2

Theoretical Foundations

2.1 The Concept of Lean Six Sigma

2.1.1 Roots and Definition of Lean Management

In the early nineteenth century, Taylor [1911] initiated lean management with his work "The Principles of Scientific Management" and a description of mass production techniques employed by Henri Ford to manufacture his Model T. Due to accelerated progress and globalization[1] the rational organization for mass production he described led to significant disadvantages in terms of effectiveness, speed and flexibility (see [Hummels and de Leede, 2000, p. 75])—not only in the automobile industry. Ever since, increased competitiveness in the marketplace has necessitated the transformation to more effective forms of organization to speed up the customer order fulfillment cycle (see for example Knuf [2000]; Levy [1997]). It has made more sense to utilize the brain power of all workers (see [Dahlgaard and Dahlgaard-Park, 2006, p. 268]), to focus on core competencies, and to improve the whole value chain by extending the order fulfillment mapping to customers and suppliers (see Bhasin and Burcher [2006] and Comm and Mathaisel [2000]; Hines and Taylor [2000]; Liker [2004]; Weiss [2001]).

The Japanese engineers Taiichi Ohno and Shigeo Shingo took Henry Ford's high throughput and low inventories as a role model for the overall reduction of waste (see [Arnheiter and Maleyeff, 2005, p. 9], Inman [1999] and [Emiliani, 2006, p. 168]).

[1] Globalization can be defined as the increasing international integration of business, driven by technology and leading to the emergence of global markets. In other words, customers' desires have been homogenized globally with increased expectations, demanding a much higher quality standard of finished goods (see Levitt [1983]).

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Waste was defined as "anything other than the minimum amount of equipment, materials, parts, space and time which are absolutely essential to add value to the product" ([Russell and Taylor, 2000, p. 737]). Their company Toyota was the first to embrace lean thinking and the principle of using less of everything with its Toyota Production System (TPS) in the 1950s. Toyota, striving for perfection in their organization (see [Arnheiter and Maleyeff, 2005, p. 10]) and thereby revolutionizing the automobile industry, systematically identified seven different kinds of waste to streamline their processes (see [Töpfer, 2009b, p. 28], Drew et al. [2004] and [Pepper and Spedding, 2010, p. 139]): over-production, defects, unnecessary inventory, inappropriate processing, excessive transportation, waiting, and unnecessary motion.

Improved processes removed three types of barriers: waste, variability, and inflexibility (see [Drew et al., 2004, p. 36]). During the 1980s, when Just-In-Time (JIT) programs[1] followed in the Anglo-Saxon world, Toyota was the main reference for successful productivity increase. Critics have pointed out that conditions differ in other industries, so that applying the pioneering work of the automobile industry could be misleading (see Bhasin and Burcher [2006] and Adler and Cole [1993]; Norman et al. [2002]). On the other hand, case studies have proven that this argument can also be interpreted as one of the key misconceptions about lean management (see [Arnheiter and Maleyeff, 2005, p. 11f.]).

Linking back to the first research question, the lean part of Lean Six Sigma already contains corporate success factors. They way of thinking in lean management is very much productivity and goal driven.

In terms of waste reduction, Lean management's key element for the elimination of all non-value-added activities is the use of performance measurements. Employees are enabled to observe and improve their own working steps on a decentralized level (see for example Lantelme and Formoso [1999]) through repeated actions and control (see Bhasin and Burcher [2006] and Vasilash [2001]) on a daily basis (see Bhasin and Burcher [2006] and Ohno [1988]) and at the lowest level (see Bhasin and Burcher [2006] and Hines and Taylor [2000]). Therefore lean also stands for increased and continuous individual learning on the operational floor, making the organization competent for not just one-time change but the continuous change demanded by the business environment.

[1] JIT is an adaption of the TPS, according to the International Motor Vehicle Program (IMVP) benchmarking study and the work of Womack et al. [1990] (see [Pepper and Spedding, 2010, p. 138]).

As the TPS developed through sequential steps over a time horizon of over 30 years, the lean philosophy is characterized as a long-term journey (see [Bhasin and Burcher, 2006, p. 64] according to Turfa [2003]; Vasilash [2000]).

The success of lean management is based on performance and outcomes of individual employees. The motivation and ambition of individuals and the willingness and flexibility for continuous change therefore determine the long-term success of a company.

