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I-TRIZ for Six Sigma Business Process Management

1. What is Six Sigma

Six Sigma is an acronym for advanced customer driven business process management and leadership strategy. The concept of Six Sigma was born in Motorola in 1986 and since then has been successfully introduced in many big companies (GE, Motorola, Alliance Signal etc.) as well as medium size companies with huge business and financial impacts.

Six Sigma implements a systematic approach to improving and leading the business and combined 3 basic concepts, i.e. customer orientation, business process focus and problem solving based on hard facts and measured data.

The management strategies are implemented through business-case (meta-level) and relevant spin-off project management, which have a very strong measurable link to the business vision, strategy and business score cards. Six Sigma project management is realised in pre-defined phases, like , e.g. DMAIC (Define, Measure, Analyse, Improve and Control) for process improvement and DMADV (Design, Measure, Analyse, Design, Verify) for design of new products/systems (so-called Design for Six Sigma or DFSS).

Diverse tools are used to implement these processes, i.e.

- analytical tools for problem definition and solving,
- statistical tools for data measurement, evaluation and processing.
- statistical process control,
- process modelling and simulation etc.

In this article we summarise our research and application results in using I-TRIZ methodology for customer driven innovation [1] and tools at different phases of Six Sigma Project management and implementation. We discuss the existing bottlenecks of Six Sigma deployments both for improving business processes and/or optimising products/systems.

Our objective it to bring both methodologies and their users, i.e. Six Sigma and I-TRIZ together to get a synergy in efficient business improvement.

I will appreciate greatly any comments and discussions of this article and hope it may be a first article in a series of the follow-up articles and benchmark studies on training and /or using these methodologies together.

2. Six Sigma Bottlenecks and New Demands for Future Deployments

2.1. Just-in-Time Six Sigma Deployment

There are often significant delays in Six Sigma projects and intermediate deliveries. One of the most frequent reasons are decision-making errors leading to rework and time-consuming data collection activities.

Some of them are listed below in relation to Six Sigma project phases:

Define/Identify Phase

- lack of knowledge about the customers, customer profiles and their requirements/wishes/preferences/problems,
- poor project selection and/or problem formulation
- underestimated secondary problems which may arise during and/or as a result of primary problem solving
- poor definition of alternative causes-effects and screening of significant inputs
- failures in narrowing the scope of the projects into the wrong direction (phrase is not clear)
- limited (non-exhaustive) failure analysis

Measure Phase

- time-consuming data-collection and measurements
- lack and/or high variability of measurement systems (Gage R&R)

Improve/Design Phase

- lack of really 'productive' and/or innovative ideas on improvements (upgrade to 4 sigma level and higher) or competitive (re-) design
- time- and labour consuming DOE (Design of Experiments)

Verify/Control Phase

- non-systematic and limited failure prediction

These reasons lead not only to delays, but also increase the Cost of Poor Quality (COPQ) of Six Sigma deployment, particularly due to the consequent rework, i.e. repeated idea collection, screening the

alternatives, measurements and analysis. They also significantly deteriorate overall acceptance and support in further deployments, etc.

Demand in additional efficient analytical techniques and tools, which not only accelerate the above decision-making activities but also

- make decision-making and problem-solving activities error-prone,
- increase their productivity and reduce cycle time, and
- increase Roll Throughput Yield of innovative and competitive solutions through the whole six sigma process,

is apparent and urgent.

2.2. Low Cost Six Sigma

Small and medium size companies or business units, which actively enter Six Sigma community, have extra limitations when deploying Six Sigma methodology, i.e.

- Personnel is limited and working often overtime.
- It is often difficult (if not impossible) to find relevant candidates for Black and Green Belts, which could be later involved full or even part time in six sigma projects.
- Resources, both financial and human, for six sigma projects are extremely limited. Situation when Black and/or Green Belts are alone conducting their projects working overtime is quite usual.
- Innovative products and services are critical to business survival and should be very fast updated.
- Big capital investments are often avoided or postponed, even when their ROI (return on investment) is very high and convincing.

