

# A Review of Critical Factors contributing towards failure of Lean Six Sigma

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**Abstract:** *Lean Six Sigma (LSS) is a continuous improvement methodology that aims to reduce the costs of poor quality, improve the bottom-line results and create value for both customers and shareholders. The purpose of this paper is to explore the critical failure factors for LSS in different sectors, such as manufacturing, services, higher education, etc. The following research is based on a systematic literature review of 56 papers that were published on Lean, Six Sigma and LSS in well-known academic databases from 2003 to 2018. There are 34 common failure factors of LSS cited in this paper. There are some common factors for failure, such as a lack of top management commitment and involvement, lack of communication, lack of training and education, limited resources and others. Many gaps and limitations are discussed in this paper and need to be explored in future research. The paper is one of the first systematic literature reviews to explore the critical failure factors of LSS and discuss the top failure factors from different angles, i.e. countries' evolution, organization's size (small- and medium-sized enterprises and large organization's) and industry nature.*

## 1. Introduction:

Today, Lean and Six Sigma are the most popular business strategies for enabling continuous improvement (CI) in the manufacturing, service and public sectors. CI is the main goal for any organization wishing to achieve quality and operational excellence and to enhance performance (Antony et al., 2012a; Thomas et al., 2009). Therefore, the integration of the two approaches improves efficiency and effectiveness and helps to achieve superior performance faster than the implementation of each approach in isolation (Antony et al., 2012a). This interest in LSS has led to many attempts to produce a comprehensive approach to achieve CI. There are noticeable limitations in the fields of research into areas of LSS (Chakravorty and Shah, 2012; Laureani and Antony, 2012), but the benefits of applying Lean and Six Sigma in parallel are noted in many case study papers in both the manufacturing and the service sector. It is also significant that the number of available

papers on LSS, though still small in comparison with other quality improvement methods, has shown exponential growth since the first papers were published in 2003. As a consequence, this paper includes research papers on both Lean and Six Sigma to take into account more failure factors for LSS.

### *1.1 Critical failure factors*

Garg and Garg (2013) and Ganesh and Mehta (2010) have defined CFFs in term of enterprise resource planning (ERP) as the key aspects (areas) where ‘things must go wrong’ in order for the ERP implementation process to achieve a high level of failure”. They also have defined failure as “an implementation that does not achieve a sufficient return on investment (ROI) identified in the project approval definition”. According to Al-Mashari (2001) study in ERP as well, “strategy development is critical to ERP implementation, as its absence has resulted in poor outcomes” Moreover, a number of academic papers have targeted CFFs such as the study done by Yeo (2002) in CFFs in information system (IS) project. Yeo (2002) has studied the interaction between some factors such as organisational, financial, technical, human and political factors which then these factors named CFFs for IS project. However, Yeo (2002) study did not define the term CFFs but only defined some situations when project defines as a failure. Other study done by Belassi and Tukel (1996) in projects management CSFs/CFFs has only listed some factors that lead projects to success or fail with no any definitions for CFFs.

Furthermore, there seems to be insufficient research investigation on the critical failure factors of Lean, Six Sigma and Lean Six Sigma (LSS). Hence, authors argue that this paper will be valuable in term of identifying CFFs of LSS.

### *1.2 LSS*

LSS was defined by Snee (2010) as “a business strategy and methodology that increases process performance resulting in enhanced customer satisfaction and improved bottom line results”. Organisations give many reasons for implementing LSS, for example to improve business performance and operational efficiency, to improve product quality, to reduce production costs and to improve customer satisfaction, especially considering the growth of global markets (Antony et al., 2007, 2012a; Snee, 2010). The first integration of Lean and Six Sigma occurred in 1986 in the US-based George group (Salah et al., 2010). However, the term LSS was first introduced into literature around 2000 (Antony et al., 2012a; Laureani and Antony, 2012; Snee, 2010). The popularity and deployment of LSS are notable in the industrial world, especially in large western organisations such as Motorola, Honeywell, GE, Du Pont, Merck, Johnson & Johnson, Bank of America and others (Laureani and Antony, 2012; Snee, 2010) and in some small- and medium-sized manufacturing enterprises (SMEs) (Antony et al., 2005; Kumar et al., 2011).

