Innovation: the Key To a Successful Project

A SIX SIGMA LEVEL OF PERFORMANCE CANNOT BE ACHIEVED WITHOUT INNOVATIVE THINKING.

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Quality practitioners use Six Sigma to achieve dramatic improvement. It requires about 20,000 times improvement to go from 3σ or 66,807 defects per million opportunities (DPMO) to 6σ or 3.4 DPMO. Such improvement must occur at a fast pace; otherwise it would take several lifetimes to achieve Six Sigma level performance.

Incremental and continual improvement needs to be replaced with breakthrough improvement or continual reengineering. Breakthrough improvement is achieved through innovation, which has been an implicit intent of Six Sigma but has been inadvertently ignored in the methodology. To attain innovation, some training providers suggest using TRIZ, an acronym for the Russian theory of innovation.[1] Because TRIZ is rarely used to develop breakthrough solutions, I examined certain methods for realizing the full potential of Six Sigma by understanding creativity and innovation processes and came up with an empirical innovation methodology that can be integrated into Six Sigma.

The lack of innovative thinking at the leadership or project level is one factor that prevents significant improvement in bottom line or process performance. When applying the theory of constraints to the Six Sigma process, I learned effective leaders must possess these four skills to produce lots of improvement very fast:

1. **Time management:** A lack of time management skills stalls the execution of any planned activity. Projects fall behind schedule because people like to work on convenient things instead of important things. People think they are busy but are unable to see any progress.
2. **Process thinking:** This relates to Walter Shewhart's plan-do-check-act (PDCA) cycle. Plan is where you prepare for service processes or set up for production processes, do is where you take steps to perform tasks involved in a process or projects, check is where you represent the verification of the output of process activities, and act is where you correct any unacceptable process outputs.
3. **Statistical thinking:** This requires an understanding of random and assignable variation. The random variation is uncontrollable, while the assignable variation occurs because of a specific action. Statistical thinking allows leaders to make a decision based on the understanding of the nature of variation.
4. **Innovative thinking:** In the past, this was used predominately by a select few who were either in research and development or were self-motivated to do something differently. If an organization plans to benefit from a Six Sigma initiative over the long term, its leaders must institutionalize innovative thinking throughout the organization.

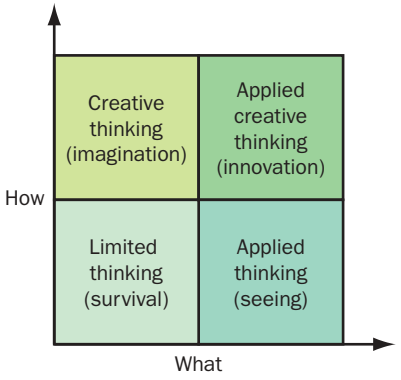
Innovation and Six Sigma Initiatives

In *The Innovator's Solution*, Clayton M. Christensen and Michael R. Raynor emphasize sustained innovation for achieving corporate business growth.[2] They believe a successful era of superior performance in the life of a corporation occurs due to some

innovative disruption. Sustaining innovation requires not just the ideas, but also the packaging of the ideas for growth opportunities.

Breakthrough improvement levels are emphasized in the Six Sigma world; however, methods to produce breakthrough solutions for a project have not been developed. ASQ's body of knowledge for Six Sigma Black Belt certification does not even include the word innovation.

Figure 1. **What vs. How Thinking**



The tools included in the define, measure, analyze, improve, control (DMAIC) methodology allow practitioners to make decisions based on facts or identify causes of existing problems. However, it is up to the Six Sigma practitioner to use innovative approaches for dramatic improvement. The main innovation tools include TRIZ or brainstorming packaged in different forms. Unfortunately, these tools lack an established framework for innovation that can be institutionalized through education and practice.

To quantify an improvement as a breakthrough or as disruptive, we must fall back on statistical thinking. When a process varies within the normal range of operation, the change is considered random or uncontrollable. When the change is significantly beyond random variation, it is considered assignable.

