Institutionalizing Innovation

(Praveen Gupta and Shan Shanmugham)

Abstract

Loss of opportunities in the absence of innovation causes frustration. Demand for innovation has become a norm. Global competition requires use of breakthrough innovation for large numbers of improvements very fast. TRIZ has been in the U.S. for over a decade. Application of TRIZ is growing continually; however, TRIZ has not achieved its full potential. Analysis shows that effective use of TRIZ requires infrastructural support, and commitment to innovation. TRIZ, the Russian Theory of Innovation, is a set of principles and tools that must be incorporated in the corporate culture of innovation.

To commit to the continual innovation requires a good understanding of theory, practice and results of the innovation methods. Scattered and successful application of innovation methods demonstrates that the innovation process is more than sporadic creativity. The author has developed a heuristic model of innovation that is based on the previous work of Einstein, Poincar`e and Alex Osborne. To institutionalize innovation one must look at all the components of innovation including a framework, process, and measurements.

Introduction

Information is accelerating innovation that has rapidly become a distinguishing factor to maintain the leadership position and financial performance of a corporation. Many authors have researched and published on creativity, tools of creativity, and innovation. However, for innovation to become a way of life we have a long way to go. The demand for innovation is increasing. Questions remain how much change can be called as disruptive or innovative, how to institutionalize innovation in a corporation, and how to measure innovation. This paper revisits the prior work and answers some of the questions about innovation, and offers a process to institutionalize innovation, including building a Creativity Room in every company.

Breakthrough Innovation

Clayton M. Christensen and Michael R. Raynor, in their book The Innovator's Solution, have emphasized sustained innovation in achieving corporate business growth. (Christensen, 2003) According to them, 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, instead the packaging of ideas for growth opportunities. In the Six Sigma world breakthrough improvement levels are emphasized, however, methods to produce breakthrough solutions for a project have not been developed. The tools included in the DMAIC methods allow practitioners to make facts based decisions, or identify causes of problems that exist. The missing link to achieve sustained breakthrough solutions is the innovation methods, and even quantifying how much improvement qualifies as a breakthrough improvement. In other words, how to recognize innovation is occurring or continual and incremental process improvement is taking place.

