

# **Critical Success Factors of Lean Six Sigma Implementations in Philippine Food Manufacturing Companies**

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## **Abstract**

Lean Six Sigma (LSS) is a data-driven philosophy that drives performance improvement by eliminating waste and reducing variability. Food Manufacturing (FM) companies introduce programs like LSS to improve competitiveness. However, LSS implementations are complicated and complex. Companies must carefully manage the implementation of LSS to achieve the desired outcomes. In line with this, proper management of Critical Success Factors (CSFs) can enhance the initiative's chances of success. This research aims to identify, rank, and understand the CSFs, and recommend strategies to manage them within Philippine FM companies. A combined approach of structured literature review, structured survey, and structured interview were used to gather the necessary data. The thematic analysis and Relative Importance Index method revealed that there are 15 CSFs. These CSFs were synthesized into 4 clusters: Synergy, Expertise in LSS, Effective Management, and Dedicated Leadership. Thus, to be successful, all stakeholders within the company must have the essential hard and soft skills to execute the DMAIC framework and manage the initiative as a whole. More importantly, they must have the proper working environment, be aligned to the intended goal, and fully cooperate and contribute to the activities that must be accomplished to achieve the target future state.

## **Keywords**

Lean, Six Sigma, Implementation, Critical Success Factors, Food Manufacturing

## **1. Introduction**

Manufacturing in the Philippines has always been an important sector of the economy. It accounts for more than fifty percent of the country's industrial sector and around twenty-five percent of the Gross Domestic Product (GDP). It is comprised of sub-sectors such as food, tobacco, textile, chemical, metal, and equipment manufacturing, to name a few. However, among its sub-sectors, the single most significant component of Philippine manufacturing is food manufacturing (FM) (Department of Trade and Industry 2020).

The FM industry contributes more value to the GDP than any other manufacturing sub-sector. It accounts for more than thirty-five percent of the total manufacturing value contribution from the 1990s until the early 2010s. It also employs the most among the sub-sectors, with an average employment contribution of more than twenty percent (from 2001 to 2010) and twenty-five percent (from 2011 to 2013) (Department of Trade and Industry 2020).

The industry's importance to the economy has been highlighted by the COVID-19 pandemic that we are currently experiencing. To curb the spread of the virus, the Philippine government implemented lockdowns throughout the nation. However, this resulted in many local consumers' early stockpiling of essential food products concerned about running out of stock (Euromonitor 2021). While FM companies were able to deliver, they had difficulties in satisfying customers' demands and expectations.

One way to address this issue is to restore and maintain the company's efficiency, effectiveness, and quality. Companies adopt various manufacturing strategies to improve competitiveness and satisfy customer demands and expectations. In recent decades, companies have opted to introduce Lean Six Sigma (LSS) in their organizations to improve overall competitiveness through increased efficiency, effectiveness, and quality (Mundra and Mishra 2020).

LSS is defined as a data-driven approach that drives performance improvement through waste elimination and variability reduction. LSS has gained tremendous interest and is accepted worldwide for the numerous benefits it can bring, all of which improve a company's competitiveness. However, its implementation is complex, complicated, and not straightforward (Alhuraish et al. 2017). Implementation of lean can be considered as any other change program introduced to an organization (Al Manei et al. 2017).

Like any other change program, LSS implementations have the possibility of failure. To further accentuate this point, Mundra & Mishra (2020) noted that most organizations fail to implement LSS successfully, thereby missing out on its benefits. This is where companies must be cautious since unsuccessful implementations can negatively impact the company's resources and employee morale toward LSS.

Companies must carefully manage the introduction and implementation of LSS in order to achieve desired outcomes. In line with this, proper management of Critical Success Factors (CSFs) can boost a program's success rate. CSFs are defined as the essential factors that must be satisfied for the program or organization to succeed. It can also be defined as the few key areas that "must go right" to succeed (Rockart 1979). Hence, it is essential to determine and manage the driving forces or CSFs that influence the success of LSS implementations.

