QMD Managing for Quality Webinar Series

Session #12

Managing for Quality Amidst Digital Turbulence

Gregory H. Watson, PhD.

November 17, 2020

ASQ Quality Management Division
Excellence Through Quality™

How will "Managing for Quality" change?

Session 1	Making Quality-Based Executive Decisions
Session 2	Leading Transformation – Managing Improvement
Session 3	Designing Quality as an Inclusive Business System
Session 4	Conducting Executive Inquiry and Formulating Strategy
Session 5	Understanding Japanese-Style Strategy Management
Session 6	Organizational Learning – Triple-Loop Experience
Session 7	Engineering Management – Designing Future Firms
Session 8	Understanding the Financial Component of Quality
Session 9	Reflecting on Strategic Implications of Attractive Quality
Session 10	Discovering Profound Insights of Operational Excellence
Session 11	Defining Quality to Apply to Everyone, Everywhere
Session 12	**Managing for Quality Amidst Digital Turbulence**

ASQ Quality Management Division
Excellence Through Quality™

Abstract of Session #12:

This webinar provides a capstone of the most important lessons to be learned from the previous eleven webinars in this series. It illustrates how quality management can be presented as a viable methodology in the emerging digital age and how transformation will be necessary to address changing priorities that this entails.

Any turbulence in the profession that occurs as a result of this transformation need not be damaging to our careers; but rather it can be helpful to redefine a career transition pathway so that the quality professional can be an indispensable component in future organizations. For quality to remain relevant, each of us must be diligent and reinvent our career over the coming decade.

Learning Objectives for Session #12:

Learning Objective 1: Summarizing Historical Lessons Learned
Investigate the current state of technology applications affecting the work of quality professionals and determine what is the relevant meaning of the Quality 4.0 idea and how it automates many traditional quality activities.

Learning Objective 2: Specifying Relevant Digital Technoshifts
Discover which technologies will be moving forward and will change the way that traditional industries operate and how these technoshifts will be impacting the way that work is performed in the future.

Learning Objective 3: Identifying Relevant Career Implications
Learn how these technologies will impact the future career of quality professionals and what the implications will be for your skill development to assure your competence in this evolving digital age.

Managing for Quality Amidst Digital Turbulence

Part 1:

Prelude: Advent of the Digital Era

“Software is a gas” … it expands in space!

Software expands in size to fill available memory and processing power that is developed by technology – thereby requiring the need for further technology developments.

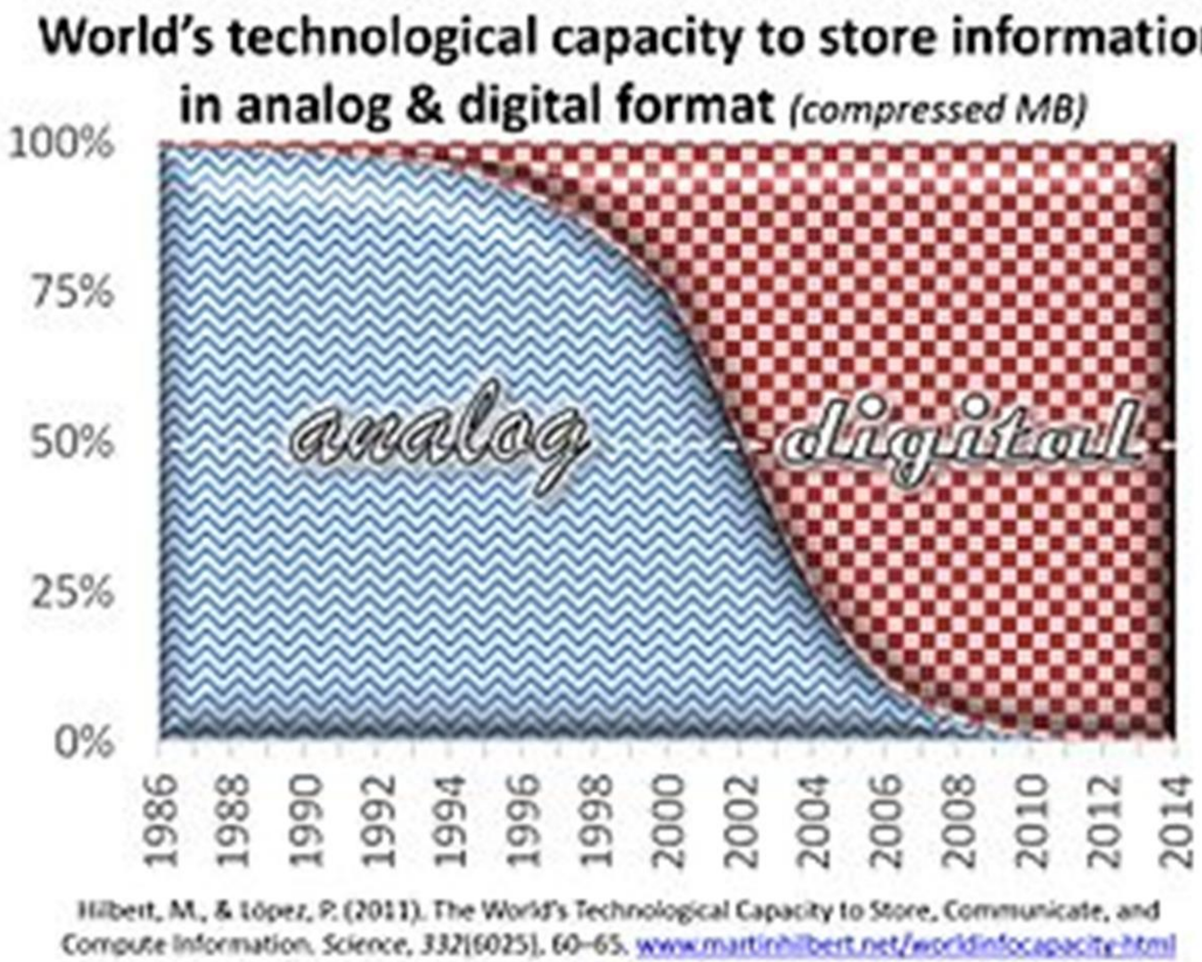
Nathan's Laws of Software:

1. **Software is a gas:**
   Software always expands to fit whatever container it is stored in.
2. **Software grows until it becomes limited by Moore's Law:**
   The initial growth of software is rapid, like gas expanding, but is inevitably limited by the rate of increase in hardware speed.
3. **Software growth makes Moore's Law possible:**
   People buy new hardware because the software requires it.
4. **Software is only limited by human ambition and expectation:**
   We'll always find new algorithms, new applications, and new users.

