EOQ Conference
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International Academy for Quality

Designed Improvement:

NEXTGEN Quality Thinking

Gregory H. Watson, Chair
IAQ Designed Improvement Think Tank

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IAQ THINK TANK PROJECT DESCRIPTION

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Dr. Juran's Exhortation Regarding Six Sigma:

Joseph M. Juran
(1904-2008)

"Without a standard, there is no logical basis for making a decision or taking action."
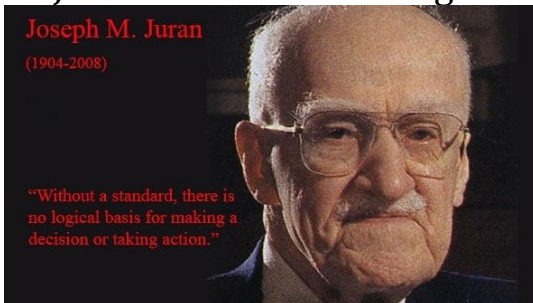
- Joseph M. Juran challenge in May 2001: "Don't make the same mistakes with Six Sigma that ASQ made in the development of Quality Engineering."

- Quality is not a brand and entitlement; a brand's reputation must be diligently earned daily through coordinated, inclusive acts of all members of the organization and then validated by the external consumers of its deliverables in the marketplace.

- Without a standard … there can be no improvement!

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The Problem as Presented ….

- Request from EOQ in November 2014:

  Develop a formal certification program for Lean Six Sigma Green Belt, Black Belt and Master Black Belt qualifications under the EOQ Personnel Registration Unit program.

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The Challenge Accepted ….

PROJECT DESCRIPTION:

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- After an initial benchmarking analysis of European and globally-based Six Sigma initiatives it was determined that there was no accepted standard for Six Sigma or Lean Six Sigma.
- In addition conflict with improvement initiatives from IT, accounting and engineering was observed.
- IAQ Think Tank Mission: develop an inclusive, generic approach for continue improvement that operates in a cross-functional way for all organizations – especially SME's.

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IAQ Designed Improvement Think Tank:
PROJECT DESCRIPTION:

Established a joint development project managed by Laatukeskus Excellence Finland:

Purpose and Organization:

This project began with a desire by the Board of Directors of the European Organization for Quality (EOQ) to standardize training in Lean Six Sigma methods throughout Europe. But, it quickly realized that the need was much broader. In 2014 the International Academy for Quality (IAQ) established a Think Tank to define a generic "systematic improvement" methodology to satisfy the EOQ's requirement. Laatukeskus Excellence Finland was appointed by EOQ to manage this project and coordinate its application within Europe.

The project team has been requested to develop a generic model and engage a broader global quality community to reach consensus for a final model and to develop a data base of case studies that demonstrate how to apply the method.

IAQ Think Tank Formed for the Investigation ….
PROJECT MANAGEMENT:

- The International Academy for Quality (IAQ) was set up in 1966 to be an independent professional quality organization whose membership of leading globally-recognized professionals is by invitation only.

- IAQ Think Tanks are established to conduct inquiries into particular subjects of interest to the Academy and develop academically-sound research that can be used by the global quality community to advance quality knowledge everywhere.

- Laatukeskus assigned as EOQ cognizant organization.

IAQ Designed Improvement Think Tank:
IAQ CORE TEAM MEMBERS:

Program Manager:
Tani Järvinen, Companion, IAQ; CEO, Laatukeskus [Finland]
Think Tank Chair:
Gregory H. Watson, Honorary Member, IAQ ; Advisor Laatukeskus [Finland]
Team Members:
- Lars Sörqvist, Academician, IAQ [Sweden]
- Bjorn Andersen, Academician, IAQ [Norway]
- Robert Schmitt, Academician, IAQ [Germany]
- Jeroen De Mast, Associate Member, IAQ [Netherlands]
- Paulo Sampaio, Associate Member, IAQ [Portugal]
- Pedro Saraiva, Associate Member, IAQ [Portugal]
- Markku Nieminen, Associate Member, IAQ [Finland]
- Jiju Anthony, Past-Associate Member, IAQ [United Kingdom]

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The Problem as Perceived ....

- The initial problem was perceived as a lack of quality standard for Six Sigma which could be applied in the European community for professional development and certification of qualifications.

