



QC&RE Division
Webinar 1
2 May 2012

A Systems Approach to Quality Management: How Quality Supports Business

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Webinar Series Description:

Managing for quality requires a systems approach that includes all components of a comprehensive product: hardware, software, service and people processes. Such quality systems are designed using technologies that include: applied statistics, process management, reliability engineering, information systems, and data base management. When problems occur, diagnostic analysis is required to contain the issue as well as develop prompt corrective action as well as effective preventive action to eliminate recurrence of the issue. In the century since Frederick W. Taylor introduced scientific management, quality methods have been developed and expounded by numerous "luminaries" who have been heralded as gurus in the field and they have promoted various theories and methods. However, in retrospect it is now possible to take a systems approach to define the act of "managing for quality" in a way that supports achievement of business objectives in a comprehensive, cross-functional way. This first lecture in this series of six lectures on various aspects of modern quality management will set the stage for understanding the modern integrated approach that blends traditional financial management with quality management to achieve productivity in a cohesive management system that delivers business control within the framework of flexible growth while encouraging innovative improvement in the business system.

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IIE Quality & Reliability Division Webinar Series:



- **Session 1: Systems Approach to Quality Management**
- **Session 2: Structured Approach to Lean Process Management**
- **Session 3: Managing for Reliability**
- **Session 4: Benchmarking for Competitive Advantage**
- **Session 5: Applying the Kano Model for Requirements Analysis**
- **Session 6: A Modern Approach to Value Engineering**

About Presenter:



Gregory H. Watson is a Fellow of IIE and currently is the Senior Vice President, International on the Board of Trustees. Previously, he has served on the Board of Directors of the IIE Quality & Reliability Engineering Division. He is also presently Chairman and Academician in the International Academy for Quality. He is a past-President and Fellow of the American Society for Quality (ASQ). Mr. Watson is a registered European Engineer (EUIng) in both systems and industrial engineering, holds advanced degrees in engineering, law and management, and is completing his PhD in Industrial Engineering at Oklahoma State University to prepare for a retirement career in education. Mr. Watson is President of Business Excellence Solutions, Ltd., a Finland-based management consulting company and has previously held executive positions with Xerox Corporation, Compaq Computer Corporation and the Hewlett-Packard Company. He is the author of ten books. **Strategic Benchmarking** (John Wiley, 1993) was chosen by Fortune Magazine as a Book-of-the-Month selection and named by Library Journal as one of the 12 best business books of 1993. Among the awards he has received, Mr. Watson is the only non-Japanese recipient of the Deming Medal from the Union of Japanese Scientists and Engineers. He has received over twenty major awards including the Distinguished Service Medal from ASQ, the Founders Medal from the International Academy for Quality, the C. Jackson Grayson Medal from the American Productivity & Quality Center, the Magnolia Quality Contribution Award from the City of Shanghai, and the Gold Medal of the Finnish Society for Quality. Mr. Watson may be contacted at greg@excellence.fi.

The imperative for continual improvement:

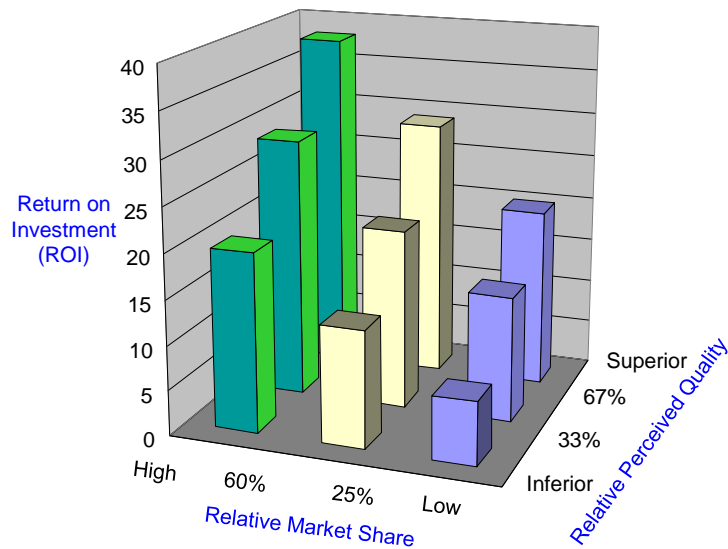


W. Edwards Deming (1900-1993)

“You don’t have to do this, survival is not compulsory.”

~ W. Edwards Deming

Customer perceived quality drives business results!