Quality Management Division
ASQ Excellence Through Quality™

Nathan Myhrvold, Former Chief Technology Officer, Microsoft
Keynote address: “The Next Fifty Years of Software,” at the 50th Annual ACM Conference (1997)

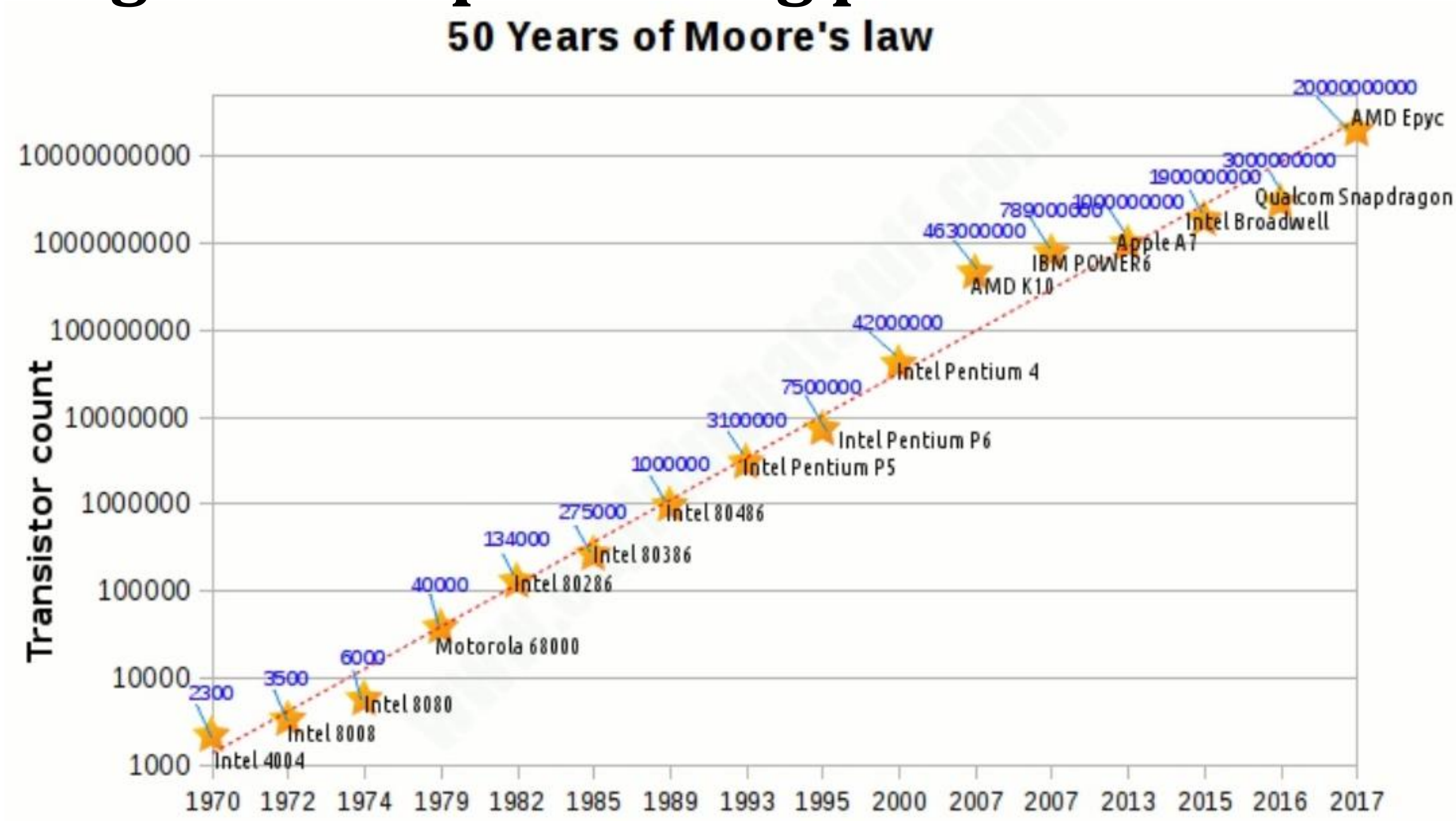
The analog-to-digital transition is complete!



Digital technology has become dominant over all analog applications except for human aspects of analog work activities – and here there are many forms of digital support also.

ASQ Quality Management Division
Excellence Through Quality™

The growth in processing power continues!