Increasing competition and complexity of customer demands have forced FM companies to implement various manufacturing strategies, particularly LSS, to improve their performance by increasing efficiency, effectiveness, and quality. However, due to the inherent complexity of LSS, companies fail to execute LSS within their organization correctly. To reduce the chances of failure, companies must fulfill their CSFs completely. It is, therefore, critical for companies to know which are the CSFs that drive an LSS implementation. In line with this, listed below are the problems that the researcher wants to answer in this study:

- A. What are the CSFs for implementing LSS in Philippine FM companies?
- B. Does the LSS framework address these CSFs? If not, what can be improved on the framework to help address the CSFs?

### **1.1 Objectives**

This study aims to identify, rank, and understand the CSFs for implementing LSS in Philippine FM companies. This paper also aims to assess the LSS framework under the CSF perspective and how it ensures proper execution of the CSFs to increase the chances of success. If the researcher finds that the current LSS framework fails in the aforementioned area, this study intends to recommend how to improve the management of the CSFs.

This study builds on established knowledge presented by past researchers and fills the gap in the literature by presenting localized insights on the CSFs of LSS implementations in the FM companies in the Philippines.

## **2. Literature Review**

Investigating CSFs is imperative as it helps companies implement a program and avoid failures that can be costly (Netland 2016). Rockart (1979) defines CSFs as the "limited number of areas in which, if they are satisfactory, will ensure competitive performance for the organization." Brotherton & Shaw (1996) described CSFs as the essential things that the company must achieve to produce the most significant competitive leverages (Lande et al. 2016). Boynton & Zmud (1984), as cited by Netland (2016), also stated that CSFs represent those few managerial or enterprise areas that must be given special and continual attention to bring about high performance and success.

Lean originated from the concept of the Toyota Production System (TPS). Toyota developed TPS in the 1940s to gain a competitive advantage through improved efficiency. While it was initially focused on the automotive industry, it has been applied to almost all manufacturing sectors (Salonistis & Tsinopoulos 2016). The term "Lean" was popularized

by Womack et al. (1990) in the book “The Machine That Changed the World,” which investigated the differences in productivity between the Japanese and Western automotive companies.

The Lean approach is an incremental improvement that aims to eliminate waste and overburden, resulting in more value to customers (Ohno 1988). Shah & Ward (2007), as cited by Al Manei et al. (2017), defined Lean as an integrated socio-technical system whose main objective is to eliminate waste by reducing or minimizing supplier, customer, and internal variability. While Zhuo (2016) pointed out that Lean is a business strategy used to improve quality and service, eliminate waste, reduce time and costs, and enhance overall organizational effectiveness.

On the other hand, Motorola introduced SS in the mid-1980s to significantly improve its processes (Ali et al. 2020). The term ‘sigma’ of SS is derived from the standard deviation measure in statistics. Standard deviation is a measure of variation and dispersion of a set of values. It is usually denoted by the symbol  $\sigma$ , the lowercase of the Greek letter sigma.

SS is implemented using the Define, Measure, Analyze, Improve, and Control (DMAIC) framework. Its goal is for the output of the process to reach near perfection at only 3.4 defects per million opportunities (DPMO). This translates to 99.99966% of products or services satisfying customer requirements (Montgomery & Woodall 2008).

Linderman et al. (2006) identified SS as an organized and systematic method for process improvements and new product and services development, based on statistics and scientific techniques, to eliminate defects defined by end customers (Kuvvetli, 2016). Also, Harry (1998) argued that SS is a strategic initiative that helps organizations improve quality, boost profitability, increase market share, and improve customer satisfaction through statistical tools (Dubey, 2016). Therefore, SS focuses on the elimination of variation and defects in quality (Madhani 2020).

LSS is described by Muir (2005) as the convergence of the two previously discussed concepts: Lean and Six Sigma (Lande et al. 2016). Lande et al. (2016) stated that Lean addresses the efficiency issue through its emphasis on speed and waste, while SS addresses the effectiveness issues through its focus on process evaluation and defect and variation reduction. Snee (2010), as cited by Costa et al. (2018), defines LSS as an integrated Lean and SS problem-solving program that aims to address the company’s root causes of poor performance. It is a strategy and methodology whose objective is to increase the process performance, enhance customer satisfaction, and drive positive bottom-line results. Also, Laureani & Antony (2012), as cited by Lande et al. (2016), argued that LSS could be defined as a business improvement methodology that maximizes value by improving quality, speed, customer satisfaction, and costs.