* Bradley T. Gale, *The PIMS (The Profit Impact of Market Strategy) Principles*, Free Press, 1987.

Today's Topics:



- Theory of Profound Knowledge
- Systems Approach to Quality Management
- Structured Approach to Learning

System of profound knowledge – W. Edwards Deming:



Theory of Profound Knowledge – 1992

W. Edwards Deming (1900-1993)
The New Economics (1992)

“The theory of knowledge teaches us that a statement, if it conveys knowledge, predicts future outcomes, with risk of being wrong, and that it fits without failure observations of the past.”

“To put it another way, **information**, no matter how complete and speedy, **is not knowledge.**”

“Knowledge has temporal spread. **Knowledge comes from theory.**”

“**Without theory, there is no way to use the information that comes to us.**”

Four elements of the theory of profound knowledge:

What is profound knowledge?

Statistical knowledge of process performance

Deming identified four aspects of **profound knowledge**:

- **Structure of Systems**: understanding the system in which work is being done (process management).
- **Control of Variation**: knowledge of system operation comes from a study of performance variation, improvement requires the control of the sources of variation (statistical thinking).
- **Development of Knowledge**: knowledge comes by observing work, defining a theory, testing and confirming it (measurement system).
- **Psychological Impact**: human behavior must be understood, motivated and coordinated to achieve results (collaborative culture).

What is a system?

- **System**: a collection of processes that are working together to achieve a common purpose by sharing their resources for their mutual benefit.
- **Truth about systems**: they have a **purpose**; systems have competitors; systems are in **transformation** (old to new state); in systems there are independent **components** that must cooperate to achieve the purpose; the system must create **value**; a system cannot manage itself; one does not optimize a system by optimizing its component parts.
- When comparing the relationship between **cause and effect**, what is a loosely **coupled system** compared to a tightly coupled system? Does it matter? Why?
- How much **“cooperation”** is required among the components within a system? Is this **the** critical means to improvement?
- If I claim a loosely coupled system is **“stochastic”** what would it imply?

Scientific approach to improvement methods:



Frederick Winslow Taylor (1856-1915)
“Principles of Scientific Management” (1911)

“The system must be first!”

“The greatest permanent prosperity for the workman, coupled with the greatest prosperity for the employer can...only exist as the result of the **greatest possible productivity** of the men and machines of the establishment.”

“One of the dangers to be guarded against, when the pay of a man or woman is made in any way to depend upon the quantity of the work done, is that **in the effort to increase the quantity the quality is apt to deteriorate.**”

The “system component” in improvement:

“A system is a set of interrelated components. Each of a systems elements is connected to every other element either directly or indirectly” (Ackoff).

Physical systems are more simple than biological or social systems and the dynamic interaction between multiple types of systems must be understood so that systems of people (e.g., technocrats and bureaucrats) can share a common understanding of the total system complexity.

We tend to apply the Pareto Principle to discover the frequently occurring contributor to problems, but, in a systems world frequency of contribution is not the same as dominance for causal contribution to the overall system variation.

Jay W. Forrester, Principles of Systems (Cambridge, MA: MIT Press, 1968).

Russell L. Ackoff, “Toward a System of Systems Concept,” *Management Science*, Vol. 17, No. 11, July 1971.

Theoretical approach to process control:



“Theory of Control”

Walter A. Shewhart (1891-1967)

The Economic Control of Quality of Manufactured Product (1931)

“To indicate the relationship which the **theory of control** bears to exact science, it is interesting to consider six stages in the development of better ways and means of making use of past experience. They are:

- “1. Belief that the future cannot be predicted in terms of the past.
- “2. Belief that the future is pre-ordained.
- “3. Inefficient use of past experience in the sense that experiences are not systematized into laws.
- “4. **Control within limits.** } **Statistical Process Control**
- “5. Maximum control.
- “6. Knowledge of all laws of nature – exact science.”

The “statistical component” in improvement:

Statistical Thinking:

A process of learning and then taking action based on three following principles:

- **All work occurs in a system of interconnected processes.**
- **Variation exists in all processes – use data to learn about processes.**
- **Understanding and reducing variation are the keys to performance management and business improvement.**

Special cause variation is any deviation from standard process performance that can be assigned a cause. Common cause variation is the natural level of variation that exists in the process – it has no assignable cause but represents variation that is inherent in the system design.

When **common cause variation** is too great to obtain performance results expected of the process, then transformation or redesign is required.

