Assessing Critical Failure Factors For Implementing Lean Six Sigma Framework In Indian Manufacturing Organizations

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Abstract

In present scenario manufacturing organizations are facing problem-related to quality, cost, and customer satisfaction in the current market. To overcome such situation manufacturing companies are ready to adopt continues improvement (CI) techniques which keep them stable in fluctuation in demand as per the market situation. Lean Six Sigma (LSS) continues improvement methodology which helps to improve the bottom line result of the company with the use of their tools and techniques. The successful implementation of Lean Six Sigma approach provides significant improvement in key metrics but deficiency of proper implementation of LSS provides a negative effect. To prevent such situation need to have knowledge about their failure factors. The study main objective is to assess the Lean Six Sigma critical failure factors (CFFs) for implementing their framework in manufacturing organizations. The leading LSS-CFFs for manufacturing organizations situated in India has been identified and selected through literature review and experts opinion. The model on LSS critical failure factors has been developed using ISM-MICMAC approach. The developed structured model will help LSS practitioners, consultants, researchers to anticipate the potential CFFs to implement LSS framework in their organization for continues improvement and achieve a leading position in a competitive market.

Keywords
Lean Six Sigma, Continues Improvement, Critical Failure Factors, ISM-MICMAC, Manufacturing Organization

1. Introduction
Manufacturing organizations is one of the rapid growing sectors in India and it has tremendous impacts in the Indian economy. India is 5th largest manufacturer within the globe with total manufacturing value added of over 420 billion USD in 2016. The average of seven percent growth has been achieved every year which account 16 to 20 percent total GDP in India (The Hindu, Business Line, 2018). Today due to increase in demands for quality products and services, manufacturing organizations are continues adopting continues quality improvement approaches such as Total Quality Management (TQM), Lean manufacturing (LM), Six Sigma (SS). The Lean manufacturing approach is used to eliminate wastes, continuously improve quality, and create value to customers (Grasso, 2005; Fullerton et al. 2014; Swarnakar and Vinodh, 2016). Six Sigma is a methodology which highlighted the variation in the manufacturing process and helps to reduce them through their statistical tools and techniques (Vinodh and Swarnakar, 2015). The combination of these both approaches (Lean Six Sigma) provides extensive benefits to the organization and improves the bottom line result. The concept of combining LSS principles began in the middle the to late 1990s. The adaptation of the LSS approach maximizes the value of shareholder through continues improvement (George and George, 2003). Numerous studies have reported the LSS framework implementation benefits such as increase in production utilization rate, reduction in defects, improvement in quality, improve production capacity, improvement in key metrics, eliminate non value adding activities (Lee and Wei, 2010; Bhuiyan et al., 2006; Kumar et al., 2006; Vinodh et al., 2011; Vinodh et al., 2014; Chen and Lyu, 2009; Chakravorty and Shah, 2012; Waite, 2013, Swarnakar and Vinodh, 2016) The successful implementation of LSS framework in a manufacturing organization resulted in benefits such as uninterrupted and defect-free production. It also helps to achieve a higher degree of competitiveness in a competitive market if implemented successfully. The deficiency of proper implementation will achieve the negative effects which cause decrease quality, dissatisfied customers,

fluctuation in demands, and negative image of the organization. To prevent such type of situation need to have knowledge about LSS critical failure factors which affects the successful implementation of LSS framework. The objective of this study is to assess LSS-CFFs which affected the implementation of Lean Six Sigma framework in manufacturing organizations. In this context, the leading Lean Six Sigma CFFs has been identified and selected through literature review and experts opinion. Then, develop the proper model which shows the contextual relationship between identified LSS-CFFs using Interpretative Structural Modelling and Matrice d' Impacts Croises Multiplication Appliquee a un Classement (ISM-MICMAC) approach. This study would help industry person, practitioner, researchers to anticipate the potential model of LSS-CFFs to implement LSS framework in their organization to achieve continues improvement and leading position in a competitive market.

2. Literature Review

The literature has been reviewed in two perspectives: the first part covers a literature review on LSS critical failure factors and second covers literature review on application of Interpretative Structural Modeling (ISM) approach.