In addition, LSS takes the DMAIC framework and the statistical approach to variation reduction of SS while integrating the emphasis on value creation and waste reduction of Lean (Lande et al. 2016). It is a proven strategy for process management and excellence to reduce variations and eliminate defects in the service and manufacturing processes, resulting in business process excellence (Snee 2010).

With this further understanding of the concepts, the researcher conducted a detailed investigation of the factors identified by previous studies.

In summary, the researcher was able to reveal the 25 most common factors identified. These factors are as follows: (1) Management Commitment, Involvement, and Support, (2) Education and Training, (3) Adequate Resources, (4) Organizational Structure and Culture, (5) Organizational Expertise, Knowledge, and Understanding, (6) Acceptance of Change, (7) Employee Involvement and Empowerment, (8) Leadership, (9) Linking and Alignment to Organizational Strategy, (10) Organizational Communication, (11) Linking and Alignment to Customer Relationship and Satisfaction, (12) Proper Usage and Integration of Tools and Practices, (13) Favorable External Factors, (14) Reliable Information and Performance Measurement Systems, (15) Project Management, (16) Structured Management Systems, (17) Organizational Readiness, (18) Linking and Alignment to Supplier Relationship and Performance, (19) Project Prioritization and Selection, (20) Teamwork, (21) Employee Benefits, Incentives, and Rewards, (22) External Support from Consultants, (23) Employee Motivation and Ownership, (24) Favorable Internal Factors, and (25) Structured Improvement Procedure (Abid et al. 2020, Abu et al. 2019, Alhuraish et al. 2017, Ali et al. 2020, Al Manei et al. 2017, Baskaran and Lakshmanan 2019, Caldera et al. 2019, Costa et al. 2020, Davis and Fifolt 2018, Dubey et al. 2016, Gandhi et al. 2018, Hudnurkar et al. 2019, Kaswan and Rathi 2019, Knol et al. 2018, Kuvvetli et al. 2016, Lande et al. 2016, Lodgaard et al. 2016, Madhani 2020, Marzagao and Carvalho 2016, Mohammad and Oduoza 2019,

Mundra and Mishra 2020, Netland 2016, Parmar and Desai 2020, Pereira et al. 2017, Pereira and Tortorella 2018, Secchi and Camuffo 2019, Sieckmann et al. 2018, Singh et al. 2021, Stankalla et al. 2018, Zala et al. 2020, Zhuo 2016)

### 3. Methods

In this study, a combined approach of structured literature review, structured survey, and structured interview was used to achieve the objectives.

The structured literature review consists of peer-reviewed journal papers, articles, and books. Research works published in the databases of EBSCO, Emerald Insight, Science Direct, and Taylor & Francis Online were used to investigate the CSFs in LSS implementations. Keywords such as “Lean Six Sigma,” “Lean Manufacturing,” “Six Sigma,” “Critical Success Factors,” “Enablers” and “Barriers” were used to identify research works relevant to the study at hand.

The structured survey was developed based on the literature review findings to determine whether it applies to the Philippine FM sector. The Relative Importance Index (RII) method was used to analyze the data gathered from the survey. Singh et al. (2021) employed the RII method to extract the significant implementation factors in their study. The equation below shows the formula from which the RII is derived.

$$RII = \frac{\sum W}{A \times N}$$

Where:

W = Likert scale weight assigned by each respondent to a specific CSF

A = Highest weight on the Likert scale

N = Total number of samples

Akadiri (2011), as cited by Rooshdi et al. (2018), stated that there are five importance levels derived from the RII values. The five importance levels and their corresponding RII ranges are shown in Table 1. Thus, the results were interpreted according to these five importance levels ranging from very high importance to very low importance. This analysis segregated and extracted the very high importance factors or CSFs according to the Philippine FM setting.