- At this time there was no European-wide accepted document that defined Lean Six Sigma or Six Sigma qualifications. Numerous consulting firms offered a wide variety of programs under the "banner" of a Six Sigma or Lean Six Sigma title, but there was little in the way of agreement among their training programs and approaches to qualification. Most of these were commercially motivated.

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The Problem as Understood ....

1. Proliferation of conflicting "standards and approaches" to the Six Sigma-related body of knowledge by America, Europe and China with new standards produced by ISO and a consortium of US-based consultants which result in differing positions on how to implement these methods.

2. The approaches recommended for deployment of Six Sigma are burdensome for SME application and major companies have customized these methods to fit their own needs which creates a concern for standard implementation among many resource-poor quality organizations in SME companies.

3. In addition to these Six Sigma-related methods several other methods compete for organizational improvement among a few "non-Six Sigma" based improvement methods: business process reengineering, activity-based costing, and also lean enterprise management.

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Investigation Conducted ....
NATURE OF INQUIRY:

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- The first step was to conduct a survey and document the "state of the art" – approximately 284 Mbytes of files describing the related "body of knowledge."

- Benchmarking studies were conducted of the way to implement these methods by American and European companies and the approaches taken by all the major consulting companies and universities in teaching and presenting these Six Sigma-related methods.

- A detailed study of Japanese TQM methods was also undertaken for sake of comparison.

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Appreciation for the Japanese contribution ….

**JUSE**
Union of Japanese Scientists and Engineers

- Since 1948, JUSE (Union of Japanese Scientists and Engineers) has conducted a systematic development of quality as a science. It has continually built upon the prior advances to establish progress in learning about and understanding all aspects of the process for managing quality in organizations.
- This quality methodology has been practiced with a great deal of success throughout all Asia and globally.
- The Japanese quality way is ta basis for all systematic approaches to managing for quality [reference the presentation on integrated quality by Dr. Kano].

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Performance Improvement Refines Daily Management:

All change must be implemented in the daily management system to be effective!
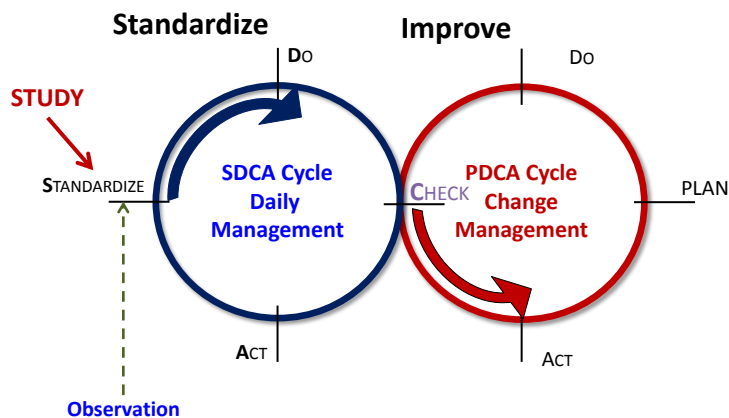
Management of quality in the routine activities is achieved using work standards.

* Standardize-Do-Check-Act (SDCA) / Plan-Do-Check-Act (PDCA) is the fundamental process mental model.

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SDCA/PDCA is an agile way to continual improvement:

Agile improvement alternates cycles of improvement and consolidation in a pattern that seeks increased alignment with the actual needs of customers.

A standardization cycle provides the opportunity to consolidate and solicit customer feedback for reflection on the degree of alignment achieved to date.

The improvement cycle provides an opportunity to leap forward and achieve increased capability thru application of creativity to better deliver customer needs.