2.1 Literature review on LSS critical failure factors

The failure factors were introduced by the Rubin and Seeling in 1967. The authors have examined the experience of the project manager on the basis of their failure of projects. This study was the birth of assessing failure factors. Then Barker et al. (1983) have been reported the new definition of failure 'the failure occurs due to inadequate concept and system. The other researchers introduced the failure factors, Antony and Desai (2009) reported the failure factors such as Poor project prioritization and tool selection, Lack of continuous monitoring approach, Internal resistance against culture change, Ineffective training programs in his study. Aboelmaged (2010) introduced the failure factors such as Poor project prioritization and tool selection, Lack of top management attitude, commitment and involvement, Lack of resources, Narrow view of LSS as a set of tools, techniques, and practices, Lack of process thinking and process ownership, Lack of estimation of implementation cost. Albliwi et al. (2014) highlighted the critical failure factors Poor project prioritization and tool selection, Lack of employee engagement, Weak deployment infrastructure, Lack of management involvement and awareness, High implementation cost, Lack of knowledge about Lean Six Sigma techniques, tools, and practices. Jeyaraman and Teo (2010) introduced the failure factors such as Lack of employee engagement, Lack of clear vision and a future plan, Lack of employee engagement and participation/lack of team autonomy, Lack of experience in Lean/ Six Sigma project implementation, Ineffective project management, Lack of clear vision and a future plan. Psychogios and Tsironis (2012) highlighted the failure factors such as Lack of employee engagement, Lack of management involvement and awareness, Lack of reward and recognition by top management, Lack of knowledge about Lean Six Sigma techniques, tools, and practices, internal resistance against culture change, Ineffective training programs. Bhasin (2012) introduced the critical failure factors such as High implementation cost, Lack of top management attitude, commitment and involvement, Resistance of culture change, Poor communication, Narrow view of LSS as a set of tools, techniques and practices, Lack of process thinking and process ownership, High implementation cost, Lack of clear vision and a future plan. Pamfilie et al. (2012) introduced the failure factors such as Lack of reward and recognition by top management, Lack of management involvement and awareness, Lack of awareness of the need for Lean/Six Sigma. Antony et al. (2012) highlighted the critical failure factors such as internal resistance against culture change, Lack of knowledge about Lean Six Sigma techniques, tools and practices, Lack of top management attitude, commitment and involvement, Poor project selection and prioritization, Lack of resources (financial, technical, human, etc.). From the literature review, it is observed that the LSS projects are affecting industry excellence. However, very few authors have addressed these issues and tried to highlight the failure factors. Moreover, no author has been obtaining the relation between them.

2.2 Literature review on application of the ISM approach

ISM approach is used to obtain the complex relationships between variables. The concept of ISM was developed by Warfield in 1974. It is a suitable technique for analyzing and solving the complex problems related to decision making such as vendor selection problem (Kannan and Haq, 2007), modeling the various selected barriers of Six Sigma approach (Soti et al., 2011), the modeling of flexible manufacturing enablers (Raj, 2008), analyze and modeling the reverse logistics (Govindan et al., 2012), studying and modeling of the supply chain (Raut et al., 2017), examining the sustainability barriers and enablers (Bhanot et al., 2017), etc.

2.3 Motivation for the study

LSS implementation in manufacturing industries is apparent that the successful implementation of LSS framework provides significant benefits to the organization and help them to achieve continues improvement. The positive implementation of Lean Six Sigma frameworks will also bring effective cultural changes in the organization but the implementation deficiency can bring negative effect which causes capital wastage. Thus there is a need to having knowledge of Critical Failure Factors which impact on the implementation of LSS framework. The straight implementation of LSS framework causes more chances of framework failure. The literature presented the authors have been used the ISM approach for developing the relationships among factors in different perspectives such as supplier selection (Thakkar et al., 2007; Kannan et al., 2009; Luthra et al., 2017) and no study has been reported with using ISM approach to assess the critical failure factors for LSS framework implementation in manufacturing organization. The developed model for LSS-CFFs would help manufacturing organizations to prepare the strategy for prevention from CFFs during the implementation of LSS framework.

3. Research Methodology

This study used a combined methodology to assess the Lean Six Sigma Critical Failure Factors to implement LSS framework in manufacturing organizations. Thus combined approach included a literature review and experts opinion to identify and select the LSS-CFFs. The literature has been searching and reviewed from different databases such as Scopus, Google Scholar, Emerald Insight, Springer, Elsevier related to the LSS-CFFs, LSS framework, and ISM methodology. The opinions of professionals have also used to gather the initial data. The experts selected from different manufacturing organization situated in India are having more than 10 years' experience in the LSS implemented organizations. The relationships among the various selected LSS-CFFs are identified through Interpretive Structural Modeling (ISM) approach. ISM is an emerging modeling approach used to develop and understand the complex relationships among the selected factors. In this process, a set of factors which directly or indirectly related to each other, are systematically structured and formed a model after predicted the structure of complex process issue in a properly designed pattern which implied graphically as well as word. The steps used in this study are clearly shown in figure 1.

