PROMETHEUS GROUP | USER CONFERENCE

Reliability Centered Maintenance Results and Maturity

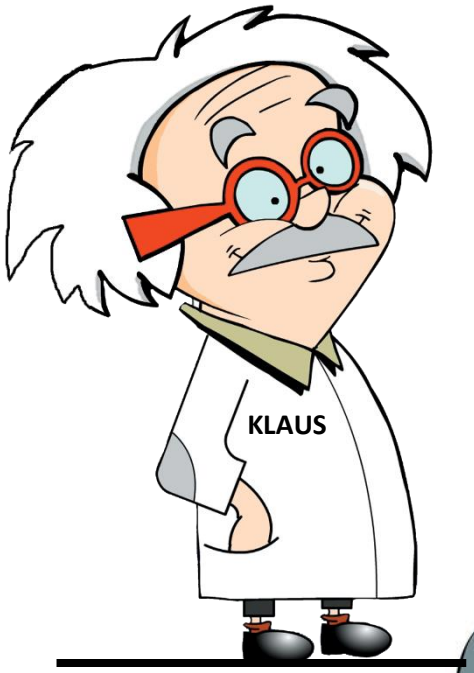
The University of Tennessee College of Engineering
Reliability & Maintainability Center (RMC)

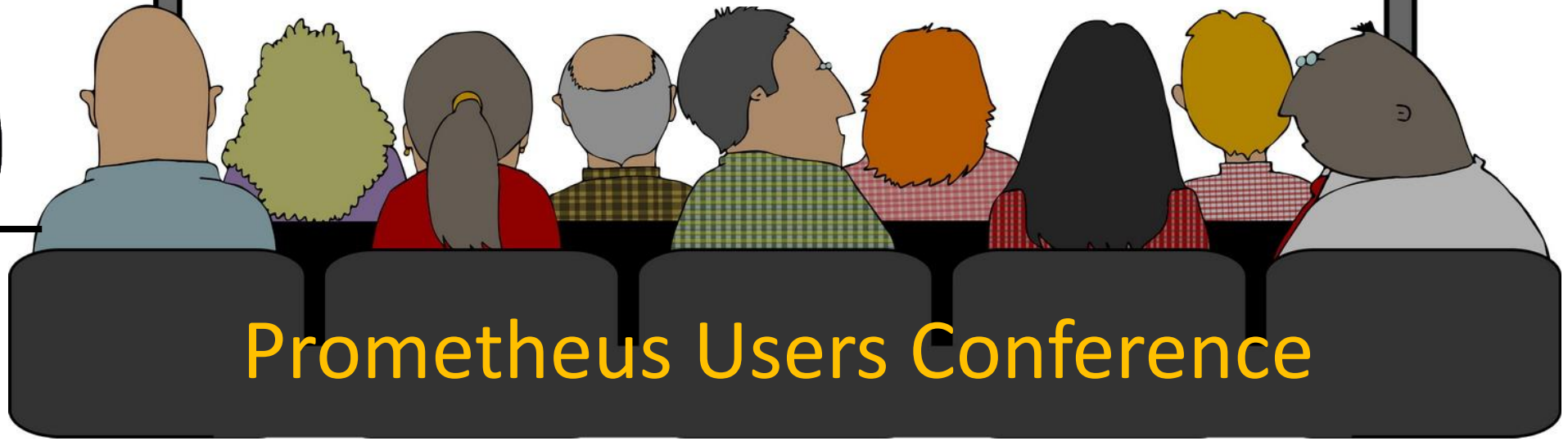
Dr. Klaus M. Blache Director – RMC
Research Professor - UT

RMC

The topics of this Keynote :

- **Evolution of R&M and related implications from a long-time practitioner**
- **Understand R&M process maturity**
- **Top quartile metrics and benefits**
- **Moving from “what to change” to “how to change”**
- **Today’s reality - transitioning to Industry 4.0 & 5.0**





Prometheus Users Conference

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RMC Purpose

University Knowledge + RMC Practical Implementation = Business Results

The Reliability and Maintainability Center is a university - industry association dedicated to improving industrial productivity, efficiency, safety, quality & profitability through advanced reliability and maintenance practices, technologies and management principles.

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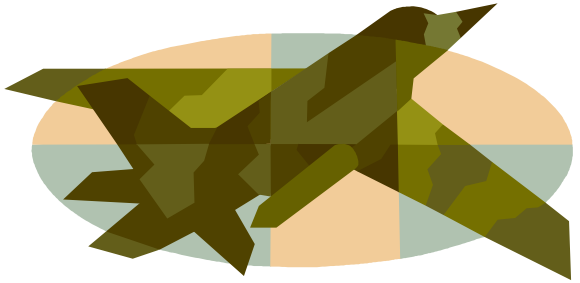
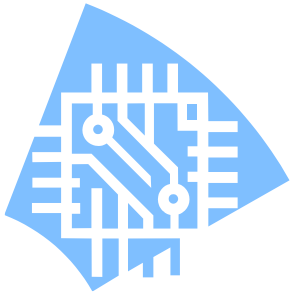

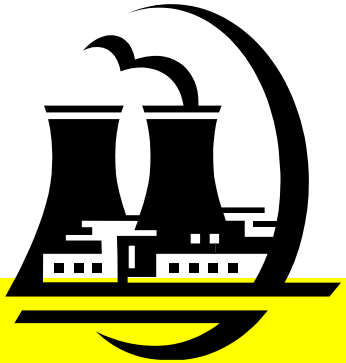

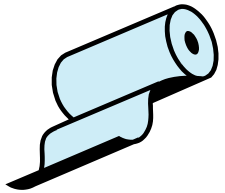
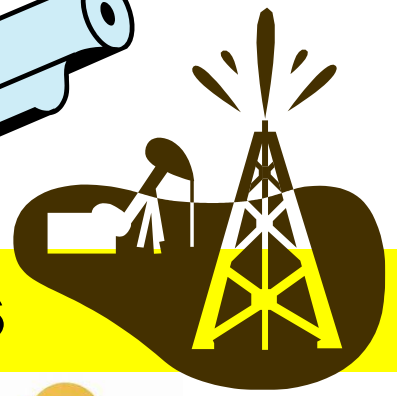

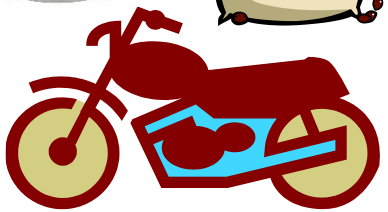
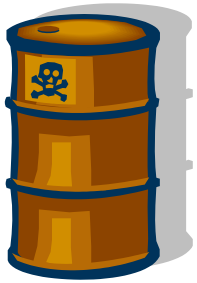

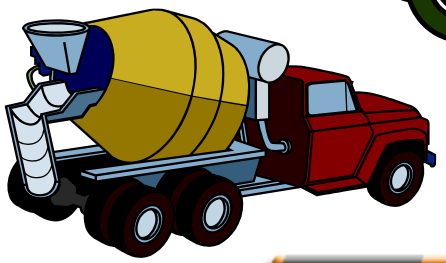

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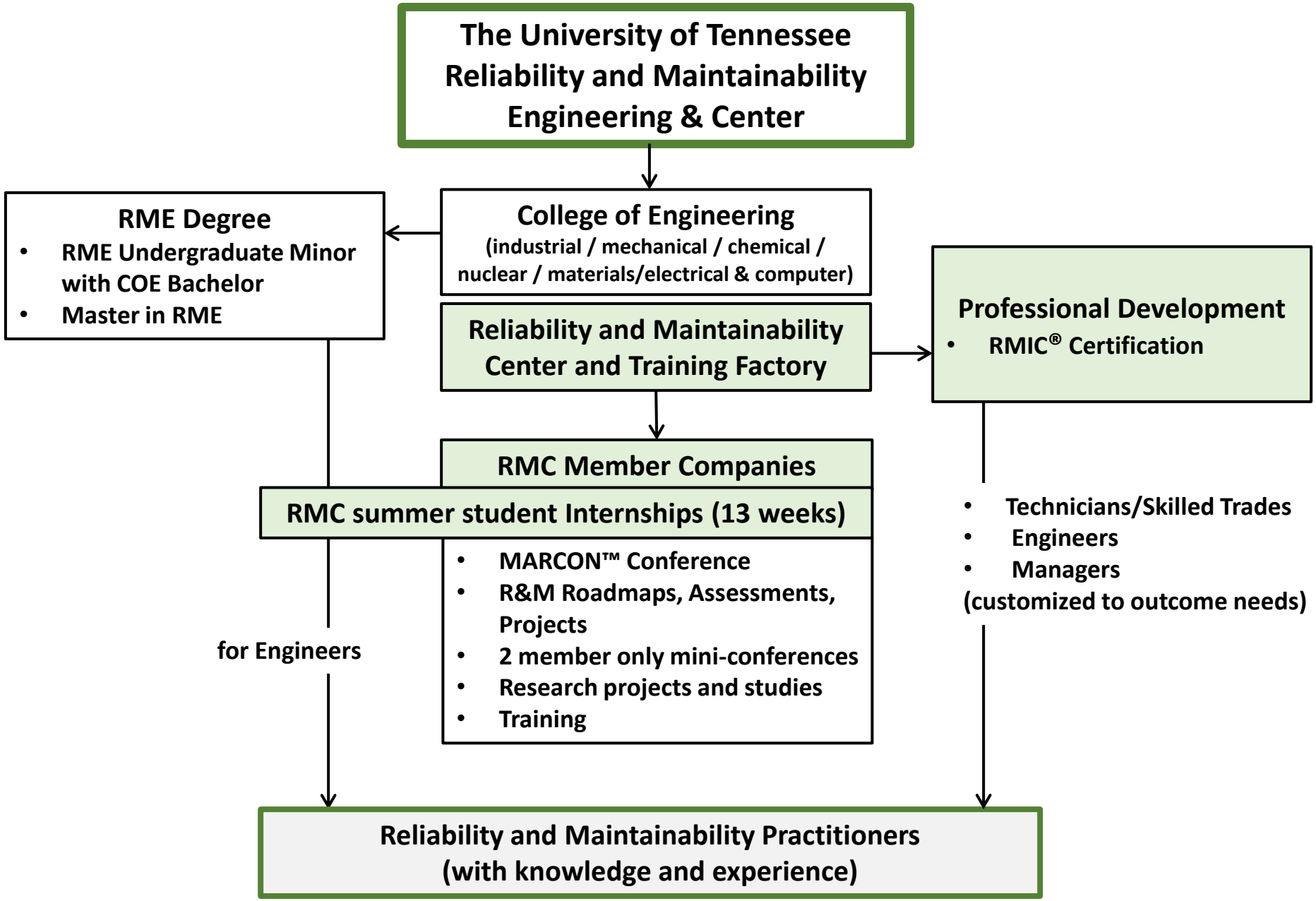

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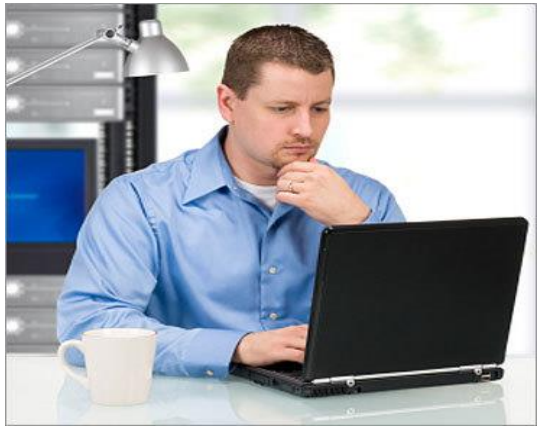
Implementation Focused

RMIC®
Pathways

(learn how to make R&M a Competitive Advantage)