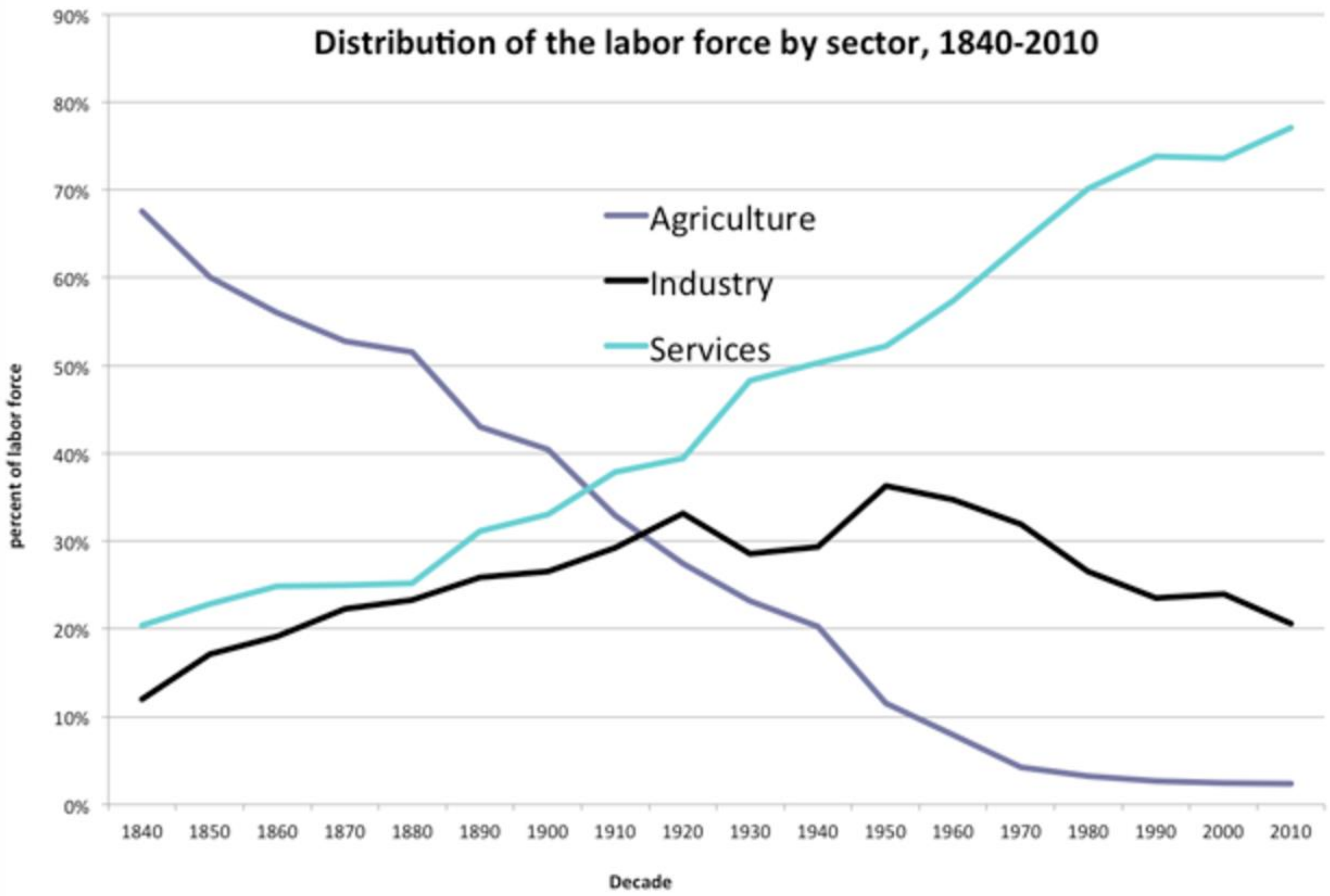


Source: https://www.electrical4u.com/moores-law/

Quality Management Division
ASQ
Excellence Through Quality™

Digital technology will continue to evolve and to disrupt ways of working as memory, access speed, and processing power all increase simultaneously.

The nature of human labor has shifted:



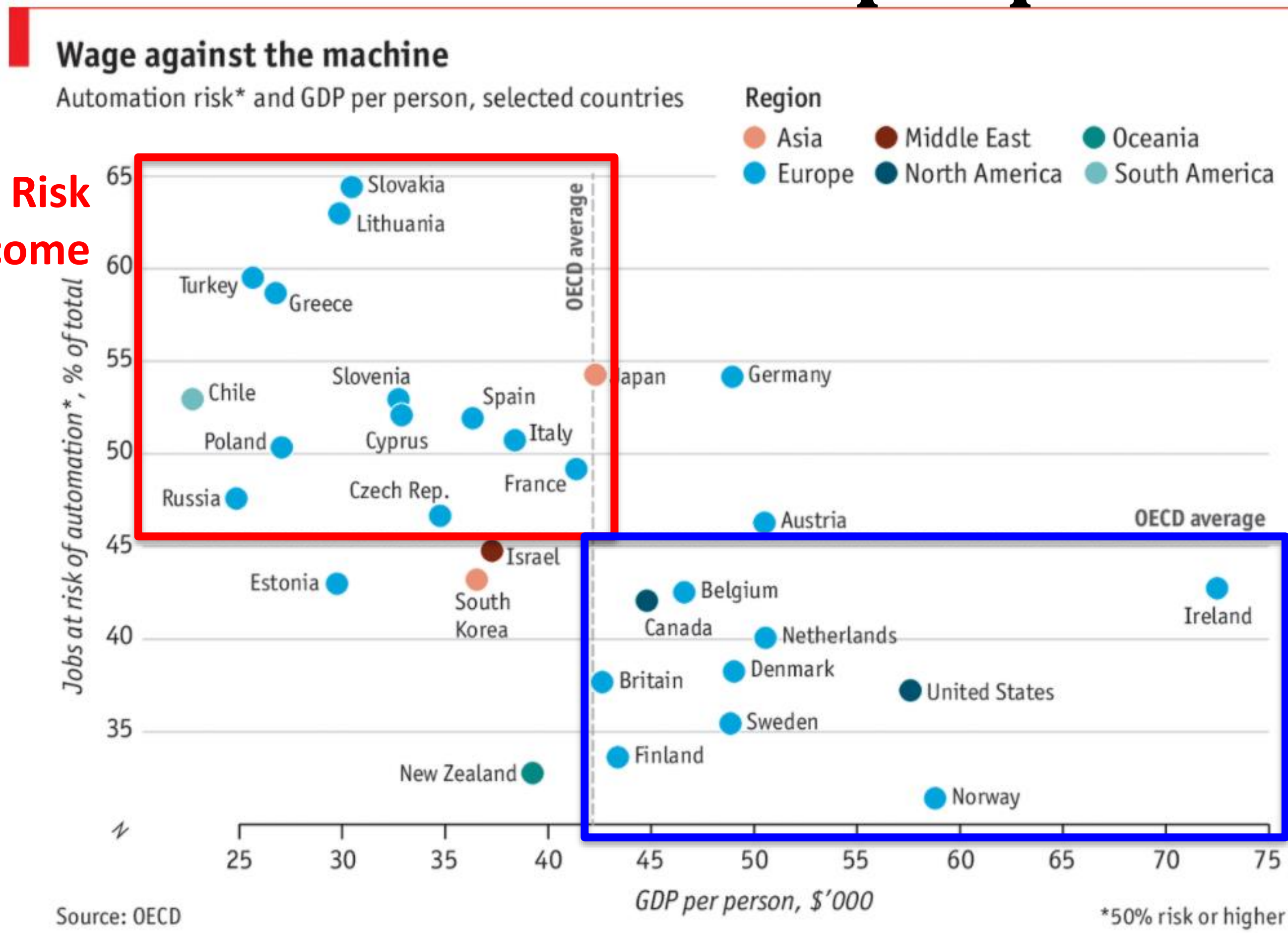
Source: Bureau of Labor Statistics (2017): http://www.bls.gov/emp/ep_table_201.htm

Quality Management Division
ASQ
Excellence Through Quality™

The loss of manual industrial jobs will continue as society continues to shift toward a service-based economy.

Jobs at Risk based on GDP per person:

High Risk
Low Income



Low Risk
High Income

Source: The Economist: https://www.economist.com/graphic-detail/2018/04/24/a-study-finds-nearly-half-of-jobs-are-vulnerable-to-automation

Quality Management Division
ASQ
Excellence Through Quality™

Low-income workers will be more highly affected by digital automation than higher income people who tend to work in the service sector.

Studying the future requires introspection:

"Do not seek to follow in the footsteps of the old masters, seek instead what these masters sought."

~ Matsu Basho (1644-1694)

There are major implications for quality:

Traditional areas of emphasis for quality applications are decreasing!

Industrial emphasis on advanced technologies will continue for "large capitalization firms" (e.g., Fortune 500) with emphasis on automating may technologies that are applied by their supply chain partners.

Agriculture will continue its trend toward application of technology to increase productivity of "automatable" activities, leaving only manual "picking and handling" activities as low-paid labor requirements.

Service businesses will continue to expand with an emphasis on the support of automated production for consulting, maintenance, and design of systems as well as hospitality and recreational businesses.

Managing for Quality Amidst Digital Turbulence

Part 2:

Quality 4.0: The Digitalization of Quality

Quality Management Division
ASQ Excellence Through Quality™

Summarizing Historical Lessons Learned

"Regardless of how it's done, transaction costs will continue to plummet as computers get more powerful. Low transactions costs are a wonderful thing, if you are in a transaction business."

~ Nathan Myhrvold

Quality Management Division
ASQ
Excellence Through Quality™

What is the meaning of "Quality 4.0" – a fad?