Cycles of improvement increase the inherent design capability of the work system and move its performance toward the currently available "ideal" level of performance as constrained by factors of: technological capability, organizational understanding of customer experience, human competence and capability, and the alignment in strategic and operational direction.
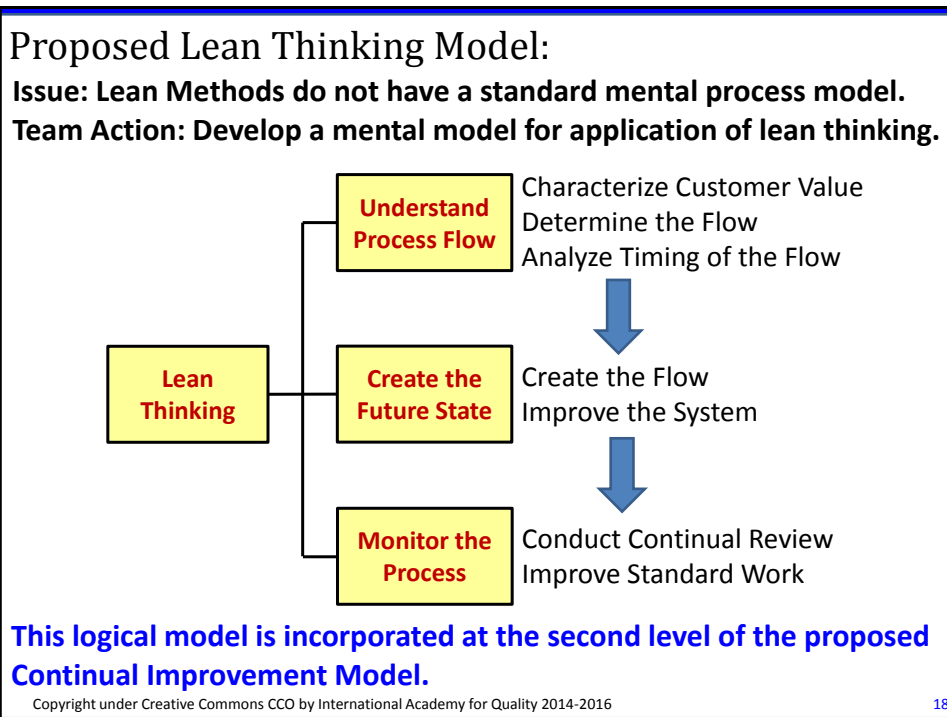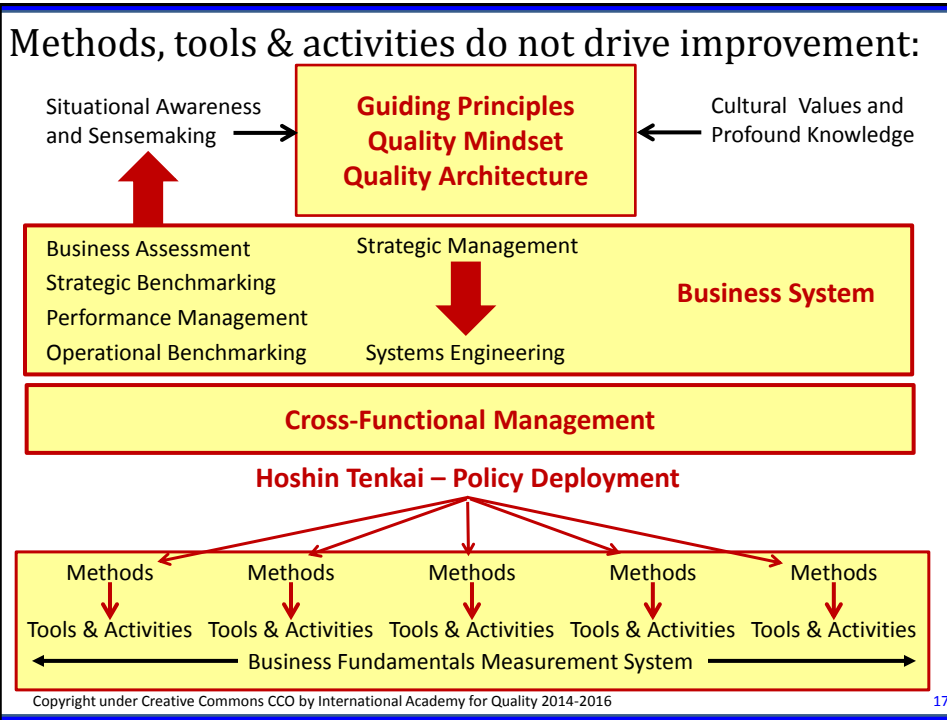
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Results Obtained …. Understanding "lean" better:

- Many of the methods studied had "bolted on" management fads as options to the core Six Sigma DMAIC methodology (e.g., balanced scorecard, net promoter score, etc.) without any academic rigor or critical investigation.
- Many non-proponents of Six Sigma-related methodologies have stated that statistical methods are not important for the continual improvement of organizations.
- Several of the approaches had created complex bureaucratic organizational designs that are impossible for SME companies to implement.
- Most importantly, it was clear that the Western understanding of lean methods deviated greatly from the practice of these methods in Japan [reference Nicholas Modig, What is Lean?].
- This created the first discovery: a mental model for the use or application of lean methods in organizations.