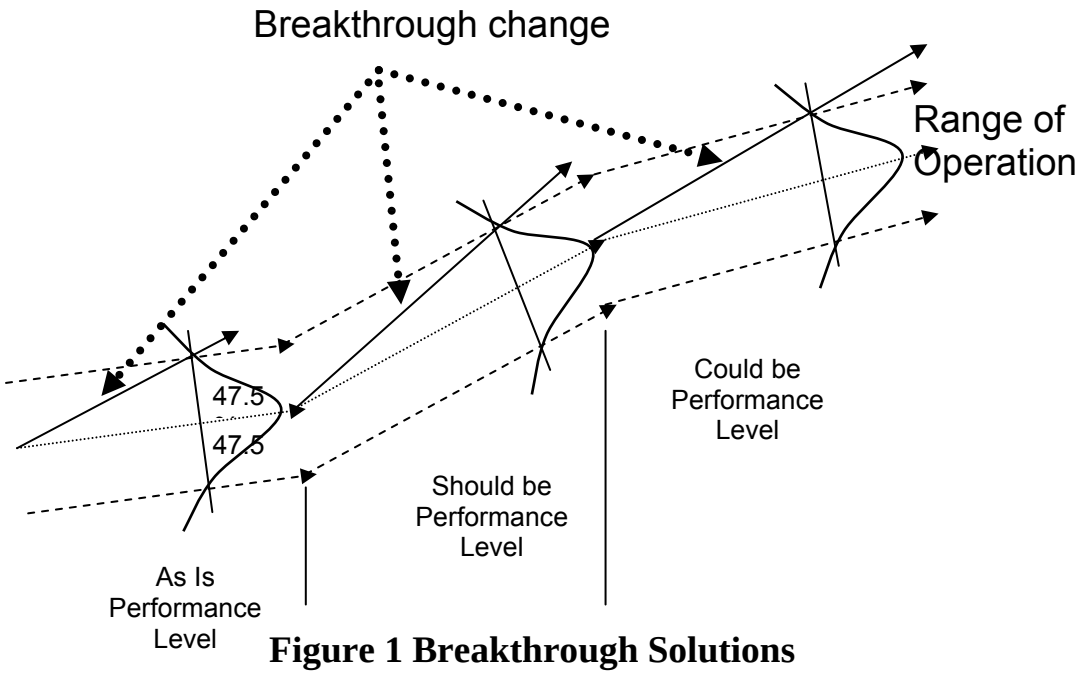

Figure 1 Breakthrough Solutions

Figure 1 shows when a solution may become a breakthrough solution. (McCarty, 2004) The process improvement has three levels of performance. 'As Is' implies the baseline performance, even though it changes over time through continual improvement. The 'Should Be' level of performance represents the entitlement with the current resources. The 'Could Be' level of performance would represent a breakthrough from the 'should be' level of performance normally determined based on benchmarking competitors or for best practices. To define a 'breakthrough' while solving a problem, one must fall back on the statistical thinking. Accordingly, when a process varies within normal range of operation, the variation or change is considered random or uncontrollable. When the change is significantly beyond the random variation, it is considered assignable. Practically speaking, when the change is within the two standard deviation, it can be considered random, i.e., common, and when the change is in beyond the 95% area, it can be considered significantly different. Therefore, one can say that when a solution generates improvement greater than 47.5%, the solution can be considered a breakthrough solution, i.e., an innovative solution. The breakthrough can occur at any time deliberately or accidentally.

TRIZ Summary

TRIZ, a Russian theory of innovation, is a systematic approach to innovation based on the analysis of hundreds of thousands of patents (Altshuller, 1996). TRIZ was invented and structured by Genrich Altshuller, a patent examiner for the Russian Navy. Among hundreds of thousands of patents, he observed and compiled some repeating patterns. TRIZ provides the first understanding of the trends, or patterns, of evolution for technical systems. TRIZ captures patterns of creativity without addressing the creativity process itself. TRIZ can be considered an inventive problem solving technique.

Altshuller observed four major technical areas of innovation, which are Mechanical, Electromagnetic, Chemical and Thermodynamics. In order to innovate on demand, one must

recognize the opportunity for innovation. If someone is struggling in making decisions due to more than one situation, that means there is some contradiction. TRIZ classifies contradictions into two categories:

Technical contradiction when two competing technologies are involved. When one is trying to improve one characteristics of a technical system, the other characteristic must be compromised.

Physical contradiction occurs when two opposite properties are required from the same element of a technical system or from the technical system itself.

1. Separation in time
2. Separation in space
3. Separation in state of the matter
4. Separation between the whole system and its parts.

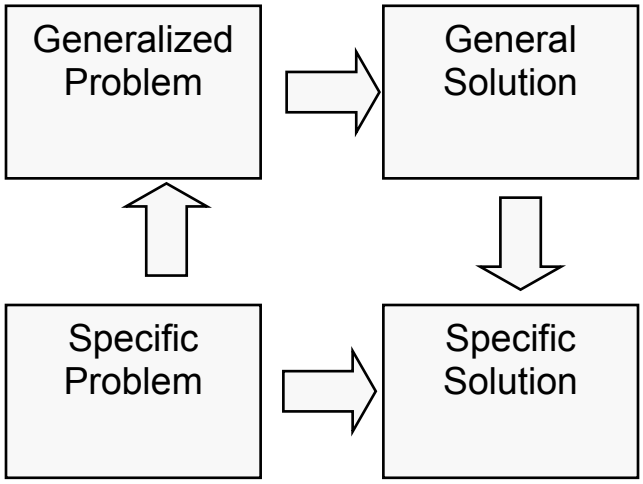

Figure 2 TRIZ Approach to Inventive Problem Solving

The TRIZ methodology consists of describing a specific problem, generalizing it, defining the ideal solution, then applying to a specific problem. This is shown in Figure 2. To generalize a problem, one must go a level or two up to understand a problem at a system level. At a higher level, there are more opportunities with a bigger impact, therefore, more opportunities for innovation. At that higher level, the ideal solution is designed first. The ideal system must be more reliable, simple, and effective. TRIZ promotes a person to solve a problem without adding complexity to the system. When inventing a solution, one reduces barrier to a system achieving its ideal state.