The “knowledge component” in improvement:

There are distinct categories of facts that bias proposed problem solutions. We can observe facts using one perspective (e.g., physical), but interpret it using a different perspective (e.g., political). Thus, “managing by facts” is subject to a subjective manipulation by those who lack a shared political vision.

Limitations of Knowledge – what can we know with confidence?

Type of Data	Explanation of Data	Nature of Data
Physical data	Continuous variables (engineering quality data)	Tangible
Biological data	Ergonomic data (time and motion)	
Process data	Timing and attribute data (pass/fail compared to criteria)	Less Tangible ↓
Economic data	Approximations (estimates based on probability forecast)	More Intangible
Political data	Leadership and strength of relationship (fixed scale/rank)	
Social data	Interactions or relationship (group norm relativity)	↓
Moral data	Values or personal philosophy (individual relativity)	Intangible

Chester I. Barnard, *Functions of the Executive* (Boston: Harvard, 1936).

The “psychological component” in improvement:

In an “inverted” Kano Model **avoidance of unattractive quality** happens with a shift in motivation, assessed using Maslow’s hierarchy of needs, where the ***fundamental need becomes emotive, rather than rational.***

Driving improvement requires engagement of all combined human resources in an organization. Teamwork must become a way of working in the culture and ***individuals must be respected for their knowledge and encouraged to participate in improvement activities*** to assure the best possible result as well as to stimulate their collaboration during implementation.

Teams must work across functional and organizational boundaries to embrace the complete “informal organization” of process stakeholders to assure maximum improvement is achieved with a minimal investment of time. This necessitates maximum cooperation and collaboration.

System-wide improvement requires active engagement of both managers and workers who participate in improvement activities. Each must contribute in a specified role that is appropriate for their competence.

So, how does profound knowledge lead to quality?

Some questions for consideration:

- Is quality limited to physical parts?
- Does quality include production processes?
- Does quality include service processes?
- Does quality include management processes?
- What does “managing for quality” really mean?

What is quality?

- It is a noun: quality is a state that can be attained
- It is a modifier: quality is possessed as an attribute
- It is a collection of tools and methods: quality is a profession
- It is a relative judgment: quality is perceived as subjective

No matter how quality is defined – it must make a difference in results!

Begin by building sensitivity to customers!



Noriaki Kano 狩野紀昭 (1940-)
Japanese Quality Professor

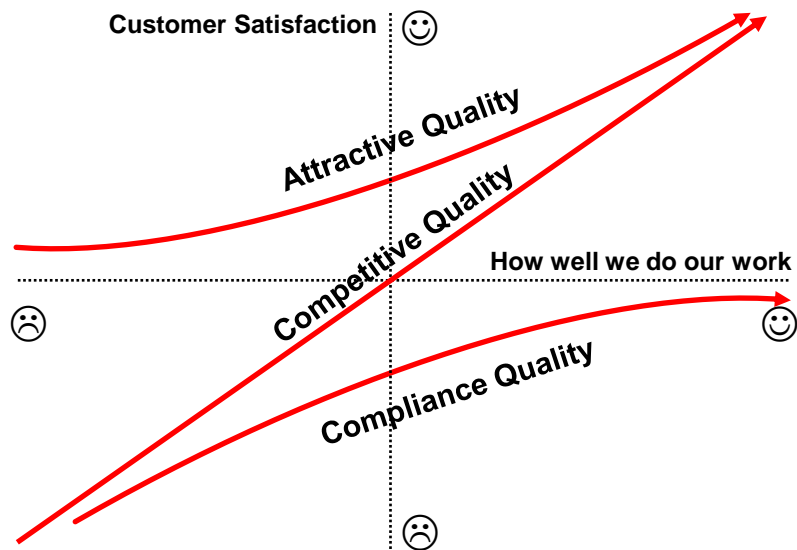
“Theory of Attractive Quality” (1984)

“Quality activity can only begin if top management is conscious of the critical need for organization wide commitment to quality and its own responsibility for introducing such activity.”

“Improving all attributes of quality will not lead to satisfied customers as not all attributes are equal in their eyes. Some quality attributes will increase the value to customers because they are attractive and do not detract even when their physical fulfillment is not strong.”

Attractive quality anticipates the needs of customers!