3 + 3 + Project = RMIC®

Over 12 Training Partners



Engineers

Trades/Technicians

Leaders

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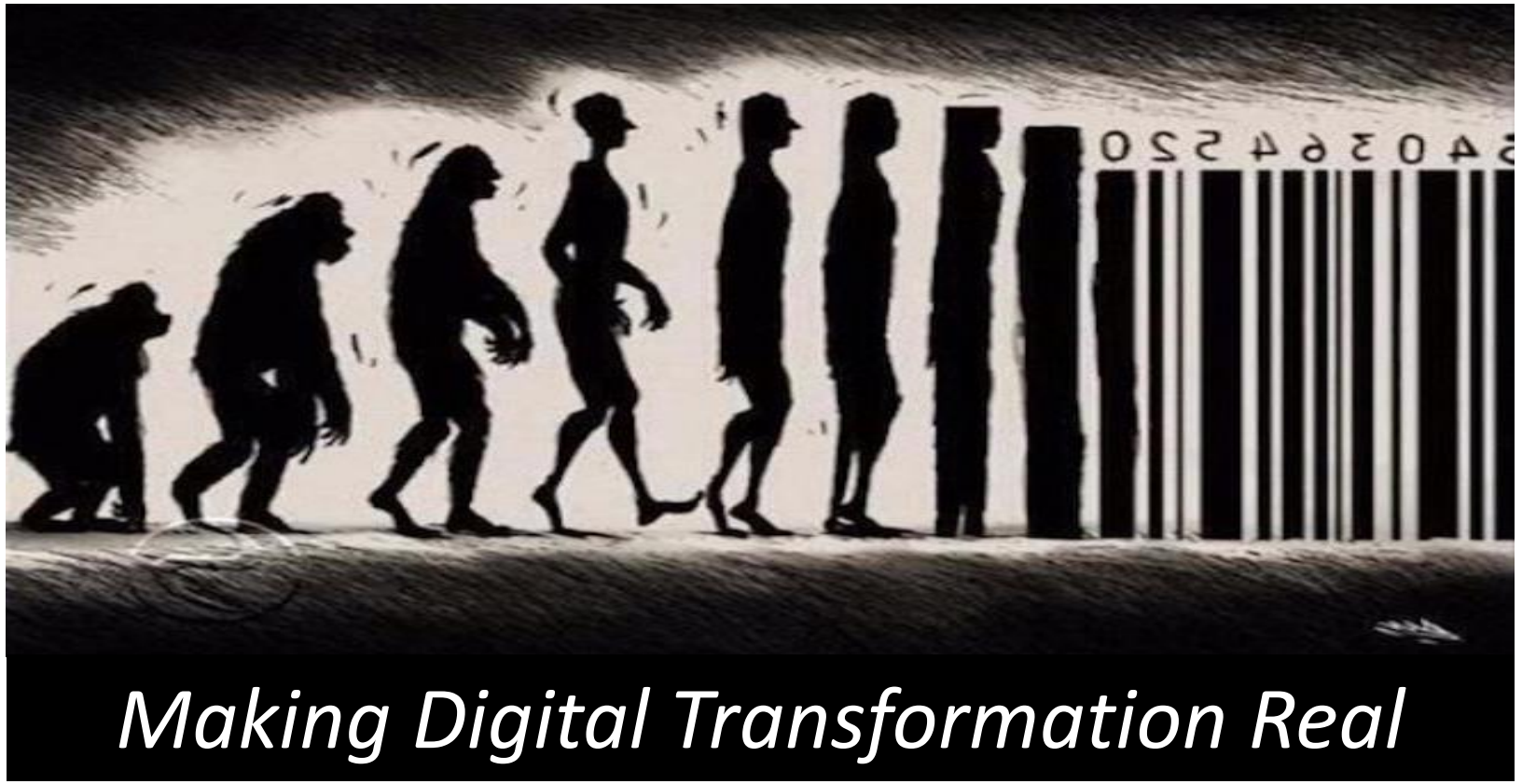
Evolution of R&M and related implications ……. from a long-time practitioner

Paradigm Shifts **Disruptive Innovations**



Source: Philosophersfor Change.org

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The past

"If we don't get better at culture, we won't be able to get to the tough problems."

Every 20,000 hours flying: 4,000,000 hours maintenance
With RCM down to 66,000 hours maintenance
Safety got 6 times better

Evolution of R&M Tools & Technologies
(Dr. Klaus Blache)

Increasing Acceptance, Usability, and ROI →

Some shutdown & work planning
Some computer usage
Fix it when it's broke
ZONE OF UNCERTAINTY
Design for reliability & maintainability
Better CMMS and analytics
RCM, FMEA, PMO, RCA
Condition Monitoring
ZONE OF UNCERTAINTY
30 years
30 years

< 1950 | 1950 | 1980 | 2010 | 2020 | >2025

Increasing Capability With New Tools & Techniques →

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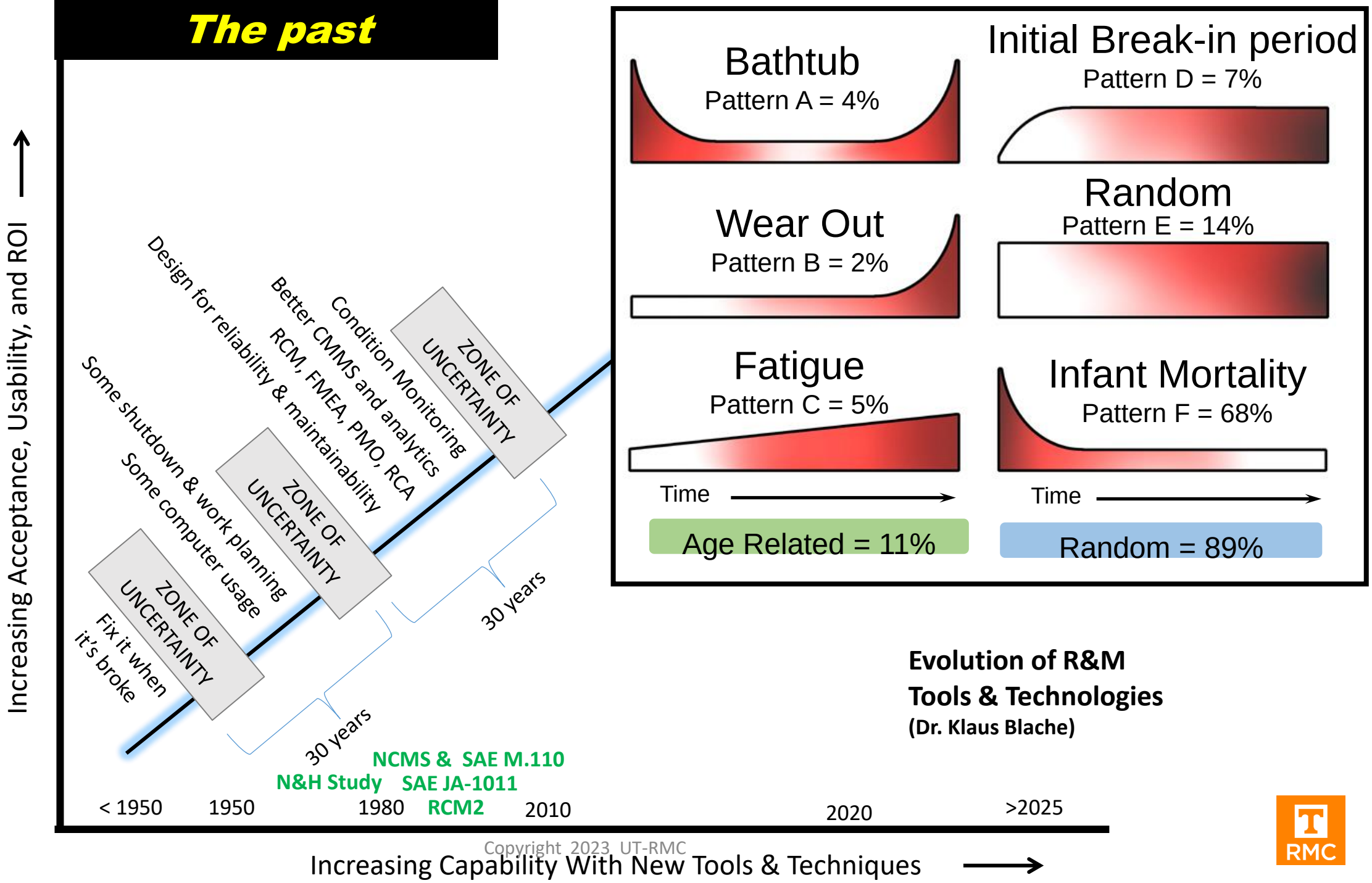
http://spiritgeek.com/wp-content/uploads/2015/03/PastPresentFuture.jpg

The past



Evolution of R&M Tools & Technologies
(Dr. Klaus Blache)

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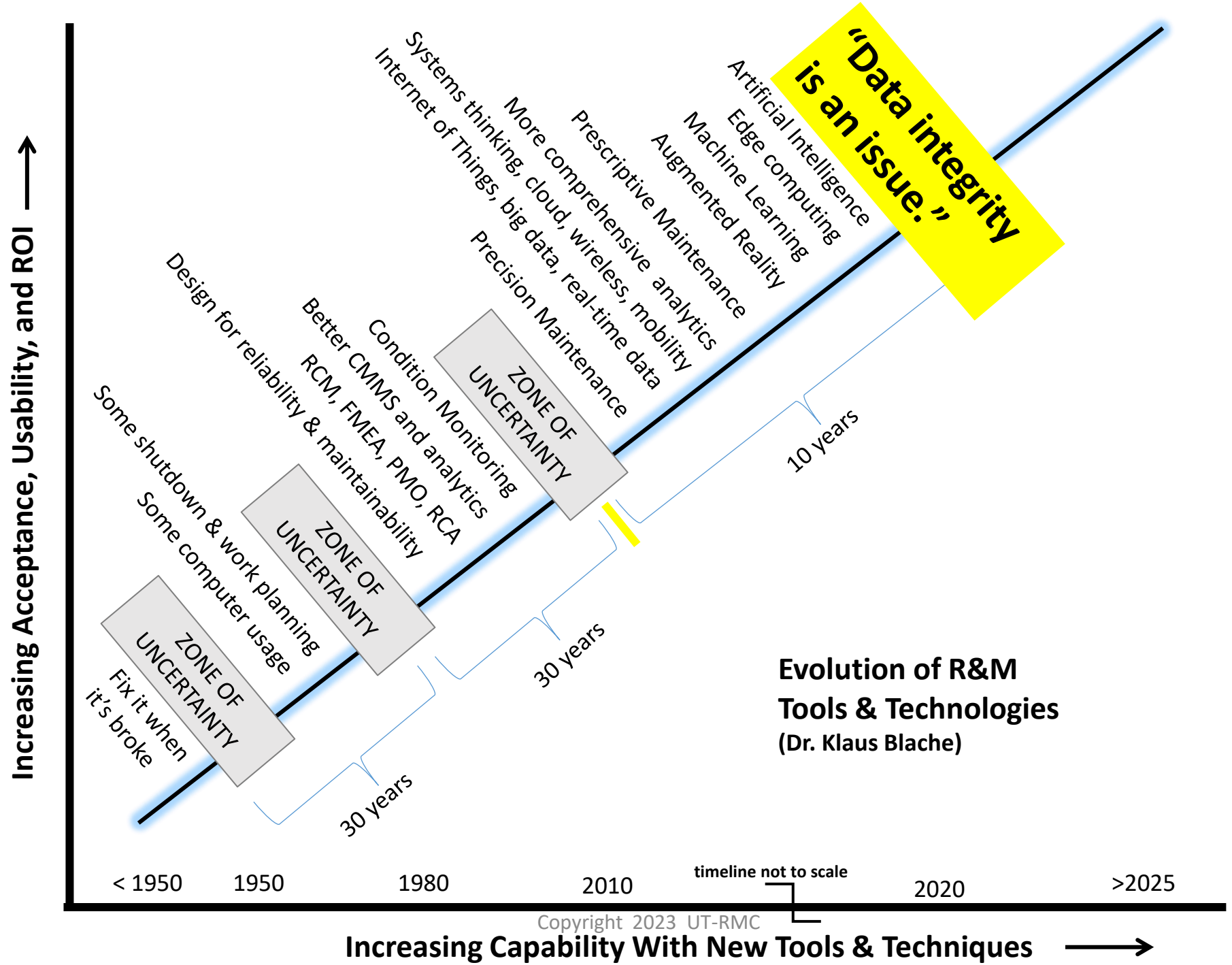

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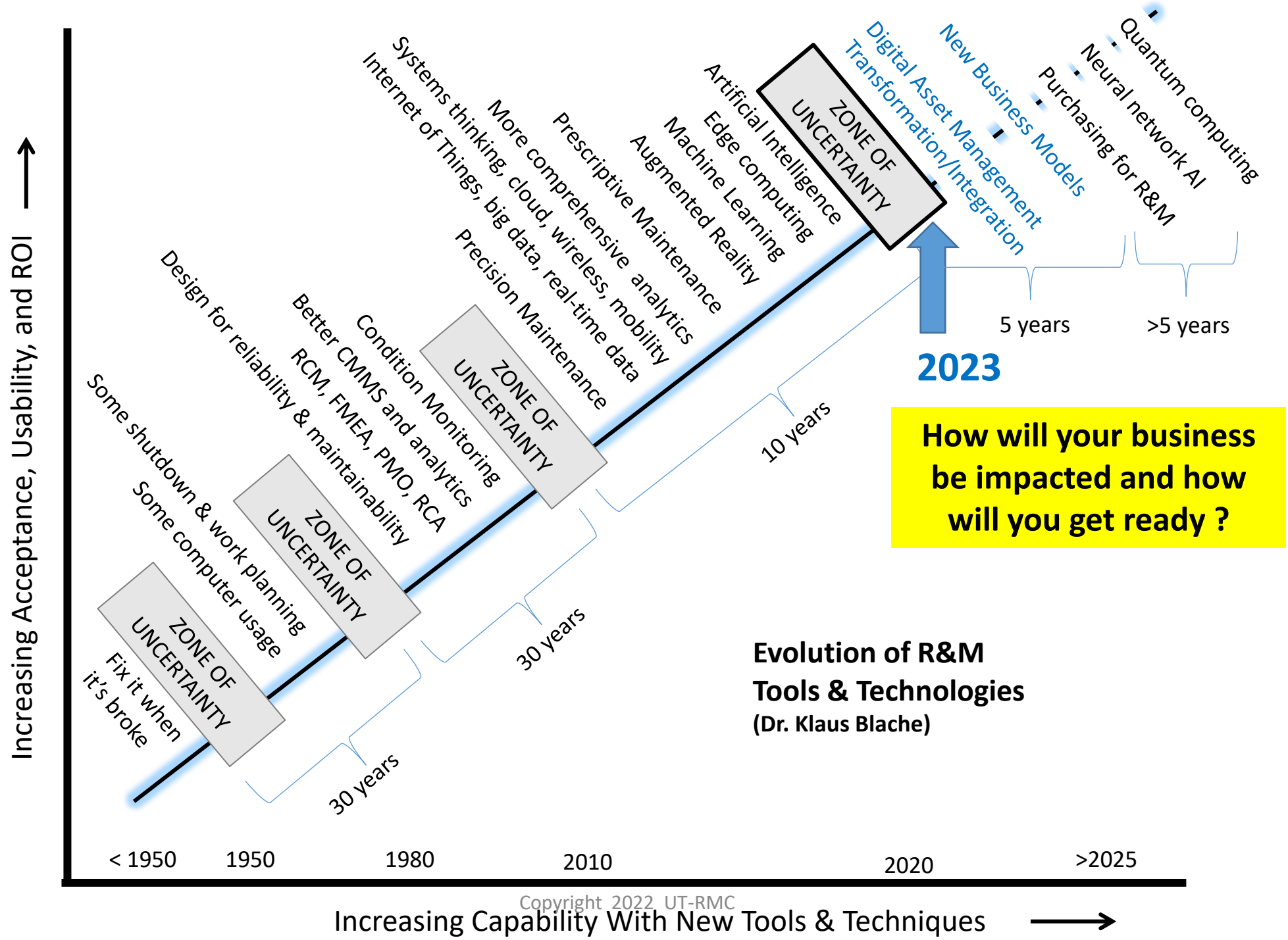

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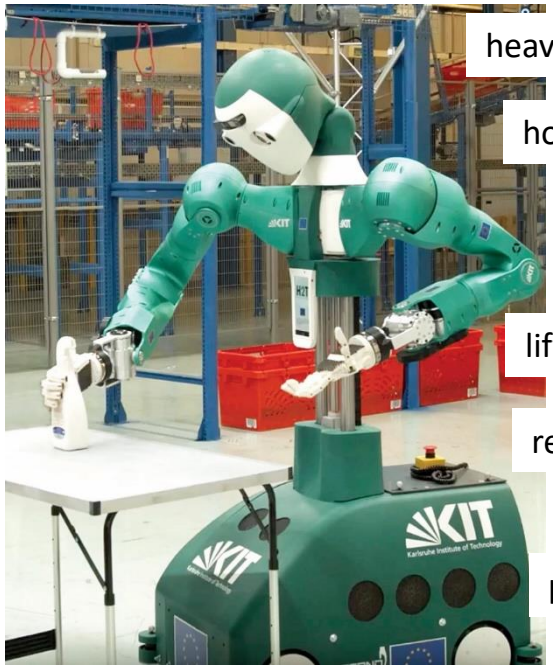
Industry Trends

Automation/ML/AI – how much/how fast?