Altshuller felt that the main objectives of an inventive theory should satisfy the follow conditions:

1. Be a systematic procedure

2. Guide through a broad solution space to the ideal solution
3. Be repeatable and reliable
4. Be familiar to inventors

Key TRIZ Principles

In reviewing the thousands of patents, Altshuller distinguished between incremental and breakthrough inventions. The breakthrough inventions used up to 40 Inventive Principles. When a contradiction is resolved, an innovation may occur. Key TRIZ principles include the following:

- Do it Inversely
- Do it in advance
- Do a little less
- Save space
- Remove contradiction in time or space
- Fragmentation / Consolidation
- Dynamization
- Self service

When solving a problem, one must ask why the problem occurs in the first place. Understanding the reason for the problem and thinking about it opens our mind to accept the current situation as it is. Then, one should look into what is the real problem. In other words, what act is not happening as desired? This will really get to the core of the problem. Sometimes, people try to solve a problem that does not exist and become frustrated. Recognizing a contradiction is a critical step that requires critical thinking. Finally, once the reason or contradiction is understood, one should imagine the 'ideal' solution. The ideal solution would be the perfect world that one must visualize. Then, we channel our resources in resolving the contradiction to achieve the 'ideal' state and investigate many possibilities.

Building an Innovative Corporation

Leadership for Innovation

Successful leaders recognize the significance of innovation and the required leadership. The leader must believe and understand the role an innovative culture can play in the growth of a corporation in future years. They consider innovation in all areas of business, and all aspects of business in creating a culture of innovation. To lead an organization towards learning and innovating entity, the organizational environment must influence thoughts, planning, and acts. Johnson Controls, an organization that has lived longer than a century, has recognized the role of innovation as stated in its Values as responding to its customer needs through improvement and innovation.

To launch or sustain the innovation initiative, the leader must commit to recognize intellectual involvement of all employees, value of all information available, and evolution of all employees and processes. The leader of an organization sets beliefs, initiative, and environment for

innovation. The *v*isionary leadership develops a corporate meaning of innovation in the organizational context, and develops a corporate strategy to learning and innovating success. The leadership establishes expectation and recognition for innovation from employees at all levels. The strategy involves training, recognition, innovation expectation and objectives, roles of executives, managers and employees, intellectual property aspects, and transformation from innovation to product or service for realizing economic benefits. The leadership, executives, and managers can set example through their own behaviors, attitude, innovative thinking and actions, and support to innovation. Eventually, it must pay to innovate.

Organization for Innovation

In order to integrate and promote innovation in our normal daily activities, the organization must create the innovation model with resources allocated to make it work. In other words, the innovation must become an element of our profitability and growth streams. The innovation begins with ideas, i.e., there must be a mechanism to generate ideas from all employees of the company. The ideas are reviewed for relevance and applicability. In either case, the supportive feedback must be given for each idea. Employees must be encouraged to think and reflect on their experience and look into the future with new ideas or innovative products, services or solutions. Innovative or learning organizations support some kind of in-house library, where employees could browse through learning resources to re-energize themselves intellectually.

