



Quality 4.0 in a Complex World

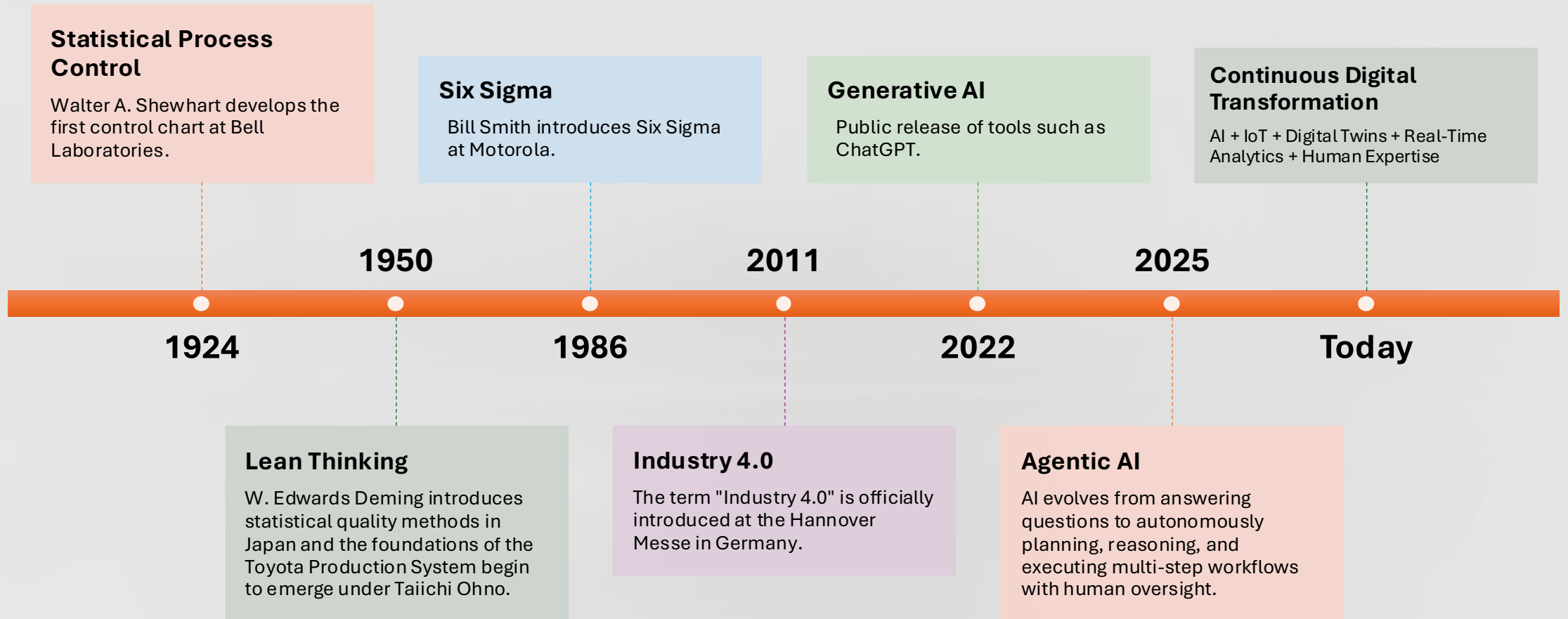
Leading with Data, Digitalization, and Human Insight

Beth Cudney, PhD

IAQ Academician

ASQ Fellow, ASEM Fellow, IISE Fellow

The world has changed faster than our quality systems



The evolution of quality



Quality 1.0

Inspection



Quality 2.0

Statistical Control



Quality 3.0

Lean Six Sigma



Quality 4.0

AI

IoT

Machine Learning

Digital Twins

Predictive Analytics

Human-AI Collaboration

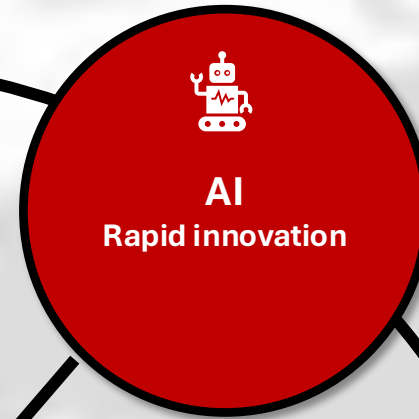


Quality 5.0

Human-centered

Intelligent

Sustainable



Quality is no longer managing variation → Quality is managing complexity



Quality 4.0 is a business imperative

AI Adoption

88%

of organizations use AI in at least one business function (McKinsey, 2025)