Table 1. Relative Importance Index Levels

Importance	Symbol	Relative Importance Index
Very High (Critical)	VH (C)	$0.8 < RII \leq 1.0$
High	H	$0.6 < RII \leq 0.8$
Medium	M	$0.4 < RII \leq 0.6$
Low	L	$0.2 < RII \leq 0.4$
Very Low	VL	$0.0 < RII \leq 0.2$

To further analyze, structured interviews were conducted with experts in the field or the Certified LSS Master Black Belts. The thematic analysis methodology was used to analyze and uncover the themes or patterns from the interview data gathered and transcribed. Figure 1 provides a general overview of the phases of thematic analysis (Braun and Clarke, 2006).



Figure 1. Phases of Thematic Analysis

#### **4. Data Collection**

The researcher gathered primary data from respondents through a survey questionnaire and from the experts through an interview. This allowed the researcher to utilize and leverage the knowledge, expertise, and experience of the survey respondents and experts to answer the research problems presented.

Electronic copies of the questionnaire were distributed and collected by the researcher among the qualified respondents of FM companies located in the region 4A of the Philippines. For a respondent to be qualified, he/she must be currently employed in the FM company and is certified LSS Green Belt or higher. The researcher conducted the pre-test (n=30) and the actual survey (n=295) in the span of two months.

A total of 295 electronic copies of the questionnaire were distributed and collected by the researcher among the survey respondents. All of which are deemed valid. This can be attributed to the purposive sampling methodology that allowed the researcher to screen probable respondents and select only those with proper qualifications.

In terms of the respondents' professional characteristics, almost half (46.78%) belong to the production and operations department of their company. The others belong to the operational excellence department (13.90%), maintenance and engineering department (13.22%), quality assurance and control department (10.51%), warehouse and logistics department (9.83%), and environment, health, and safety department (5.76%). It can be noted that most of the respondents are in the middle stages of their careers, with 38.98% mentioned that they are in the lower management level and 31.86% are in the middle management level. Correspondingly, a good portion of the respondents is at the staff level (25.76%), while the rest are at the top management level (3.39%). As to the respondents' tenure in their current FM company, 30.85% are within 4 to 6 years, 25.08% are within 1 to 3 years, 19.66% are less than 1 year, 18.64% are within 7 to 10 years, and 5.76% are greater than 10 years. Finally, an overwhelming majority (79.66%) of the respondents have at least LSS Green Belt Certification, 18.98% have at least LSS Black Belt Certification, and 1.36% have LSS Master Black Belt Certification.

Regarding the company profile where the respondents, 41.69% are located in Laguna, 23.39% are in Batangas, 20.00% are in Cavite, 7.80% are in Quezon, and 7.12% are in Rizal. The sizes of the companies are predominantly medium (40.00%) and large (37.63%), while a minority are small (12.54%) and micro (9.83%). For the products manufactured by the companies, sauces, dressings, and condiments account for 9.62%, baked goods for 8.55%, processed meat and seafood for 8.55%, ready meals for 8.12%, savory snacks for 7.48%, rice, pasta, and noodles for 6.84%, dairy for 5.98%, sweet biscuits, snack bars, and fruit snacks for 5.98%, processed fruit and vegetables for 5.98%, edible oils for 5.77%, soup for 5.56%, confectionary for 5.56%, sweet spreads for 4.70%, baby food for 4.27%, ice cream and frozen desserts for 4.06%, and breakfast cereals for 2.99%. Lastly, 33.90% of the companies have been implementing LSS for 4 to 6 years now, 29.49% for 1 to 3 years, 20.00% for less than 1 year, 10.85% for 7 to 10 years, and 5.76% for more than 10 years.

The researcher then interviewed experts in the field of LSS. This is to assess, verify, and further analyze the results of the survey as well as critique the current LSS framework. Note that the interviews were conducted one-on-one with the researcher. This ensured the independence of ideas and opinions between experts. For an expert to be qualified, he/she must be a Certified LSS Master Black Belt. The researcher conducted the interviews virtually. This is due to face-to-face meeting complexities presented by the current pandemic.

