Overview of process improvement techniques

My first encounter with process improvement began back in my NS days – WITS (Work Improvement Team Scheme). I started my career back in early 2000 and as a fresh engineering graduate, I was involved in a few Quality Control Circle (QCC) and was exposed to concepts such as Statistical Process Control (SPC) and Design of Experiment (DOE). Looking back, it was daunting, given the lack of context and perspective. This article attempts to give an overview of the various quality improvement tools and their applications.

Some critical questions that will be addressed in this article include:

- What are the current process improvement methods?
- What are their order or sequence of application, if any?
- Any pre-requisites to their application?

The need for process improvement started when production moved from artisan (craftsman) to mass production, which saw the need to run in an optimised manner for profit. Surprisingly, it is only as recent as the early nineteenth century when Taylorism, which focuses on scientific management emerged. American multinational automaker, Ford, has shown incredible efficiency for the production of the Model T and is probably the epitome of Taylorism. Nevertheless, Taylorism does not work in the long term with its regimental nature of the work where the fine division of labour reduced workers to a mindless cogwheel in the entire system of thing and doing one simple repetitive task.

Toyota studied Ford's approach and improvised on it with the thinking from Juran and Deming (PDCA) to develop the Toyota Production System (TPS), which is a human-centric approach focusing on processes.

The process improvement methodology is listed below in chronological order:

- Scientific Management - Taylorism, 1920s
- Toyota Production System (TPS), 1940s
- TRIZ (Theory of Inventive Problem Solving), 1946
- Design Thinking, 1969
- Total Quality Management (TQM), early 1980s
- Theory of Constraints (TOC), 1984
- Six Sigma, 1986
- Lean - evolution from Toyota Production System, 1989
- Agile and Scrum,2001
- Lean Six Sigma, 2000s

The Russians developed their own process improvement based on TRIZ in 1946 after World War II, which is grounded on the rule that problems and solutions are repeated across industries. Although they have developed 40 principles based on the pattern of patent inventions, given the arduous nature, TRIZ did not gain enough traction to be mainstream.

The currents WITS and QCC mentioned earlier is in fact the legacy of TQM (Total Quality Management). Operationalising TQM in practice was not an easy task and that limited adoption in the industry.

The term "bottleneck" originated back in 1984 from the Theory of Constraints (TOC). It was overshadowed by the resurgence of Lean (derived from Toyota Production System) in 1990s, which was broader in scope and encompassed the TOC.

Design thinking (DT), based largely on user experience is getting popular in the service sector recently, although the development was as early as 1969. The development involved interviewing users to create the user profile and establishing prototype product that catered to the user profile.

Six Sigma, pioneered by Motorola, took a center stage in process improvement due to overwhelming support from companies such as General Electric (GE) and Honeywell back in the early 1990s. With its designation of the belt system to denote the level of proficiency – Yellow belt, Green belt, Black Belt and Master Black Belt – Six Sigma is suitable for solving complex issues with interactive causes by modelling the outcome.

Womack et al. coined the Toyota Production System as "Lean" in his pioneering book, "The Machine that Changed the World", which helped to propel it into the limelight. The integration of Lean with Six Sigma (LSS) back in the early 2000s ensured its dominance in process improvement methodology.

Agile and Scrum are mainly process improvements for software development which is against their traditional waterfall technique, where all the user requirements are evaluated at only near the end of the project. The software is modularised to meet certain core requirements, focusing on quick turn-around for each module to pass UAT (user acceptance testing) before peripheral requirements, refinements and final debugging are added in piecemeal in the next few revisions.

Mainstream techniques	Key points
Toyota Production System (TPS) / Lean management	▪ Lean is able to encompass most of the concepts in TOC and TQM, and it is also broad-based enough to be used in both the service and manufacturing sectors ▪ The continuous improvement nature (one factor at a time, PDCA- plan do check act) and Kaizen allows it to be grasped by the rank and file
Six Sigma	▪ Data centric ▪ Without an automated data collection system, it will be hard to data mine and perform data analytics ▪ Useful when there is interaction in the process and leverage on DOE to model the interactions precisely ▪ Can integrate very well into Lean as Lean Six Sigma (LSS)

The recent focus on manpower lean, job redesign, and bringing value to customers help bring Lean back to the forefront. SMEs can leverage on such techniques, starting on Lean to remove waste, standardise work processes (i.e. the low hanging fruits), and then move on to deploying automation techniques to lay the foundation for data analytics (Six Sigma) for future improvements.

To address the questions that were posed earlier, one possible sequence of application will be Lean management, automation (which includes automated data collection) and then Six Sigma for Big Data analytics. The pre-requisite for Six Sigma deployment will lie in system automation for data collection capability. E

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