### *1.3 Lean and Six Sigma failures in the literature*

A number of authors have argued that although companies have successfully deployed CI initiatives such as Lean and Six Sigma, a significant number of companies have failed to gain any benefits from their deployment and other companies have failed to achieve the expected results (Kumar et al., 2008a, b; Martinez-Jurado and Moyano-Fuentes, 2012). According to Ringen and Holtskog (2011), of every three CI initiative projects in general, two fail to attain the expected results. Moreover, Pedersen and Huniche (2011) reported that up to 70 per cent of the companies implementing Lean have failed. In 2006, research conducted in UK organisations implementing Lean showed that fewer than 10 per cent of the organisations have implemented it successfully (Bhasin and Burcher, 2006). Many authors, such as Chakravorty (2009) and Kumar et al. (2007, 2008b), have reported a survey of aerospace companies carried out in 2005. The results of the survey showed that respondents' satisfaction with Six Sigma results was lower than 50 per cent, while only 20 per cent were satisfied and 30 per cent were dissatisfied. Feng and Manuel (2007) stated that their survey of health-care companies showed that 54 per cent of the surviving companies do not anticipate implementing the Six Sigma strategy. A review of 47 studies in health care undertaken by Glasgow et al. (2010) concluded that 62 per cent of Six Sigma and Lean initiatives failed as a result of a lack of stakeholder acceptance. These failures and dissatisfaction with the results are not because of a shortage of improvement programmes. Most of the companies failed to pay attention to the critical success factors during implementation, such as top management commitment and involvement, communication with the shop floor workers, selection of projects, training and so on. Hence, a significant number of CI projects have failed (Chakravorty, 2009; Laureani and Antony, 2012; Snee, 2010). Moreover, LSS implementation success and failure depend on how and where it is applied (Duarte et al., 2012). The search of the reviewed papers illustrated that there is a clear limitation in the publication of the factors that lead to LSS failure. Therefore, this research aims to narrow the gap in the literature by exploring the most common CFFs of LSS.

## **2. Methodology**

This paper investigates the most well-known elements that lead to LSS disappointment in various businesses, which have been distributed in scholastic diaries, by efficiently checking on the writing. As indicated by Okoli and Schabram (2010), an efficient writing survey is "a deliberate, unequivocal, exhaustive and reproducible strategy for recognizing, assessing, and integrating the current group of finished and recorded work delivered by analysts, researchers, and specialists". Tranfield et al. (2003) expressed that the precise survey has turned into an "essential logical movement". To date, just two methodical surveys have been distributed with respect to LSS, which were done by Glasgow et al. (2010), on social insurance, and Zhang et al. (2012), who directed a general audit. Creators have contended that there is an unmistakable requirement for more systematic audits to be completed in the zone of LSS disappointments to conquer any hindrance in the previous writing. This paper means to introduce a precise writing survey of all the diary papers that exist in various scholastic databases with

respect to Lean, Six Sigma and LSS from 1995 to 2013. These dates were picked to guarantee that the outcomes and discoveries are cutting-edge.

### 2.1 Approach and phases

In this paper, the methodology incorporates a methodical writing audit process as appeared Table I. These ten stages are basic and should be followed in an efficient audit. Three stages underlie these ten stages, as appeared in Figure 1. The procedures and stages in this methodology have been adjusted from a few scholarly sources, for example, Okoli and Schabram (2010), Thomas et al. (2004) and Tranfield et al. (2003).

### 2.2 Criteria

The incorporation and rejection criteria are expressed so as to make it obvious to perusers why a few articles with which they are commonplace may have been avoided from the audit (Booth et al., 2012). Okoli and Schabram (2010) contended that disentangling research by criteria by, first, inspecting the title, and after that the unique when required, helps the analyst to spare time and exertion. Receiving this methodology, the creators analyzed papers by title and after that abstracts when required, and by this implies incorporated every one of the papers that meet the consideration criteria; in any case, the utilization of this strategy implied that it was impractical to prohibit every single irrelevant paper (see Table II). In addition, an examination incorporation and prohibition model is extremely basic to evaluate the nature of papers. Hunting down applicable papers was constrained to papers was distributed somewhere in the range of 1995 and 2013 to ensure that all data are cutting-edge.