Theory of attractive quality – Noriaki Kano:

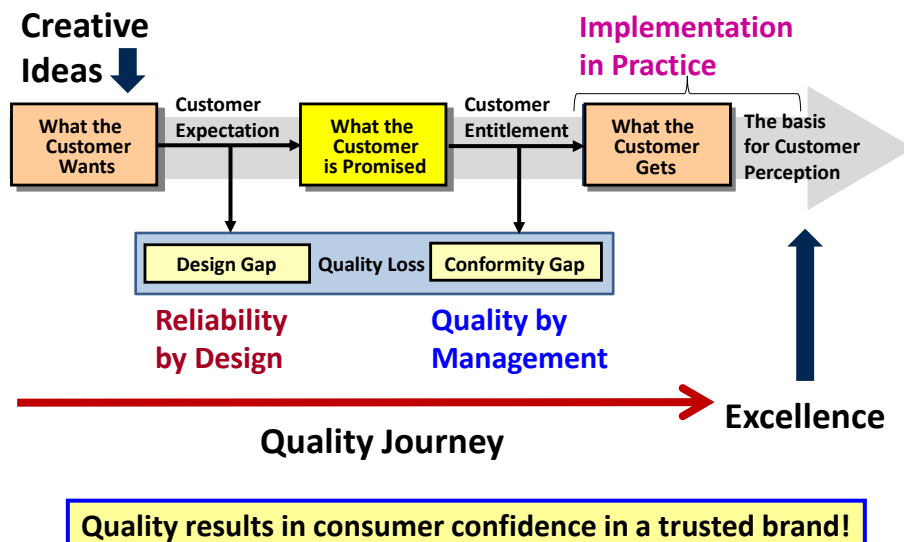


* Kano, N.; Seraku, N.; Takahashi, F.; and Tsuji S. (1984), Attractive quality and must-be quality, Quality, Journal of Japanese Society for Quality Control, 14:2, pp. 39–48.

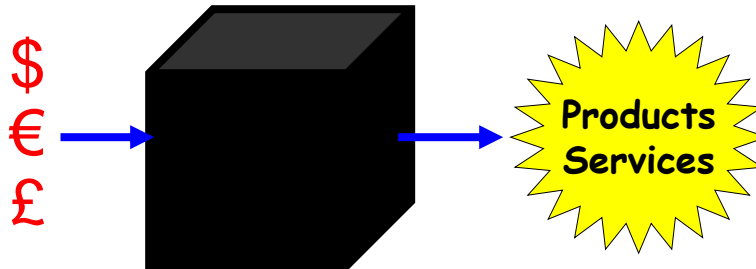
Quality approach to mutual prosperity:

- Quality is coupled with the concept of producing exceptional value as judged by the consumers of your products and services.
- Genichi Taguchi taught that **poor quality results in a loss to society**. Noriaki Kano encouraged mankind to **pursue attractive quality**. As an outcome of these two complementary ideas, it is clear that **lack of quality causes a loss for everyone**.
- Quality is not a 'zero-sum game' where 'I win-you loose!' When we achieve high quality then we all win! It must be mutually beneficial – good outcomes for all!
- Producing quality is free, according to Phil Crosby, as the losses that poor quality causes are no longer inflicted upon society!
- Prosperity is a state of 'economic well-being – **success** – for all the participants as process stakeholders (suppliers, organizations itself and is customers).

What is the process for quality delivery?



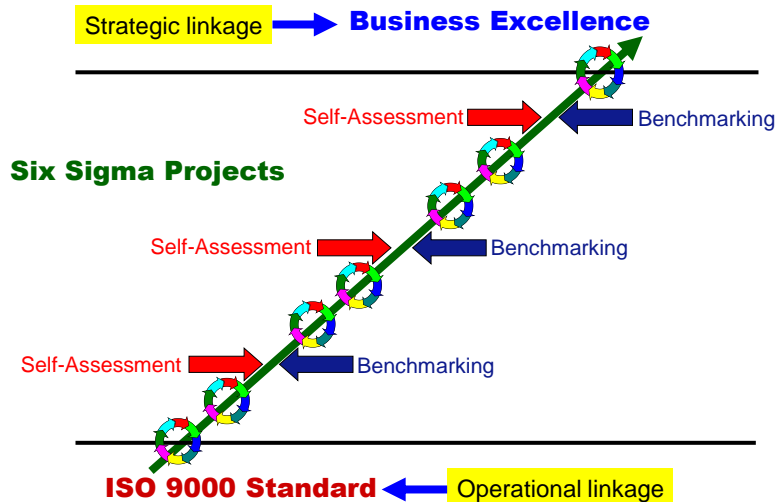
Outside-in quality is different from inside-out quality!
From the outside-in our organization is a black box!