Robots/cobots in:
- In every household
- On every maintenance team

http://robostuff.com/wp-content/robostuff-com/gallery/robots-catalog/asimo.jp g



heavy lifting

holding

lifting

reaching

passing objects

Tech behind new maintenance cobot "exceeds state-of-the-art" - The Manufacturer

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… Some Examples of Most Frequent Plant-Floor Observations

- **Workforce is not engaged. No robust continuous improvement.**
- **There is a lack of clear processes and roles.**
- **There is a lack of understanding of processes and roles.**
- **The workforce has no culture of discipline.**
- **Some have good processes, simulations models, engineers with excellent analytical skills, but they don’t trust the data enough to make key decisions.**
- **Some have a relatively good and happy workforce culture, but people aren’t held accountable to following processes.**

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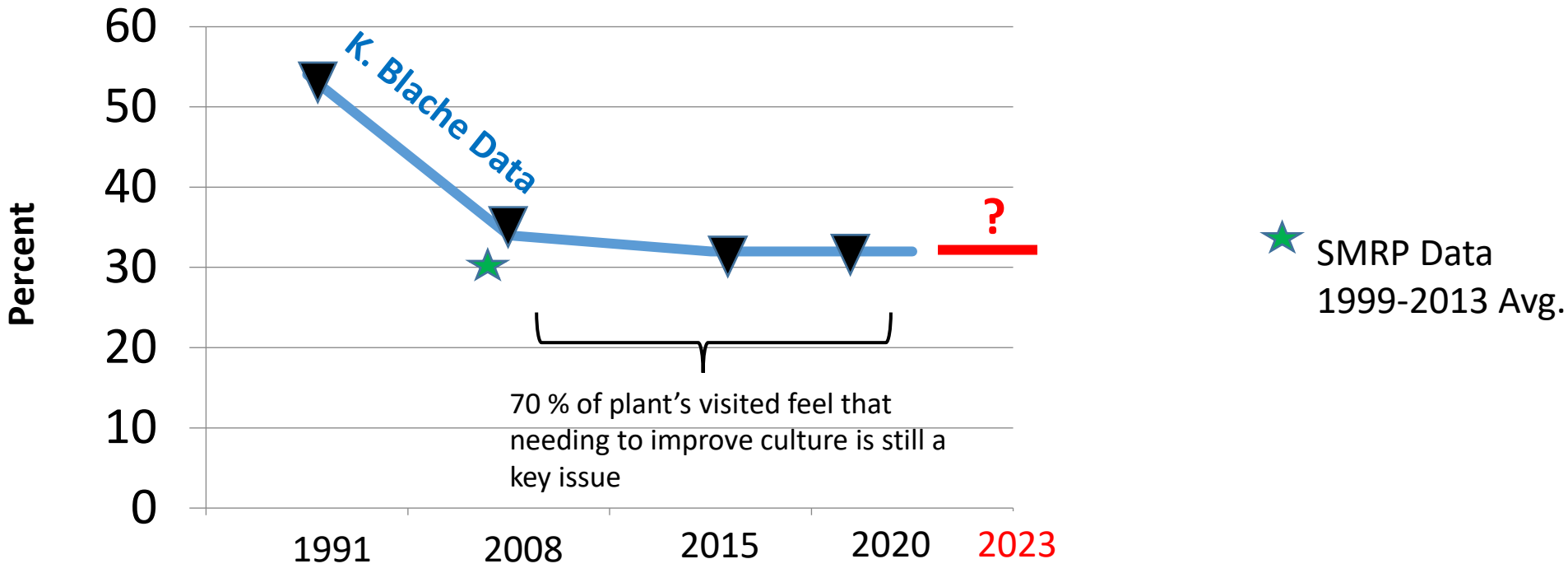
RMC

North America Reactive Maintenance



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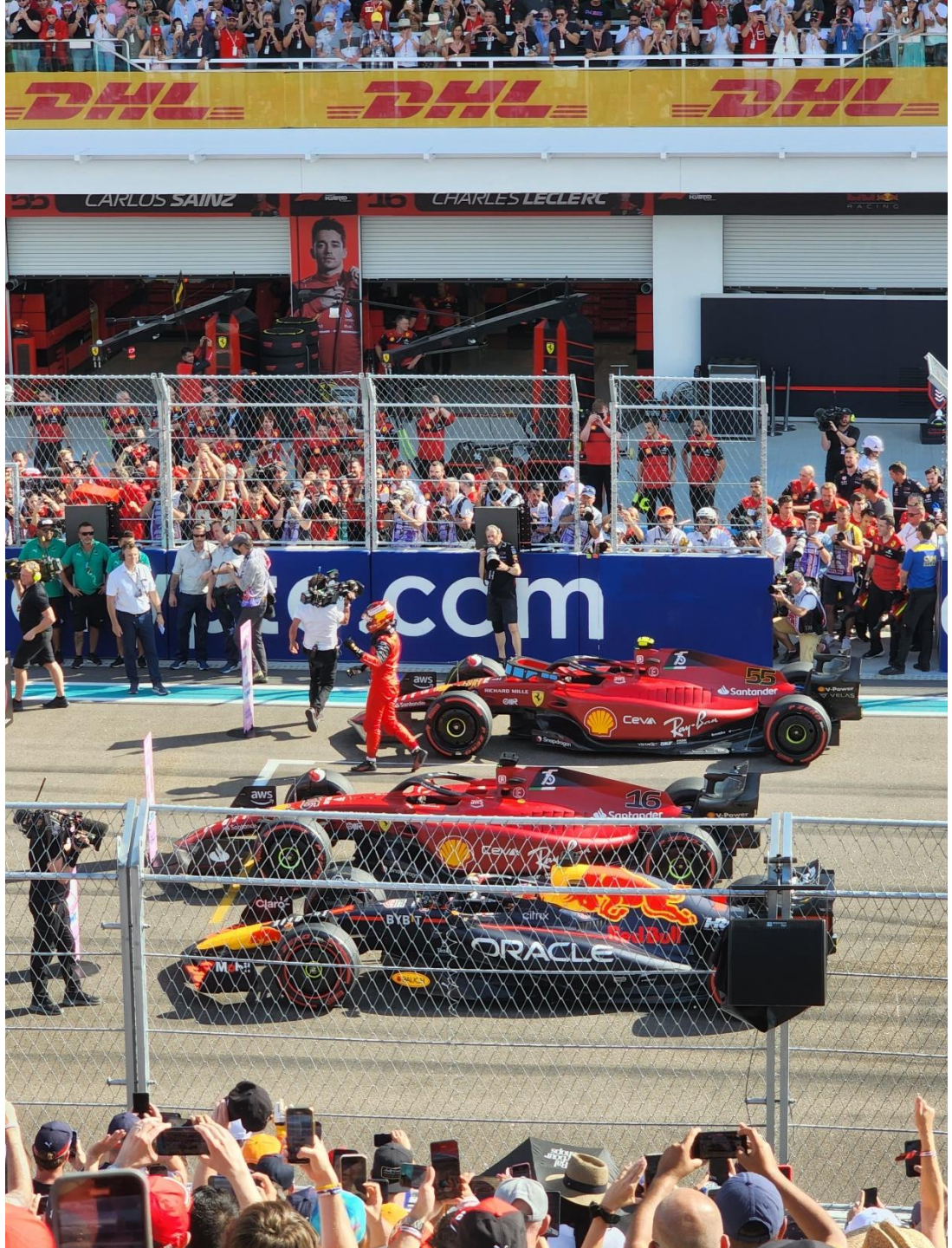

Formula 1 Race – Miami

Max Verstappen / Red Bull

1.82

- 3.786

- 0.657

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Reactive to Proactive Mindset

Typical Reasons for R&M Implementation Failures

- **Historical dysfunctional process and engrained culture that supports old processes**
- **Many organizations/facilities think that they are better than they are**
- **How it's all related and the impact on operational excellence is not fully understood, so there is a lack of support from other plant functions**

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Reactive to Proactive Mindset

Typical Reasons for R&M Implementation Failures

- **People not being held accountable for not following the plant processes**
- **Too often companies try to get better at performing maintenance activities, rather than focusing on how to not have to do the maintenance at all**
- **Over 70% of companies point to culture as the main roadblock to R&M best practices, yet there is insufficient focus on improving it**

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What presumed little things go on in your Maintenance Department that can have a "Butterfly Effect" on your organization?

"A butterfly can flutter its wings over a flower in China and cause a hurricane in the Caribbean."

Consider Trades/technicians that:

- **Take verbal job requests that should be formal work orders**
- **Sometimes gets to job site and discover that operations personnel won't allow the machine to stop**
- **Receive unclear maintenance tasking direction, so they improvise**
- **See most jobs prioritized as Safety/ High Priority just to get to the top of the list**

Source: *Efficient Plant* , Maintenance and the Butterfly, June 2018, K. Blache

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What presumed little things go on in your Maintenance Department that can have a "Butterfly Effect" on your organization?

Consider Trades/technicians that:

- **Skip less-critical PM checks because many can't be finished in time and/or on a monthly schedule (they are often reported as completed, thus making the KPI's look good**
- **Struggle to find the correct part, because all parts are not coded with a standardized system, a problem that also effects reordering/procurement**
- **Learn that only some of the asset history is captured because Work Orders are not closed with enough detail or at all**

Source: *Efficient Plant* , Maintenance and the Butterfly, June 2018, K. Blache

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What presumed little things go on in your Maintenance Department that can have a "Butterfly Effect" on your organization?

Consider Trades/technicians that:

- Hoard parts because they don't trust stock room data
- Do not perform root-cause, trending, and reliability growth tracking analysis because they lack quality asset data
- See continuous backlog growth, assuming you are counting all Work Orders not performed
- Are unable to predict costs other than that they continue to go up
- Doubt data validity/accuracy, though KPI's look good (for the most part, looking at daily plant-floor practices reinforces their distrust)

Source: *Efficient Plant* , Maintenance and the Butterfly, June 2018, K. Blache

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Understand R&M Process Maturity

https://www.duperrin.com/english/wp-content/uploads/2021/03/continuous-improvement-scaled.jpeg