It can be noted that all interviewees have proven expertise in LSS through their MBB certifications and vast years of experience, as indicated in Table 2. The interviewees have been exposed to and successfully implemented LSS in various industries such as business process outsourcing, airlines, healthcare, finance, telecommunications, shipping, engineering, pharmaceuticals, fast-moving consumer goods, and, more importantly, manufacturing (including food manufacturing). Also, the majority of the interviewees mentioned that they pioneered LSS in their respective companies. These characteristics qualify all interviewees as experts in the implementation of LSS.

Table 2. Professional Characteristics of the Interviewees

Expert	Certification	Years of Experience	Industries
A	MBB	20	Manufacturing, Business Process Outsourcing, Fast-Moving Consumer Goods, Airlines
B	MBB	14	Manufacturing, Business Process Outsourcing, Healthcare, Finance, Telecommunications
C	MBB	12	Pharmaceuticals, Business Process Outsourcing, Shipping, Engineering
D	MBB	7	Manufacturing
E	MBB	13	Manufacturing, Business Process Outsourcing

## 5. Results and Discussion

### 5.1 Results and Discussion to Answer Research Question 1: What are the CSFs for implementing LSS in Philippine FM companies?

Table 3 presents the RII, ranking, and importance level of each factor resulting from the survey. The researcher identified 11 factors that can be considered critical to the success of LSS implementations. These factors have at least an RII of 0.8. The CSFs identified are (1) Teamwork, (2) Management Commitment, Involvement, and Support, (3) Employee Motivation and Ownership, (4) Leadership, (5) Project Management, (6) Employee Benefits, Incentives, and Rewards, (7) Proper Usage and Integration of Tools and Practices, (8) Reliable Information and Performance Measurement System, (9) Adequate Resources, (10) Linking and Alignment to Organizational Strategy, and (11) Employee Involvement and Empowerment.

Table 3. Relative Importance Index of Factors

Factors	RII	Ranking	Importance Level
Teamwork	0.825	1	Critical
Management Commitment, Involvement, and Support	0.821	2	Critical
Employee Motivation and Ownership	0.816	3	Critical
Leadership	0.812	4	Critical
Project Management	0.810	5	Critical
Employee Benefits, Incentives, and Rewards	0.809	6	Critical
Proper Usage and Integration of Tools and Practices	0.807	7.5	Critical
Reliable Information and Performance Measurement Systems	0.807	7.5	Critical
Adequate Resources	0.805	9	Critical
Linking and Alignment to Organizational Strategy	0.804	10	Critical
Employee Involvement and Empowerment	0.803	11	Critical
Project Prioritization and Selection	0.789	12	High
Organizational Expertise, Knowledge, and Understanding	0.788	13	High
Education and Training	0.787	14	High
Structured Improvement Procedure	0.786	15	High
Organizational Communication	0.780	16	High
Structured Management Systems	0.731	17	High
Acceptance of Change	0.711	18	High
Organizational Readiness	0.697	19	High
Organizational Structure and Culture	0.682	20	High
Linking and Alignment to Customer Relationship, and Satisfaction	0.681	21	High

Linking and Alignment to Supplier Relationship and Performance	0.681	22	High
External Support from Consultants	0.674	23	High
Favorable Internal Factors	0.668	24	High
Favorable External Factors	0.662	25	High

To assess, verify, and further analyze the results of the survey, the researcher conducted interviews with LSS experts. The experts agreed that the 11 factors identified are indeed critical to the success of LSS implementations, especially at the project level. Given that most of the respondents are Green Belts, the experts believe that the majority of their experience is at a project level. This ultimately showed through the resulting RII.

In addition, the experts stressed the importance of looking at the perspective of the program level and its main actors, the Black Belts and Master Black Belts. Given this, they mentioned 4 additional factors that can be considered critical. These additional factors are (1) Organizational Expertise, Knowledge, and Understanding, (2) Education and Training, (3) Acceptance of Change, and (4) Organizational Structure and Culture.