The digitalization of industry requires that we redefine quality so that it remains a relevant activity for the future:

Quality 4.0 is a response to the emerging customer requirement to expand its digital industrial applications.

The application of (1) *digital technologies* to (2) *productive systems* to gain (3) *profound knowledge* of their operations so that their real-time performance may be optimized.

Quality Management Division
ASQ Excellence Through Quality™

* Gregory H. Watson (2020), "The Art of Leading Change in the Age of Quality 4.0," ***ASQ Lean and Six Sigma Conference***, February 24, 2020.

1. Application: Leveraging digital technologies

Digital technologies that are fundamentally influencing production:

- **Artificial Intelligence**: the ability of computers to perform tasks that normally require human intelligence.
- **Machine Learning**: an AI discipline of experiential learning where machines adapt to new situations by self-training.
- **Deep Learning**: a ML discipline where algorithms learn by analyzing extensive data sets to create adaptive patterns.
- **Neural Networks**: a computer architecture that is modeled after the synapse and neural functions of the human brain.
- **Blockchain**: a data management system where transactions are traced across several computers using a linked network.
- **Augmented Reality**: superimposition of computer-generated images on a person's real world to form a composite.

Applying technology to improve productivity.

2. Application: Integrating productive systems

"A collection of if–then rules that together form an information processing, computer simulation model of some cognitive task, or range of tasks."

Productive Systems include cognitive acts of learning and maturing in order to function effectively. *Integration of things and people* characterizes *Industry 4.0* and PS systems typically contain four elements:

1. Hardware and software mechanisms of production.
2. Human components in design and execution of the system.
3. Information in a knowledge base to operate the system that includes human skills and competence.
4. Data collected which describes how the system operates by its sequence of activities and feedback loops to maintain the system in a state of control.

Improving productivity – reducing human error.

Richard M. Young (2001), "Productive Systems in Cognitive Psychology," Neil J. Smelser and Paul B. Baltes (eds.), *International Encyclopedia of the Social and Behavioral Sciences*. (London: Pergamon).

3. Objective: Obtaining profound knowledge

Profound Knowledge: Statistical understanding of how real-world process behavior changes so future system states may become predictable with some probability.

Dimensions of Profound Knowledge:

- **Structure of Systems**: understanding the system in which work is done and decisions are made.
- **Statistical Thinking about Process Variation**: the knowledge about system operations comes from the study of performance variation, improvement requires the control of the sources of variation.
- **Learning to Develop Knowledge**: profound knowledge evolves by observing work, defining a theory, testing and confirming it.
- **Psychological Impact**: human behavior must be understood, motivated and coordinated in a collaborative culture.

Quality Management Division
ASQ Excellence Through Quality™

Creating and sustaining profitable results.

* W. Edwards Deming (1994), *The New Economics* (Cambridge: MIT Press).
** Gregory H. Watson (2018), *The Theory and Practice of Profound Knowledge* (Stillwater, OK: Oklahoma State University).

Quality activities support digitalization:

Quality concentrates on productive systems and profound knowledge:

Components of a Productive System:

- ✓Technological systems
- ✓Human social systems
- ✓Management systems
- ✓Cultural values

Rapidly advancing!

Next areas for development but currently falling behind!

Profound Knowledge Develops Productive Capability:

- ✓Systems perspective!
- ✓Managing the knowledge domain!
- ✓Predictive analytics!
- ✓Human understanding!

Quality Contributions to Digitalization

Quality Management Division
ASQ Excellence Through Quality™

Specifying Relevant Digital Technoshifts

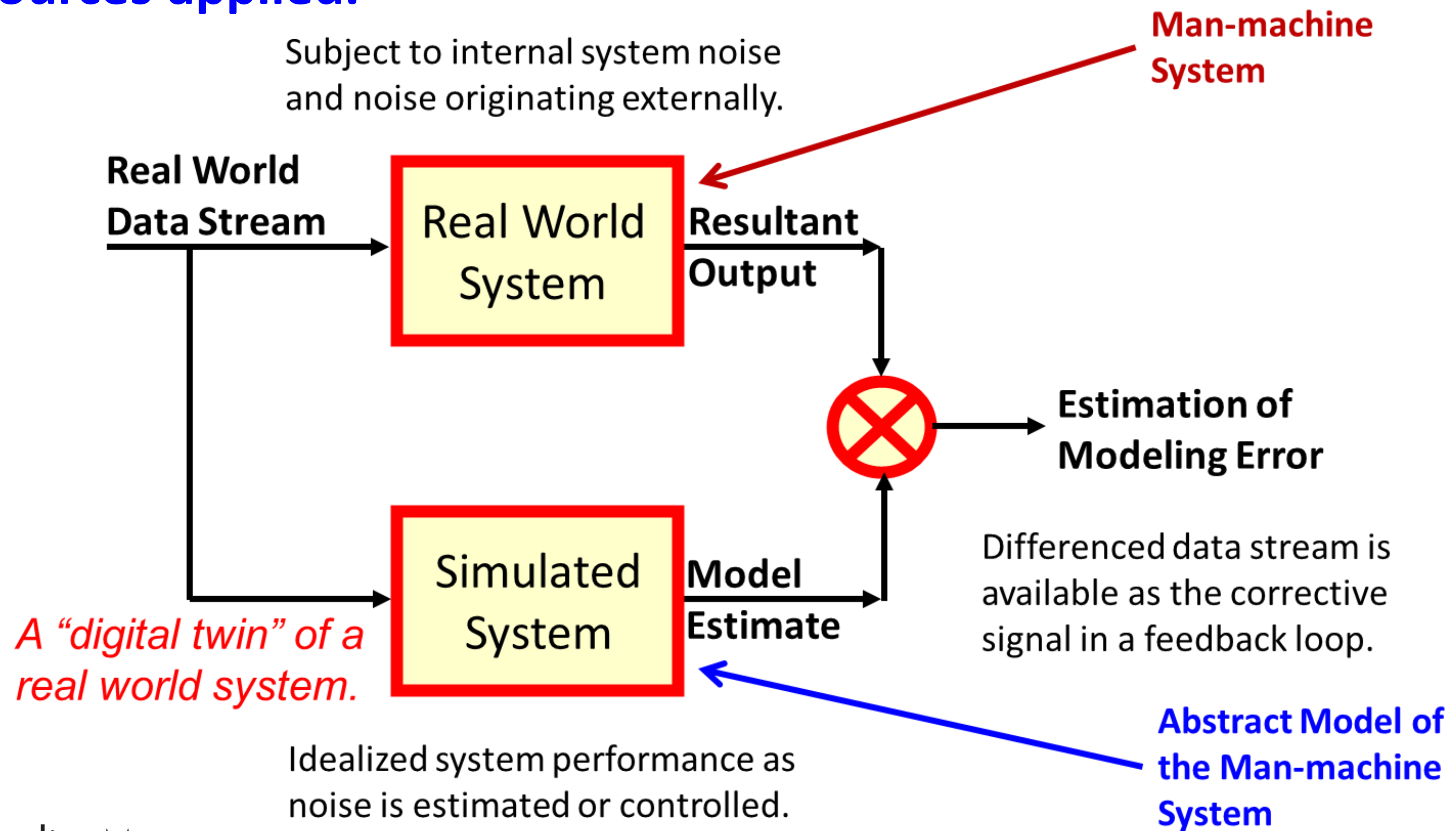
"Any sufficiently advanced technology is indistinguishable from magic."