Customers see our organization as a complete “entity” and expect to have the relationship with that entity operating consistently across all of its units (there is an expectation of flawless collaboration among the internal functions).

To ourselves we are a complex network of systems, structures, processes, and people. How we combine our skills and resources to work in the “black box” is described by the process model of business which cascades down to our individual work activities.

Integrating quality into the management system:



Tools and Methods of Quality Management Systems:

ISO9000 Standard +	Lean Six Sigma Method +	Business Excellence
<ul style="list-style-type: none"> •Customer Management •Commercial Requirements •Work Standards •Process Mapping •Work Documentation •Control Plans •Documentation Control •Management Review •Work process Audit •Managing by Fact •PDCA Problem Solving •Basic Quality Toolkit •Basic Statistics •Corrective action •Preventive action •Continuous improvement 	<ul style="list-style-type: none"> •Exploratory Data Analysis •Variation Reduction Process •DMAIC Problem-Solving •Risk Analysis •Hypothesis Testing •Measurement System Analysis •Pull System Work Flow •Cycle Time Reduction •Constraint/Bottleneck Relief •Waste Elimination •Mistake-Proofing •Just-in-Time/Kanban flow line •ANOVA/Regression •Design of Experiments •Statistical Process Control •Visual Factory 	<ul style="list-style-type: none"> •Leadership and Governance •Strategic Linkage •Strategic Plans and Projects •Ethics and Social Responsibility •Organizational Assessment •RADAR Methodology <ul style="list-style-type: none"> •Review •Approach •Deployment •Assessment •Results •Performance Measurement <ul style="list-style-type: none"> •Business Results •Operational Indicators •Comparative Benchmarks •Knowledge Management

Business Excellence vs. Operational Excellence:

Business Excellence	Operations Excellence
<p>Big Q – Strategic Quality</p> <p>Culture (Company) Vision, Mission and Values Policy and Philosophy</p> <p>Competition (Business Learning) Innovation Leverage Benchmarking</p> <p>Change (Renewal) Strategic Operational</p> <p>Cascade (Alignment) Improvement Projects Objectives and Targets Measures</p> <p>Communication (Awareness) Message Media</p>	<p>Little Q – Operational Quality</p> <p>Competence (People) Individual and team development Training/development program</p> <p>Capability (Process) Daily process management Data bases and analytic software</p> <p>Compliance (Product) Quality management system Performance agreements</p> <p>Certification (Standardization) System certifications/standards Functional certifications/standards Industry certifications/standards</p> <p>Conformity (Learning) Business and operational reviews</p> <p>Correction (Repair & Improvement) Corrective / Preventive Actions</p>

So, what is Lean Six Sigma?

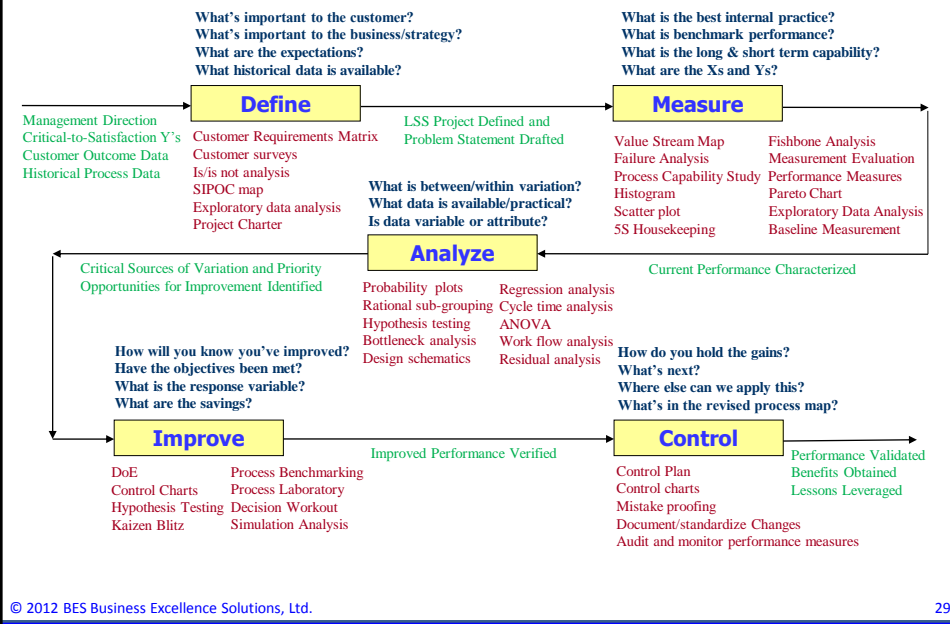
- **A philosophy of management** – the flawless execution in performance of the customer’s experience as compared to their expectation for results by taking out waste, removing defects, and increasing reliability of work efforts.
- **An analysis methodology that applies the scientific method** – Lean Six Sigma performs rapid, team-based problem-solving that focuses on getting the most out of current processes to optimize return on investment for the money that is already invested in current process capability while reducing working capital committed to business operations. It combines the approaches of the Toyota Production System and Six Sigma statistical problem-solving methods.
- **A process measurement methodology** – Sigma is a statistical quality measure of performance; the number of standard deviations between average level of performance and the customer’s requirement for performance. It is a market-oriented measure of “flawless execution” of work processes and outcomes.
- **A disciplined work culture** – people routinely manage with data and create an intolerance for variation and waste that affects their customers.