In their benchmarking study, Womack and Jones [1996] analyzed the superiority of the Japanese TPS over the dominant system of mass production in the Western automotive industry (see [Töpfer, 2009b, p. 30]). Identifying a significant performance gap through the analysis of 52 plants in 14 countries over a five year period (see [Bhasin and Burcher, 2006, p. 57]), they asked for more discipline and focus in lean implementation (see AberdeenGroup [2006a]) by following five principles (see [Töpfer, 2009b, p. 30] according to Womack and Jones [1996]). As a reaction to the fast circulation of the great rhetorical presentation of Womack and Jones [1996], some authors, like Kieser [1996], immediately referred to Lean Production as a short-dated trend with a bell-shaped curve that is already beyond its peak and out of fashion. Newman and Chaharbaghi [1998] even argue that Japanese manufacturing culture had been invented by Western observers who, blind to the weaknesses of lean production and their own strength, created a false model of cause and effect (see [Newman and Chaharbaghi, 1998, p. 514]). But the widespread implementation of lean fundamentals in organizations has disproved this criticism: in not only North America but also Europe many companies have continued to adopt the lean principles, with substantial increase in their performance (e.g., see [Töpfer, 2009b, p. 30] and AberdeenGroup [2006a]).

The exact level and quality of lean implementation (impacting Organizational Success and Organizational Culture) has not been broadly studied or defined yet. In terms of Organizational Success, lean does not necessarily result in improved financial performance (see Bhasin and Burcher [2006] and Lewis [2000]). A statistically significant relationship between profitability and lean production could not be proven (see [Bhasin and Burcher, 2006, p. 60] and Oliver and Hunter [1998]). And with conditions of high and stable domestic demands in the Japanese economy at the time of the study of Womack and Jones [1996], the role model of productivity is questionable in the first place (see [Bhasin and Burcher, 2006, p. 60] and Katayama and Bennett [1996]).

Although no statistically significant relationship between lean production and financial profit could be proven, performance increases have been observed in mainly North American and European companies adopting lean principles.

Throughout its history, Lean has suffered from various definitions that deviate from the origins described above and serve different authors' understandings and publication purposes (see Koskela [2004]). Independent of the discussion how to operationalize and differentiate between Lean thinking and Lean production, the basic idea and ambition to eliminate waste (Japanese: Muda) in order to streamline all processes throughout an organization and to obtain competitive advantages is more popular than ever (see Töpfer and Günther [2009]). Today the Lean philosophy is believed to have become a mindset (see [Bhasin and Burcher, 2006, p. 64] according to Elliott [2001]) and visible mainstream (see AberdeenGroup [2006a]). That Womack et al. [1990] never intended to build a profound theory based on their MIT study (see the interpretation by Koskela [2004]) should not be accepted as an excuse for the missing disclosure of measures and methodological details that prove the superiority of the Japanese automobile production (see [Minssen, 1993, p. 37] and [Bhasin and Burcher, 2006, p. 63]). It needs to be emphasized that the breakthrough of Lean thinking or Lean production as a popular management instrument has been based less on precise data and objective facts than on belief (see [Minssen, 1993, p. 37]) and on convincing and powerful rhetoricians. They have argued that Lean is a key factor in reshaping old-fashioned organizational structure (see [Hegner, 1994, p. 300]) and will solve the current business challenges (see [Kieser, 1996, p. 23f.]). To design the production systems in a way that products and services are delivered to the customer with minimal waste and maximal value sounds rather simple (see [Knuf, 2000, p. 58]. The underlying complexity in the complete realignment of all organizational systems and in how to specifically measure the improvements in multiple dimensions[1] is completely ignored. This criticism seems disappointing given that Lean has been widely recognized and analyzed across various academic disciplines and underlines the obscure nature of the topic (see [Emiliani, 2006, p. 169]). Lean is a concept that stresses performance measurement as a critical

[1] For example, through the differentiation between the three underlying elements philosophy, culture, and technical tools or processes (see Bhasin and Burcher [2006] according to Convis [2001]; Pullin [2002]).

success factor (see Lantelme and Formoso [1999]) in improving communication and coordination and creating a lifelong community of loyal workers (see [Minssen, 1993, p. 38] and [Bhasin and Burcher, 2006, p. 65] according to Allen [1997]). But it was not originally described and evaluated as such by Womack and Jones [1996] through clear and reliable data.

To summarize, no published recipe exists disclosing the complexity and specific steps a company needs to consider and take in order to reach certain improvements in performance with lean management.