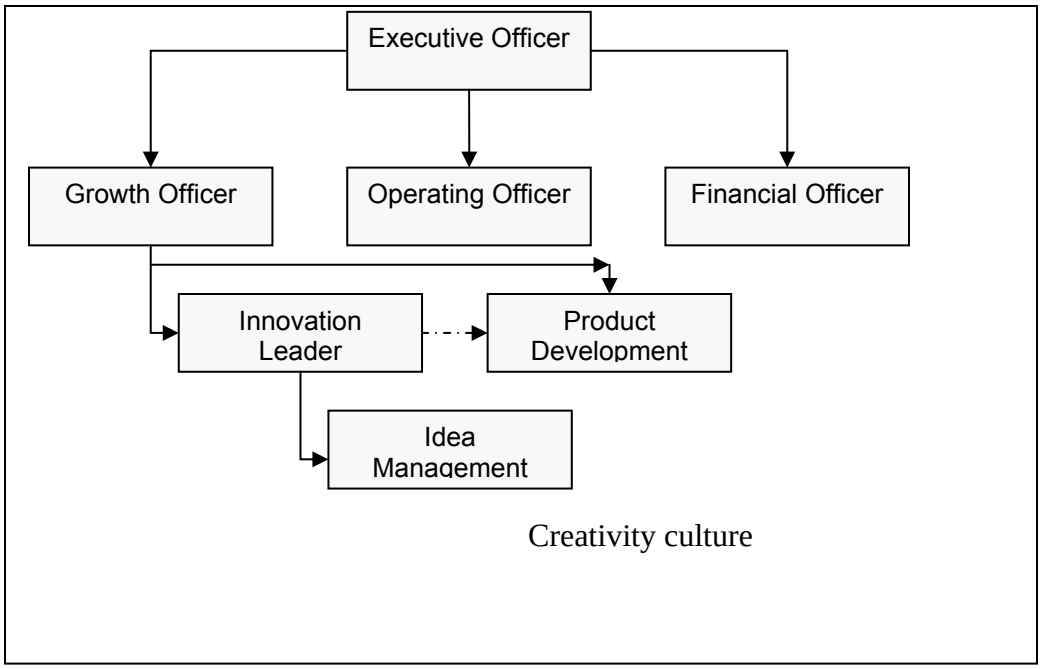

Figure 3. Organization for Innovation

A recommended organizational structure could incorporate the elements as shown in Figure 3, which shows that the culture of creativity cultivates ideas, ideas are managed into innovations, and innovations are transformed into products or services for economic gain. (McCarty 2004)

Culture for Innovation

The culture for innovation begins with a room for play. If one looks at a typical house layout, it includes a variety of rooms such as study room, kitchen, bedrooms, bathrooms, living room, family rooms, and den. When one enters into the kitchen, one gets ideas about food. If one gets into the study room one gets ideas about the topic in mind. Similarly, if an organization likes to have ideas from its employees, it needs to create an environment, or even a room for creative ideas. The environment must be such that one gains sensory experience, knowledge in its field of interest, or imagine in time and space. The leadership would like employees to develop observation-fueled insights, a keen eye for details, and being inspired to do things differently from being close to the action. In other words, anyone close to ones action must develop a keen eye for details and come up with lots of ideas for improvement through innovation. Janine Benyus has said in her book Biomimicry that innovation can occur from a purposeful effort, can be "kissed by the muses,' or as a result of a "flash of genius." (Benyus, 1997) As one creates culture of innovation, the leadership must increase the odds of happening innovation in either purposeful manner or by bringing the genius out of its employees. According to Janine, there are three conditions for a successful innovation that must be met. They are 1. innovation is work, 2. innovators build on their strengths, and 3. innovation must have an economic impact. Innovation occurs from hard, focused, and purposeful work demanding persistence, diligence, and commitment.

Process for innovation

Everything in life is a process. Therefore, applying Deming's PDCA (Plan, Do, Check, and Act) cycle sheds light on its various components. Like any other process, the innovation process requires inputs in terms of machine, material, methods and manpower (people) based on Ishikawa's Cause and Effect analysis. One must think creatively as to the kinds of equipment or tool that can be used, material of information, methods, as shown in Figure 4, and people, who want to innovate. (McCarty 2004) The method of innovation must be loosely defined and difficult to replicate easily. The intent is within some defined paradigm, one must enjoy the flexibility to try, experiment, fail, learn and innovate. The innovation process must include experiencing variety of things stretching outside the box or domain of work, creating combinations or associations, mentally validating for 'go' or 'no go' for further play or trials. The mental massage of various concepts or models result in some practical ideas that are explored further for formulation of products, processes or services. Ultimately, the objective of every employee or player is that one must create value through innovation to achieve growth objectives of the business and employees.

If the innovation turns out to be impractical or uneconomic for further implementation, one must not become dejected or disappointed. The creative or innovation process must be a lot of fun, rather than waiting to have fun with the resulting product. It takes many ideas to convert into one good to great product or service. Therefore, the creative play is necessity; the idea generation is the imperative, and every employee's overriding responsibility is to oneself, the organization, and society. If ideas do not turn into some products or services, people need to

continue to play or create. It does strike only after several trials; the challenge is how to play effectively.