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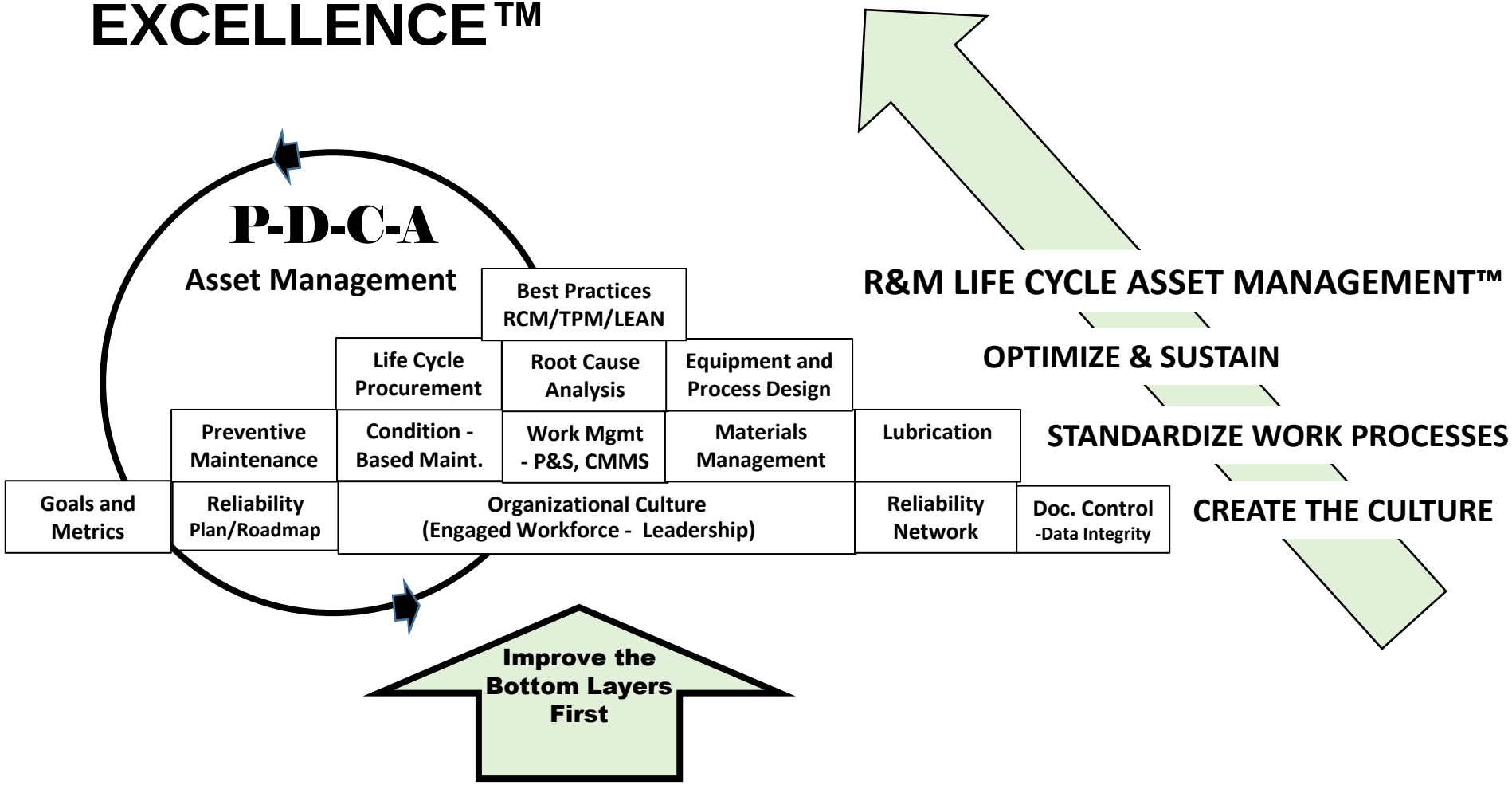
R&M COMPETITIVE EXCELLENCE™



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Top Quartile Metrics and Benefits

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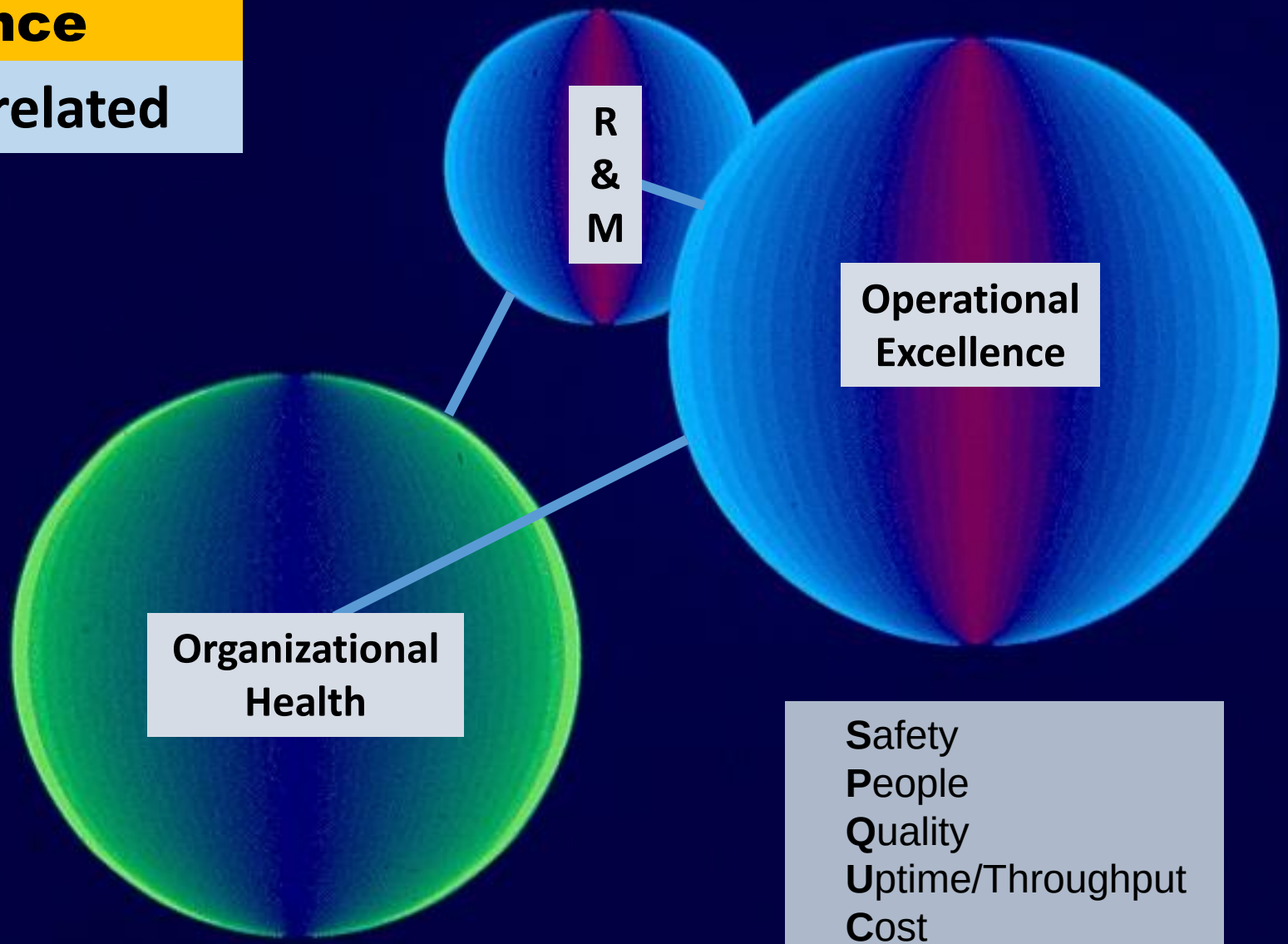
http://here2there.ca/wp-content/uploads/2019/01/metrics.jpg

Transitioning to Excellence

It's all related



Safety
People
Quality
Uptime/Throughput
Cost

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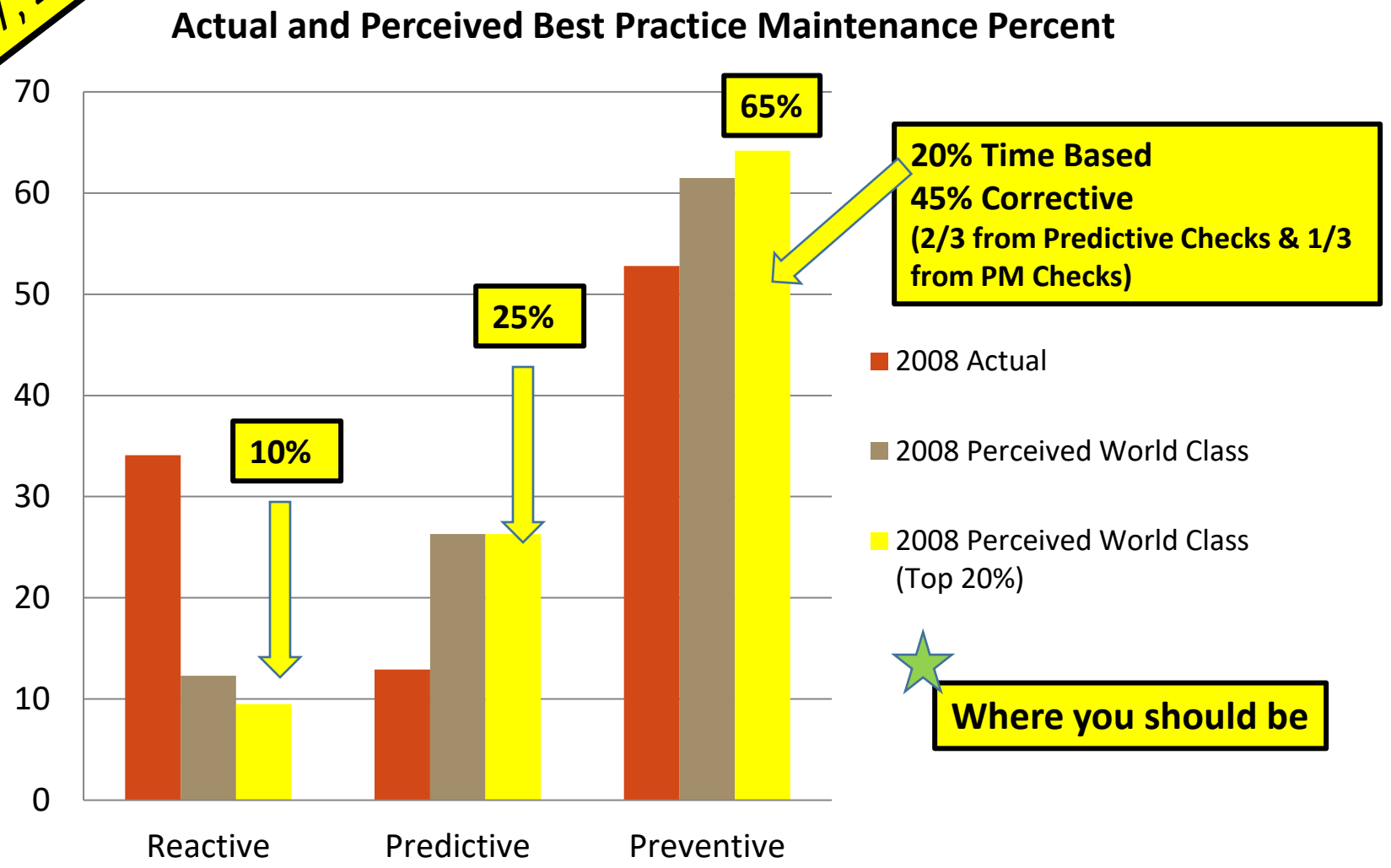
North America
(2008/2009)

Revalidated 2017, 2019



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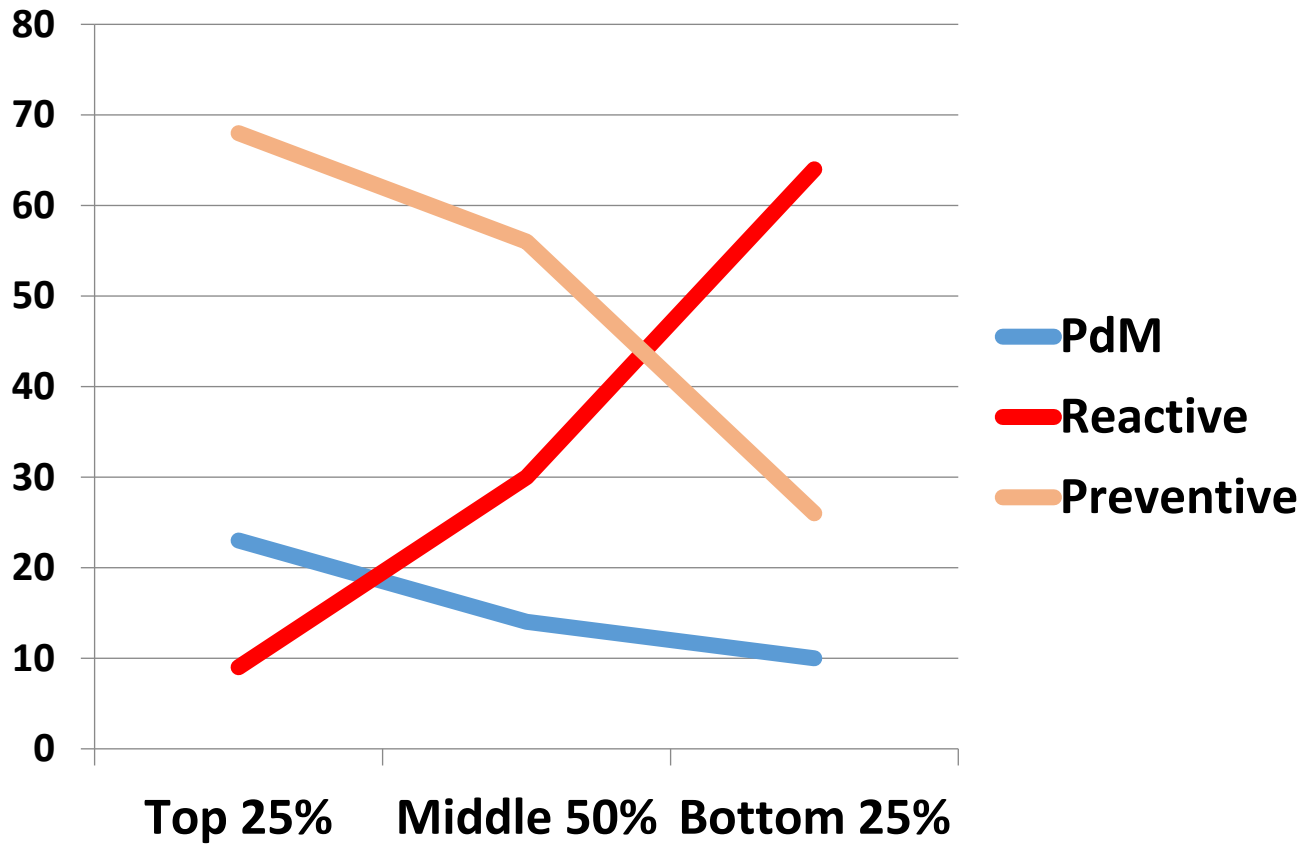
Average Maintenance Type Percent
(sorted by Reactive, 2017/2020 UT-RMC Studies, Dr. Blache)