The complexity of lean management implementation, especially obstacles through a misuse of the concept or people management failures (which could also include traits of leadership or cultural barriers) is neither described nor accounted for in practice.

The impact of culture[1] has been spotlighted as well. For example, differences in national cultures could limit the application of the Japanese mentality to the Western industry (see [Wong, 2007, p. 415]). This becomes even more important as numerous authors state that corporate culture and the alignment between thinking and behaving lean are crucial to reach the potential organizational benefits (see Bhasin and Burcher [2006] according to Bartezzagni [1999]; McNabb and Sepic [1995]; Schonberger [1996]; Utley et al. [1997]).

In order to increase performance with lean management, the corporate culture needs to support or align with lean thinking.

To highlight the true nature of how lean is implemented in practice, lean management seems to be as exhausting as losing weight is for a human being (see [Springer and Schulz, 2007, p. 68]). In the Western industry, lean implementation has focused on improvement and management has tended to concentrate on tools and practices (see [Pepper and Spedding, 2010, p. 142]). Adequate attention has not been paid to the human element or people management in particular (see [Emiliani, 2006, p. 169] and Bhasin and Burcher [2006] according to Bidanda et al. [2005]; Chung [1996]; Lathin and Mitchell [2001a,b]; Prabhu [1992]; Siekman [2000]), leading to severe problems in the organizational culture.[2] Possible consequences may include visible downsizing symptoms hypothesized by [Weiss and Udris, 2001, p. 105]:

[1] For a detailed definition and conceptualization of the term culture and its differentiation into multiple layers (national, organizational, corporate), see section 2.4, The Concept of Corporate Culture.

[2] Again, for a detailed definition of Organizational Culture and its differentiation from Corporate Culture, see section 2.4, The Concept of Corporate Culture.

- Headcount reductions and job cuts lead to insecurity among employees and anxiety about the future.
- Increased pressure on working performance and increased competitiveness among employees lead to loss of solidarity and to mobbing.

Adverse effects on morale, increasing levels of worker unhappiness and withdrawal, ultimately lead to operational failures (see [Pepper and Spedding, 2010, p. 141] according to Hines et al. [2004]). Intensified work pace and demands through lean production can even cause adverse health effects (see Landsbergis et al. [1999]). With these consequences, however, the basic ideas of lean management seem to have been misunderstood, as no layoff of an employee could take place unless absolutely necessary (see [Arnheiter and Maleyeff, 2005, p. 11] according to Emiliani [2001]). **Employees are seen as knowledgeable assets to a company, and their layoff risks being counterproductive.** In successful lean operations, co-workers are more friends than predators. The company has much interest in retaining their employees all their lives and respect for people is a key value (see for example [Emiliani, 2006, p. 169]) rather than something that is just paid lip service (see Bhasin and Burcher [2006] according to Norman et al. [2002]). Increased competitiveness and hostile activities would contradict the community and togetherness of loyal workers. Therefore lean implementation in the Western world is mainly about cultural change in the organization (see Bhasin and Burcher [2006]; Sawhney and Chason [2005]) without drastic cuts in its shape.

It becomes clear that Lean Management itself has to be considered precisely and from different angles in order to understand the true and sustainable effects on Corporate Culture and Corporate Success.

In essence, **Lean Management is described to have positive effects on Corporate Success, but only if the influencing factors (Culture, Leadership) support the mind set of Lean Management in the right direction (focus on empowered people as the core asset of a company)**.

The next section will explore the roots of Six Sigma to be able to integrate it with Lean Management and to define the character of Lean Six Sigma as a whole. In preparation for chapter 3 (Literature Review) further forces impacting Corporate Culture and Corporate Success will be identified and summarized.