S.No	Process	Defination
1	Research purpose and objective	The purpose and objectives are clearly identified after a review of the most common gaps that appear in the literature
2	Develop research protocol	The protocol includes the study scope, strategy, criteria, quality assessment, data extraction and so on. This protocol will be followed during the systematic literature review process
3	Establish relevance criteria	The research criteria help to ensure that we include only the papers most relevant to the research question and exclude unrelated papers
4	Search and retrieve the literature	Electronic search for relevant articles in top academic and specialist journals, and hand research in bibliographic lists if needed
5	Selection of studies	Dependent on research criteria
6	Quality assessment for relevant studies	Using appropriate tools to assess articles for quality. Each article should be scored for its quality depending on the methodology used
7	Data extraction	Extract the relevant data from each study included in the review

Table 1: Research processes and definitions

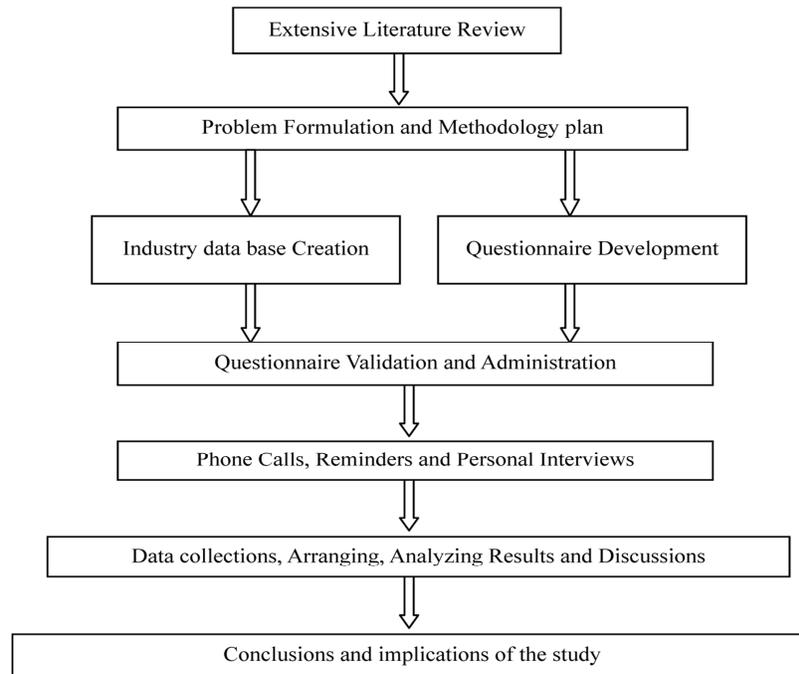


Fig 1. Summary of Research Phases

### 2.3 Material and outcomes

The "diary" look for research writing was attempted through four surely understood scholastic databases: Emerald, Elsevier, ProQuest and Taylor and Francis. Inquiry strings were utilized as pursues: [(lean) or (six sigma) or (lean six sigma) AND (ceaseless enhancement) AND (failure)]. In the interim, the writing seek was constrained to the English language as it were. This inquiry of databases outlined that not a single research articles identified with LSS were in sight before 2003 and the primary paper on LSS disappointment factors was distributed in 2009 by Thomas et al. The audit brought about 56 papers distributed on Lean, Six Sigma and LSS disappointment in various segments: fabricating, administrations, open, medicinal services and advanced education. These investigations were directed in different nations, including the USA, the UK, Brazil, Denmark, Australia and some Asian nations. The main five most regular disappointment components will be examined in the talk segment just as the basic disappointment factors as indicated by nations' advancement, associations' size and enterprises' inclination. The information gathered for investigation and the key discoveries of this paper are introduced in table structure to encourage understanding.

### 3. Results

#### 3.1 Growth of articles

The examination demonstrated that there are 11 papers on LSS disappointment, and that the primary paper to talk about LSS disappointment was distributed in 2009 by Thomas et al. Be that as it may, this number expanded by four papers in both 2010 and 2012. Besides, the look of databases for Lean disappointment factors brought about 18 papers, while Six Sigma disappointment factors showed up in just 12 papers. Contrasted and other quality enhancement philosophies, this number of articles is very low. The relatively low volume of articles demonstrates that there is a pivotal requirement for more examination into the CFFs of LSS, particularly as LSS usage is quickly developing in prominence here, confirm by driving partnerships referring to LSS as a foundation logic for their business.

#### 3.2 CFFs of LSS

Checking on the papers brought about 34 factors that lead to Lean and Six Sigma arrangement disappointments (see Table III). A portion of these elements were referred to by a critical number of creators. Then again, different components were referred to by just a single creator.

### 4. Discussions

#### 4.1 Most regular basic disappointment factors

There is a discernible increment in the notoriety of LSS and the dimension of LSS sending in the modern world, particularly in vast associations in western nations, for example, the USA and the UK and in some SMEs in creating nations, for example, India. This area of the examination means to reveal the insight into the main five CFFs of LSS sending.