~ Arthur C. Clark

Quality Management Division
ASQ
Excellence Through Quality™

Productive System = Thinking System

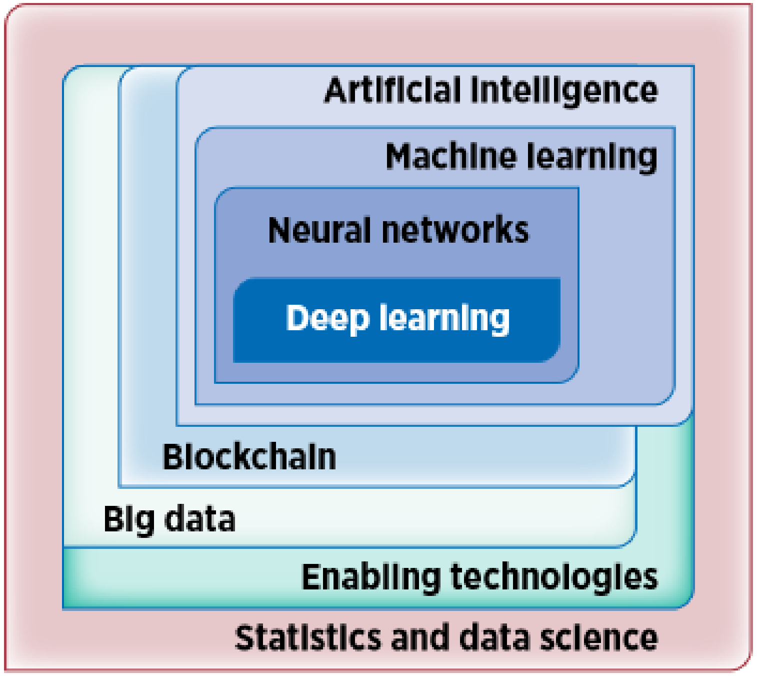
Digital Twin models performance of operational system – and enables the simulation of performance for variation in system inputs and level of resources applied.



Quality Management Division
ASQ Excellence Through Quality™

Practical Question: What needs to be corrected: the real-world system or the simulated system?

Understanding the "thinking architecture:"



PERSPECTIVE:

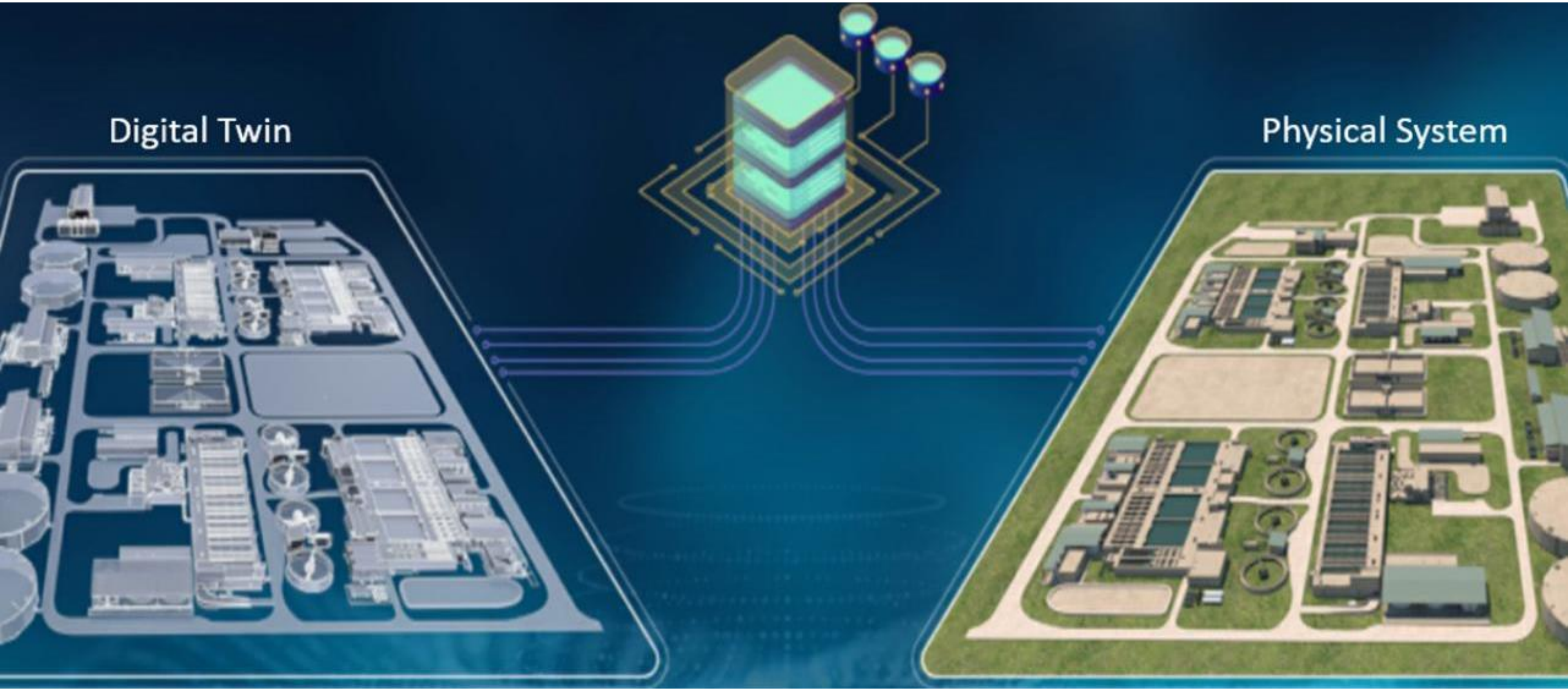
Learning about the technologies that comprise Industry 4.0's "digital twin" that supports industrial automation. These methods integrate educational knowledge in a comprehensive data inquiry eco-system.

Data eco-systems define how data flows across various platforms, layers, and digital technologies. It identifies how they can operate collaboratively in a system to support decision making and provide information in feedback loops to manage connected operating systems in a network.

* Nicole Radziwill (2018), "Let's Get Digital," ***Quality Progress***, October, Vol. 51, No. 10, pp. 24-29.

Cognitive systems create "digital twins:"

In the future all operating systems will have a digital twin for simulation.