### **Organizational Expertise, Knowledge, and Understanding**

“We had to slowly integrate LSS into the organization by introducing it to select people who are serious and interested in the program. These people should be good and passionate about math because there are lots of statistics in LSS.”  
Expert A

### **Education and Training**

“Education and Training. If they are not equipped with the right tools, then it will still not be successful. Even if you have the internal drive, but you do not know what to do, people will lose momentum, and the project will die a natural death.”  
Expert B

### **Acceptance of Change**

“The people should be open to change before they can accept LSS. This will result in successful LSS implementation.”  
Expert D

“In addition, based on my experience, another critical factor is change management or Acceptance of Change. Normally, we integrate change management into the project itself. Particularly, if there are numerous stakeholders in the project, we make major plans for change management. We do various activities, such as orientations, to make sure that they understand the changes.”  
Expert E

### **Organizational Structure and Culture**

“Another critical factor is Organizational Structure and Culture. When you say culture, these are the norms of the organization. If they are used to a laid-back culture or traditional, they are not open to new ideas and just want it to do it their way, it will be harder for a practitioner to inject the concept of LSS DNA. This is the cultural aspect of LSS. This also applies to their openness to change.”  
Expert C

The researcher believes that it is within the experts’ authority to suggest CSFs due to their vast experience and expertise in implementing LSS. Therefore, the researcher decided to classify these 4 additional factors as CSFs because they purposely highlighted and identified them in the interviews conducted. However, it must be noted that the researcher included these factors with reservations.

Figure 2 exhibits the thematic map for the CSFs of LSS implementations. The 15 CSFs identified are presented in the ellipses in the outer portion of the map. It must be noted that the 4 CSFs only identified in the interviews are shown with black fill and white text.