Manufacturing

92%

say smart manufacturing will define competitiveness (Deloitte, 2026)

Cyber Risk

\$4.44 million

Average global data breach costs (IBM, 2026)

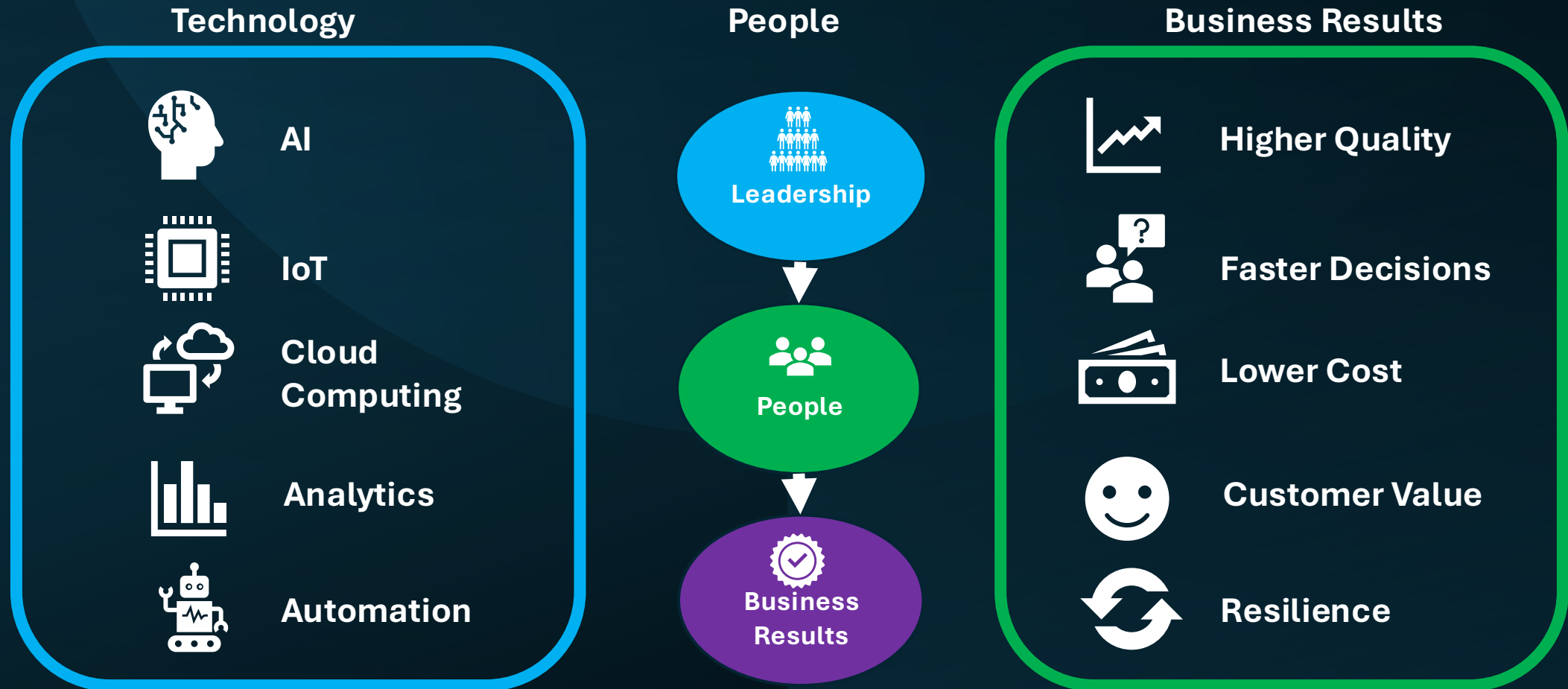
Execution Gap

33%

have scaled AI enterprise-wide (McKinsey, 2025)

Quality matters more than ever

Technology enables. Leadership empowers. Execution delivers.