Therefore following *demands* for successful and just-in-time Six Sigma deployment become especially critical:

a) availability of methods and tools for *efficient generating low-cost six sigma solutions, if possible already at early stages of deployment*
b) solutions have to be *innovative and competitive* if they relate to (re-)design of new product, technology or service
c) *cycle-time* of Six Sigma projects have to be further reduced
d) *costly errors in decision making*, especially at the early phases of Six Sigma projects, which lead to rework (e.g., extra and/or redundant measurements) have to be avoided

2.3. Zero Defect challenges for Forecast-Based Business Processes

There are core business processes where the Cost of Defect or Failure is extremely high and critical to the overall business longevity. Those are e.g.,

a) Forecast-based business development strategic decisions

- Should the company focus on new products or other growth strategies?
- What role do new products play in the overall growth strategy?

b) Forecast-based Intellectual Property protection decisions
   - How to develop high-quality patent umbrella which provides long-term protection for the current and following product lines?
   - How to develop it efficiently (within reasonable time-scale and budget)

Application of analytical tools which support analysis of trends and patterns of market development, positioning of the company and planning further short-term tactics based on the longer-term evolution analysis are in strong demand. Such tools are complementary to the quantative data-driven statistical tools and make use also of qualitative data to analyse and predict further evolution of technology, market etc.

2.4. Detect and Eliminate Root Causes

This is a typical task for any Six Sigma project. But there are often especially painful areas in the companies, where many years of multiple trials and errors and even application of Six Sigma tools did not lead to an insight into the root causes of some negative effects.

Application of alternative, e.g. I-TRIZ analytical and knowledge-based tools for Anticipatory Failure Analysis and Prediction supports efficient and effective problem solving in such situations.

Failure detection and/or prevention in high-risky human-machine systems is another important application area for such tools.

3. TRIZ Can Help to Avoid Six Sigma Bottlenecks

TRIZ (pronounced "TREEZ", the Russian acronym for the Theory of Inventive Problem Solving) is an established science, methodology, tools and knowledge- and model-based technology for stimulating and generating innovative ideas and solutions [2].

It was originated by Genrich Altshuller in the mid 1940s who published many books, technical publications, etc. until the late 1980s.

Historically it is widely spread in Eastern Europe, particularly in the countries of the former USSR and since early 1970s has been a part of many university-, college- and school-education programmes. Now more and more European and particularly German universities in cooperation with industries successfully integrate TRIZ into the curriculum. Last years it has been successfully used in different industries, also in Pacific countries.

TRIZ science extends traditional system engineering approaches and provides powerful systemic methods and tools for problem formulation, system- and failure analysis, both as-is and could be, particularly by using system patterns of evolution.

Many vendors offer published by G.Altshuller TRIZ tools single or in some combinations.

What is different and new in TRIZ in comparison with traditional innovative or decision making techniques used in Six Sigma:

- First, original ways of problem formulation through
  - intensifying contradictive requirements instead of avoiding or compromising contradictions at the early stages of problem formulation (i.e. define phase)
  - inverting of problem formulation, which is especially efficient in cause-effect and input-output analysis and detection of root causes of failures
  - explicit use of the concept of Resources
- Second, efficient strategies and a set of decision-support techniques and tools for generating innovative solutions for the problems
  - Traditional Six Sigma techniques mostly comprise data-based and process modelling Idea Collection techniques with some Idea-Stimulation techniques, like brain storming, morphological analysis etc. and DOE. The first are often not efficient enough for complex problems and/or for finding low-cost efficient innovative solutions in a short time and/or finding solutions to upgrade the performance from 2-3-4 to higher sigma levels etc.
    The latter are data-based and may be time-, labour- and cost-consuming.
  - TRIZ offers systemic and powerful set of analytical techniques and tools for both Idea-Collection and innovative Idea-Stimulation (e.g. Altshuller's matrix for solving contradictions, Substance-Field Models, system evolution patterns etc.).
    These techniques are particularly applicable at the Define/Identify and at the Improve/Design phase.
- Third, TRIZ Idea Generation process is much more efficient in comparison with other known techniques and tools
  - Traditional Idea-Generation Process consists of three steps, i.e.
    1. generate alternatives
    2. screen alternatives
    3. evaluate top concepts
  - TRIZ offers efficient tools for accelerating these process steps and supports error-prone decision making and evaluation

Originally TRIZ was mostly applicable for analysis and innovative problem solving for manufacturing processes, e.g. process/product/performance improvement, failure correction, innovative design, etc.

TRIZ basic postulates, methods and tools, including training methodologies invented by G. Altshuller have been further developed and significantly enhanced by his followers, researchers and trainers, particularly by the Kishinev TRIZ-specialists leaded by Boris Zlotin and Alla Zusman (from 1982 to present) and later became known as Ideation TRIZ (I-TRIZ) generation of methodology and tools [3,4].