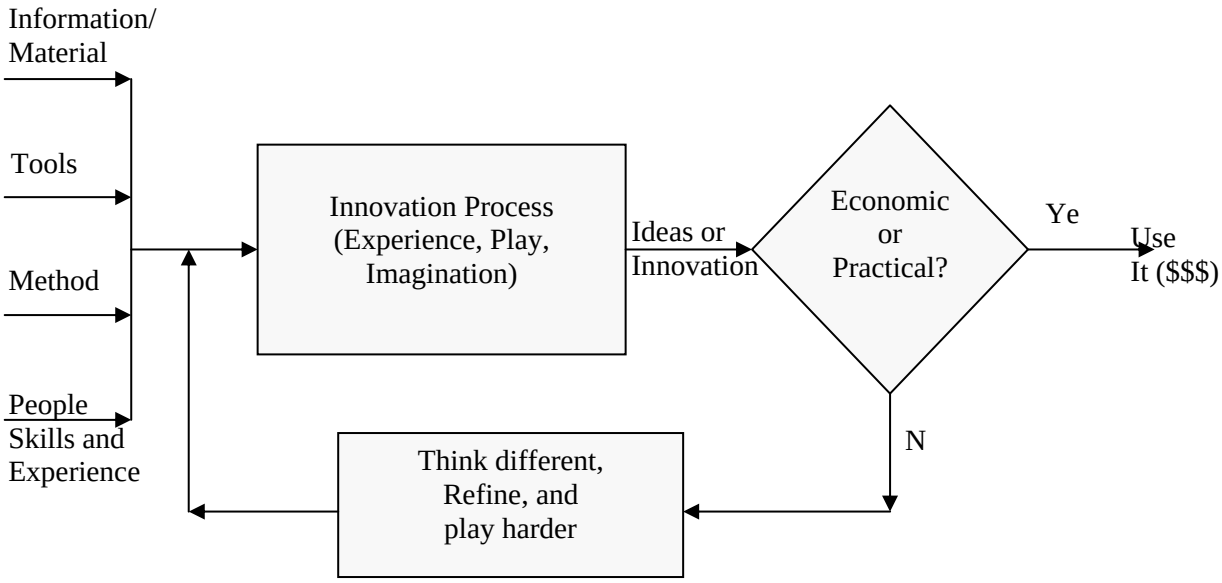

Figure 4. Innovation process

Measuring Innovation

Considering innovation is a loosely defined process, it can be measured in terms of ideas generated, patents filed, engineering awards given, new products introduced, revenue from new products earned, number of people deployed in innovation, or hours allocated for innovation, etc. Ultimately, the measurements must be established as needed in any organization. The intent of measurements must be to grow the role of innovation in the growth of a corporation. Six Sigma Business Scorecard (Gupta, 2003) has developed a set of measurements relating to the growth and profitability. Innovation is a critical aspect of the scorecard. The ten measurements utilized in determining the Business Performance Index (BPIn) are as follows:

1. Employee recognition by CEO
2. Profitability
3. Rate of improvement
4. Employee recommendations
5. Purchase ($)/Sales($) ratio
6. Suppliers quality
7. Operational Sigma
8. Timeliness
9. New business/Sales ratio
10. Customer satisfaction

Measurements 1,3,4,and 9 promote innovation in an organization. The Employee recognition by the CEO is based on innovative solutions with a significant and visible impact on corporate performance.

Training Employees in Innovation

Any major corporate initiative begins with an education to ensure learning, consistency, productivity, and results. The objective of training is that people becoming familiar with the innovation process, can accentuate their capabilities, and direct their creativity in the direction of corporate goals. The innovation training may include short durations of classes, directed plays, or totally free time to play. The training without any lecture or direction may become the training for innovation. Just get the people in a planned environment, give the learning objectives, and turn them loose. Employees prefer more hands on training than any instructional training. The innovation training certainly must be an innovative approach in itself. Irrespective of the method of innovation training, the corporation must set goals for innovation training, and measure training effectiveness.