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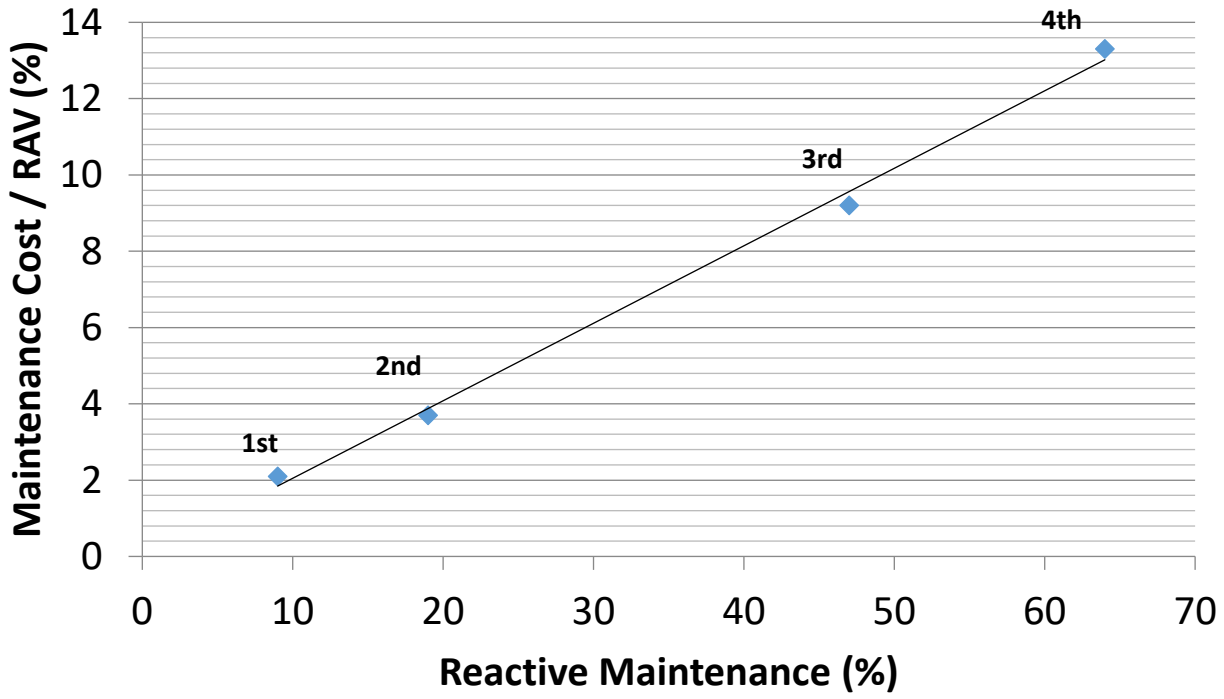
What Is Your Quartile ?

	1st	2nd	3rd	4th
Reactive Maintenance (%)	9	19	47	64
Maintenance Cost / RAV (%)	2.1	3.7	9.2	13.3



Dr. Klaus Blache, 2017,2019 Studies, UT-RMC

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Top Quartile Companies in Reactive

- **Average 23% resources allocated towards PdM and 9% Reactive Maintenance**
- **Were 27% better in OSHA Recordable Incident Rate than the average of the remaining facilities**
- **Averaged 7% higher OEE than Middle (2nd & 3rd Quartile) and 11% higher OEE than Bottom Quartile**

K. Blache, UT-RMC, 2017, 2020
***R&M in Industry* studies**
(over 120 companies representing about 3,000 facilities)

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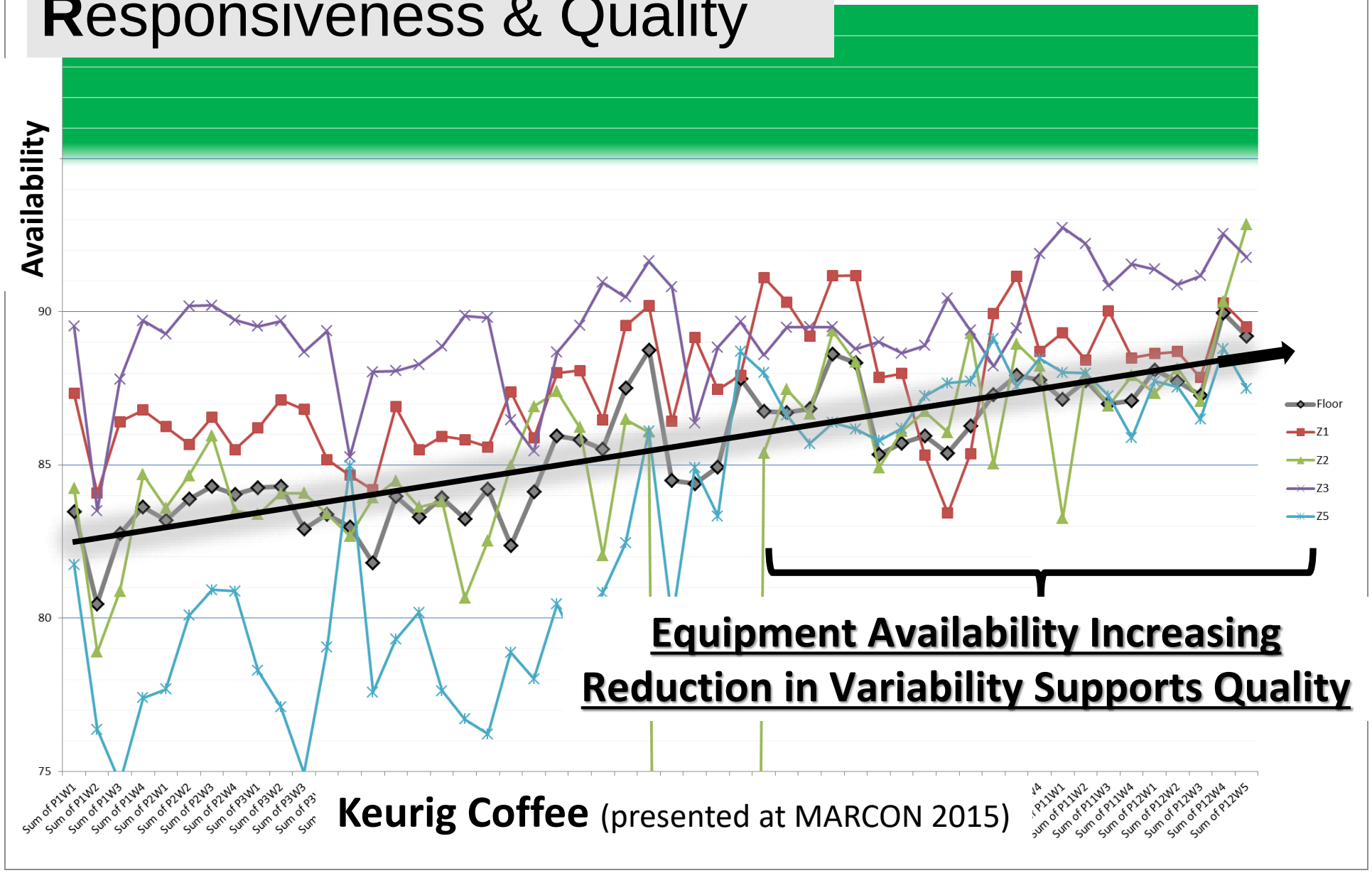
Responsiveness & Quality



Equipment Availability Increasing

Reduction in Variability Supports Quality

Keurig Coffee (presented at MARCON 2015)

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Moving From “What to Change” to “How to Change”

How

What

Adapted from :https://cdn.pixabay.com/photo/2015/09/20/08/02/change-948008_960_720.jpg

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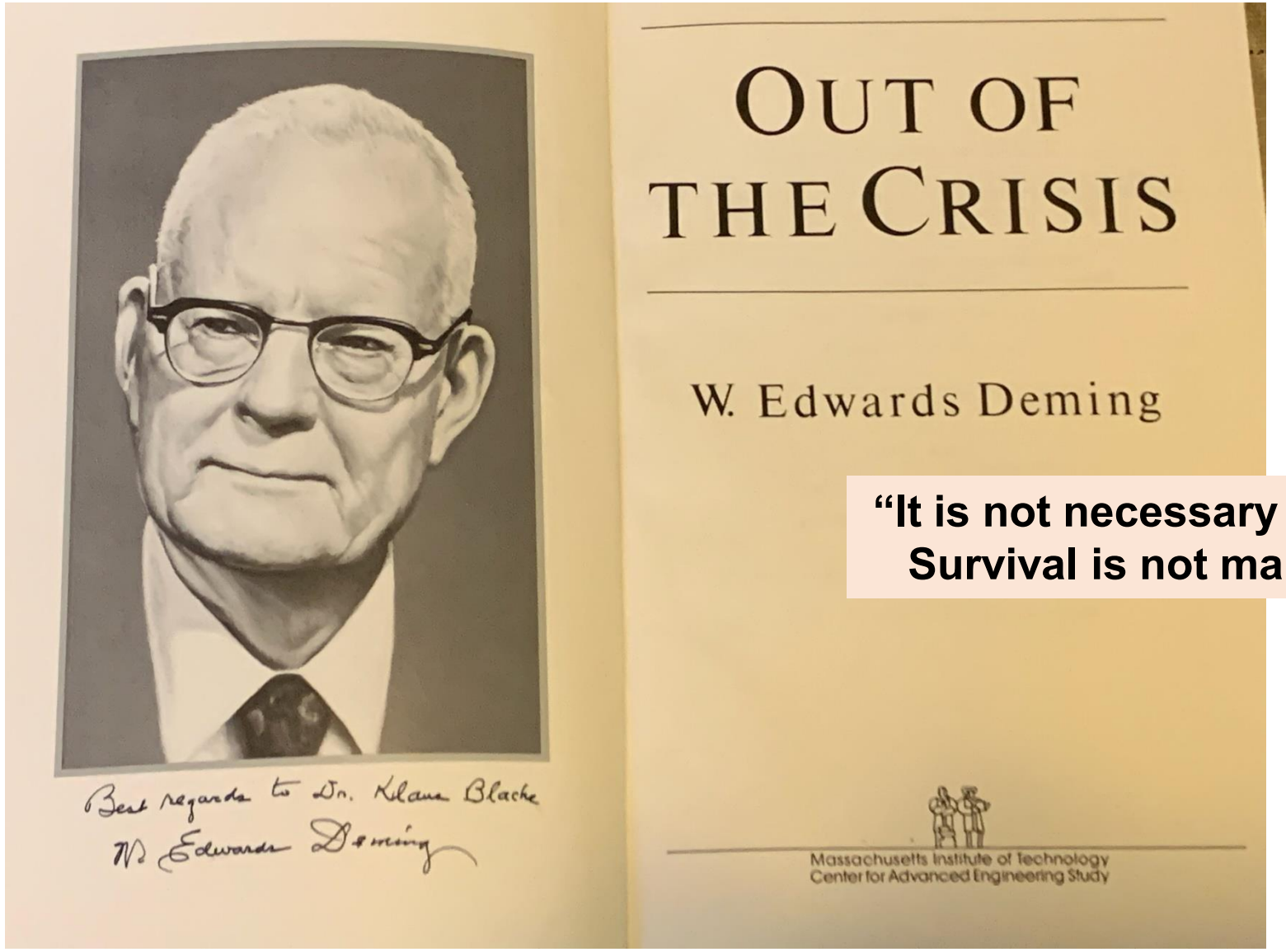
Today's Reality - Transitioning to Industry 4.0 & 5.0



"It is not necessary to change. Survival is not mandatory."