These elements are as per the following:

- (1) Lack of best administration disposition, responsibility and association has been distinguished as the most CFF of LSS in this paper as it showed up in 20 of the papers found. This factor has been observed to be a basic disappointment factor in all enterprises in various nations and diverse hierarchical sizes. Numerous creators, for example, Ho et al. (2008), Kwak and Anbari (2006) and Snee (2010), have expressed that without best administration duty and backing, LSS extends effectively fall flat. The job of best administration is to guarantee that all the required assets are accessible and that no hindrances happen amid the venture organization (Martinez-Jurado and Moyano-Fuentes, 2012; Snee, 2010). Creators have contended that this factor is especially basic to LSS achievement or disappointment as its appearance in countless features its criticality.
- (2) Lack of preparing and instruction has been referred to as the second best factor of LSS disappointment. Numerous associations consider preparing to be a misuse of cash and excessively exorbitant. Notwithstanding, preparing ought to be seen as a basic factor for the effective execution of LSS and a system to decrease the LSS usage time (Laureani and Antony, 2012; Snee, 2010), which can make reserve funds for the organization and diminish the work cost (Bhasin, 2012a, b; Chakravorty, 2009).

(3) Poor LSS venture determination and prioritization: Su and Chou (2008) and Duarte et al. (2012) trusted that choosing the wrong venture can lead the whole LSS exertion to fall flat. In this way, choosing the correct task is a basic factor for LSS.

#### **4.5 Future research**

Manufacturers believe that future research is required to assess the criticality of a couple of components that appeared in few cases explored in this examination. These factors fuse weak associating of the LSS methodology to suppliers (Bamber and Dale, 2000), the nonappearance of perception of how to start (Kumar et al., 2009a), the nonattendance of usage of genuine speculation (Thomas et al., 2009, and so on. Future research is in like manner expected to recognize the fundamental disillusionment factors for LSS course of action in association with countries' progression (rotted and making countries), industry (open, organization, human administrations, propelled instruction and gathering) and affiliations' size (SMEs and significant affiliations). In addition, there is an absence of preparations on quality upgrade, especially in the LSS zone in cutting edge instruction. Looking for four databases achieved one paper that met the examination criteria, which was conveyed in 2012 by Antony et al. Makers believe that affiliations need a manual for the successful utilization of LSS in each division, especially for affiliations that need to start LSS beginning with no outside help.

#### **5. Conclusion**

Notwithstanding the way that LSS has been used in relationship as a quality improvement action for quite a while and various scholastics are enthusiastic about driving investigation on LSS, there is a nonattendance of academic research concentrating on LSS fundamental disillusionment factors. From this time forward, the inspiration driving this investigation was to explore the components that lead LSS dares to flounder in different divisions, for instance, creating, organizations, propelled instruction, etc. The examination endeavored a purposeful composition overview of four without a doubt saw insightful databases using thought and shirking criteria. Glancing through the databases achieved 65 insightful papers on Lean, Six Sigma and LSS that met the investigation criteria. Looking at these papers achieved 34 essential dissatisfaction factors of LSS game plan in affiliations. Affiliations' CEOs and bosses should concentrate on the essential accomplishment elements and should think about the most broadly perceived frustration factors that lead diverse relationship in a comparative industry to bomb in their LSS adventures. They furthermore need to understand their affiliation's accessibility and limit before starting any LSS adventure. Exactly when affiliations start the errand, chiefs should support the LSS bunches as their assistance and duty is a standout amongst the best fundamental accomplishment factors for LSS adventures. In any case, a nonappearance of the officials support surely drives the whole dare to miss the mark. It is clear from the results in this paper a nonappearance of benefits is a colossal test for affiliations, paying little personality to the advancement of the country or the proportion of the affiliation. An absence of budgetary resources is beyond question one of the key limits to LSS achievement in innumerable

trust that LSS is still in its starting periods, especially in cutting edge instruction, and it will be one of the world-class quality upgrade programs in the coming years, particularly in western countries. Moreover, the massive gap in the composition that ought to be tended to in future research has been inspected in this paper, for instance to recognize the CFFs of LSS sending for countries at different periods of headway (made and making), particular organizations (open, organization, delivering, etc.) and assorted affiliation sizes (SMEs and colossal affiliations). Like some other examination, this examination has its requirements: one obstruction could be that the amount of databases looked for was bound to four.

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