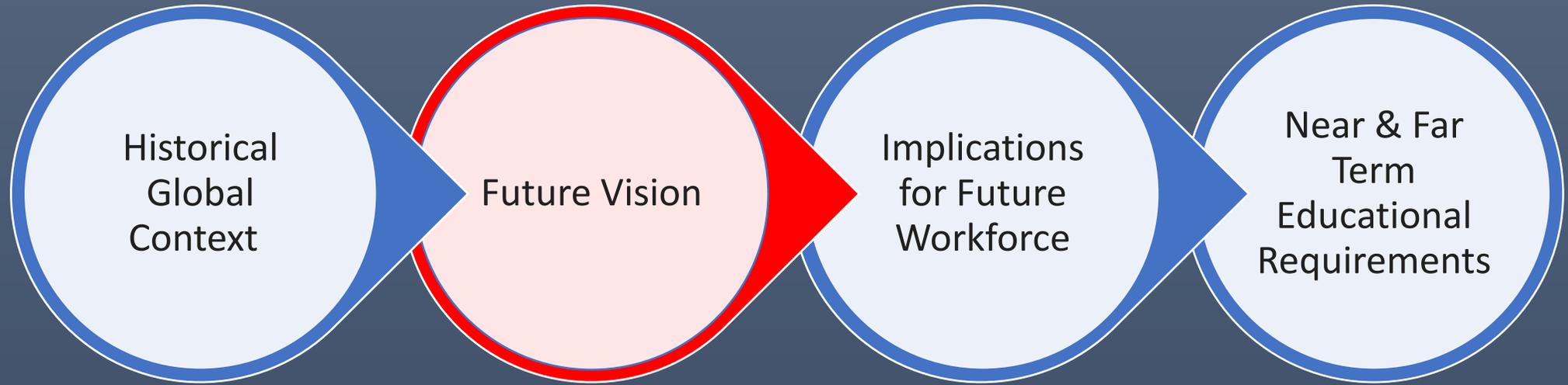

Tesla Factory 2017

Ford Factory 2000

A Fourth Industrial Revolution:

First mechanical weaving loom 1784

First assembly line 1870

First programmable logic control system 1969

1st industrial revolution
Through introduction of mechanical production facilities with the help of water and steam power

2nd industrial revolution
Through introduction of mass production with the help of electrical energy

3rd industrial revolution
Through application of electronics and IT to further automate production

4th industrial revolution
On the basis of cyber-physical production systems (CPPS), merging of real and virtual worlds

Industry 4.0

Industry 3.0

Industry 2.0

Industry 1.0

Degree of complexity

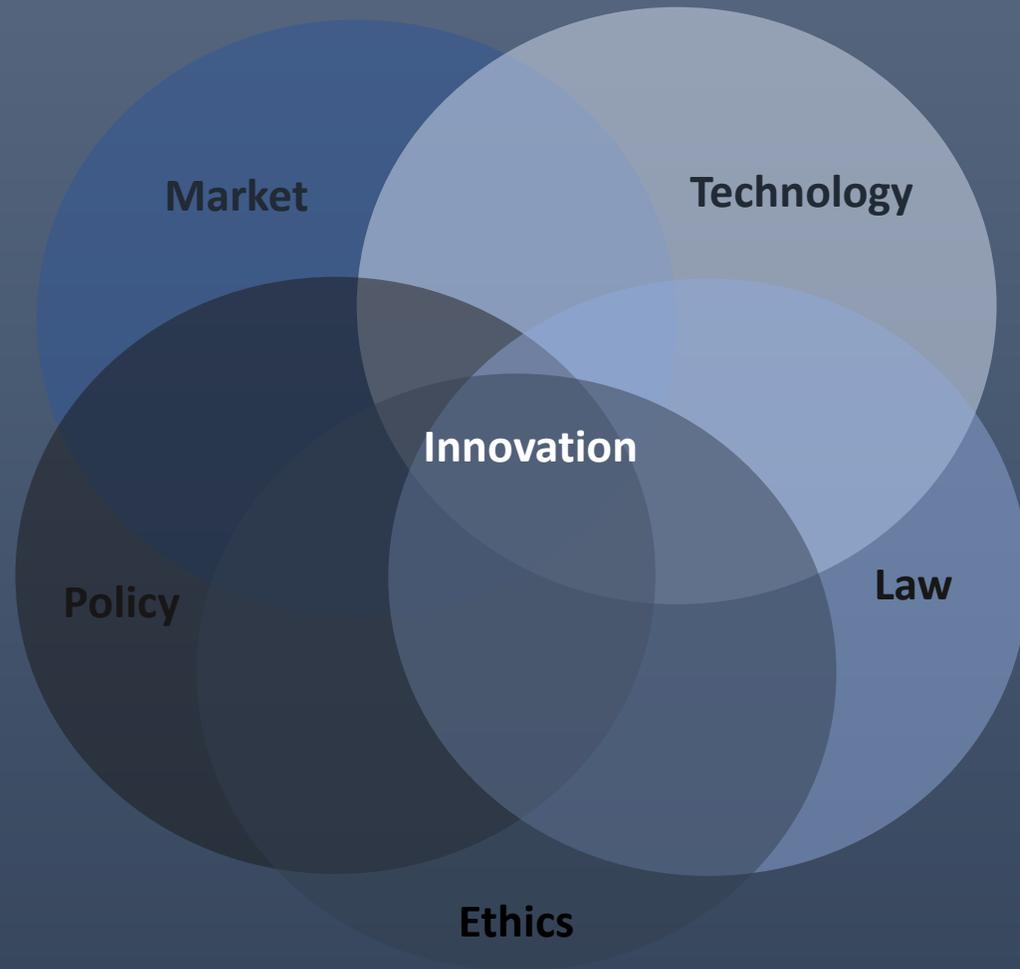End of 18th century   Beginning of 20th century   Beginning of 1970s of 20th century   Today