Practically speaking, when the change is within two standard deviations of the current process mean, it can be considered a common change. The two standard deviations represent a probability of occurrence of an event to be about 95%.

When the change in a parameter is significant to the extent that the probability of occurrence is greater than 95% or less than 5%, it can be considered significantly different or breakthrough. Therefore, when a solution generates improvement greater than 47.5% in a desired characteristic, the solution can be considered a breakthrough improvement.

Innovation and DMAIC

Innovation must become a main tenet of DMAIC. Project teams must decide to look for an innovative solution in the define phase because it will allow them to innovatively define problems with the expectation of significant improvement.

Then, during the measure phase, the team can begin to understand the process using various predictive tools, such as C_p and C_{pk}, instead of simple descriptive statistical tools, such as mean and standard deviation.

In first identifying causes, the team can use TRIZ or other creative methods. During the analyze phase, however, the objective is to define the total domain of the problem in terms of its variables, then expand the problem domain using innovative thinking. Here, the team can use innovative thinking during the root cause analysis to identify potential causes beyond the initial ones.

In the improve phase, the team can experiment with the combination of variables that will likely make a significant impact. To develop an innovative solution, the team should think creatively to come up with alternative solutions and strive toward perfection.

The team can innovatively use the control phase to sustain dramatic improvement of processes and products.

Creativity for Problem Solving

Current Six Sigma courses emphasize the rigid framework of DMAIC and its associated tools instead of providing a framework to think creatively and apply DMAIC differently. Black Belts apply these tools in a rote manner and spit out numbers without reflecting on the results. They emphasize the application of tools instead of solving the problem using the tools effectively.

Figure 1 illustrates the relationship between what to think and how to think.[3] When you think about what is needed, you focus on a quick fix, and the outcome ranges from adverse to incremental change. When you apply creativity to solve a problem at a higher and more general level, innovation occurs; and when you apply innovation to solve the problem, benefits are realized.

To develop innovative thinking, you must challenge the obvious. To solve a problem, you must be able to think of different ways problems are created. Each different way isolates that way from solving the problem and gets you closer to the ideal. Some common steps to innovative thinking include:

- Visualizing the problem in different ways, from different angles.
- Representing your thoughts in visuals.
- Thinking fast and frequently.

THE "NEVER" IN NEVER CRITICIZE IS PROBABLY THE MOST IMPORTANT THING TO REMEMBER BECAUSE IDEAS ARE GENERATED OUT OF POSITIVE ENERGY.

- Trying different combinations.
- Investigating the opposite side.
- Thinking beyond the known.
- Looking for disconnects.
- Looking for ignorance.
- Thinking in teams and building on others' ideas.

Generating New Ideas

One way to expand the universe of ideas is to think about the ideas behind successful products or processes. Learn from others' success stories by understanding the premise behind the success story. Try to adopt the following activities to generate new ideas:

- Look for ideas continually.
- Never criticize; wonder.
- Imagine uncharted territories.
- Roam around the world in your mind.
- Visualize situations.
- Handle multiple variables.
- Prioritize a combination of variables.

The "never" in never criticize is probably the most important thing to remember because ideas are generated out of positive energy. Whenever you criticize a situation or a person, you create negative energy and mental stress. Criticism closes the mind, while support opens the mind.

Skills and Attributes of an Innovative Thinker

Innovators ignore the status quo, think of an ideal scenario and then logically move from a solution to a general problem to a specific solution. They analyze a situation internally through introspection and reasoning. They develop a personal approach to put a puzzle together based on their experiences, categorize their ideas, and clarify and validate them using various events and experiences.

Innovators continually observe everything that goes on around them, experience as many aspects of life as they can and capitalize on new opportunities and reflect on their lessons by combining various situations or variables. They simulate the application of their newly gained knowledge until the ideas are clarified and can help solve a problem or develop a new product or service. Learning is their motive, and fun is a necessity.