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Methods, tools & activities do not drive improvement:

Situational Awareness and Sensemaking → **Guiding Principles / Quality Mindset / Quality Architecture** ← Cultural Values and Profound Knowledge

Business System

Business Assessment
Strategic Benchmarking
Performance Management
Operational Benchmarking

Strategic Management

Systems Engineering

Cross-Functional Management

Hoshin Tenkai – Policy Deployment

Methods	Methods	Methods	Methods	Methods
Tools & Activities	Tools & Activities	Tools & Activities	Tools & Activities	Tools & Activities

← Business Fundamentals Measurement System →

Proposed Lean Thinking Model:

Issue: Lean Methods do not have a standard mental process model.
Team Action: Develop a mental model for application of lean thinking.

Lean Thinking

Understand Process Flow — Characterize Customer Value / Determine the Flow / Analyze Timing of the Flow

Create the Future State — Create the Flow / Improve the System

Monitor the Process — Conduct Continual Review / Improve Standard Work

This logical model is incorporated at the second level of the proposed Continual Improvement Model.

Understanding Process Flow in Lean Management:

This initial step in the mental model of lean management is often the one that is missing or reduced in emphasis. This is the initial step of a 10-S process to understand current state performance.

Understand the Process Flow [Current State Analysis]		
Characterize Customer Value	**Determine the Flow**	**Analyze Timing of the Flow**
1-SIPOC Analysis	1-One-Piece Flow	1-Lean Process Measures
2-Customer Requirements Analysis	2-Seven Flows	2-Process Effectiveness Analysis
3-Muda-Mura-Muri	3-Spaghetti Map	3-Value Stream Map
4-Seven + Wastes	4-Six Losses	4-Rolled Throughput Yield
5-I-Chart of Process Results Analysis	5-Theory of Constraints	5-Analysis of Variance (ANOVA)
6-Takt Time	6-Five Why Analysis	6-Yamizumi Diagram
7-Fishbone Diagram/Mind Map	7-Five W's + 1 H Analysis	7-Inventory Buffer Analysis
8-Process Capability Analysis	8-Deployment Diagram	8-Process Bottleneck Analysis
9-Seven Zero's of Production	9-Gemba Walk / Hansei	9-Pareto Diagram
10-Makigami Diagram	10–Lean Process Audit	10-Radar Diagram

ISSUE: How have the organization assigned responsibility for quality to the participants in the work process flow? Has the process of *Hansei* been applied cross-functionally in the "Check" steps of PDCA and SDCA ?

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Implementing Lean Process Management Approach:

The lean "toolbox" of methods provides mechanisms by which to address waste. This is the visible part of lean operations and it is most often emphasized in lean improvement efforts.

Creating the Future State Process (Remedial Journey)	
Create the Flow	**Improve the System**
1-Increase Customer value	1-Standardize work (gensoku)
2-Eliminate waste	2-Establish housekeeping and improvement (10-S)
3-Design work to flow	3-Eliminate 3D's (dirty, dangerous and difficult)
4-Eliminate failures and mistakes	4- Mistake proof work process (Poka Yoke)
5-Create Continuous Flow (apply kanban)	5-Generate Alerting information (Visual Factory)
6- Balance work flow to takt time (heijunka)	6-Integrate man-machine tasks (Jidoka)
7-Implement Customer Demand Pull	7-Hanedashi, tebanare, and chaku-chaku production
8-Decrease lot size and use one-piece flow (Just-in-Time)	8-Plan for Every Part (PFEP) procurement process
9-Shorten changeover time (SMED)	9-Maternai handling (minomi, jundate, and junbiki)
10-Handle variation in demand	10-Workers Own Processes (Ji Kotei Kanketsu (JKK)
11-Take control over variation in the flow	11-Autonomous equipment maintenance by workers
12-Identify "one-best-way" for standard work (gensoku)	12-Total Productive Maintenance (TPM)
13-Innovate in flow (Reengineering principles)	13-Kaizen Teian employee suggestion system
14-Develop flow by using new technology (Information Technology and manufacturing technologies)	14-Waterspider supervisory function
	15-Systematic approach to CI teamwork
15-Kansei kougaku – engineer for the (human) senses	16-Kami Shibai – supervisor auditing work discipline

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Continual Process of Monitoring and Improving Flow:

The objective of management is to develop a self-regulating system of work that is self-motivated culturally to continually improve the quality of work by reducing waste, cycle time and cost.