World Economic Forum

# II. A Future Vision: Complex Interrelationships

- Science
  - Brain –> neuroscience →AI
  - Mathematics -> math formalism -> software assurance
  - CS/Material Science -> AI chips
  - Mathematics+CS+life sciences = Omics
  - Behavoral Sciences
  - Quantum +CS = Quantum Computation
  - What is the 'Science-Vector'?

- Technology
  - AI- thinking tech
  - AR/VR – Visualization tech
  - Robotics – doing tech
  - Energy sources/storage
  - Engineered biology
  - 3D Manufacturing
  - Distributed identity platforms

- Policy/Law/Ethics
  - Intersection with science and tech
  - Insufficient frameworks
    - Speed and agility ←overall theme
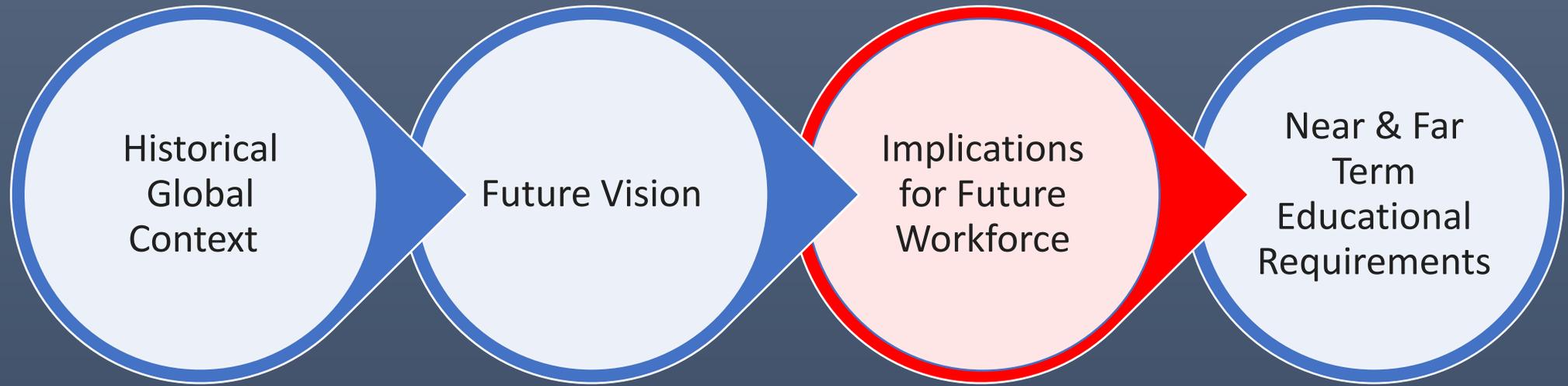
Agility, Speed and efficiency is essential