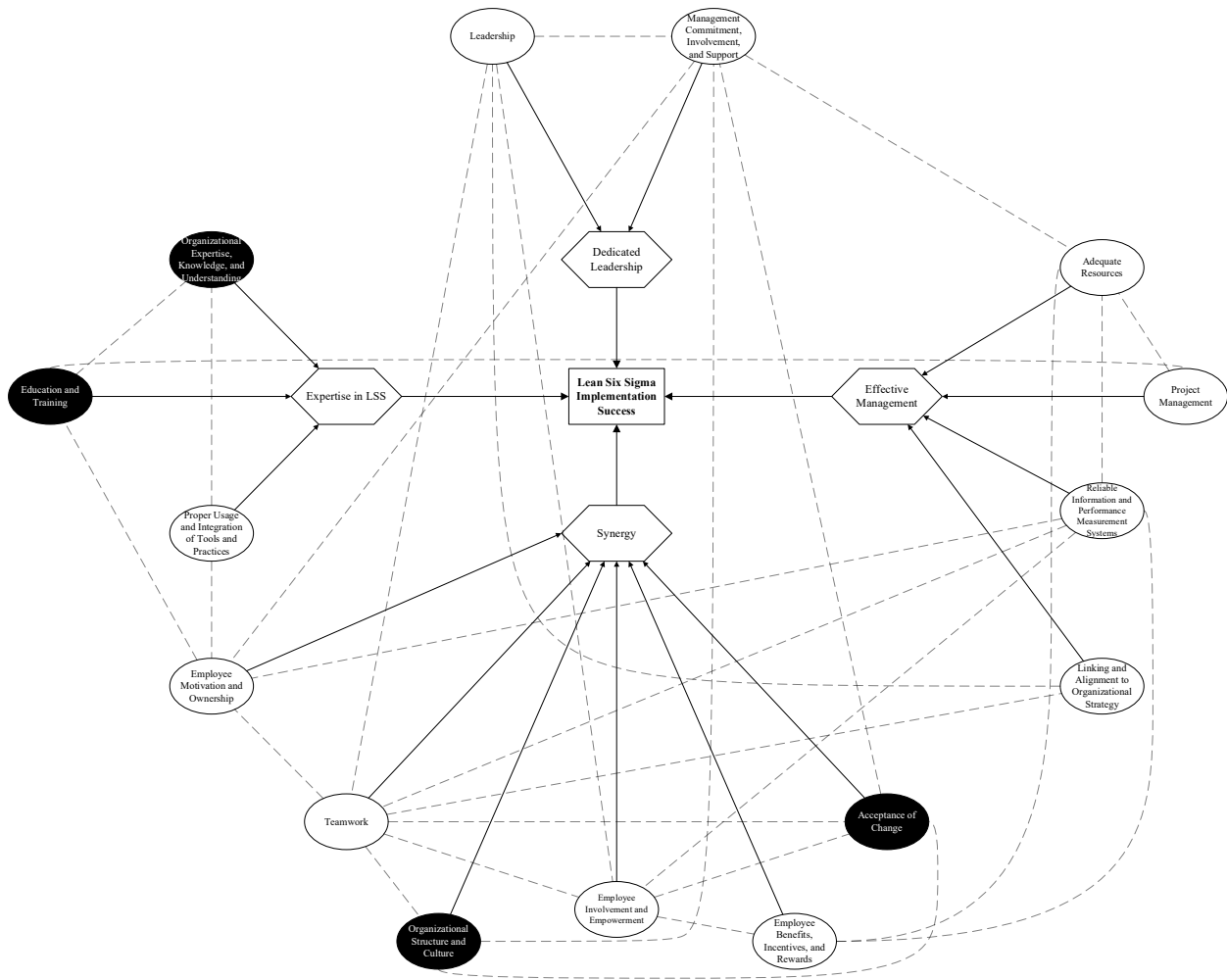


Figure 2. Critical Success Factors of Lean Six Sigma Implementations

These CSFs can be synthesized into 4 clusters that each LSS implementation must have to succeed. These are (1) Synergy, (2) Expertise in LSS, (3) Effective Management, and (4) Dedicated Leadership. The clusters are shown as hexagons in the inner portion of the map. In addition, a presence of a relationship between two CSFs is shown by connecting the CSFs through a dashed line.

## 5.2 Results and Discussion to Answer Research Question 2: Does the LSS framework address these CSFs? If not, what can be improved on the framework to help address the CSFs?

As for improving the LSS framework, the experts have two conflicting proposals. Some experts mentioned that the current LSS framework is already a complete approach and sufficient to address the CSFs. Hence, there is no need to change anything. On the other hand, some experts suggested opportunities for improvements in the LSS framework. The details are further explained in the following paragraphs.

First, it was identified in the interviews that the CSF Employee Benefits, Incentives, and Rewards should be included and reinforced as a standard activity in the current LSS framework and its overall program. While some beltlers and companies practice this CSF in their implementations, it is not explicitly mentioned in the LSS framework. Therefore, the majority are still not providing their teams with the appropriate benefits, incentives, and rewards, which may negatively affect their perception and satisfaction towards the program in the long run. However, as mentioned before, the beltlers and companies must take precaution in implementing CSF. They must be careful not to make the Employee



Benefits, Incentives, and Rewards as the driver of the program. The type and amount of the benefit must be sustainable for the company and must only be determined once the success of the project has been checked and verified.

“This is actually a gap in our current framework. In my experience, giving incentives is important as a means to get everyone on board. So why not make it a standard?”

Expert A

Second, the experts suggested that, when brainstorming solutions for the problem at hand in the Improve Phase, the LSS framework should instruct beltlers to first consider and explore the use of the most recent technologies. This will allow the initiative to have a more meaningful context and contribution to the company’s overall technological strategy.

“Nowadays, we are going to the internet of things, robotic process automation, and other technologies. Remember, when this framework was created, the technological landscape was very different. Today, we experience faster process improvements because of the statistical tools that we have, and we can automate processes, etc.”

Expert B

The third and final opportunity for improvement stated in the interviews is the addition of a Benchmarking Phase in the LSS framework, ideally before the Improve Phase. This additional phase will allow the beltlers to estimate and gauge where the company’s performance stands compared to its competitors. More importantly, the Benchmark Phase will allow the companies to rationalize their improvement targets based on the industry average and best-in-class performance.

“Before you come up with an improvement goal in the Improve Phase, you benchmark first. This is because, maybe, the improvement you are targeting is very limited compared to the benchmark performance. So, when you say 5% increase, where did you reference it? But when we know that the world-class performance is 90% while we are at 70%, I can now target 80% for this project, and another 10% increase in next to reach world-class performance.”

