Some Practical Issues in the Application of Lean Six Sigma to Service Systems

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ABSTRACT
Six Sigma as a quality improvement framework has gained considerable popularity in the past two decades. Its extension Lean Six Sigma has also been embraced by many organizations for improvement of quality and business competitiveness. One important factor for the popularity of Six Sigma and Lean Six Sigma is their potential for improving service systems, in contrast to the conventional perceptions that only manufacturing systems can benefit from statistics-based methodologies. There are however a number of issues related to the nature of service systems that must be resolved before the full benefits of Lean Six Sigma can be realized. In this paper, these issues are discussed from a practical point of view from three angles: analytical, organizational, and personal. Awareness of the existence of such issues, if not the answers to all of them, is a pre-requisite to effective adoption of Lean Six Sigma tools.

Key words: Lean Six Sigma; Service; Quality Management.

1.0 Introduction

Six Sigma had its origin in the manufacturing industry in the 1980s, and has since been adopted by many organizations by virtue of its effectiveness in deploying data-based tools and statistical thinking (Goh (2002); Brady and Allen (2006)). Subsequently, its extensions Design for Six Sigma or DFSS and Lean Six Sigma - for example Tennant (2002), George (2002), Tang *et al* (2006), and Watson(2007) - have gain considerable popularity with their promises of built-in performance during the design stage and efficiency and productivity during the production stage.

As Six Sigma was developed with the intention of reducing the "dpmo", or defects per million opportunities, the concept of "defect" has been extended from manufacturing to service. Thus there is a noticeable prevalence of Six Sigma or Lean Six Sigma to service systems, beyond the traditional domain of manufacturing systems. This is indeed one of the strengths of Lean Six Sigma: it widens the horizon of application of its tools in the real world, and as the importance of service is on the rise today, Lean Six Sigma presents itself at the right juncture.

It should be realized, however, that owing to the basic difference between the characteristics of manufacturing and those of service systems, a number of practical issues has surfaced from time to time during the application of Lean Six Sigma, some of which may not even have been brought up to the attention of Lean Six Sigma learners. It is certainly useful to discuss such issues and their impact on the effectiveness of Lean Six Sigma; even when complete solutions are not available, the mere awareness would play an important role in defining one's understanding of the potential – and perhaps limitations as well – of the tools of Lean Six Sigma, and helping to shape realistic expectations on outcomes of application projects.

Three general aspects are focused on in this paper, at (1) the analytical level; (2) the organizational level, and (3) the personal level. Such classification of items will help formulating counter-plans or solutions, although there could be other ways, for example presenting an all-inclusive analysis in accordance to the DMAIC (Do-Measure-Analyze-Improve-Control) format.

2.0 Service Systems

Service systems share a common characteristic, that is they are not associated with the generation of particular physical objects. Other than this, they can take on various forms, ranging from for example the dining experience at a restaurant to the relief efforts organized after the occurrence of some natural disaster in a geographical region. Sometimes attempts are made to formally and positively define a service system – see, for example, Tang and Zhou (2009) -- though most Lean Six Sigma practitioners tend to use a reverse approach, namely regarding anything non-manufacturing as service.

Description or definition of service by exception may have difficulties, for example it would put certain types of human effort such as agriculture and warfare into ill-defined categories. However, if one is to limit one's attention to systems commonly encountered in modern and developed communities – such as transportation, healthcare, finance – then the concept of service quality is easer to grasp. Thus the discussion here of service systems is not intended to be universal or exhaustive, but to suit the general concept as just described.