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Industry 4.0/5.0

Resilient

Sustainability

Planet Friendly

Human Centric

[What Is Industry 5.0 And How It Will Radically Change Your Business Strategy? (forbes.com)](#)

Adapted from: https://cdn1.vogel.de/H4JazspPRvpHu56P99lipMIQi2I=/fit-in/1200x630/filters:format(png):quality(90)/images.vogel.de/vogelonline/bdb/1710100/1710177/original.jpg

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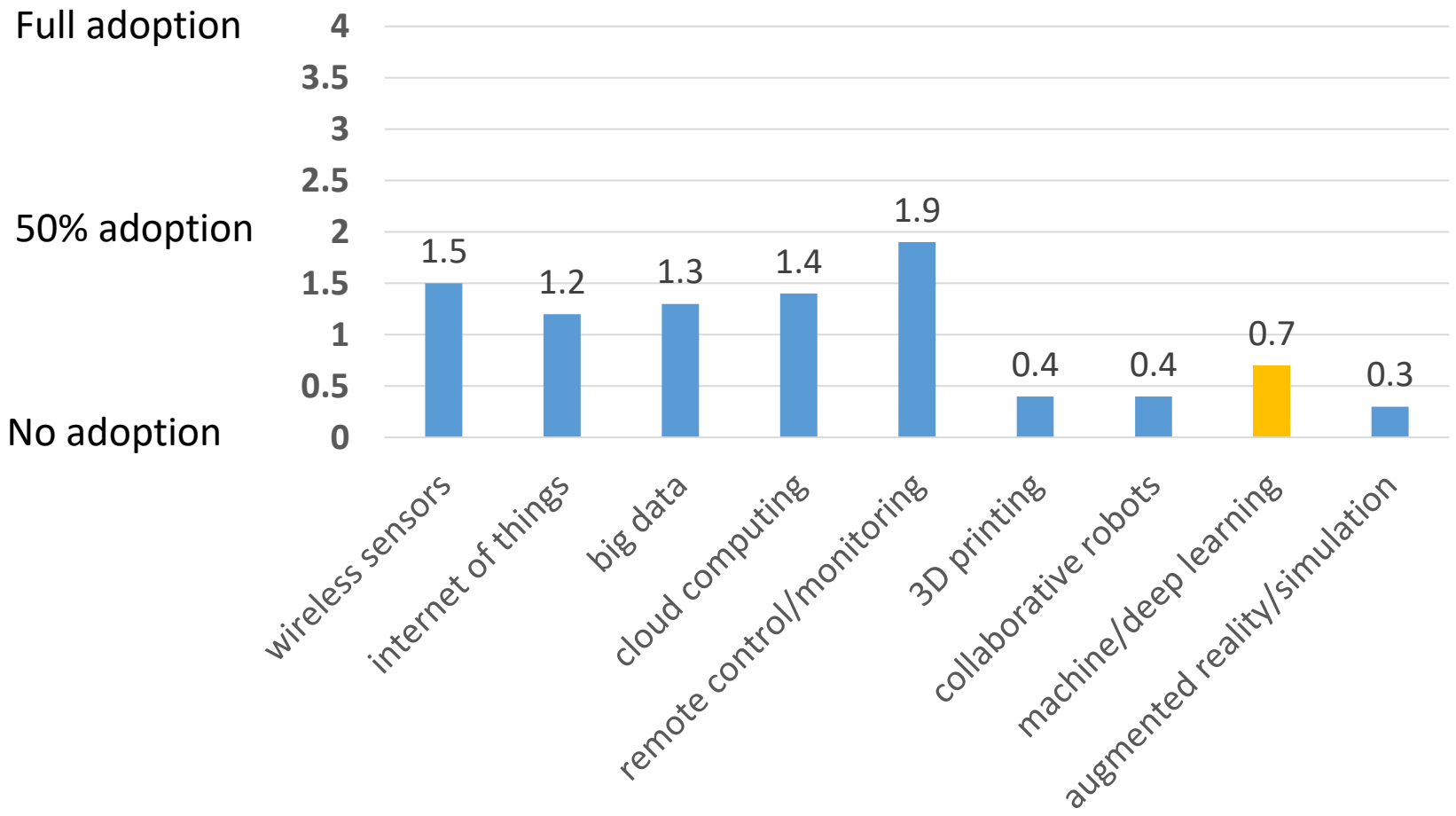
Digital Technology Adoption
North America



Dr. K. Blache, 2020 study

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IoT Has a Steep Learning Curve

"Many enterprises have launched pilot projects to develop IoT-enabled products and services or use IoT to achieve operational improvements. Of these, less than 30 percent have taken their IoT programs beyond the pilot phase." From the 300 that went beyond the pilot phase, "about one-sixth said their companies had seen a significant payoff from IoT."

"Our survey suggests that the first 15 or so IoT use cases typically have a modest payback – and the average payback continues to rise until companies have implemented around 30 cases."

McKinsey&Company

Source: https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/what-separates-leaders-from-laggards-in-the-internet-of-things
Picture: https://c1.staticflickr.com/7/6184/6097858420_02c105565f_b.jpg

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Workforce Expectations Have Changed

Great Resignation - Wikipedia

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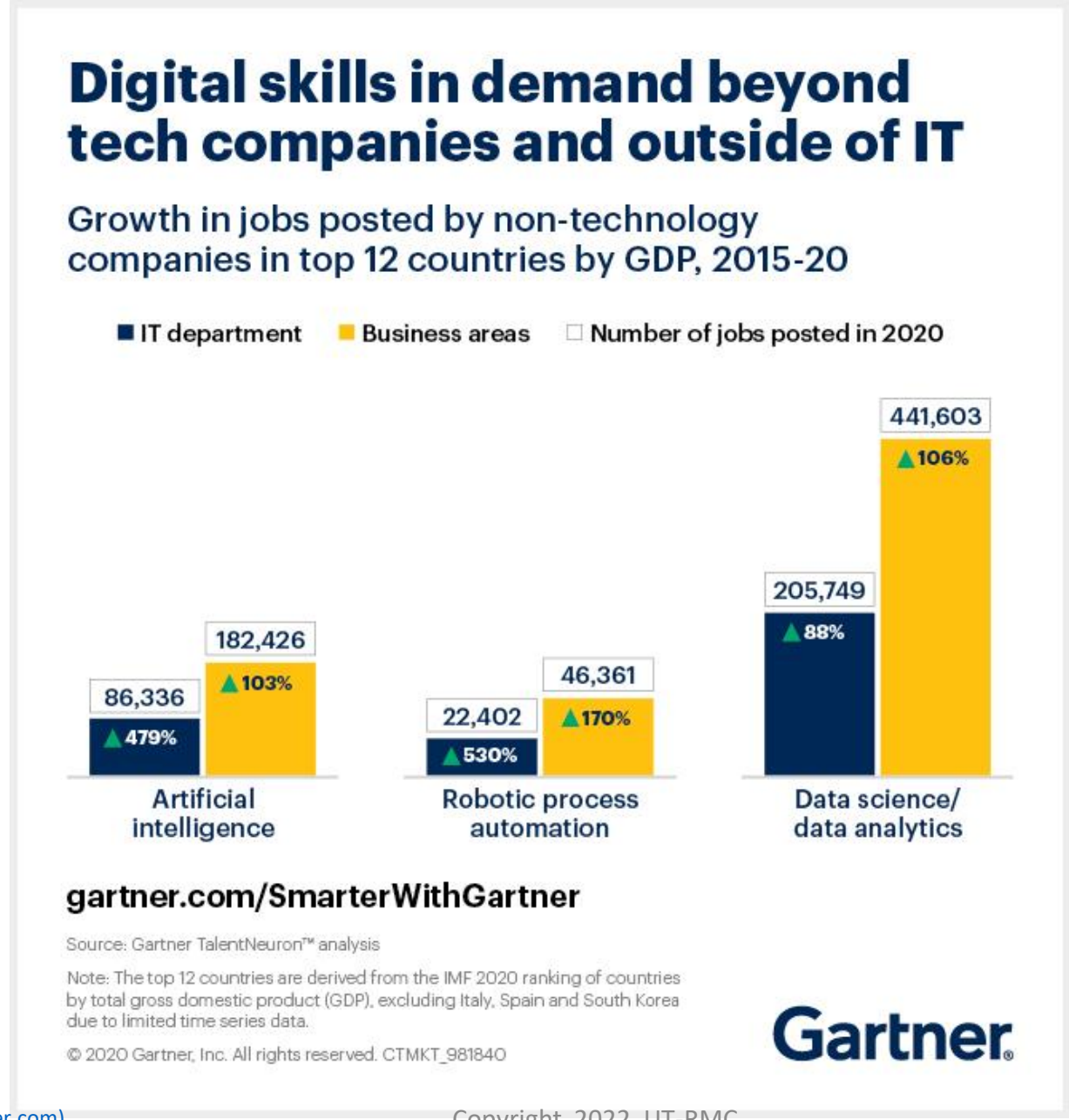
Lack of Digital Skills



[Lack of Skills Threatens Digital Transformation (gartner.com)]

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Nearly 1 in 3 workers lack foundational digital skills

Many workers who have serious digital skill gaps are nevertheless employed in jobs that require them to use computers.

- **NSC's analysis found that fully 38 percent of workers with *no* digital skills have jobs that require either moderate or complex computer skills.**

By Amanda Bergson-Shilcock May 20, 2020
Nearly 1 in 3 workers lack foundational digital skills, new report finds - National Skills Coalition

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Agility is the new Lean

Stability is the new just-in-time

Understand your business/workforce readiness for digital transformation

Attention to Organizational Health and Human Factors will enhance the successful implementation of Industry 4.0

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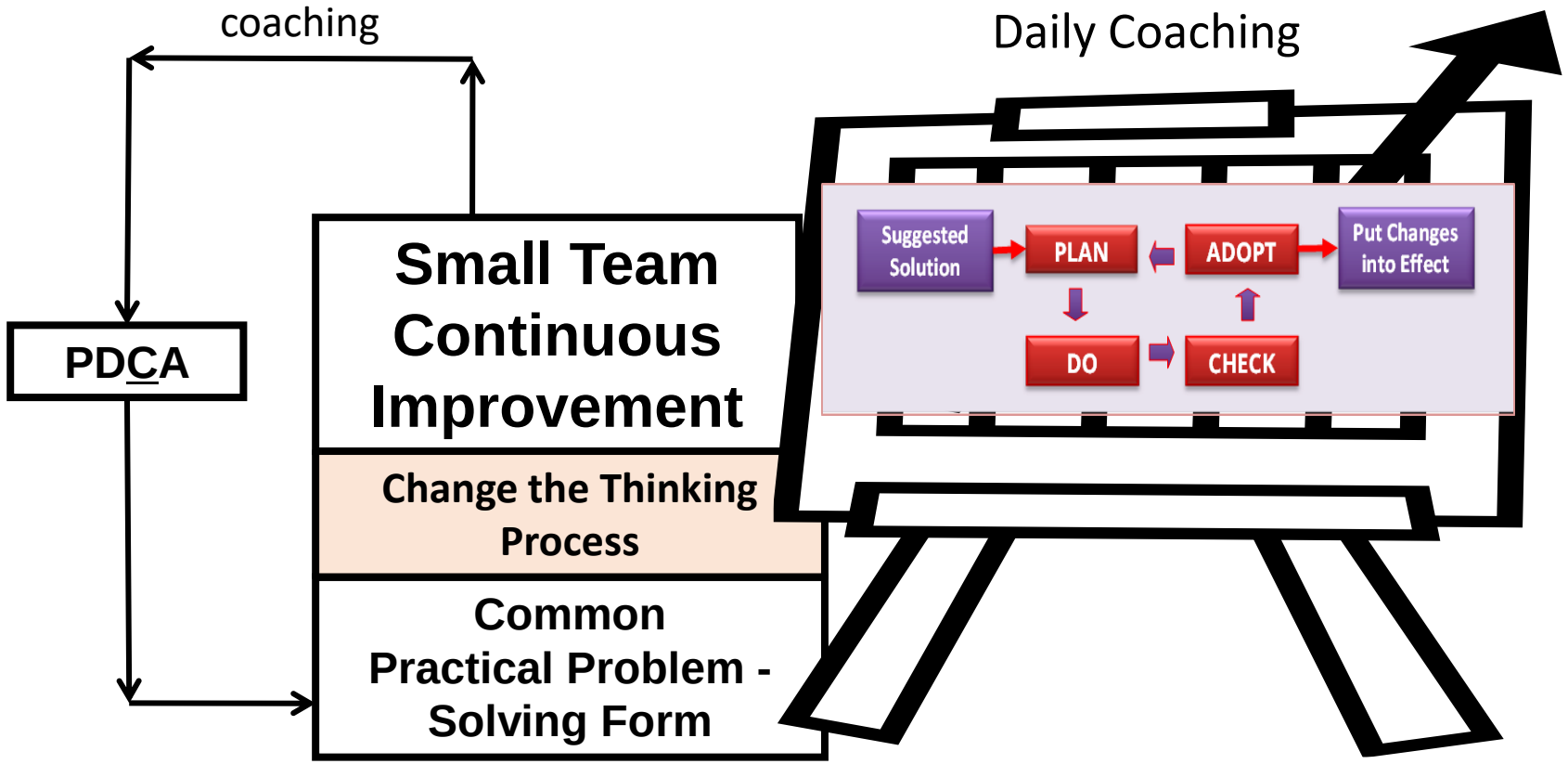
What the Best-of-the-Best Do Better



Mainstream Improvement Process
(Best Plants)

https://drdollah.files.wordpress.com/2014/10/pdca-3.png

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What is it going to take?

How much more proof is needed?

What are you going to do about it?