Mental models of decision-making help drive change:

Generic Approach	DMAIC	DMADV
Explore / Characterize / Plan-Do	Define	Define
	Measure	Measure
	Analyze	Analyze
Learn / Optimize / Check-Act	Improve	Design
	Control	Verify
Change / Implement	Integrate / Standardize	Produce

- What would be the features of a simplifying model that is able to integrate the components of DMAIC and DMADV into one way of working at “continual improvement” whether it be for a process, service or product?

BEST Lean Six Sigma™ DMAIC:



Decision-making processes in LSS Improvement:

Lean Six Sigma (LSS) organizes the principles, methods and tools of quality so that teams can work on three systematic processes:

DMAIC – Statistical Problem-Solving – increasing capability in current processes

- **Define** – what performance improvement is required?
- **Measure** – how well are we doing today?
- **Analyze** – what contributes most to our degradation?
- **Improve** – what can we do to get better?
- **Control** – how can we maintain excellent performance?

DMADV – Design for Six Sigma – creating new outcomes with higher capability

- **Define** – what is the business issue that we are facing?
- **Measure** – what alternatives do we have to consider?
- **Analyze** – what does our customer need from us the most?
- **Design** – what is the best way to deliver this requirement?
- **Verify** – can we assure continuing, reliable performance?

BEST Lean Six Sigma™ Ten-S:



10-S Method

Whose responsibility is it to accomplish each step in this lean process management approach?

- **Study** – Analyze work to find waste and value losses
- **Sort** – Divide work into categories according to value
- **Sanitize** – Clean the work place to make waste visible
- **Systematize** – Organize the flow of the work activity
- **Streamline** – Eliminate unnecessary activities
- **Simulate** – Check work performance prior to change
- **Synchronize** – Set the timing for optimal work flow
- **Safeguard** – Eliminate the possibility of mistakes
- **Standardize** – Assure all work follows the standard
- **Self-Discipline** – Consistently perform and improve

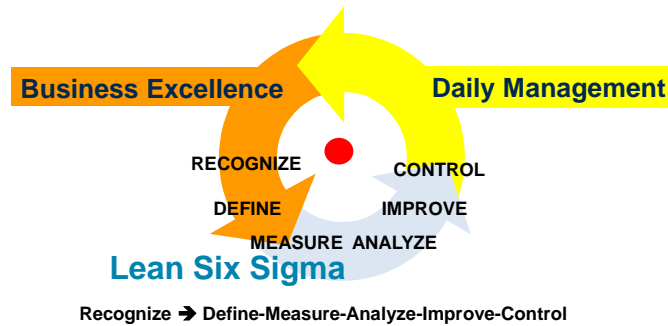
Measure improvements in management's language:

Management keeps score for its measure of success in financial terms. Thus, the final measure of the value of an organization is monetary. However, the pragmatic success of an enterprise is determined less by its degree of profitability than by the distribution of the wealth that it has created.

If we eliminate waste from enterprises and increase their efficiency, delivering a higher value of its "actual entity" (products and services), then the enterprise is eligible to be considered successful. However, true success is attained when its contribution to society raises the standard of living of its entire social system – in other words, the benefit of the organization's performance is dispersed across the full spectrum of the organization's social system.