2.1.2 Roots and Definition of Six Sigma

Built on principles of Deming's Total Quality Management (see Brady and Allen [2006]), at first glance Six Sigma looks strikingly similar (see [Schroeder et al., 2008, p. 536] according to Clifford [2001]). The underlying philosophy, tools, and techniques are in fact very similar (see [Schroeder et al., 2008, p. 537]). For example, Six Sigma's process improvement methodology, the DMAICR cycle, is comparable to Deming's PDCA cycle (see [Senapati, 2004, p. 684] and [Kumar et al., 2008, p. 458] according to Bertels [2003] and [Pepper and Spedding, 2010, p. 142] according to Andersson et al. [2006]; Pande et al. [2000]). Differences are seen in following aspects: The innovation of Six Sigma lies in the organizational implementation (deployment approach and emergent structure, see [Schroeder et al., 2008, p. 548]) and the emphasis on the scientific approach (see [Pepper and Spedding, 2010, p. 144]). On the other hand, TQM's focus on behavior and investment in people proves a broader focus for transformation of organizational culture (see [Senapati, 2004, p. 688]), shifting toward the core element "All One Team" (see [Pepper and Spedding, 2010, p. 143]). Based on the Joiner Triangle, Six Sigma and TQM can be depicted as skewed triangles (see figure 2.1, simplified according to [Pepper and Spedding, 2010, p. 143]), each approach somewhat failing to provide a coherent system philosophy, aiming for equal growth on each side of the triangle (see [Pepper and Spedding, 2010, p. 143f.]).

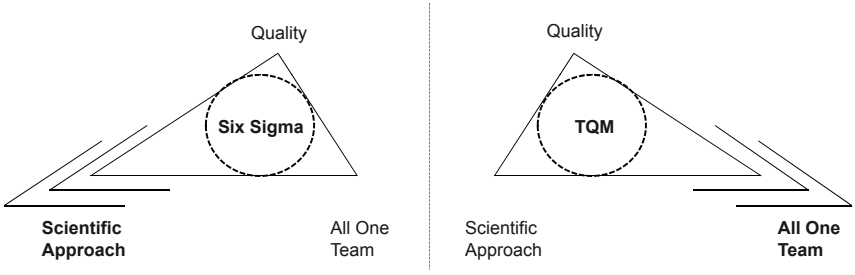

Figure 2.1: Focus of Six Sigma vs. TQM - Skewed Joiner Triangles (Source: [Pepper and Spedding, 2010, p. 143])

In the end, **Six Sigma has emerged as a strategy that includes TQM, a stronger customer focus, additional data analysis tools, financial results,**

and project management to meet customer needs (see [Kumar et al., 2008, p. 458] according to Kwak and Anbari [2006]). However, Six Sigma may still mean different things to different people: depending on the organizational level at which the individual resides, the concept can be interpreted as either **a metric, a philosophy, or a methodology for quality improvement** (see [Mitra, 2004, p. 293f.]). There is no single definition for Six Sigma: as for Lean Management the attempt to operationalize differs by author and publication purpose. The following description of the historical foundations will reconstruct the road that perceptions of Six Sigma have taken over the years.

The name Six Sigma stems from the goal to have not more than 3.4 defects per million opportunities (DPMO) (see for example [Linderman et al., 2003, p. 193] and [Brady and Allen, 2006, p. 3]). Alternatively, based on the Gaussian normal distribution, Six Sigma aims at a quality level of 99.99966% for all process and product attributes (see [Töpfer, 2007c, p. 3] and [Günther, 2010, p. 6]). Invented by William Bill Smith and first implemented by Motorola in 1987, Six Sigma originally served as a method to reduce manufacturing defects (see Kumar et al. [2008]; Senapati [2004] and Schroeder et al. [2008] according to Barney [2002]; Folaron [2003]).

Six Sigma's popularity has been boosted by the development and promotion of Six Sigma at GE (General Electric Company). In 1996, GE's CEO Jack Welsh declared Six Sigma as GE's corporate strategy for improving quality and competitiveness (Dahlgaard and Dahlgaard-Park [2006] according to Park [2003]). The top-down initiative is deployed in terms of projects, each with clear objectives, time frame, and results, with the gains expressed financially where possible (see [Goh and Xie, 2004, p. 237]). Carried out by designated personnel trained as champions, master black belts, black belts, green belts, etc., the projects follow a logical sequence (see [Goh and Xie, 2004, p. 237]), each using a selection of instruments from the Six Sigma toolkit that are suitable for the specific context.

To summarize, Six Sigma aims to achieve specifically defined objectives in a certain time with a structured project management method and dedicated improvement specialists.

Despite initial scepticism and hesitancy, over time Six Sigma has turned into the only quality improvement initiative with much application outside manufacturing, even reaching service industries and health care management (e.g., see [Kumar et al., 2008,

p. 457f.] listing Antony [2004]; Antony and Fergusson [2004]; Frings and Grant [2005]; Krupar [2003]; Moorman [2005] and Kwak and Anbari [2006]; Sehwail and DeYoung [2003]; Töpfer [2007b]). Recently published case studies have focused on small and medium enterprises (SMEs) (see Kumar et al. [2006]; Wessel and Burcher [2004]), technology-based manufacturing (see Motwani et al. [2004]), and the food sector (see Knowles et al. [2004]).