Monitoring the Process to Assure Conformance and Seek Improvements	
Continual Review	
1-Self-Inspection (Zero QC)	17-Jishu Kanri – Self-Mastery Management System
2-Problem Solving (SDCA)	18-Jishuken – Management-Driven Kaizen Projects
3-Process Kaizen (PDCA)	19-Catchball – interactive planning process
4-Cross Functional Teams (yokoten)	20-Nemawashi – informal target negotiation
5-Quality Circle Activities	21-Ringiseido – Shared decision process
6-Kaizen Improvement Projects	23-Tatakidai – Discussion of ideas across levels
7-A-3 Report for Daily Management System	24-Shoujinka – Flexible manpower assignment
8-Strategic Management by Policy (SMBP)	25-Shouryokuka – Labor-saving devices
9-Hoshin Kanri (Strategy Management System)	26-Menashinoshoujinka – Decrease staff to demand
10-Hoshin Tenkai (Policy Deployment)	27-Nagara – Doing more than one thing at a time
11-X-Matrix for Hoshin Tenkai	28-Shigoto – Increase value-adding work
12-Kaikaku Projects – Breakthrough Projects	29-Soikufu – Creative ideas from workers
13-Irei Projects - Strategic Imperative Priority Projects	
13-Hourensou - Frequent reporting to management	
14-Nichijo Kanri (Daily Management System)	
15-Hinshitsu Kanri (Quality System for Daily Management)	
16-Presidential Review	

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Results Obtained …. Generic Approach for Improving:

- As an organizational objective "improvement" has three distinct focus areas: doing todays work better so that it consistently meets standards at the lowest total cost; increasing capability of today's work so it approaches an ideal level of performance: and moving today's work to an exceptionally different performance level. These objectives translate into quality practices by managing compliance in the performance of daily work standards; continually improving the quality of daily work to reach its ideal performance; and creating innovative ways that manage work through disruptive breakthroughs giving a totally new way to manage work.
- The mental models defining these focus areas must be integrated and aligned to manage work properly.

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CONTINUAL IMPROVEMENT MODEL

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Results Obtained ... Continual Improvement Model:
- The model is a seven-step project management process that pulls data through a series of questions and operates at three levels of competence in conducting an inquiry:
    - (1) Maintaining and improving standard work (process doers who operate at a so-called "yellow-belt" level);
    - (2) Solving more complex problems and integrating work flows across processes (process facilitators who operate at a so-called "green-belt" level); and
    - (3) Increasing work performance capability by designing improved cross-process work flows (process designers who operate at a so-called "black-belt" level).
- This model uses core measures of work processes: quality of throughput, consistency, safety, economy of operations, and worker motivation. It also applies team-based methods as supervised by a trained facilitator who leads the effort.

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Continual Improvement Model:

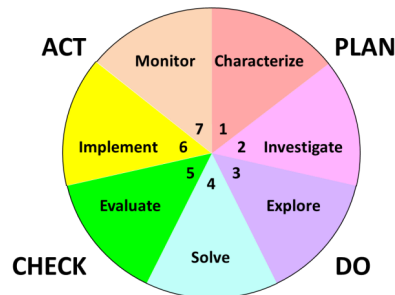**A thinking process to pull observations into data that shows causality and improves the way that people work:**
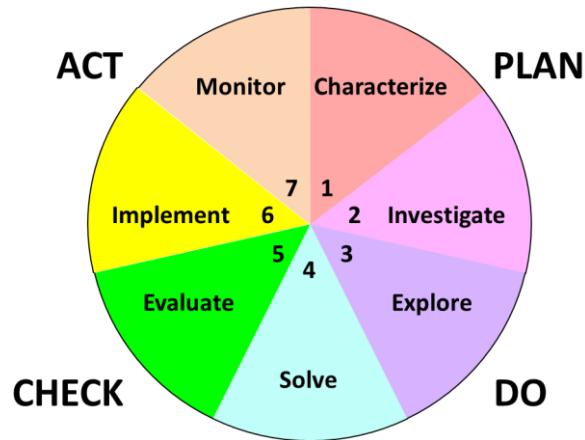
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1. Characterize

Questions Addressed:
- What is the issue or concern?
- What are the symptoms?
- How big is the potential impact?
- Where is the situation occurring?
- How does it affect our customers?
- Who should take responsibility?