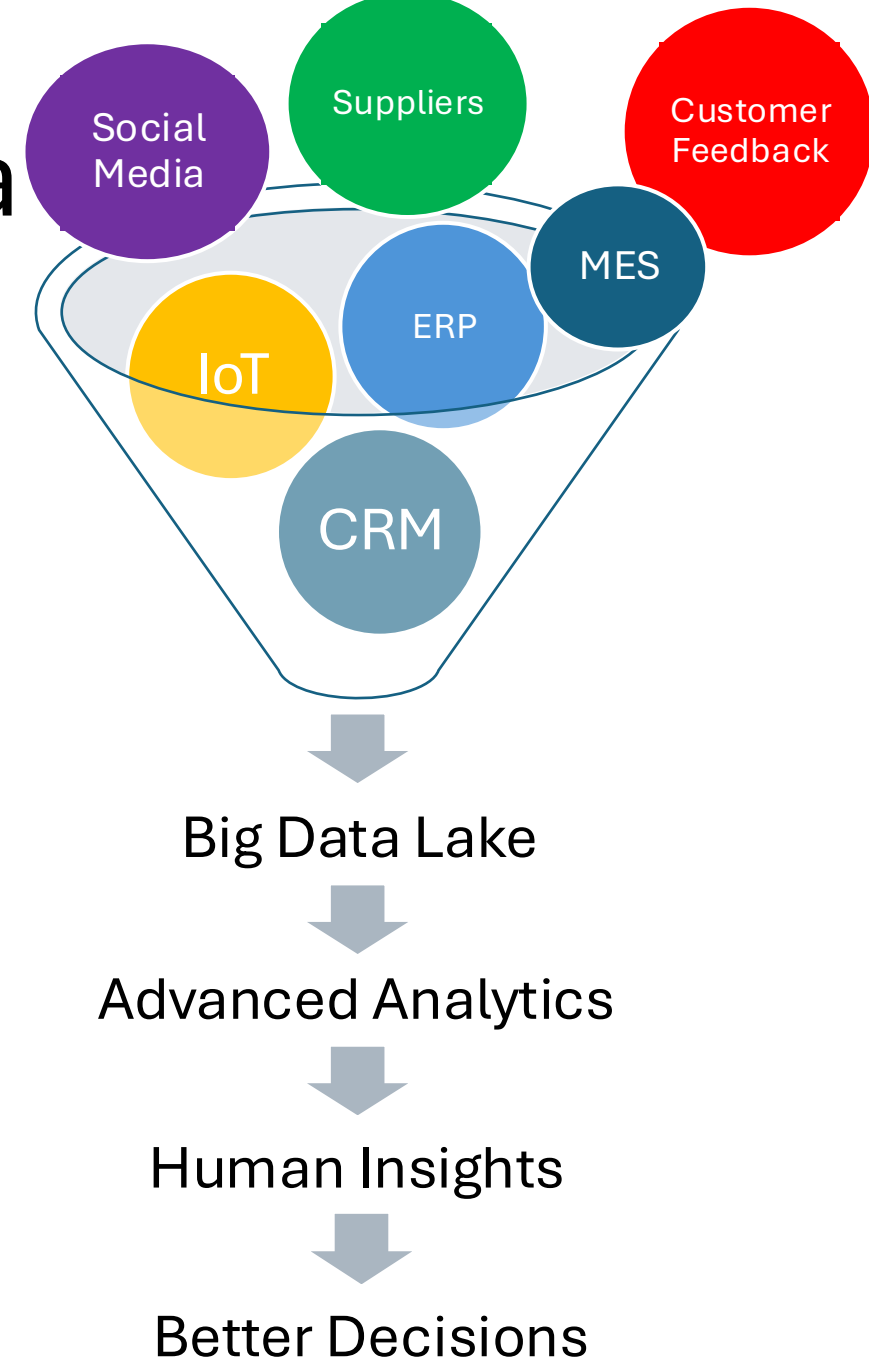


Organizations are drowning in data

**Are we collecting information
or
creating insight?**

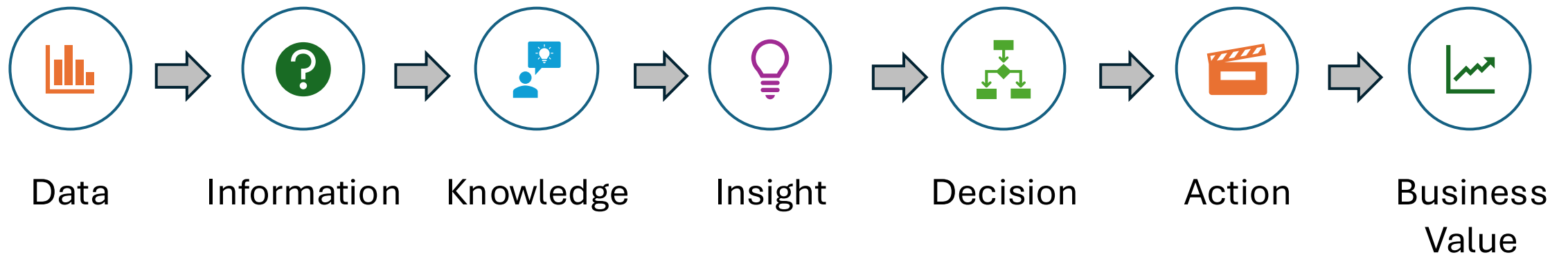
**Over 400 million terabytes of data are
created every day worldwide.**

**We don't have a data problem.
We have a decision problem.**



From data to decisions

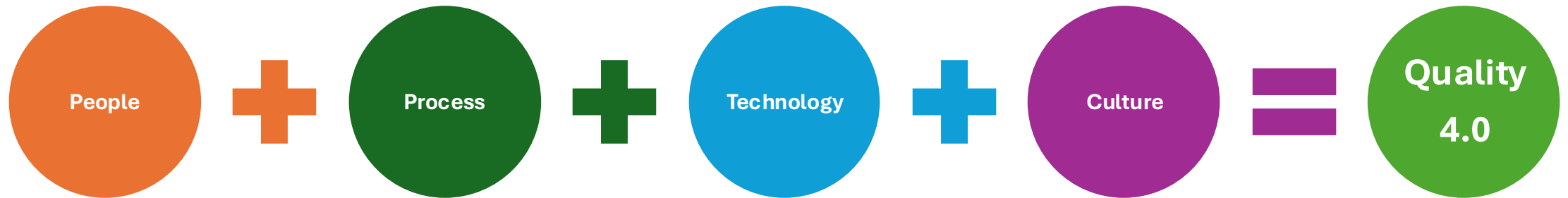
Quality 4.0 transforms data into business value.



**Organizations do not gain a competitive advantage from collecting data.
They gain it by making better decisions.**

Defining Quality 4.0

Quality 4.0 integrates digital technologies with quality management principles to improve performance, resilience, and customer value.

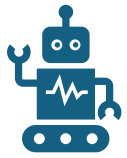


AI is **NOT** replacing
quality
professionals

Instead, it is changing their
work.

Traditional Role	Quality 4.0 Role
Find defects	Predict failures
Reactive	Continuous monitoring
Manual analysis	AI-assisted decisions
Reports	Real-time action