3.0 Service Quality Considerations

In the study of quality management, customer satisfaction and business competitiveness, there are a number of attributes of service systems that distinguish service from manufacturing. These may be summarized as follows:

3.1 Identification of "defects" critical to quality

a. What constitutes a defect or defective could be very personal and hence subjective
b. Delays are common in the recognition of defects or defectives
c. A defect or defective is often more readily noticed (and seems more critical) than a "good" outcome
d. Level of quality tends to be measured and compared via a negative scale (e.g. *dpmo*, defects per million opportunities, instead of yield; complaints about service received tend to be more attention-catching than compliments)

3.2 Nature or basis of improvement

a. In a given study, the process in question can be, and often is, more relevant or felt more important than the product
b. An instance of service tends to have to be highly customized (*vs.* standardization or mass production in manufacturing)
c. The role of raw material is usually low
d. Inventorization, i.e. accumulation of services, is normally not possible

3.3 Feasibility of applying analytical tools

a. Standardization, calibration and benchmarking could be inadequate, difficult, or impossible
b. Service quality relates much more with information flow and utilization than what many traditional quality practitioners are used to
c. Available information tends to be qualitative (i.e. discrete or attribute data) rather than quantitative (i.e. continuous or measured data)

d. Service systems do not lend themselves readily to data-intensive methodologies such as those entailed in Lean Six Sigma

3.4 Situation-specific considerations

a. Specification limits or tolerances not only tend to be arbitrary or impossible, it could also be location-dependent and time-varying
b. System boundary could be difficult to draw in a study; noise is usually large and, by definition, not controllable
c. Customers themselves could be voluntarily or involuntarily involved in the way service is generated
d. Cultural factors, values and ethics could be involved in judgments

Thus a person familiar with manufacturing process studies has to adopt a very different approach when it comes to service systems. Most service systems are in need of improvement in the sense of a Kano quality system -- Kano (1984) -- rather than reduction of *dpmo*: in fact coupled with human emotions, sentiments and expectations, it is near impossible to define a "defect".

4.0 Analytical Aspects

When it comes to formally apply Six Sigma, perhaps the greatest challenge is in "undoing" the training that Six Sigma Black Belts and Green Belts have been through. The original Six Sigma methodology was motivated by arguments based on a normal distribution. All the concepts of 3.4 *dpmo* as a bench mark, *z* scores, short-term and long-term performances and so on, are derived and extended based on normal distributions.

While the behavior of many natural physical quantities can be approximated by the normal distribution, the same cannot be said of common service systems; for example the Poisson distribution is more likely to be appropriate to describe lapses in a specific type of service. With the collapse of the normal distribution background, the idea of "sigma level" as a proxy for "quality level", with the attendant arguments about improvements, comparisons and so on, is no longer valid. Thus a Lean Six Sigma project cannot be based on concepts of "sigma level" without checking the behavior of background data.

Even if the normal distribution is a reasonable approximation, there are still arguments against the non-linear nature of "improvement"; for example the *dpmo* reduction for a change from five sigma level to six sigma level is very different from a change from two sigma level to three sigma level. Other controversies, such as the rationale for 1.5 sigma shift in the long term, also carry over from the study of manufacturing systems to that of service systems; the justifications are, if anything, even more uncertain or unconvincing in the latter.

What is even more challenging, from a statistical modeling point of view, is that many service systems tend to be time-variant owing to changing expectations, lifestyle, culture, demography, political decisions, and so on. Assumptions about noise behavior, often taken for granted in the modeling of manufacturing processes, cannot be made lightly: For example, data independence is an important yet often ignored requirement in system modeling – as a result of the shallow Statistics training or knowledge of some practitioners.

5.0 Organizational Perspectives

A common phenomenon is that top management somehow heard of Lean Six Sigma and wants to have it too. Some would like to "have it too:, after hearing exciting stories about Motorola, General Electric, Allied Signal, and the like. Some were promised by consultants that each project would save them half a million dollars. The usefulness or otherwise of such "motivation" is obvious if it is realized that not every organization operates in the same scale, same structure, same product or same market as the companies mentioned above; in fact if a small organization's annual turnover is a million dollars, how could a Lean Six Sigma project be expected to save two hundred thousand dollars a year, and potentially three projects or six hundred thousand dollars a year? Quote: "Thousands of ASQ customers around the world have obtained practical benefits from their ASQ Lean Six Sigma education. Our program's first-time students have saved their organizations more than $200 million in direct cost savings from initial training projects": ASQ (2010).