It becomes clear why the name Six Sigma does not solely stand for an error rate or a process improvement tool in the manufacturing industry anymore. The concept has evolved into a management philosophy,[1] spread over different industries. Six Sigma combines established elements of quality management in an intelligent way to transform the whole value chain of an organization at a rapid pace, i.e., includes them as a critical part of successful corporate management to increase organizational performance (see [Töpfer, 2007c, p. 7f.] and [Brady and Allen, 2006, p. 3]).

Like Lean Management, Six Sigma has gained momentum in industry but lacks academic research (see Linderman et al. [2003]; Schroeder et al. [2008]). Schroeder et al. [2008] employ a definition to explain Six Sigma by using field observation, the (foremost practitioner) literature, and pure thought. To avoid the mistakes of previous authors who were too general in their definitions, they focus on obtaining a scientific definition of Six Sigma, including both the "what" (the elements of Six Sigma) and the "how" (relationships between these elements) (see [Schroeder et al., 2008, p. 537]). In line with the characterization above, the resulting definition of Six Sigma suggests four relevant elements that are hypothesized to be linked in a five factor mediation model as shown in figure 2.2 ([Schroeder et al., 2008, p. 543]): parallel-meso structure, improvement specialists, structured method, and performance metrics.

These factors constitute Six Sigma's structured project management approach, leading to a high impact on organizational performance and a correction of the preconception Six Sigma is "old wine in new skin" to Six Sigma is "better wine in old skin" (see Masing [2004]; Töpfer [2007c]). To define Six Sigma's nature even further, Six Sigma has also been evaluated through a **goal-theoretic perspective** (see Linderman et al. [2006, 2003]). By setting explicit goals in improvement projects, Six Sigma enables behavioral change of organizational members, e.g., by creating perceptions

[1] Management philosophy is defined as the thinking and acting stimulated by the leadership of an organization (see [Simon, 2000, p. 80]).

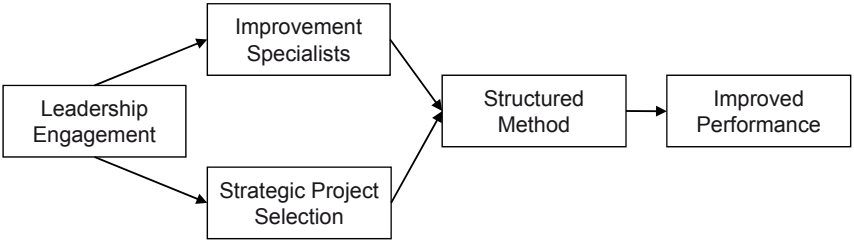

Figure 2.2: Six Sigma Framework - Mediation Model with five variables (Source: [Schroeder et al., 2008, p. 543])

about how much change is possible (see Linderman et al. [2003]). **In contrast to Lean Management, Six Sigma sets the pace in a more structured, scientific way: goals and change options are given to rather than created by individual employees.** Conversely, too ambitious goals lead to lower commitment levels and decreased performance, emphasizing the behavioral insight needed—next to the technical understanding—for a successful Six Sigma implementation. Compared to the framework shown in figure 2.2, the version presented in figure 2.3 has been expanded to reflect the goal-theoretic impacts (own integrated version, based on [Linderman et al., 2003, p. 197, 200] and [Linderman et al., 2006, p. 781]).

Instead of the two factors improvement specialists (known at the most rigorous level as "Black Belts", see [Mitra, 2004, p. 294]) and strategic project selection, the three components effort, persistence, and direction act as mediating variables between explicit and challenging Six Sigma goals and improved organizational performance. In parallel, the task complexity, Six Sigma training, and goal commitment also influence the relationship between goals and performance. The breakdown into variables facilitates learning more about the drivers of successful Six Sigma implementation.

Critics of Six Sigma remain (see Benner [2005]; Flott [2000]; Hammer and Goding [2001]) and numerous surveyors have noted that a significant number of companies have failed to achieve the intended benefits with Six Sigma (see Byrne [2003]; Kumar et al. [2008]); the constructs presented above set the ground for identifying the reasons for failure more specifically.

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