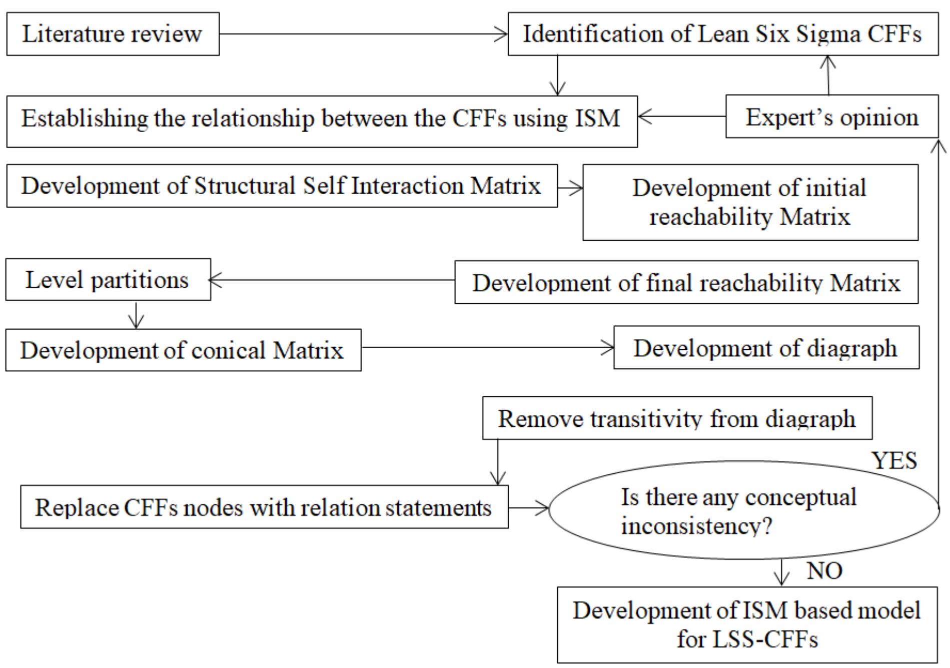

Figure 1. Detailed research methodology

4. Development of Model

4.1 Identification of Lean Six Sigma CFFs

The Lean Six Sigma CFFs has been identified through literature review and experts opinion. The literature is search and reviewed from different database sources such as Scopus, Google Scholar, Emerald Insight, Springer, Elsevier related to LSS-CFFs. The experts have been selected from different manufacturing industries from India and their opinions are used to gather initial data related to the case study. The identified CFFs of Lean Six Sigma is clearly presented in Table 1.

Table 1. Identified LSS critical failure factors

Sl. No.	Critical Failure Factors	Definition	References
1	Poor project prioritization and tool selection (CFF 1)	Selection of wrong activity or path for the implementation of LSS framework	Antony and Desai (2009), Aboelmaged (2010), Albliwi et al. (2014)
2	Lack of employee engagement (CFF 2)	Scarcity of proper meeting with working staff to implement LSS framework	Jeyaraman and Teo (2010), Psychogios and Tsironis (2012), Albliwi et al. (2014)
3	Weak deployment infrastructure (CFF 3)	Lacking the required atmosphere and setup for implementation of LSS framework	Pedersen and Huniche (2011), Albliwi et al. (2014)
4	Lack of knowledge about performance metrics (CFF 4)	Absence of skills related to performance measurement system or standard of measurement	Karim and Arif-Uz-Zaman (2013), Roth and Franchetti (2010)
5	Lack of management involvement and awareness (CFF 5)	Inappropriate involvement of management in the industry during the implementation of LSS framework	Kwak & Anbari (2006), Psychogios and Tsironis (2012), Pamfilie et al. (2012), Antony et al. (2016), Albliwi et al. (2014),
6	High implementation cost (CFF 6)	The initial cost is high for the implementation of LSS framework	Bhasin (2012), Chakravorty (2009), Albliwi et al. (2014)
7	Lack of reward and recognition by top management (CFF 7)	The non-existence of incentives by the management to encourage working staffs to implement LSS framework	Psychogios and Tsironis (2012), Pamfilie et al. (2012), Antony et al. (2016),
8	Lack of knowledge about Lean Six Sigma techniques, tools and practices (CFF 8)	Improper information and skills to adopt LSS tools and techniques during LSS framework implementation	Antony et al. (2012), Martinez-Jurado and Moyano-Fuentes (2014), Psychogios and Tsironis (2012), Albliwi et al. (2014)
9	Lack of roadmap to guide the project Execution (CFF 9)	Deficiency of proper guidelines to monitor and implementation of LSS framework	Chakravorty (2009), Albliwi et al. (2014)
10	Lack of continuous monitoring approach (CFF 10)	Absence of continues monitoring of process without any interruption during LSS implementation	Antony and Desai (2009), Albliwi et al. (2014)
11	Internal resistance against culture change (CFF 11)	Internal struggle/Lacking of support towards culture change of organization during the implementation of LSS framework	Antony and Desai (2009), Antony et al. (2012a), Bhasin (2012), Psychogios and Tsironis (2012), Albliwi et al. (2014)
12	Ineffective training programs (CFF 12)	Received unproductive training to implement LSS framework	Antony and Desai (2009), Psychogios and Tsironis (2012), Albliwi et al. (2014),