DMAIC: Recognize-Define

NEW ELEMENTS INCLUDED IN THIS PHASE:

- Strategic Alignment of Improvement Projects
- Measurement System Alignment
- Situational Awareness and Sensemaking
- Lean Thinking – Characterize Customer Value
- Behavioral Analytics (Strategic – System 1 and System 2)
- Exploratory Data Analysis (Results Measures)

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2. Investigate

Questions Addressed:
- What is the situation?
- How well is the process doing?
- How well could it be doing?
- Can the process detect problems?
- How can the process fail?
- What is the process loss function?
- Does the history show any trend?
- Where should the project focus?

DMAIC: Define-Measure
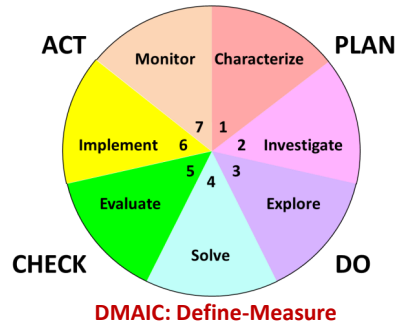
NEW ELEMENTS INCLUDED IN THIS PHASE:

- Behavioral Analytics (Operational Applications)
- Graphical Process Analysis and Mind Mapping
- Business Risk Analysis (Externalities)
- Lean Thinking – Determine the Flow
- Business Excellence Assessment
- Strategic Benchmarking

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3. Explore

Questions Addressed:
- Is anyone doing this work better?
- What are the potential causes?
- What is the cost of poor quality?
- How can the work be simplified?
- Which factors affect variation?
- Where is productive time lost?
- Where is cost wasted?
- How much variation is explained?
- What are potential root causes?
- Are there any 'missing' variables?

DMAIC: Measure-Analyze
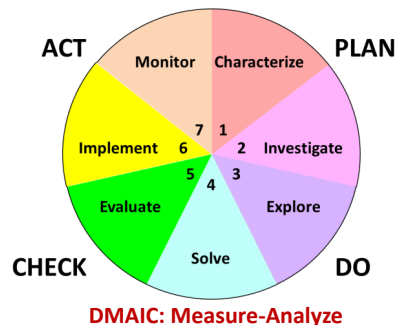
NEW ELEMENTS INCLUDED IN THIS PHASE:

- Responsibility and Risk Analysis (Internalities)
- Behavioral Analytics (System 2 Rules Development)
- Lean Process Analysis – Analyze the Flow
- Exploratory Data Analysis (Process Measures)
- Best Sub-sets Regression
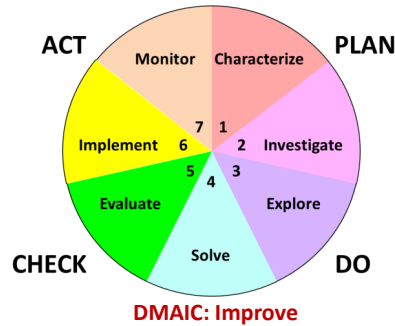- Partial Least Squares Regression

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4. Solve

Questions Addressed:
- Which factors affect performance?
- What factors manage variation?
- What factors shift the average?
- What factors reduce operating cost?
- What is their operating envelope?
- What happens outside this range?
- How are these factors controlled?
- How can the process be controlled?
- How easily can it be implemented?

ACT — Monitor — Characterize — PLAN
Implement 6 — 7 1 — 2 Investigate
5 4 3
Evaluate — Explore
CHECK — Solve — DO

DMAIC: Improve

NEW ELEMENTS INCLUDED IN THIS PHASE:
- Lean Thinking – Create the Flow
- Graphical Process Analysis and Mind Mapping
- Operational Process Benchmarking
- Corrective Action / Preventive Action (CAPA)
- Process Laboratory
- Time Series Analysis
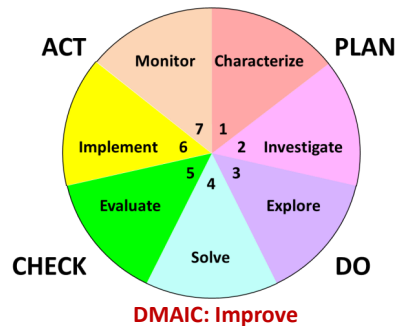- Sequential Design of Experiments (DOE)

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5. Evaluate

Questions Addressed:
- How to optimize factor settings?
- Is the solution sufficiently robust?
- Do indicators need to change?
- Are measurement methods valid?
- What financial benefit will result?
- How to capture the benefits?
- Who is responsible for action?