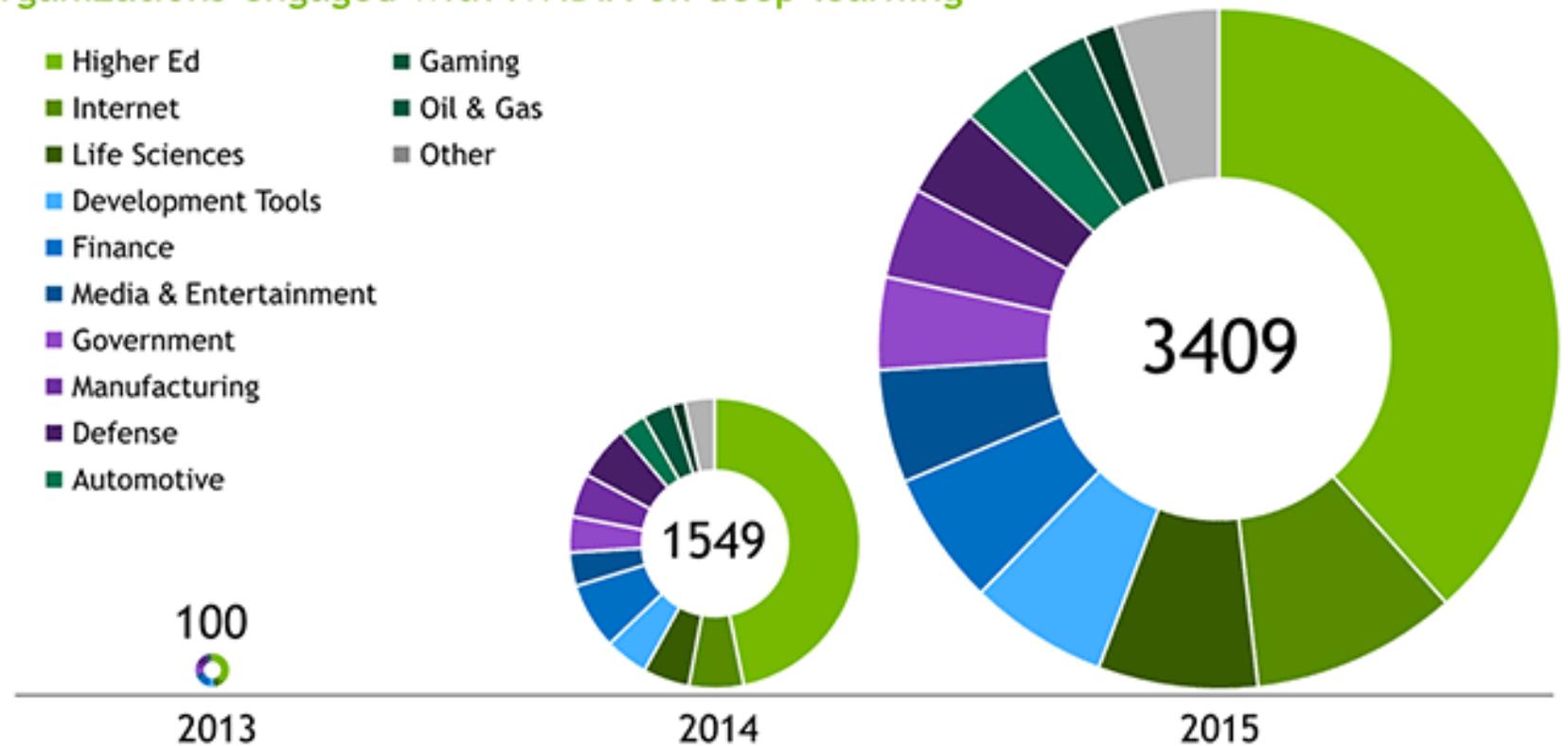User-Producer Innovation + Wide-Aperture Search
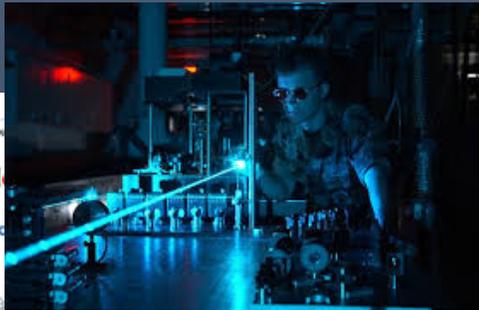
III. Implications for the Future Workforce

