Lean and Six Sigma Innovation and Design

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INTRODUCTION

Six Sigma Innovation and Design theory, strategy and supporting methods have evolved along two primary pathways – one focused on significant innovation of existing products, services, processes or systems, and a second focused on design of new products, services, products or systems. A third, more recently emerged path is referred to as LSS or *Lean Six Sigma* (Pepper & Spedding, 2010). LSS integrates and leverages the sizeable commonalities, synergies and strengths of Six Sigma and Lean Enterprise theory and methods while ameliorating their weaknesses and distinctions. In particular, LSS weds key lean methodologies and perspectives such as value stream mapping, kaizen (continuous improvement), and waste identification and minimization together with equally key Six Sigma concepts and tools such as its focused approaches to innovation and design – DMAIC and DMADV.

Six Sigma in the late 1970s at Motorola Corporation, but it is GE with which Six Sigma is most familiarly associated. Its use has proliferated due in large to its acknowledged contribution of multiple billions of dollars to the economic performance of many enterprises. Six Sigma delivers either desirable and reliable new designs or significant improvements in existing products, processes, systems of key importance to customers or – more generally – to relevant enterprise stakeholders. This is accomplished by identifying and subsequently exacting change in key measurable and internally controllable levers of change that drive outputs highly relevant to those stakeholders. Such outputs are referred to as critical-to-quality (CTQ) characteristics and directly reflect preferences of customers of the product, process or systems that is being addressed. It is because we cannot directly control these CTQs that we must instead identify and control levers of change. Doing so begins with a clear and elaborated definition and understanding of customer and other relevant stakeholder needs, desires, and expectations – the so-called voice of the customer (VOC).

Lean Enterprise theory and approaches are often associated with Toyota Corporation and the familiar *Toyota Production System* (TPS) credited to late Toyota executive Taiichi Ohno and his mentor, Shigeo Shingo (Schmenner, 2015). Lean Enterprise methods are also associated with Kaizen (continuous improvement) philosophy and methods popularized by Masaki Imai (Antony, 2015). The arc of Lean Enterprise projects and enterprises is one typically aimed at waste reduction leading to improved efficiency, increased reliability, enhanced design, and better resource utilization so that such projects tend to be internally-focused, with derivative value for the customer.

Both Six Sigma and Lean Enterprise emphasize near relentless pursuit of perfection. Lean Enterprise methods do so via continuous incremental improvement cycles with an eye toward all enterprise processes and activities. In contrast, Six Sigma projects are typically discrete in nature and target breakthrough improvement in strategically important processes, products or systems. As such, the union of Lean Enterprise with Six Sigma is both internally and customer focused, taking simultaneous aim at both cost savings and value creation.

Six Sigma Innovation, Design for Six Sigma, Lean Enterprise and – more specifically – their integration that resulting in Lean Six Sigma are discussed. Although each of these has been his-

DOI: 10.4018/978-1-5225-2255-3.ch063

torically emphasized financial objectives, in principle they be used to singly or jointly address any number of objectives, including financial, social, or ecological performance, or anything contributing to organizational resilience and robustness (Edgeman, 2013). Also discussed are distinctions between the COPIS approach to business process conception prior to process implementation and execution via SIPOC (Edgeman, 2011a); commonly used supporting tools and techniques such as the Kano Needs Model and Quality Function Deployment or QFD (Tan & Shen, 2010); and concept generation and selection (Girotra, Terwiesch and Ulrich, 2010).

BACKGROUND

Of many competing Six Sigma and Lean Six Sigma definitions, the following, adapted from Klefsjö, Bergquist and Edgeman (2006), is herein employed:

Lean Six Sigma provides highly structured innovation, design, and lean enterprise strategies and methods for acquiring, assessing, and activating customer, competitor, and enterprise intelligence in order to deliver superior product, process, system, or enterprise performance that benefits all relevant stakeholders through best and next best practices and sources of sustainable competitive advantage.

Six Sigma is not unique in this quest for exceptional performance and competitive advantage. Rather, it is the combination of Six Sigma's strategic focus, structured approaches, breakthrough performance levels sought, and relatively short time horizons within which such improvement is demanded that distinguish it from other improvement, design, and innovation approaches.

Six Sigma's is provided by its focused design and innovation approaches. Its focused innovation algorithm is referred to as DMAIC and is a simple, yet logical scheme that demands the project in question to be carefully defined (D), with definition followed by measurement (M), analysis (A), improvement (I), and control (C) phases. Design for Six Sigma (DFSS) projects may employ any of a number of approaches, with the most common being DMADV, an acronym for Define-Measure-Analyze-Design-Verify (Edgeman, 2011b). While there are similarities between DMAIC and DMADV, there are also key differences, including in the intentions behind Define, Measure and Analyze in these algorithms (Cronemyr, 2007).

Specific content of each step in DMAIC and DMADV depends on enterprise and competitive context, the knowledge array resident in project team members, and the disciplinary traditions of those team members. Superior performance may be defined in absolute terms or specific to competitive context. Sustainable competitive advantage often relies not on application of Six Sigma or other strategies per se, but rather on enterprise enculturation and the effective and efficient use of such approaches in areas of strategic importance.

The need to significantly improve product and process performance through innovation provided much of the initial impetus behind Six Sigma, yet it is perhaps its status as a documented driver of superior financial performance that has led to its proliferation, subsequent diversification to design and lean environments, and dissemination across a number of application domains. In addition to traditional manufacturing applications of Lean and Six Sigma, significant gains in a number of "soft" or service application areas have been realized and include financial services (De Koning, Does, & Bisgaard, 2008), regional and national security (Edgeman, Bigio, & Ferleman, 2005), healthcare (Kaplan, Bisgaard, Truesdell, & Zetterholm, 2009) including surgery (Mason, Nicolay & Darzi, 2015), and energy production and distribution (Kaushik & Khanduja, 2009). In many of these latter applications, financial performance has been of secondary or tertiary importance and other considerations, such as ecological or societal sustainability has been deemed preeminent.