Technology Areas Included in Quality 4.0:

Digital technology supports development of data management systems:

Data flows from noticing/detection (or situational awareness) to learning/application (sensemaking):

1. **Detection and Data Capture**
2. **Data Transmission**
3. **Data Recording and Storage**
4. **Data Sorting and Processing**
5. **Data Modeling**
6. **Data Application**

Items 1–4: **Situational Awareness**

Items 5–6: **Sensemaking**

Quality Management Division
ASQ Excellence Through Quality™

Detection and Data Capture Components:

Digital sensor systems capture data at the source of its observation.

- Load Cells
- RFID Chips
- Thermal Probes
- Proximity Detectors
- Flow Meters
- Vibrometers
- Pressure Sensors
- Bar Code Scanners
- Computer Vision
- Motion Detectors
- Limit Switches
- Mechanical Actuators
- Acoustic Sensors
- Digital Calipers
- Magnetic Sensors
- Ph Sensors
- Position Sensors
- Etc., etc., etc.

Data Transmission Components:

Moving the data from the source of observation to a point of storage.

- Broadband data
- Factory wireless network
- Handheld mobile devices
- Wearable mobile devices
- Embedded devices
- Internet of Things (IoT)
- Intranet/Ethernet
- Wide Area Network (WAN)
- Local Area Network (LAN)
- Data Streaming (Kafka/Storm)
- Micro Data Networks
- iPV6 Internet layer protocol
- iPV6 routers and switches
- Blockchain technology
- Fog/Edge/Cloud networks
- 5G network systems
- Network analyzers
- Etc., etc., etc.

Data Recording and Storage Components:

Data is stored for immediate access and use, or analytical investigation.

- Digital electronic recorders
- Magnetic recorder
- Environmental recorders
- Event recorder
- Data loggers
- Data tracking systems
- Databases (i.e., MapReduce, Hadoop, Hive and NoSQL)
- Optical storage
- Flash storage
- Cloud storage

Advances in accessible memory technologies have been doubling the worlds recorded memory capacity every two years as speed of computer processing has also increases to make processing and access more efficient.

Quality Management Division
ASQ
Excellence Through Quality™

Data Sorting and Processing Components:

These analytics are given the most visibility in designing a digital system.

- Big data analytics
- Artificial intelligence
- Natural language processing
- Deep learning
- Machine learning
- Automated process mapping
- Automated detection
- Pattern recognition
- Automated classification
- Text analysis
- Recommendation systems

Developing realistic representations as a digital twin of real-time operating systems to experiment with sets of operating factors and conditions that are beyond capability for producing in the real-world environment.

Quality Management Division
ASQ
Excellence Through Quality™

Data Modeling Components:

Models create the linkage between the digital and physical worlds.

- IDEF multiple-layer modeling
- Discrete event simulation
- Digital modeling and animation
- Dynamic systems simulation
- Neural networks
- Augmented reality
- Mixed reality
- Virtual reality
- Data science
- Probability theory

Developing realistic representations as a digital twin of real-time operating systems to experiment with sets of operating factors and conditions that are beyond capability for producing in the real-world environment.

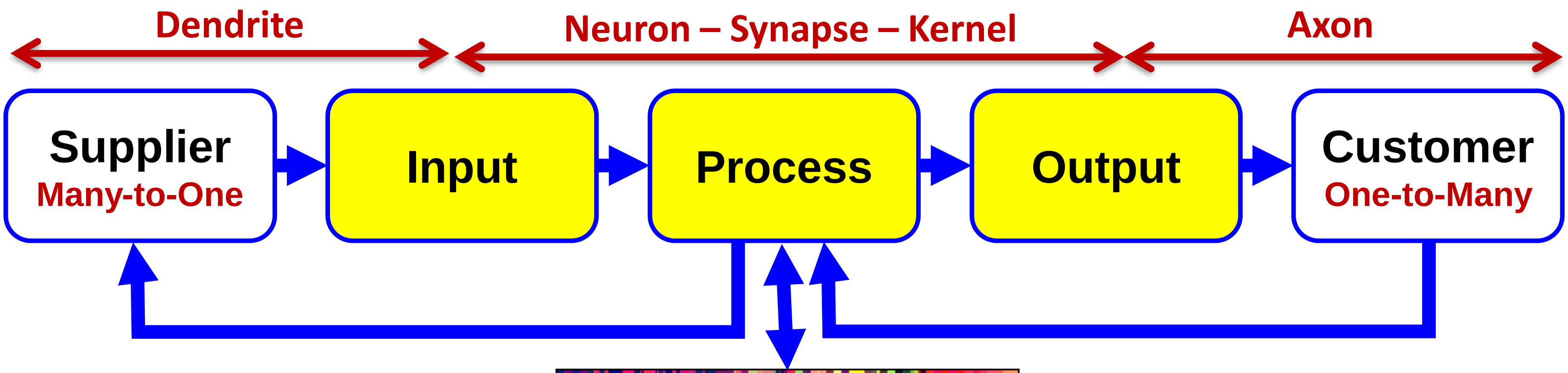
Data Application Components:

Applications enable execution of activities that create improvement.

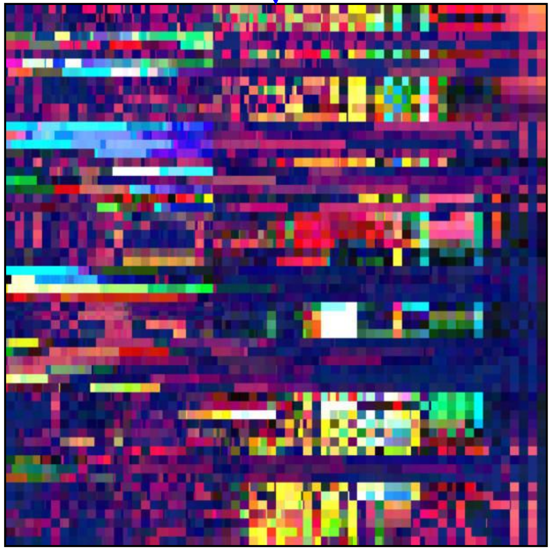
- Microsoft Teams
- Google Hangouts
- Computer-Aided Design
- Blockchain
- Computer-Aided Manufacturing
- Computer Numerically Controlled (CNC) production
- Three-D Printing / Rapid Prototyping
- Programmable Logic Controllers (PLC)
- Closed loop diagnostic and remediation feedback systems
- Automated logistics management systems
- Robotic control systems

Interpret systems as “cognitive networks” ...

1. Align end-to-end macrosystem process flows and feedback loops.



2. Organizations are very complex networks of data, processes, and people that work together in a web-like cognitive, thinking system: a neural network.