EVERY INDUSTRY WANTS INTELLIGENCE

Organizations engaged with NVIDIA on deep learning

- Higher Ed
- Internet
- Life Sciences
- Development Tools
- Finance
- Media & Entertainment
- Government
- Manufacturing
- Defense
- Automotive
- Gaming
- Oil & Gas
- Other

100

1549

3409

2013   2014   2015

III. Implications for the Future Workforce: A case study
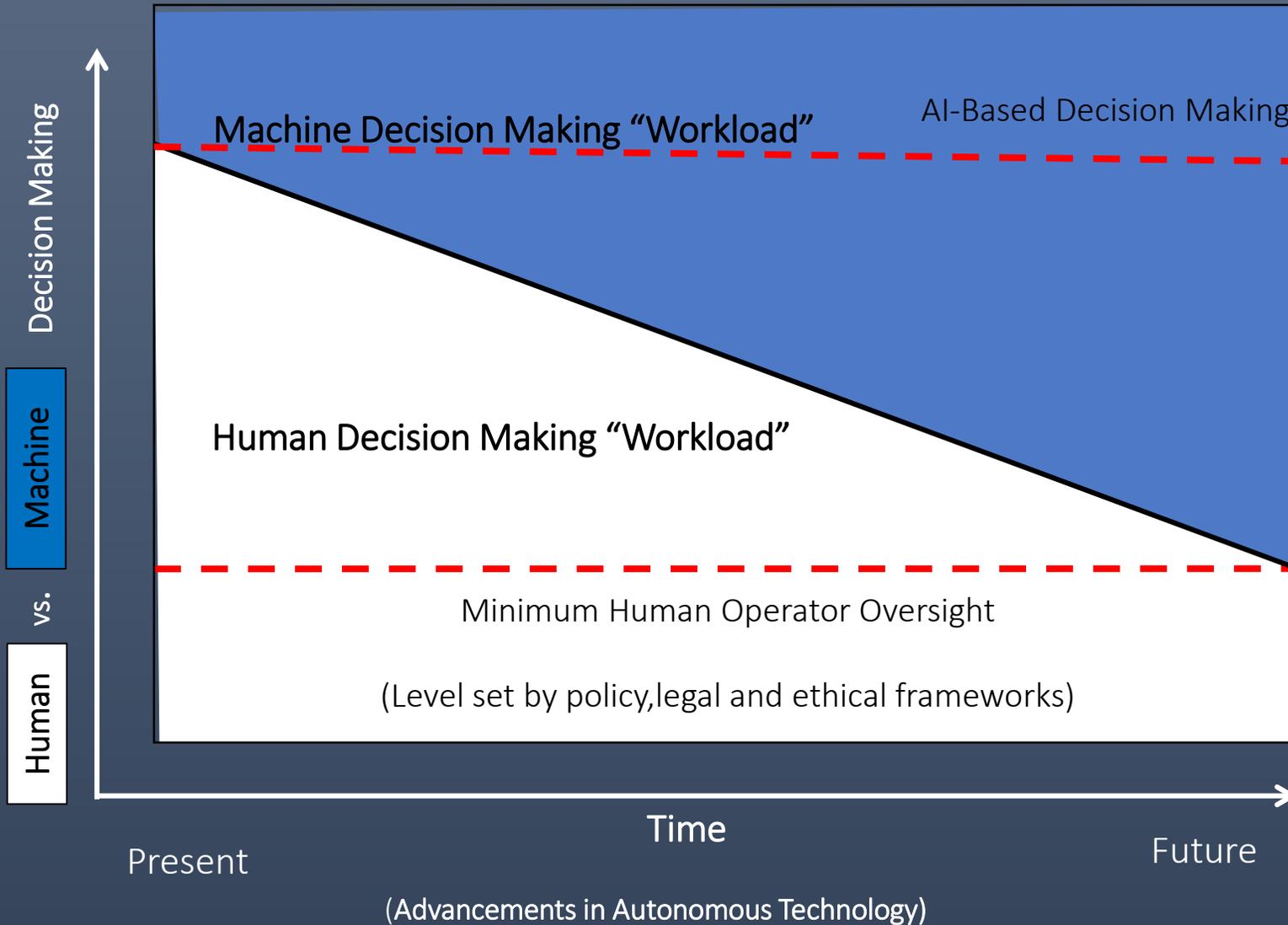
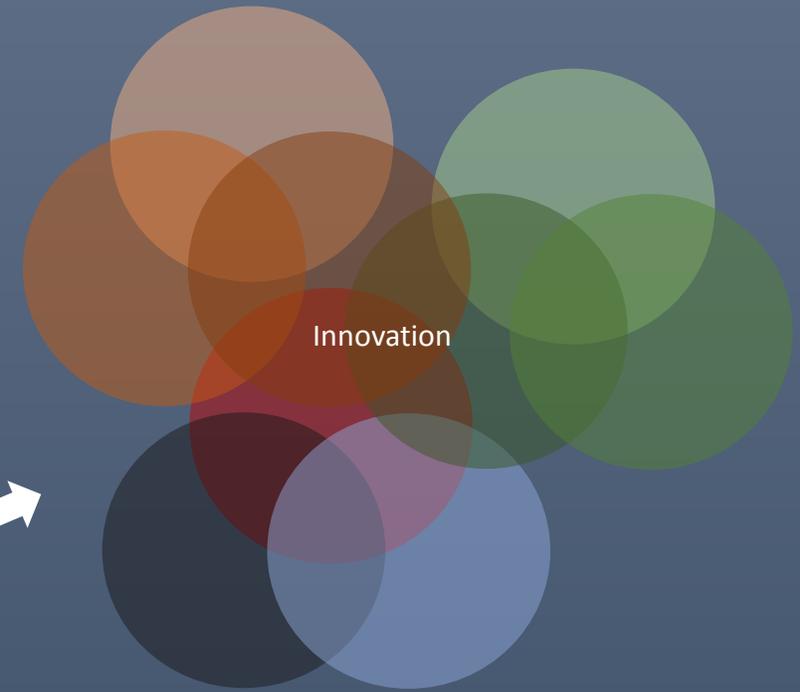Traditional Clothing Manufacturing