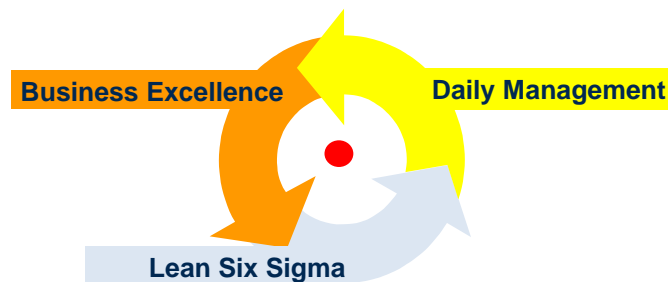
In terms of the percentage increase in standard of living, it takes less effort to raise the life quality of the lower economic classes than it does to increase the standard of living of the higher classes. At some point, affluence of the wealthy becomes a drain on society as it reduces the quality of life for the masses. One benefit of a social democracy is equality of opportunity through managed distribution of the economic benefits from successful, efficient organizations to raise the quality of life for all citizens so they can live beyond the safety net of the limits of poverty.

LSS links quality strategy to daily management:



The Process of Management (POM) begins with the need to establish the content of organizational strategy (e.g., a coherent purpose as defined by a single vision, strategic direction and strategic imperative) this must be supported by a self-assessment process, strategic benchmarking within the context of an integrated planning, execution and review process. Business excellence does not occur by accident, it is planned and executed with diligence. This defines the “recognize” front-end to an LSS-driven process of change.

What does this require?

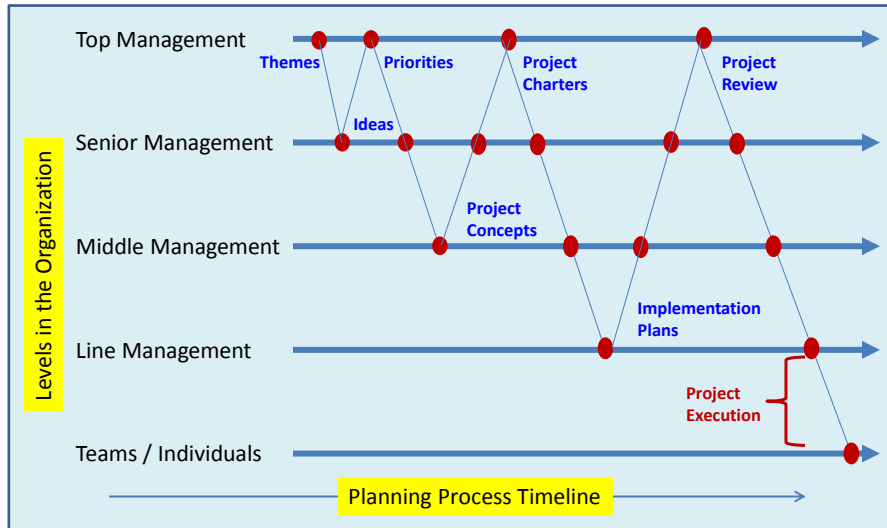


Elements necessary to get an organization “on target” include:

- Self-assessment process
- Strategic benchmarking process
- Integrated planning process
- Operational and project review process
- Business controls system

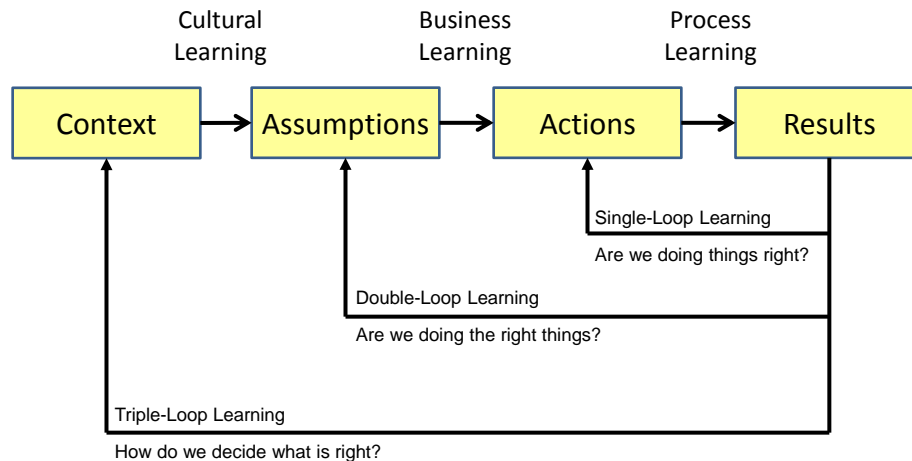
How are strategic improvement projects defined?

Managing the "Recognize" phase of DMAIC ("catchball" process):



All change is made to influence performance of the daily management system (routine work).