Paradigm Shift

Reactive to Proactive

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Benefits: Investments

Asset management initiative benefits/ improvement investments have shown ROI (return on investments) from about 5:1 to over 100:1, with an average of about 15:1 to 20:1

Dr. Klaus Blache

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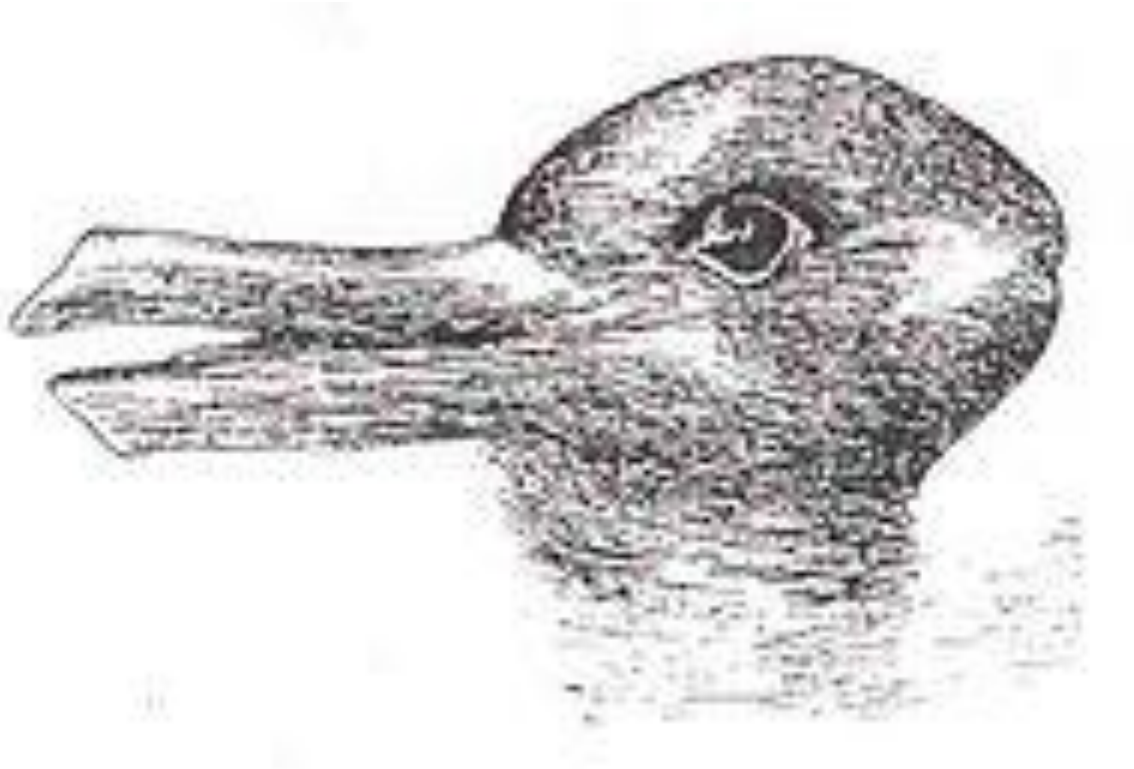
Reactive to Proactive Mindset

Paradigm Shift

Organizational Health



Operational Excellence

https://upload.wikimedia.org/wikipedia/commons/thumb/4/45/Duck-Rabbit_illusion.jpg/200px-Duck-Rabbit_illusion.jpg

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Four Levers of the Influence Model for Cultural Success

I will change my mindset and behavior if there is ……

1. Understanding and conviction
2. Reinforcement mechanisms
3. Confidence and skill building
4. Role Modeling

Source: Beyond Performance 2.0: A Proven Approach to Leading Large Scale Change, Scott Keller & Bill Schaninger, McKinsey & Company/publisher-John Wiley & Sons Inc., 2019, p 129.

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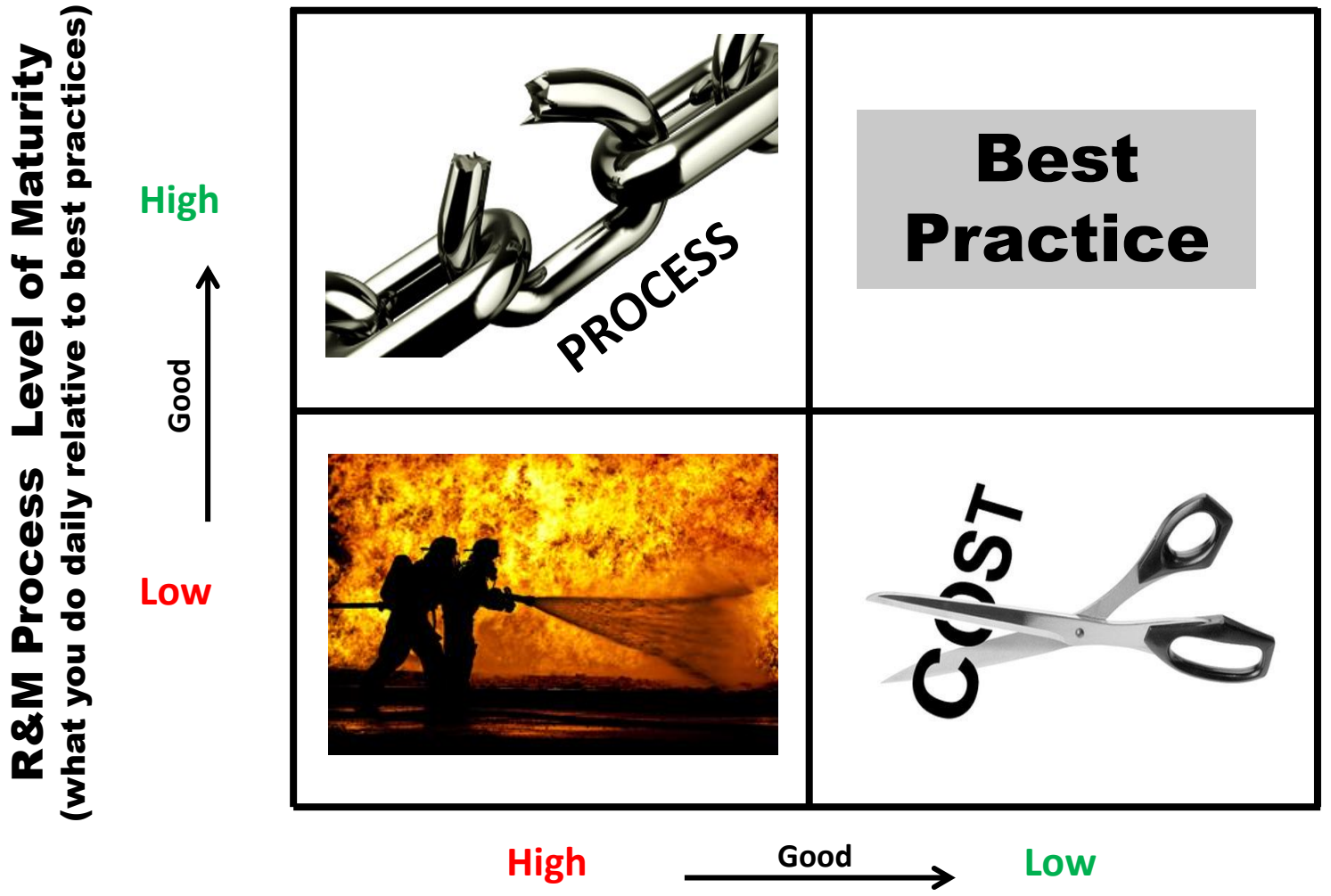
The Reliability of Everything™

"Understand Where You Are"



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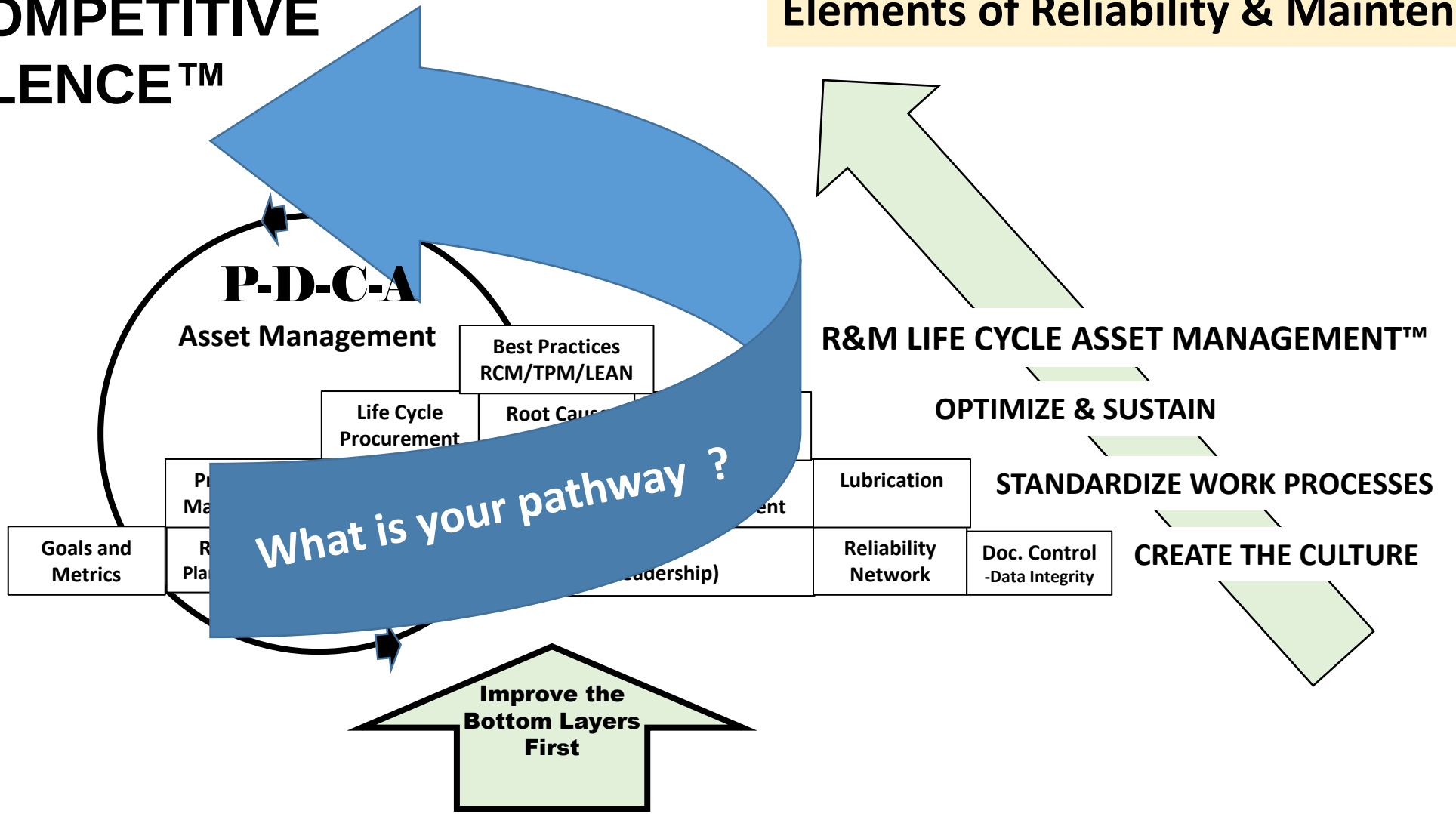
R&M COMPETITIVE EXCELLENCE™

Assess Your "Best Practice" Foundational Elements of Reliability & Maintenance



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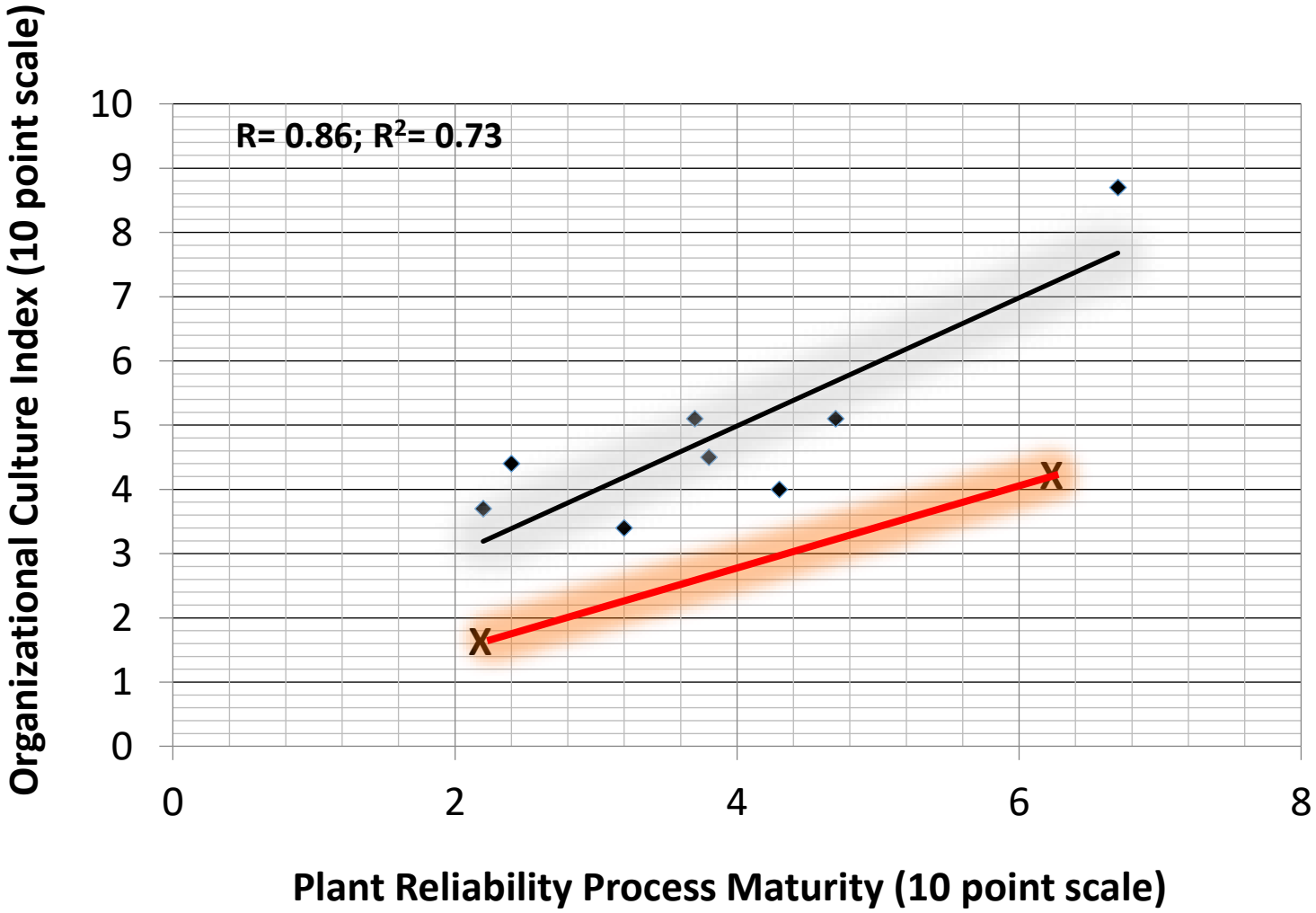
Organizational culture and reliability process maturity



Source: Book: *The Relativity of Continuous Improvement*, Dr. Klaus Blache, Dec., 2015