3D Knitting Machine

Human labor was historically cheaper than machine labor, but in the context of the current technological innovation we are experiencing, machine labor is beginning to become cheaper than human labor.

Decision Making

Machine vs. Human

Machine Decision Making "Workload"

AI-Based Decision Making

Human Decision Making "Workload"

Minimum Human Operator Oversight

(Level set by policy, legal and ethical frameworks)

Time

Present

Future

(Advancements in Autonomous Technology)

III. A vision of the future workforce

2017 Super Bowl

"Centaur"

Wetware

Innovation

Hardware   Software

Innovation
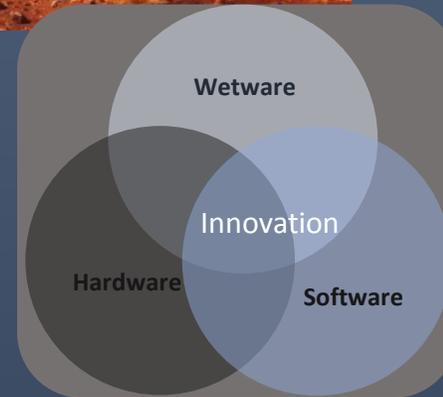
Centaur trans-disciplinary teams
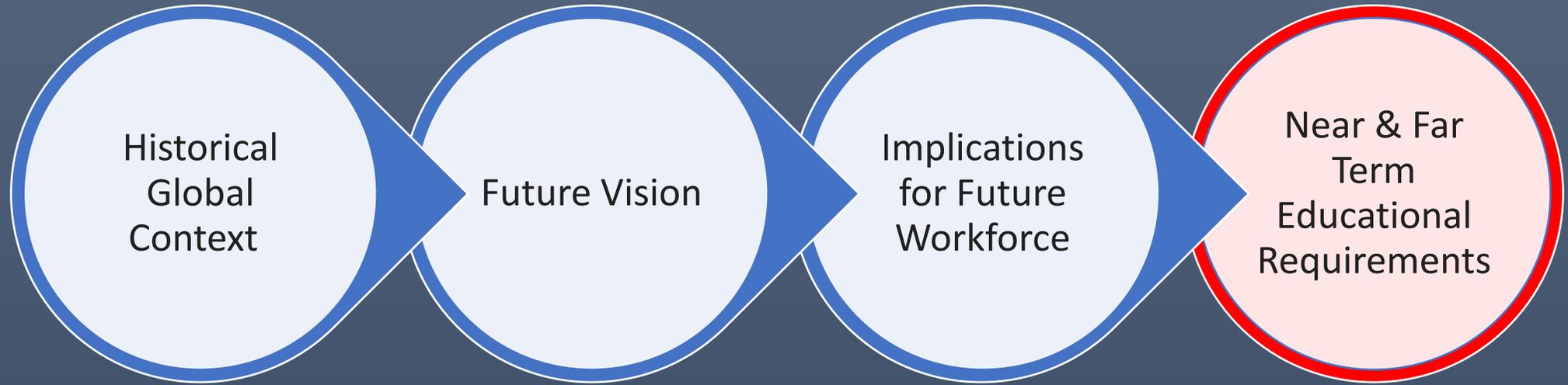
IV. Near & Far Term Educational Requirements