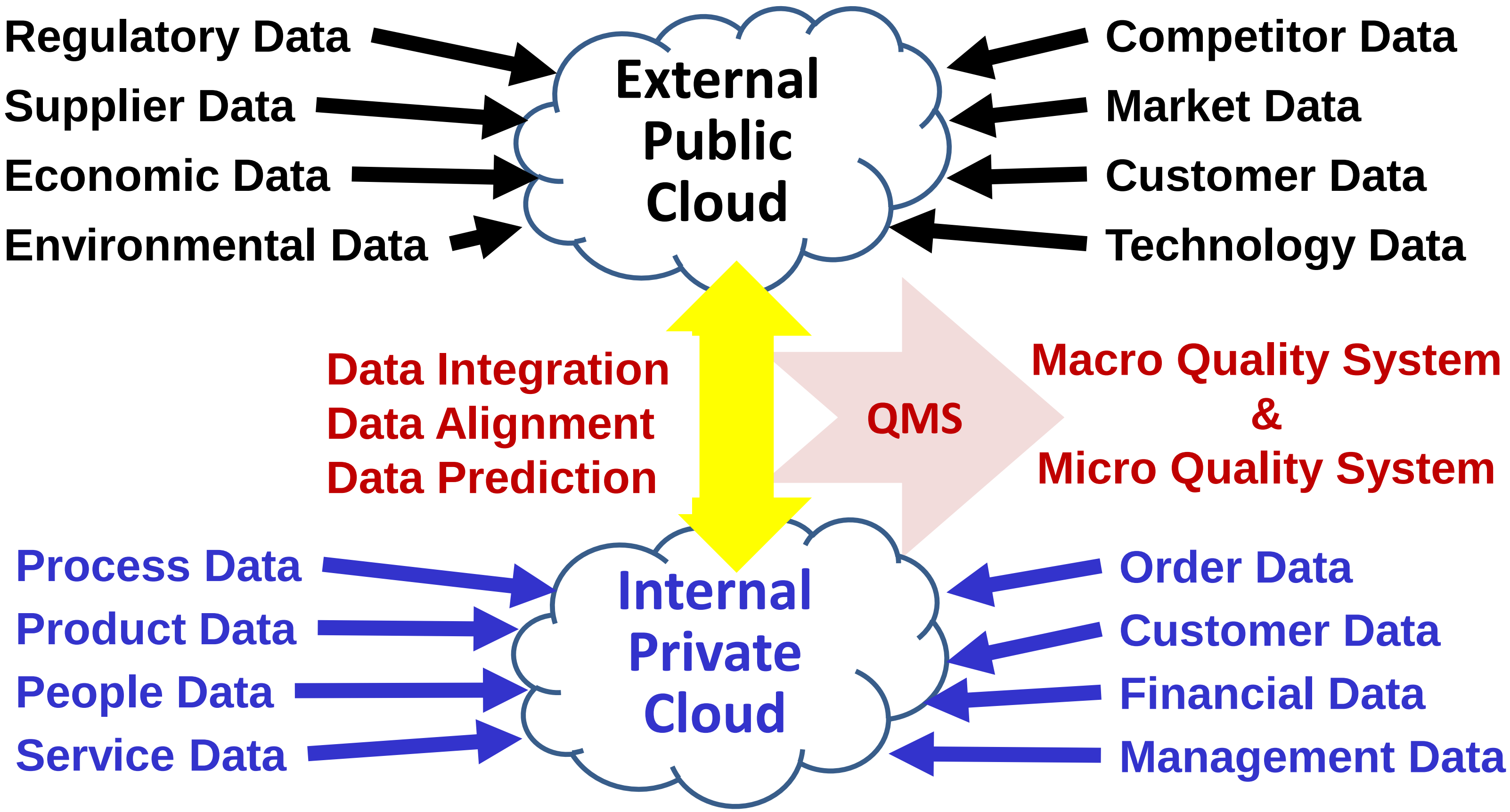
3. Engineer the links in the depth of the bottom-to-top performance measurement microsystem structure – it is a fuzzy logic system.

Quality Management Division
ASQ Excellence Through Quality™

Flow can be treated as a networked neural system.

Managing multiple “data clouds” in the future:

Rates of data captured by systems observations double every 2 years.



Quality Management Division
ASQ
Excellence Through Quality™

Clouds create new quality issues to control cyber-security, privacy, and data safety.

Identifying Relevant Career Implications

"Computerization removes the middleman."

~ Isaac Asimov

Quality Management Division
ASQ
Excellence Through Quality™

What is essential for you to learn?

Evaluate your current skill state of competence to find your needs.

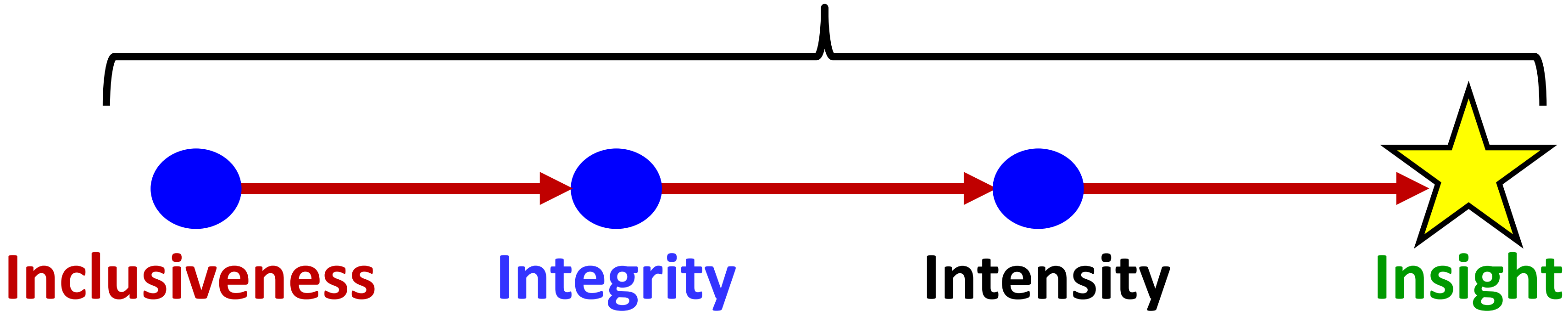
Data comes from everywhere: multiple perspectives and levels.

Dirty data comes originates in messy processes.

"The cost of bad data is the illusion of knowledge." S. Hawking.

Apply four steps of information management to avoid illusions:

Information Quality Criteria



Quality Management Division
ASQ Excellence Through Quality™

Data ubiquity drives a need to learn better, faster!

Interpreting Information Inclusiveness:

Digitization multiplies the amount of data available to collect:

- **The same data is observed from different perspectives.**
- **Enterprise management systems gather all transactions as data.**
- **Data archives are doubling in growth every two years.**
- **Accessing data is now more available through converged ICT.**
- **Managing the "Master Data" of an organization requires design.**
- **How are measurement systems, data collection systems, analysis methods, and reporting systems designed end-to-end?**

Do we get more data and less information as a result?

Increasing information integrity:

Does your data tell the truth or is it afflicted by bias and distortion?

- **Has your data been designed to capture information faithfully?**
- **When you decided on what to include in the "Master Data" was it already known how it would be used, what calculations would be required, and how reports using it would be presented?**
- **How is data processed in the information system: is it recorded as event observations, averaged data, cumulative data, etc.?**
- **Whenever data is compressed for archiving, how is it processed for storage: event observations, averaged data, cumulative data, and is in accessible form for further analysis (e.g., not PDF)?**

Integrating information intensity:

Do you get the most information content out of captured data?