4. I-TRIZ Is An Advanced and Productive Enhancement to Six Sigma

I-TRIZ is a research-based enhancement of classical TRIZ science, methodology, tools and applications.
I-TRIZ followed up and

- provides systematic approach and workflow how to define innovative directions, generate innovative ideas, how to combine them in concepts and to evaluate them,

- expanded TRIZ methodology to non-technical areas (business, management,
scientific research, transactional processes etc.) and adopts it to the Western world, i.e. mental-
cultural-, language-, business-,teaching- models, etc.,

- provides knowledge-based integration of classical and new TRIZ tools and
lines of evolution for higher repeatability, reproducibility and re-usability of innovation processes and results,

- expanded classical TRIZ way of thinking towards so-called Directed Evolution™[1],

- provides advanced decision-support knowledge-based tools and E-learning
materials

5. **Improve Six Sigma with I-TRIZ: Expected Impact**

Advanced I-TRIZ methods and tools can be used for enhancing Six Sigma methodology, both DMAIC and DMADV or DFSS, especially when Six Sigma methods and tools are by different reasons inefficient and/or insufficient.

It allows particularly to save time, find efficient low-cost improvement solutions already at the Define or Identify phase, efficiently screen measurements, avoid errors and reduce rework and consequently the Cost of Poor Quality of Six Sigma e.g. when determining the root causes of defects, designing for upgrade from 2-3-4 to higher sigma levels etc.

Integration of I-TRIZ and Six Sigma methodology & set of tools leads in general to significantly

- *increasing effectiveness* of Six Sigma deployments, especially in small and medium business units
  (i.e. make it happen AT ALL in many cases)
- *increasing efficiency* in terms of reduced life-cycle time and resources used, as well as higher ROI of Six Sigma projects
- *reduction and avoidance of "expensive" errors in decision making*, especially at the early stages of the deployment, i.e. Define or Identify phase

[1] Directed Evolution (DE) is a trademark of Ideation International Inc.

- *reduction of Cost of Poor Quality of Six Sigma* due to the rework, i.e. repeated and/or redundant measurements etc.
- *increasing Roll Throughput Yield* of Six Sigma *projects especially at the Improve/Design phase (i.e. % of Innovative Competitive Solutions/Amount of Collected Ideas)*

Once we have enough measurements, we may quantitively justify, that I-TRIZ integration *increases Sigma Level of Six Sigma Deployments*, even it may sound as a paradox to the readers of the article.

6. Six Sigma Training Update with I-TRIZ

Six Sigma training update with integration of I-TRIZ Tools is reasonable and will be effective across the whole Six Sigma Infrastructure, starting from Champions and Master Black Belts top-down.

Tools are modularised and may be matched with

- Application areas
  - DMAIC
  - DMADV
  - DFSS

- Phases of Six Sigma Project Life Cycles

- Six Sigma User-categories (champions and belts), their role, tasks in projects and background

- Target Business processes,, i.e.
  - Traditional processes, like manufacturing, transactional, etc.
  - High-risky human-machine systems
  - Forecast-based Core Business development processes

Training is organised evolutionary (1/2 -2 days modules) and successive.

Starting with Champions and Master Black Belts it starts with presentation at the beginning (2 days)

- the whole spectrum of tools and their applicability
- first set of tools which are generic for all above mentioned applications and easy enough to be trained in 1-1 ½ days

I-TRIZ Tools maybe evolutionary introduced into the Six Sigma Training programmes.

They are also offered as, e.g. annual Six Sigma Update for Champions, MBB and other belts which have been already trained and certified, e.g. 1-2 years ago or so-called Upgrade Training Modules (3-5 days).

Currently we evaluate new concepts of virtual training in I-TRIZ-based problem definition and –solving, particularly in German speaking countries (www.sixsigma-24.de - in German language).

In parallel we organise “flat virtual training” for everybody i.e. bottom-up and not necessarily for six sigma professionals. We start with basic introduction and virtual training in I-TRIZ Brainstorming (4 hours) in combination with e-Learning.

Efficient tools allocation and training concept design is customer specific and should be adopted to the existing Six Sigma Infrastructure and Business Improvement and Leadership Campaign.

Discussion

There is no doubt that integration of I-TRIZ tools and other TRIZ-based tools with Six Sigma Methodology improves significantly the overall potential of Six Sigma in Business Improvement and Development.

The success although depends on user-centred design of training concept and materials and tools and their evolutionary deployment using class and virtual (both off- and on-line) training, as well as overall commitment of the Six Sigma Leaders.

References & Links

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