Benefits from Innovation

Sustaining of the innovation initiative depends on the continual success of activities, excitement of doing, and engagement of everyone. As expectations for innovation in various functions are established, the leadership must verify performance against the expectations, and make appropriate adjustments. If an organization commits to innovation as a key component of its business strategy, it must ensure various phases of the innovation process are executed with excellence. The most critical aspect of the measurement must be the reduction in product or service cost, or impact on the corporate profitability.

Another measure of innovation would be how actively employees are intellectually involved. One can also assess if the innovation boosts employee morale, or motivates them to be more innovative. Another benefit of implementing the innovation process successfully would be simply learning, or the interest in learning new skills or ideas.

Recognition and Rewards

There is a saying that million dollar problem solvers are rewarded, while the millions of dollars opportunity creators live in oblivion in a corporation. In order to promote innovation and creativity, one must have keen eyes to observe successes. Publicizing success is equally critical as ignoring failures. In a corporation, when creativity, innovation, and risk taking become basic principles, one must establish measures to recognize and reward innovators. Recognition could be as simple as a ‘Thank You’ note, or some public recognition. Each success is recognized differently sometimes with financial incentives and other times with personal notes.

Irrespective of the value or type of recognition, one must recognize specific act or outcome of creativity or innovation. The act or outcome could be at the idea level, solution development level, or the outcome of the development process level. One can have incentive to submit an idea about process or product improvement, reward for writing and publishing paper in a

magazine, reward for obtaining a patent, recognition for successfully completing the evaluation of new product or concept, new ideas about daily activities, or a superior act of engineering, success in transforming an innovation into a commercial product or service. Ultimately, innovation must be a rewarding and an enriching experience for everyone involved.

Framework for Innovative Thinking

With availability of various innovative methodologies, tools, and practices, a framework for innovative thinking is yet to be developed. Extensive research and experience with the innovative thinking, the author has developed a model, called the Gupta's Einsteinian Theory of Innovation (GETI). GETI is based on the famous Einstein's equation $E = mc^2$, where, the "E" represents energy, the "m" represents mass and the "c" represents the speed of light, which is 186,000 miles per second.

Innovation is a transformation of one set of ideas into a value-added solution or a set of ideas, in other words, quickly processing one set of ideas to create new ideas or thoughts. Therefore, speed at which one can process these thoughts becomes an important factor in accelerating innovation, or creating innovation on demand. Applying Einstein's equation to the process of innovation, one 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. For example, try to mentally visit a place that you had already visited, and see how long it takes you to get there, infinitely small. Restating the Einstein's equation with proper substitutions, the following relationship can be obtained:

$$Innovation\ Value = Resources * (Speed\ of\ Thought)^2$$

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

$$Speed\ of\ Thought \equiv Function(Knowledge,\ Play,\ Imagination)$$

The units of the 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. It appears that the innovation value can be accelerated with better utilization of intellectual resources, than merely allocating more physical resources to innovation.

We can measure knowledge, quantify combinatorial play, but will have difficulty in measuring imagination due to the complexity of the mental processes. Therefore, imagination is transformed in quantifiable terms as, "***Pure imagination is a random extrapolation***." Thus, imagination becomes an attribute of the extrapolation, that is measurable.

Conclusion

The paper demonstrates that TRIZ offers a unique set of guidelines and process to develop innovative solutions. However, to institutionalize TRIZ, corporations must understand the basics of innovative thinking, and execute a strategy to institutionalize the innovation process. TRIZ must become a critical part of the corporate innovative process.

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Author's Biography:

Praveen Gupta, ASQ Fellow, President of Quality Technology Company, has been consulting with small to large consulting firms for over 15 years in the areas of performance improvement. His recent focus application of Six Sigma Business Scorecard, has led him to research elements of the innovation process through thought experiments. Since 1984, Praveen has published several articles, monthly columns, and books on variety of topics. His books include Six Sigma Business Scorecard (2003), and The Six Sigma Performance Handbook (2004).

Prior to founding his boutique consulting company, Praveen worked at Motorola and AT&T Bell Laboratories. He holds a MSEE degree from IIT Chicago, and BSEE from IIT Roorkee, India. He is an Adjunct Professor at DePaul University in Chicago, and lives in Lisle, IL.

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