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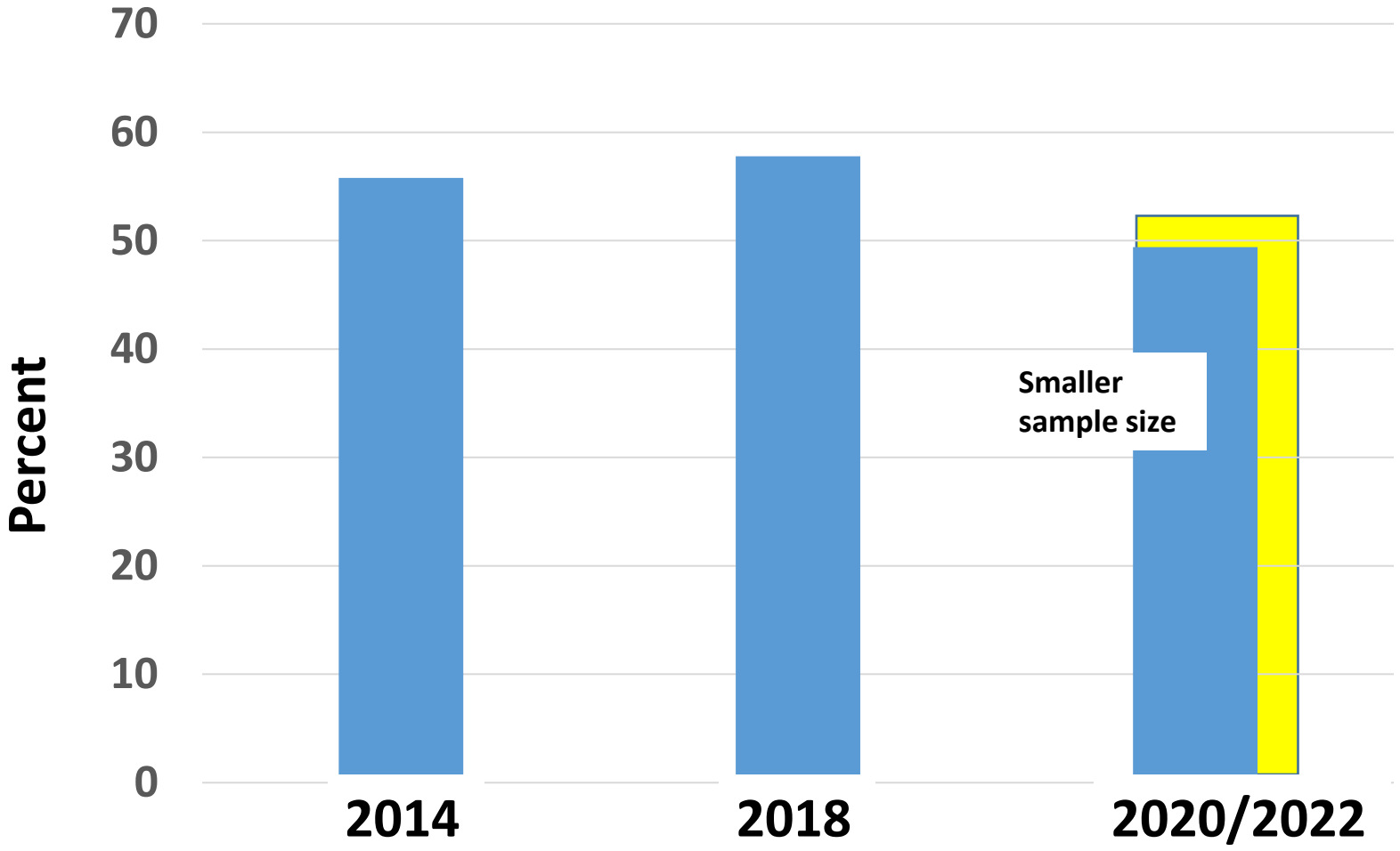
PdM Program Implementation Performance
(Percent Not Effective / Needs Some Improvement)



Source: Plant Services, State of the Industry:
Predictive Maintenance, 2014, 2018, 2020, 2022

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Organizational Culture

“Culture can account for 20 – 40 percent of the differential in corporate performance when compared to ‘culturally unremarkable’ competitors.”

Adapted from: The Culture Cycle, Professor Emeritus at Harvard Business School, James L. Heskett

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"The soft stuff is the hard stuff and without the soft stuff, sustainable best practice on reliability and maintenance is not possible. …… so maybe it should be called the sustainable stuff."

Dr. Klaus Blache

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**"All companies have a culture,
some companies have discipline,
but few companies have a *culture of discipline*.**

- **When you have disciplined people, you don't need hierarchy.**
- **When you have disciplined thought, you don't need bureaucracy.**
- **When you have disciplined action, you don't need excessive controls."**

With a culture of discipline, where people know what to do and are capable of and willing to do it, great performance is a natural outcome.

Source: Jim Collins, Good to Great (Harper Business, New York, 2001)

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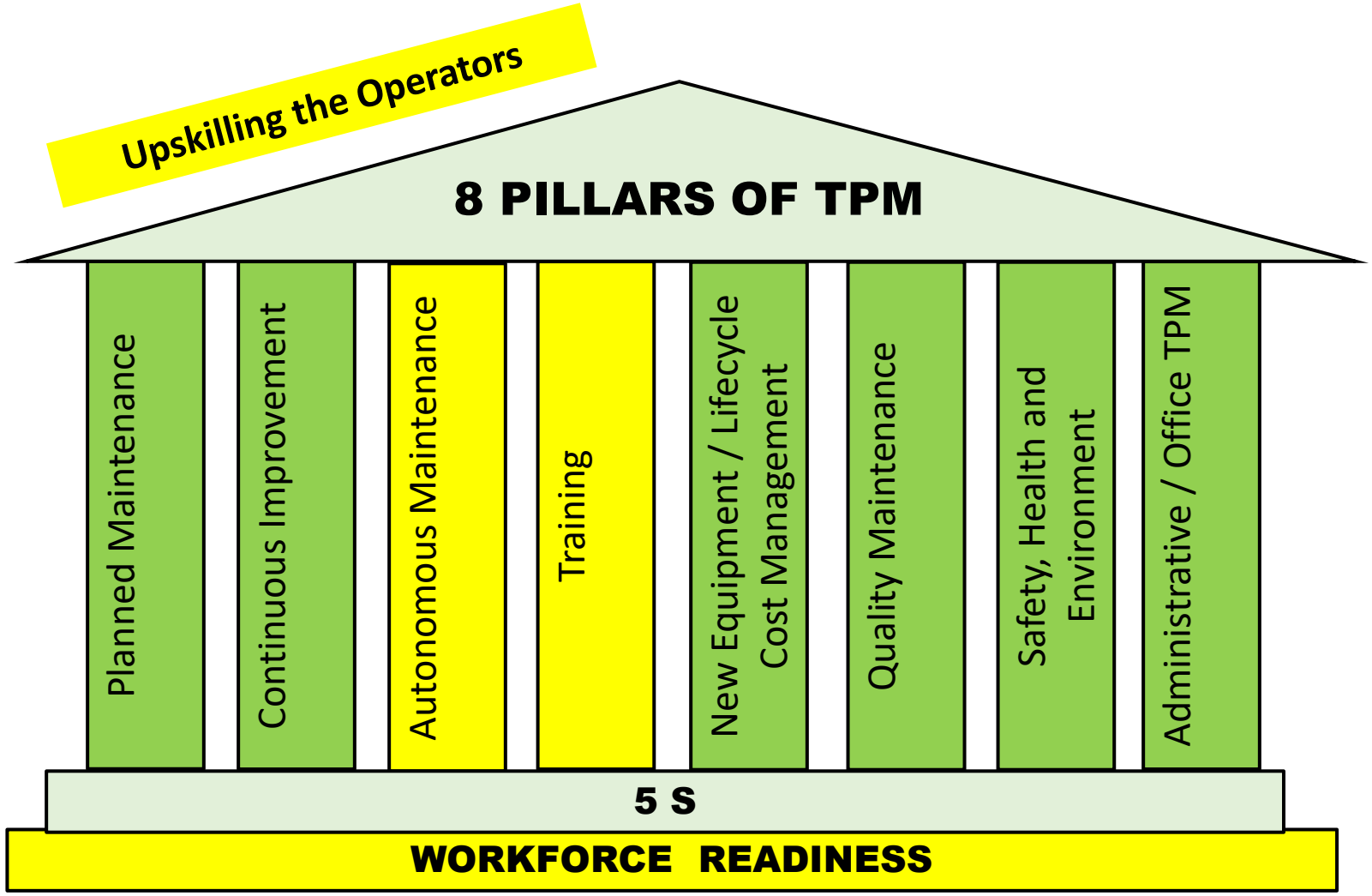

Source: Book: *The Relativity of Continuous Improvement*, Dr. Klaus Blache, Dec., 2015

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What Can/Should You Do

Dr. Blache's
Six hard pills to swallow

1. **Acknowledge the need for change**

2. **Recognize it's a journey**

3. **Assess where you are really at**
   - **Gap analysis**
   - **Monetize the opportunity**

4. **Understand that it's all related**

5. **Establish Principles/Absolutes for Process Behavior**
   - **Leadership**
   - **Line-of-sight (understood at each level)**

1. **Set Targets (including training)**
   - **Leading / Lagging KPI's**
   - **Reward behaviors that support the KPI's**
   - **Develop problem solvers**

http://www.crazyforcode.com/wp-content/uploads/2016/04/pill-problem-logic-brain-teaser-hard.jpg

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3 Must Do's – Action Items

1. Acknowledge the need for change and probably a new business model

2. Understand how it's all related (supported by data)

3. Embrace that most of your changes going forward are sociotechnical. Ready your workforce.

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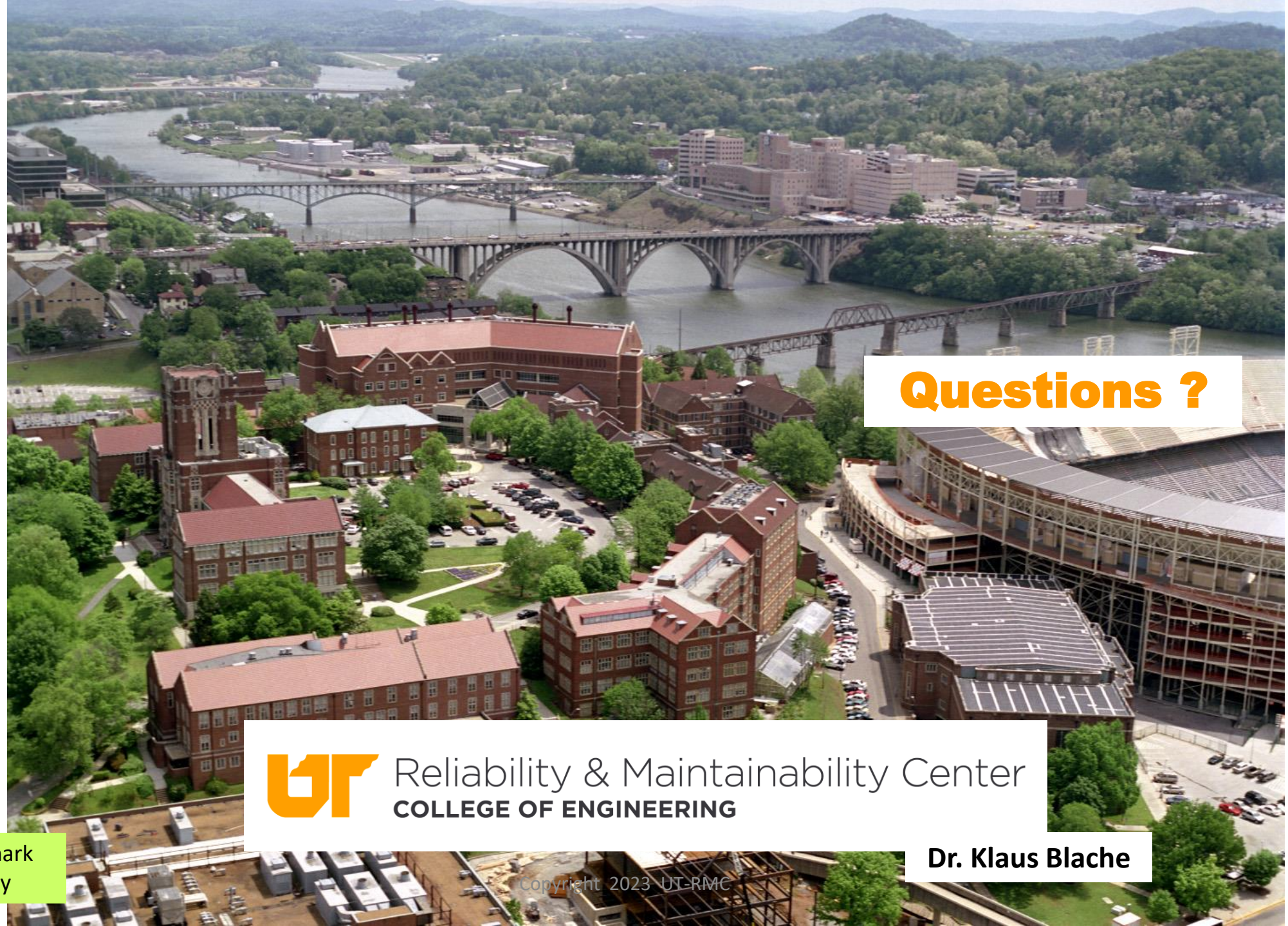

Questions ?

Reliability & Maintainability Center
COLLEGE OF ENGINEERING

Dr. Klaus Blache

Benchmark Survey

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