ACT — Monitor — Characterize — PLAN
Implement 6 — 7 1 — 2 Investigate
5 4 3
Evaluate — Explore
CHECK — Solve — DO

DMAIC: Improve

NEW ELEMENTS INCLUDED IN THIS PHASE:
- Taguchi Confirmatory Analysis
- Lean Thinking – Improve the System
- Decision Workout
- Kaizen Blitz
- Lean Accounting
- Target Cost Analysis

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6. Implement

Questions Addressed:
- What will be standard work?
- Which factors must be managed?
- What is their tolerance range?
- How will the process be maintained?
- What training will operators need?
- How will work errors be prevented?
- What is the action plan?
- How to leverage this knowledge?
- How to capture the benefits?

DMAIC: Control-Standardize
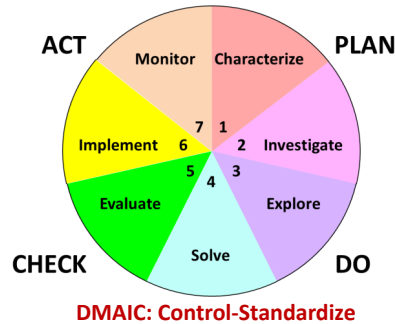
NEW ELEMENTS INCLUDED IN THIS PHASE:
- Hoshin Tenkai / X-Matrix
- Lean Process Control
- Implementation Plan
- QC Story
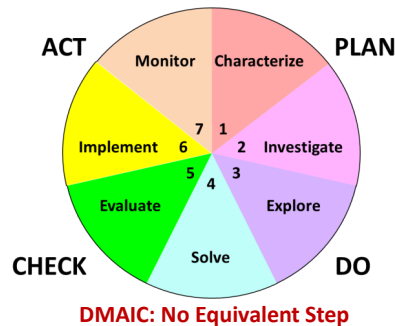- 4-Up Chart
- Benefit Capture Plan

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7. Monitor

Questions Addressed:
- How is the process operating?
- Where is standard work not right?
- Does the team work consistently?
- Where is waste occurring?
- What can be improved?
- What conditions are not safe?
- How does it affect our customers?
- What people should address it?

DMAIC: No Equivalent Step

NEW ELEMENTS INCLUDED IN THIS PHASE:
- Daily Management System (Nichijo Kanri)
- A-3 Report with Radar Diagram
- Performance Monitor System (4-Up Chart)
- Lean Thinking – Conduct Continual Review
- Lean Thinking – Improve Standard Work
- Lean Thinking – Presidential Review

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PLANNED PROJECT PILOT PHASE

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Future Development Plans ....
PROJECT PILOT PHASE:

- Develop Train-the-Trainer program for facilitators of the Continual Improvement Model – Summer 2016.
- Develop Training materials for three-tier competence model – Summer 2016.
- Deliver the Trainer Program for Pilot facilitators and organizations – Fall 2016.
- Initiate pilot projects in Finland, Germany, Portugal, and Norway – Fall 2016.
- Complete final project report – December 2016.

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Continuing IAQ Think Tank activities:

The following reports and papers will be finalized:
- Final Report of the IAQ-EOQ Designed Improvement Think Tank.
- Benchmarking Study Report: Japanese Models of PDCA
- Benchmarking Study Report: Approaches to Six Sigma DMAIC
- Critique of the Lean Six Sigma Standards
- Academic journal articles will be prepared on the topics such as: Continual Process Improvement, Exploratory Data Analysis, Hypothesis Testing, Measurement Systems Analysis, Rational Sub-Grouping and Stratification, Failure Analysis, Measurement Systems Analysis, Decision Prioritization, Lean Improvement Process, and the Process of Experimentation.

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Project Plans through 2017:
PROJECT MILESTONES:

- 2016: Complete pilot projects and final report.
- 2017: Integrate into EOQ PRU certification scheme.
- 2017: Train national level instructor-facilitators.
- 2017: Prepare IAQ book on Continual Improvement.
- 2017: Initiate IAQ Think Tank project on the topic of designed improvement for innovation.

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Thank you for your attention!

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