Integrating learning into strategic management:



Dynamics of structured learning – 1:

Triple Loop Learning: First Loop – Solving the Immediate Problem

Definition: Harvard psychologist Chris Argyus defined “single-loop learning” as the ‘detection and correction of errors’ or learning what to do.

Process Elements of Single-Loop Learning:

- Document the current standard work process.
- Instill discipline of work process measurement.
- Assure quality review of work outcomes or products.
- Implement corrections to assure standard results.
- Design preventive action to eliminate future problems.
- Change the standard work definition to assure quality.

Single loop learning elements:

- **Who:** all process workers at all levels of organization.
- **What:** standardization, problem-solving and process improvement
- **When:** daily work process execution
- **Where:** an integrated system applying to all work processes
- **How:** work standards, problem-solving methods and continuous process improvement methods (e.g., ISO9000, Lean, LSS DMAIC)
- **How much:** eliminate waste and defects in all processes.



Dynamics of structured learning – 2:

*Triple Loop Learning: **Second Loop** – The Improvement Process*

Definition: “Double-loop learning” occurs by ‘questioning the system of learning’ resulting in correction of underlying principles, theories, policies of the organization or implementing insights for change that were identified in the detection and correction process.

Process Elements of Double-Loop Learning:

- Developing a standard problem-solving process.
- Developing a standard for risk and failure analysis.
- Developing a standard performance measurement system.
- Developing a standard processes for change management.

Double loop learning aspects:



- **Who:** professional staff for project business process management
- **What:** develop and improve standard for single-loop processes
- **When:** review regularly (quarterly, bi-annually, annually)
- **Where:** centralized function for standards; distributed for inputs
- **How:** reviewing lessons learned, best practice and failed projects
- **How much:** Strive to increase project performance effectiveness

Dynamics of structured learning – 3:

*Triple Loop Learning: **Third Loop** – Charting Strategic Change*

Definition: “Triple-loop learning” – learning what we need to learn – learning how to learn differently – permanent learning that changes the way people work at the institutional or cultural level because the change masters have the power to mandate the new processes!

Process Elements of Triple-Loop Learning:

Thus, single loop learning occurs during problem-solving while double-loop learning occurs during management review of improvement projects by integrating lessons into the organization. Triple loop learning occurs through reflective review of change management efforts and by identifying insights into new knowledge for adaptation into the organization’s culture.

Triple loop learning aspects:



- **Who:** executive management team supported by quality leaders
- **What:** focus on developing an organizational process for change
- **When:** review annually as a prelude to strategic planning
- **Where:** orchestrated management meeting
- **How:** self-assessment of maturity and identify projects to improve
- **How much:** Strive to permit process capability to achieve strategic intent

Learning **creates** a quality mindset:

An attitude of quality is demonstrated in these behaviors:

- Collaboration and cooperation showing respect for individuals
- Clear communication – with intent to clarify (fair, equitable, even-handed treatment)
- Ethics, honesty, integrity of information (our words are authentic and say what we mean)
- Etiquette and respect for behavioral norms
- Broad systems perspective
- Transparency, openness to consider options and alternatives regarding issues and concerns
- **Summary: Flexibility and moderation**

Such inclusiveness promotes organizational harmony as well as rationalization of work and alignment of objectives.

Dorothy Leonard-Barton, "Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development" *Strategic Management Journal*, 1992, Vo. 13, No. 5., pp. 111-125.

Learning **avoids** a deficit in quality mindset:

Lack of quality is demonstrated in the opposite behaviors:

- Divisive, aggressive behavior demonstrating disrespect for individuals
- Prejudiced communication with an intent to obscure (unfair, inequitable, biased treatment)
- Extreme positions, fueled with inaccurate information, and purposeful misinterpretations
- Disrespect for behavioral norms – attacking others
- Narrow, single-purposed perspectives
- Vague, opaque, closed viewpoints and positions on issues and concerns
- **Summary: Rigidity and extremism**

Therefore, management needs a structured learning process to assure that its capacity to innovate is not limited.

Dorothy Leonard-Barton, "Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development" *Strategic Management Journal*, 1992, Vo. 13, No. 5., pp. 111-125.

To **be** better, we must **learn**...
... to **do** better we must **act**!



Confucius [Kong Qiu] (551-479 BC)

“What you know, you know; what you don’t know, you don’t know.”

~ Confucius

“Wisdom is knowing what you know and what you don’t know.”

~ Confucius

Inclusive quality means that all of us must examine our mindset (motivations) as well as our actions are we congruent – consistent in words and deeds? Do we have constancy of purpose?