All the fabulous claims are often repeated in brochures selling Lean Six Sigma courses which by the way are often expensive, and as a rule training or consulting fees are expected way before any real savings are realized by the clients. It is little wonder that there have been cries of "Emperor's New Clothes" (see for example Lee (2001), Schrage (2001),Morris (2006) and Mika (2006)), and a published serious study suggests that all the talks about stock prices been fostered by application of Six Sigma were unsupported in the face of facts, Goh *et al* (2003).

All these point to the need for a proper understanding of the principles and rationale behind Lean Six Sigma before its adoption. Lean Six Sigma is not a fad, and business leaders should not go for it simply because the competition has it, some customers ask about it, and they themselves feel that this is perhaps good public relations. Another possibility is to harbor unrealistic expectations after hearing the hype from incompetent or irresponsible consultants and trainers: disillusionment about Lean Six Sigma after payment of hefty fees and deploying expensive manpower in vain would double the pain. To claim that Lean Six Sigma can only lead to business success for any organization is just being irresponsible – those who make such claims should try to make a profit for a company that makes mechanical typewriters or film-based amateur cameras.

6.0 Personal Factors

Lean Six Sigma could lead to disillusion in ways pointed out above, but the tendency today seems to suggest that it is not organizations, but rather individuals, that are keen about Lean Six Sigma. Witness the advertisements for training courses for "Belts" of all sorts of colors – of course Black Belts in particular. Almost all such advertisements promise certification: certification of the individual as, for example, Black Belt, rather than an organization. This is in fact a deviation from the original motivation: to improve organizational performance and increase customer satisfaction.

It is a fact that nowadays many people sign up for Lean Six Sigma training not necessarily motivated by the operation of the company, but by the certificate that they themselves could possess at the end. Most training and certification programs also require demonstration of competence via a presentation on projects, which not infrequently then lead to some sort of "reverse engineering" – armed with final solutions and results, the "problem solving" or "improvement" process is developed backwards so that the resulting material would fit the expectation of the certification examiners, in a format that inevitably ends with "living happily ever after".

This is not to suggest a termination of the existing Lean Six Sigma training and certification system. What is needed is an ability to avoid not seeing the forest for the trees, and a serious attitude toward Lean Six Sigma projects. There is no rule that says all such projects must end in "living happily ever after". There is no

requirement that there must be savings after a rigorous study – in fact some businesses could revive only with injection of capital for a revamp. It is "statistical thinking" (see, e.g. Hoerl and Snee (2002)) that is called for in the execution of projects, and the thoroughness of its application determines the merit of the work. If this point is not appreciated, more individuals will engineer projects "suitable" for certification purposes, but the resulting Black Belts or Green Belts cannot be expected to be able to handle uncertainties of service systems intelligently and bring credit to Lean Six Sigma.

7.0 Concluding Remarks

Service systems are gaining wider attention as they assume more important roles in most economies. They are known to present considerable challenges to those used to applying Lean and Six Sigma methodologies to manufacturing. In this paper, a contrast is made between service and manufacturing, followed by discussions concerning the application of Lean Six Sigma at the analytical, organizational and personal levels. There are varying degrees of "goodness of fit" of the descriptions when it comes to individual cases, but universal applicability is by no means implied.

As the Lean Six Sigma methodology evolves and as more training and certification programs emerge in the commercial world, it is important that a rational perspective be maintained before investments are made in Lean Six Sigma by an organization for its deployment, or by a person for whatever manner of "certification", as unrealistic expectations could only lead to disillusionment.

It is worthwhile noting that Lean Six Sigma has been largely propagated outside academia and embraced by industry, which gives it a practical bent but would also mean that occasionally insufficient attention is paid to the related theoretical underpinning. The enthusiasm that is seen nowadays for personal certification is necessary but by no means sufficient to spread the effective practice of Lean Six Sigma especially in service systems. Indeed it must be said that it is only an organization with a critical mass of individuals with statistical thinking, not some certified individuals more concerned with their qualifications than customer benefits, that could bring out the true power of Lean Six Sigma.

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