The AI adoption gap



AI Use

88%

using AI in at least one
business function



Enterprise Scaling

33%

scaling AI across the
enterprise



Financial Impact

39%

measurable enterprise-
level operating profit from
AI



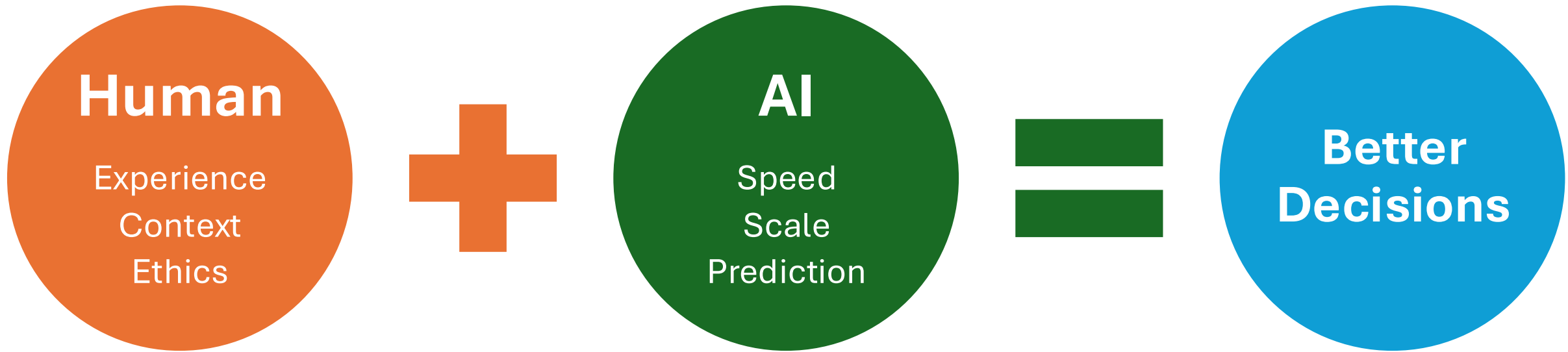
Higher Performers

6%

substantial enterprise-
wide value from AI

The biggest barrier to AI isn't technology. It's organizational transformation.

Human + AI > Human Alone



Explainable AI matters



Transparency

Can we understand why AI made the recommendation?



Trust

Will employees and customers rely on the recommendation?



Accountability

Who owns the decision?



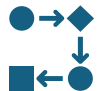
Governance

Can we audit and monitor the model?



Bias

Is the model fair?



Continuous Improvement

Can we learn and improve over time?

If you can't explain the decision, can you **TRUST** the outcome?

Quality
Engineers
need new
skills



Traditional Quality



Defect occurs



Inspection

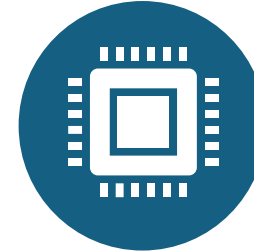


Correction



Cost of poor quality

Quality 4.0



IoT sensors



AI analytics



Predict failure



Prevent defects

Detection → Prediction → Prevention

Leading Through Complexity

Quality professionals turn today's complexity into tomorrow's advantage.

TODAY'S COMPLEX WORLD



QUALITY 4.0 LEADERSHIP



OUTCOMES: RESILIENT ORGANIZATION



In a complex world, **Quality Leadership** is the compass that guides organizations toward sustainable success.