"A key idea emerging from many conversations is that changes in educational and learning environments are necessary to help people stay employable in the labor force of the future"

Two main priorities:

- *Diversifying education and credentialing ecosystem:* Most experts see a new education and training ecosystem emerging and expect the education marketplace – especially online learning platforms – to continue to change in an effort to accommodate the widespread needs.

- *A focus on nurturing unique human skills that artificial intelligence (AI) and machines seem unable to replicate:* The human talents that machines and automation may not be able to duplicate should be the skills developed and nurtured by education and training programs to prepare people to work successfully alongside AI. Experts suggest that workers of the future should learn to deeply cultivate and exploit creativity, collaborative activity, abstract and systems thinking, complex communication, and the ability to thrive in diverse environments.

Pew Research Center

Five major themes about the future of jobs training in the tech age:

Theme 1   **The training ecosystem will evolve, with a mix of innovation in all education formats**

- More learning systems will migrate online. Some will be self-directed and some offered or required by employers; others will be hybrid online/real-world classes. Workers will be expected to learn continuously
- Online courses will get a big boost from advances in augmented reality (AR), virtual reality (VR) and artificial intelligence (AI)
- Universities still have special roles to play in preparing people for life, but some are likely to diversify and differentiate

Theme 2   **Learners must cultivate 21st-century skills, capabilities and attributes**

- Tough-to-teach intangibles such as emotional intelligence, curiosity, creativity, adaptability, resilience and critical thinking will be most highly valued
- Practical, experiential learning via apprenticeships and mentoring will advance

Theme 3   **New credentialing systems will arise as self-directed learning expands**

- While the traditional college degree will still hold sway in 2026, more employers may accept alternate credentialing systems as self-directed learning options and their measures evolve
- The proof of competency may be in the real-world work portfolios

Theme 4   **Training and learning systems will not meet 21st-century needs by 2026**

- Within the next decade, education systems will not be up to the task of adapting to train or retrain people for the skills that will be most prized in the future
- Show me the money: Many doubts hinge upon a lack of political will and necessary funding
- Some people are incapable of or uninterested in self-directed learning

Theme 5   **Jobs? What jobs? Technological forces will fundamentally change work and the economic landscape**

- There will be many millions more people and millions fewer jobs in the future
- Capitalism itself is in real trouble

IV. Near & Far Term Educational Requirements

Historical issues to consider:

1. Lack of adaptability
   - Designated order of classes: factory model (antiquated)
   - Limited recognition of different learning styles
     - Learning is a perishable skill
     - Retraining non-lifetime learners

2. Prejudice

3. Fear

Solutions via education:

1. Innovation
   - Agile curriculum (electronic printing)
   - Design Thinking

2. Computational thinking
   - First level: Programming language (second language)
   - Second level: Machine compatible thinking and norms

3. Collaboration
   - Human-Human Teams
   - Human-Machine Teams (norms/ social cognitive)

IV. Near & Far Term Educational Requirements

The Key to Success = Innovation

Speed & Agility – Flow/Zone – Challenging Assumptions