Expert E

## **6. Conclusion**

### **6.1 Conclusion to Research Question 1: What are the CSFs for implementing LSS in Philippine FM companies?**

The researcher identified a total of 15 CSFs for implementing LSS in Philippine FM companies through the combined use of the RII method and thematic analysis.

Out of the 15 CSFs, 11 were identified using the RII method. These factors have at least an RII of 0.8. The 11 CSFs are (1) Teamwork, (2) Management Commitment, Involvement, and Support, (3) Employee Motivation and Ownership, (4) Leadership, (5) Project Management, (6) Employee Benefits, Incentives, and Rewards, (7) Proper Usage and Integration of Tools and Practices, (8) Reliable Information and Performance Measurement System, (9) Adequate Resources, (10) Linking and Alignment to Organizational Strategy, and (11) Employee Involvement and Empowerment.

On the other hand, 4 additional CSFs were identified using thematic analysis. These factors were especially emphasized by experts as critical to LSS implementation. The 4 additional CSFs are (12) Organizational Expertise, Knowledge, and Understanding, (13) Education and Training, (14) Acceptance of Change, and (15) Organizational Structure and Culture.

To summarize, the researcher categorized the 15 CSFs into 4 clusters. The clusters identified are (1) Synergy, (2) Expertise in LSS, (3) Effective Management, and (4) Dedicated Leadership. These clusters can guide beltlers and companies to remember what aspects each LSS implementation must have to succeed.

## **6.2 Conclusion to Research Question 2: Does the LSS framework address these CSFs? If not, what can be improved on the framework to help address the CSFs?**

Utilizing thematic analysis, the researcher identified that the CSFs can be addressed throughout the current DMAIC framework and the encompassing LSS program of the implementing organization. However, to address the CSFs, the experts commented that the DMAIC framework must be rigorously followed and properly delivered. In addition, an LSS program must be in place to ensure a holistic and sustainable approach to the initiative and, more importantly, prepare the company for the changes that will be implemented. Therefore, by following these, the beltlers can ensure they can satisfy the CSFs and guarantee the success of their LSS implementation.

While it is mentioned that the current LSS framework is sufficient to address the CSFs, the experts still suggested the following opportunities for improvement: (1) the explicit inclusion of the CSF Employee Benefits, Incentives, and Rewards in the DMAIC framework and the overall LSS program, (2) the increased emphasis on the use of the most recent technologies when brainstorming solutions in the Improve Phase, and (3) the addition of the Benchmarking Phase before the Improve Phase. It is important to recognize that these suggestions are aimed at increasing the chances of success to address the CSFs and updating the methodology to the present-day economic and technological landscape.

## **6.3 Recommendations**

It is imperative that the LSS beltlers and FM companies address the 15 CSFs to succeed in implementing LSS in their organizations. This is because the CSFs hold a special role in ensuring good LSS implementation practices are achieved. Given this, out of the 15 CSFs, 6 CSFs aimed at ensuring that there is Synergy between all the relevant stakeholders. 3 CSFs are directed to make sure that there is sufficient Expertise in LSS within the company. In addition, 4 CSFs are designed to guarantee that Effective Management of the LSS project and the program as a whole is present throughout. Finally, 2 CSFs are focused on ensuring that Dedicated Leadership is available to support the initiative.

In addressing the CSFs, LSS beltlers, and FM companies must properly build a holistic LSS program first, as this will support the CSFs and the implementation as a whole. They must not immediately dive in and execute an LSS project without laying the groundworks for the complete continuous improvement program. Therefore, practitioners must not rush in the implementation of LSS as this negatively affects the perception of the initiative.

On the project level, the DMAIC framework is a complete and sufficient approach to address the CSFs, as mentioned in the previous sections. Given this, the beltlers must be thorough and careful in following the steps and activities within the DMAIC framework to fully address each of the CSFs.

Thus, to be successful in implementing LSS, all stakeholders within the company must have the necessary hard and soft skills to execute the DMAIC framework and manage the initiative as a whole. More importantly, they must have the proper working environment, be aligned to the intended goal, and fully cooperate and contribute to the activities that must be accomplished to achieve the target future state.

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