- Is analysis done using with enumerative or analytic data?
- Are multiple perspectives of the same data analyzed (e.g., using a measurement scale of observation, using probability distribution of the same data, and using a process capability estimate)?
- How deeply into the process detail does the data analysis probe to discover significant events?
- How widely is the search bounded to identify significant causal factors?
- How is co-linearity in rational sub-groups managed in the data?

Intensifying information insightfulness:

Do you observe your operational data from unique customer perspectives to learn those secrets that may be embedded in it?

- **How are rational sub-groups of customers by 'use case' identified as unique market segments?**
- **Have you forecast future performance using a variety of time series analysis methods to determine best- and worst-case estimates?**
- **Have you stratified the time series data, probability plots, and ANOVAs to illustrate common performance periods?**
- **Have you indicated a multi-data value stream across the baseline of process performance activities and plotted it using ANOVA steps?**

ASQ Quality Management Division
Excellence Through Quality™

Understanding the Quality 4.0 challenge:

- **Technological change continues according to the expansion principle behind Moore's Law, and our challenge will be to understand how to apply the technology.**
- **This is not a technological question: it is really a process design question.**
- **It requires systems engineering the integration of novel technologies in existing operational system designs to increase their effectiveness, efficiency, and delivery of benefits.**

Quality Management Division
ASQ
Excellence Through Quality™

Accepting the Quality 4.0 challenge:

- Chose to focus your career development on either becoming more technologically astute or becoming more capable as a manager/facilitator of teams.
- Develop systems engineering competence.
- Discover advanced analytical methods.
- Learn how human-machine interfaces work.
- Study technologies that support future advances of your organization's industry.
- Maintain currency in professional competence by seeking projects to keep you at the forefront of improvements in your industry.

How should you prepare to be ready for it?

Grade yourself on knowledge of the following topics:

- Systems Engineering
- Design Thinking
- Time Series Analysis
- Predictive Analytics
- "R" Statistical Programming Language
- SQL Data Query Language
- Microsoft Power BI Software
- Artificial Intelligence, Machine Learning, Deep Learning, Neural Networks, Big Data, and Optimal Estimation.

> **"Active engagement in the transition to and management of Quality 4.0 requires re-tooling quality professionals!"**
> **~ Gregory H. Watson**

Expand your horizon of interest to the world!

Our challenge is to reinvent ourselves and our profession!

- **Extend the scope of quality to less developed nations.**
- **Move beyond manufacturing, service, or business uses.**
- **Create more profound understanding of the quality sciences.**
- **Embrace new technologies and integrate in quality methods.**
- **Emphasize data and evidence-based decision-making.**
- **Involve all levels and disciplines in the pursuit of quality.**
- **Serve all quality customers : commercial, internal, and social.**
- **Harmonize strategic improvements with daily management.**
- **Create a culture of mutual trust, happiness, and prosperity.**
- **Most importantly: do no harm to society or the planet.**

Quality Management Division
ASQ Excellence Through Quality™

Quality must become relevant for all humanity!

Take-away Lessons Learned

“Nobody wants a prediction that the future will be more or less like the present, even if that is, statistically speaking, an excellent prediction.”

~ Nathan Myhrvold

Quality Management Division
ASQ
Excellence Through Quality™

Remaining a viable proponent of quality in the emerging digital transformation:

- For quality to stay viable a transformation is necessary to shift from "quality as specified by our grandfathers" to "quality necessary for the sustainment of human existence with acceptable quality of life for all."
- These changing priorities require resetting our priorities to meet the "grand challenges" needed for engineering quality in this new age.
- This will create turbulence in our profession during the transformation, but it need not damage your career, if you anticipate it early enough and work to adjust your capabilities to become an indispensable component in the digital future.
- Innovation requires "planned abandonment" of legacy ways through a "creative destruction" that eliminates waste, creates efficiency, builds competence, and develops capabilities in new technologies.
- For quality to remain relevant, each of us must reinvent our career over the coming decade.

Critical take-away observations:

How will you prepare yourself and your organization for all of the dimensions of change that will confront you in the future?

Summary statement

Challenges from digitalization and system integration of business will dominate your development need in the coming years.

This webinar addressed the following learning objectives to help you discover the path forward for your career:

- **Summarizing historical lessons learned**
- **Specifying relevant digital technoshifts**
- **Identifying relevant career implications**

Shifting "Managing for Quality" Webinars to focus on Macro-Quality issues and concerns:

Month	Title
December 14th	**Quality as an Environmental Mandate**
January 21st	**Quality as an Economic Imperative**
February 11th	**Quality as a Social Responsibility**
March 11th	**Quality as a Human Right**
April 15th	**Quality as a Political Policy**
May 6th	**Quality for our Manifest Destiny**

ASQ Quality Management Division
Excellence Through Quality™

myASQ

Register your interest on the ASQ QMD portal of myASQ.

ASQ Quality Management Division

Excellence Through Quality™

Thank you

Gregory H. Watson, PhD.
greg@excellence.fi

Future QMD Webinars:

Managing for Quality ASQ QMD Webinar Series by Dr Gregory H. Watson:

- No. 13: "Quality as an Environmental Mandate" December 14, 2020; 1500 ET
- No. 14: "Quality as an Economic Imperative" January 21, 2021; 1500 ET
- No. 15: "Quality as a Social Imperative" February 11, 2021; 1500 ET
- No. 16: "Quality as a Human Right" March 11, 2021; 1500 ET
- No. 17: "Quality as a Political Policy" April 15, 2021; 1500 ET
- No. 18: "Quality as our Manifest Destiny" May 6, 2021; 1500 ET

ASQ QMD Webinars:

- "Management 2.0 for Practitioners and Managers" January 28, 2021; 1800 ET by Forrest W. Breyfogle III

Quality Management Division
ASQ Excellence Through Quality™

Join ASQ for more **exclusive content** and access to **thought leadership**

ACCESS TO THE BEST QUALITY TOOLS & RESOURCES

Whether you're looking to enhance your knowledge, find solutions or stay up to date on the latest in quality and continuous improvement, we've reviewed and compiled it all for you from experts and thought leaders around the globe.

ASQ QUALITY RESOURCES | PRACTICAL TOOLS | BOOKS & STANDARDS

BECOME A MEMBER

ASQ Quality Resources

Accessible anytime, anywhere, ASQ's exclusive Quality Resources puts today's most popular quality and continuous improvement topics, tools, publications, case studies and more at your fingertips.

Learn from classic and current quality principles and theories with your unlimited access to all the knowledge and tools ASQ has to offer.

Quality Management Division
ASQ Excellence Through Quality™

ASQ Members

Continue the conversation at:

https://my.asq.org/communities/home/28

Quality Management Division
ASQ Excellence Through Quality™