For someone to be creative, he or she must do unexpected, nondestructive things beyond specified normal behaviors and be able to fantasize or imagine as far as possible.

Most innovators possess some or all of these skills:

- A quick system level understanding to speed up the creativity process.
- Unique and thoughtful ways to overcome obstacles or get around constraints.
- The ability to optimize a solution while exploiting many constraints.
- Commitment to change the paradigm.

To sustain innovative thinking, innovators must:

- Make innovation the purpose of life.
- Identify their personal talents for creativity.
- Enjoy many interests and activities.
- Listen to new ideas, and learn new tools and methods.
- Learn to express their ideas through verbal, written or visual communication.
- Correlate an outcome with the reality, and try to predict the outcome.

Framework for Innovative Thinking

Considering the availability of various innovative methodologies, tools and practices, it was a surprise to discover a framework for innovative thinking had yet to be developed. After conducting extensive research on innovative thinking, I developed a model I call Gupta's Einsteinian Theory of Innovation (GETI). GETI is based on Albert Einstein's $E = mc^2$ equation, where E represents energy, m represents mass, and

Table 1. **How To Calculate Innovation**

Resources (R)	Knowledge (K)	Play (P)	Imagination (I)	Innovation value	Comments
Degree of resources or time committed.	Extent of knowledge based on research and experience.	Percentage of possible combinations of various variables explored.	Dimension extrapolated as a percentage of ideal solution for breakthrough improvement.	Estimated innovation level.	Initial estimation of the proposed model. Further work is required.
50%: limited time; insufficient resources.	75%: significant knowledge and experience gained; latest work is to be explored.	40%: percentage of combination of variables explored mentally, experimentally or through simulation. Work is in progress.	66%: selected dimension is extrapolated such that improvement is expected to be about 30%, which is about 66% of the breakthrough improvement.	0.182: long way to find an innovative solution due to lack of imagination and play. To accelerate, improve all elements of innovation.	Innovation value = $0.5\ ((0.75 + 0.4 + 0.66)/3)^2 = 0.182$ Einstein.

Note: In absence of a fully developed relationship among the variables, an additive relationship has been used to determine the speed of thought value.

c represents the speed of light (186,000 miles per second).

Every act in nature is a process of transformation of energy from one form to another. Similarly, innovation is a transformation of one set of ideas into a productive idea or a set of ideas. In other words, innovators quickly process one set of ideas to create new ideas or thoughts. Therefore, the speed at which you can process these thoughts becomes an important factor in accelerating innovation or creating innovation on demand.

When applying Einstein's equation to the process of innovation, you can equate E to the energy (value) associated with innovation, m to the physical effort or resources allocated to innovation and c to the speed of thought, which can be faster than the speed of light. Think of it this way: If you try to mentally visit a place you have already visited, it won't take you long to get there.

The following equation defines GETI:

Innovation value = resources x speed of thought^2.

The speed of thought can be described by the following relationship:

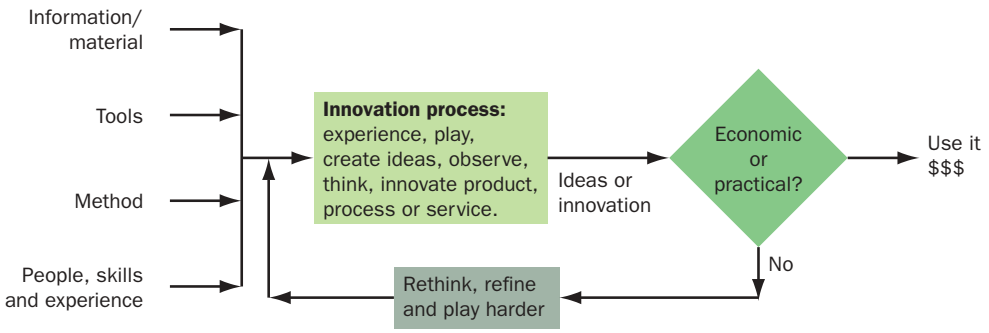
Speed of thought = function (knowledge, play, imagination)

The units of innovation value can be represented in terms of resources and ideas over the unit of time, which can be equated to a new unit, Einstein (E), with the maximum value of 1. Thus, the innovation value can be increased with more resources or faster generation and processing of ideas. The innovation value can be accelerated by making better use of intellectual resources instead of allocating more physical resources to innovation.