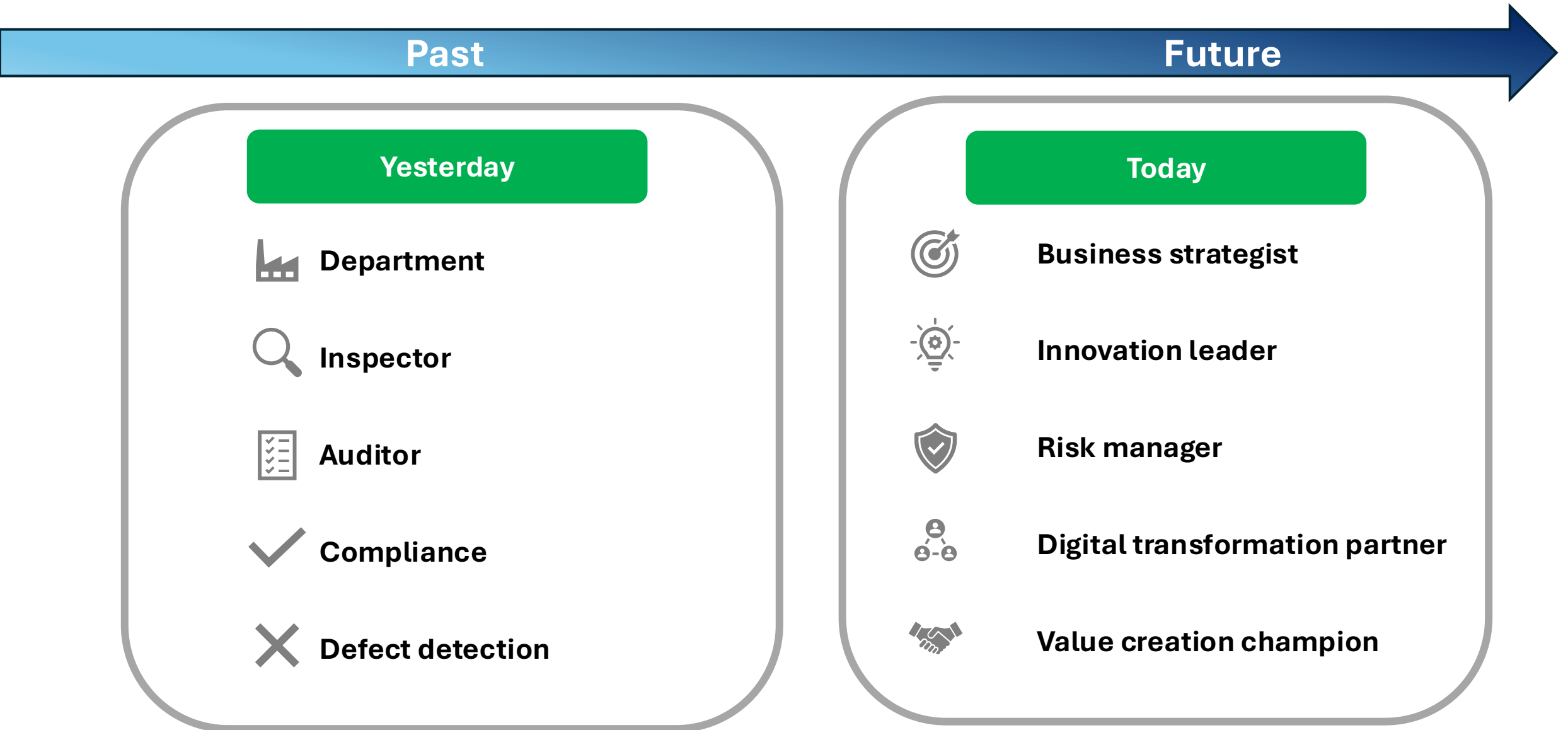


Systems thinking: Seeing the whole system



“Today's problems come
from yesterday's solutions.”
- Peter Senge

Evolving the role of quality to drive enterprise success



Quality and Sustainability

Better quality. Better planet. Better business.



KEY SUSTAINABILITY PRIORITIES



ESG

Creating long-term value for people, planet, and performance



Circular Economy

Designing out waste and keeping resources in use



Resource Efficiency

Using fewer resources to deliver more value



Carbon Reduction

Lowering emissions across the value chain



Lean

Eliminating waste and maximizing value

Sustainability and Quality Reinforce Each Other



QUALITY CREATES SUSTAINABLE VALUE



Reducing Defects

Improve quality at the source



Lower Energy

Less rework, scrap and process variability



Lower Emissions

Reduced energy use lowers carbon footprint



Lower Cost

Better efficiency drives profitability



Quality is a powerful driver of sustainability—delivering **environmental impact**, **social good**, and **economic value**.



Building Organizational Resilience



Resilient organizations combine trusted data, strong leadership, adaptable cultures, digital technologies, and continuous improvement to respond effectively to change