Table 1 defines various terms and illustrates an example of the quantification of innovation. The innovation value is equal to the resources (commitment) times a function of knowledge, play and imagination squared. More than its numerical value, the equation identifies the elements of innovation needed to maximize the innovation value.

Most innovations are based on research, current experiments and innovative thinking. We can measure knowledge, quantify combinatorial play, but it is difficult to measure imagination due to the complexity of mental processes. Therefore, imagination is transformed in quantifiable terms as, "Pure imagination is a random extrapolation," and it then becomes an attribute (extrapolation) that is measurable.

Figure 2. **Innovation Process**



Based on the GETI framework, you need to follow these steps to accelerate breakthrough solutions through innovative thinking:

1. Research a topic individually or collectively, and gain a deeper understanding of the subject. Do not immediately solve the problem without proper research and knowledge.
2. Identify the potential variables affecting the problem. Make the list as long as possible, and expand it using innovative thinking tools, such as mind mapping and TRIZ.
3. Test "what if" scenarios to isolate unlikely combinations of variables and identify likely combinations of variables.
4. Establish the dimension of improvement or the performance characteristic(s).
5. Investigate likely combinations that could improve the performance characteristic(s).
6. Extrapolate the dimensions of interest, and validate potential outcomes.
7. Expand your thinking by applying appropriate TRIZ-like principles to explore potential innovative solutions for generating significant change.
8. Continue to explore and formulate alternative solutions. Select a solution that produces expected breakthrough improvement for further validation and implementation.

In reviewing thousands of patents, Genrich Altshuller observed 40 unique TRIZ principles, including:[4]

- Do it inversely.
- Do it in advance.
- Do a little less.
- Save space.
- Remove contradiction in time or space.
- Fragment/consolidate.
- Dynamization or automation.
- Self-service or built-in service features.

Process of Innovation

Applying PDCA to the innovation process sheds light on its various components (see Figure 2).[5] Like any other process, innovation requires machine, material, method and manpower inputs based on Kaoru Ishikawa's cause and effect analysis. You must creatively determine what types of equipment or tools, material or information, methods and people who want to innovate can be used.

The method of innovation must be loosely defined, allowing room for creativity. You must be able to enjoy the flexibility to experiment, fail, learn and innovate within a defined paradigm. The innovation process must allow you to have a variety of experiences outside your typical work domain and help you create combinations or associations that mentally validate convergence through the process of elimination. The mental massage of various concepts or models results in some practical ideas that can be explored further to formulate products, processes or services.

Incorporating Innovation

While preparing to launch a Six Sigma initiative, expect to make a significant improvement in performance based on innovative thinking. Concepts of incremental improvement must be discouraged because they lead to mediocre solutions and prevent people from realizing the full potential of the initiative.

Leadership must identify and assimilate innovation into a company's values by determining corporate beliefs and tactics and creating an environment for innovation. Leaders must also define innovation in the organizational context and develop a corporate strategy to achieving the innovating success.

Above all else, leaders should establish the expectation and recognition for innovation from employees at all levels. Innovation strategies should include training; communication of expectations and objectives; roles of executives, managers and employees; intellectual property management and commercialization of the innovation to new products or services.

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3. Thomas McCarty, Lorraine Daniels, Michael Bremer and Praveen Gupta, *The Six Sigma Black Belt Handbook*, McGraw Hill, 2004.

4. Altshuller, *And Suddenly the Inventor Appeared*, see reference 1.

5. McCarty, *The Six Sigma Black Belt Handbook*, see reference 3.

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