Five leadership challenges



1. Become
data fluent



2. Lead digital
transformation



3. Build trust in
AI



4. Develop
people



5. Create
resilient
organizations

From Quality 4.0 to Quality 5.0

Quality 4.0



Digital transformation



Connected systems

**Quality 4.0 asks,
“What can technology do?”**



Data driven



Efficiency

Quality 5.0



Human transformation



Connected people

**Quality 5.0 asks,
“How should we use technology to
improve people’s lives?”**



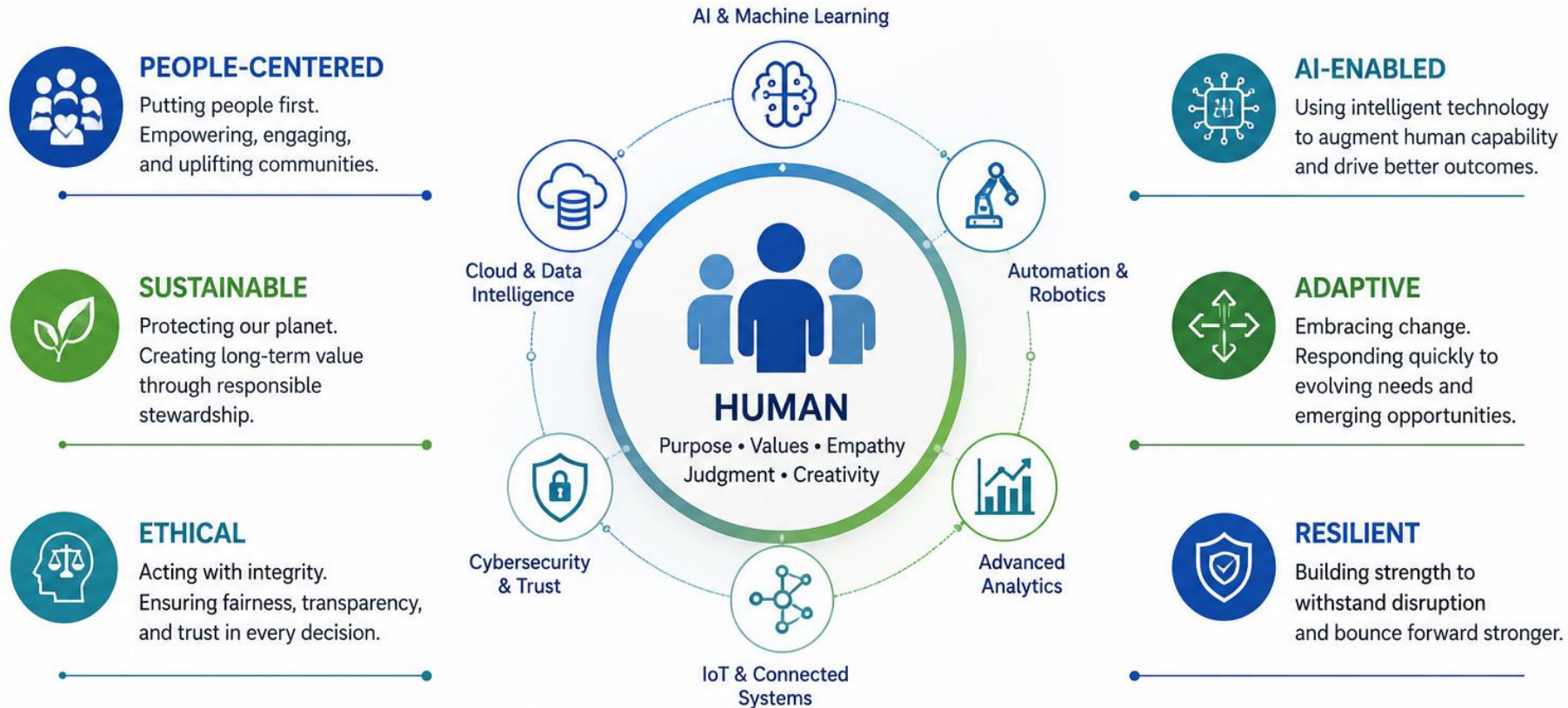
Values driven



Sustainable value

My Vision for Quality 5.0

Where Human Insight and Intelligent Technology Create a Better Future



Quality 5.0 is the future where humans lead with purpose and technology amplifies our impact for a better world.



THE FUTURE QUALITY LEADER



TRUSTED



CONNECTED



STRATEGIC



ETHICAL



ADAPTIVE



HUMAN

*Technology alone will not define the future of quality.
The leaders who combine technology with human insight will.*

Questions

Thank you!

ecudney@maryville.edu



Beth Cudney, Ph.D.

Professor of Data Analytics,
Maryville University | President, C...