4.2 Development of Structural Self Interaction Matrix (SSIM)

The SSIM for assessing LSS-CFFs for implementing LSS framework has developed based on experts opinion. In this, the various techniques are used such as brainstorming, interview, nominal group techniques, to develop a contextual relationship among identified CFFs. The relationship has been obtained through ISM principles. The four symbols were used to create the relation between CFFs. Thus, symbol 'V' represents the variable 'i' will help to achieve variable 'j'; symbol 'A' represents the variable 'j' will help to achieve variable 'i'; symbol 'X' represents the variable ‘i’ and ‘j’ will help to achieve each other; symbol ‘X’ represents the variable ‘i’ and ‘j’ are unrelated. The developed SSIM for assessment of LSS-CFFs is shown in Table 2.

Table 2. Structural self-interaction matrix (SSIM) for assessment of LSS-CFFs

		12	11	10	9	8	7	6	5	4	3	2	1
1	CFF 1	X	V	V	A	X	V	O	V	V	V	V	-
2	CFF 2	X	O	X	A	X	V	V	X	X	X	-	
3	CFF 3	X	O	X	X	A	V	X	O	X	-		
4	CFF 4	A	O	O	X	O	A	V	O	-			
5	CFF 5	V	O	A	O	V	O	V	-				
6	CFF 6	X	O	A	V	O	V	-					
7	CFF 7	A	V	O	A	A	-						
8	CFF 8	A	O	A	X	-							
9	CFF 9	A	O	A	-								
10	CFF 10	V	O	-									
11	CFF 11	O	-										
12	CFF 12	-											

4.3 Development of initial reachability Matrix (IRM)

The IRM has been developed with the transformation of SSIM symbols into binary digits. The transformation process depended on the following rules based on ISM principles. Thus substitution of symbols ‘V’, ‘A’, ‘X’, ‘O’ by digits 1and 0 to the following rules. If (‘i’, ‘j’) entry in the system is ‘V’ then the (‘i’, ‘j’) entry in the IRM becomes ‘1’ and ‘0’ when (‘j’, ‘i’). If (‘i’, ‘j’) entry in the system is ‘A’, then the (‘i’, ‘j’) entry in the IRM becomes ‘0’ and ‘1’ when (‘j’, ‘i’). If (‘i’, ‘j’) entry in the system is ‘X’ then the (‘i’, ‘j’) entry in the IRM becomes ‘1’ and ‘1’ when (‘j’, ‘i’) also and if (‘i’, ‘j’) entry in the system is ‘O’ then the (‘i’, ‘j’) entry in the IRM becomes ‘0’ and ‘0’ when (‘j’, ‘i’) also. The developed IRM for assessment of LSS-CFFs is shown in Table 3.

Table 3. Initial reachability matrix (IRM) for assessment of LSS-CFFs

		12	11	10	9	8	7	6	5	4	3	2	1
1	CFF 1	1	1	1	1	1	0	1	1	0	1	1	1
2	CFF 2	0	1	1	1	1	1	1	1	0	1	0	1
3	CFF 3	0	1	1	1	0	1	1	0	1	1	0	1
4	CFF 4	0	1	1	1	0	1	0	0	1	0	0	0
5	CFF 5	0	1	0	0	1	1	0	1	0	0	0	1
6	CFF 6	0	0	1	0	0	1	1	0	1	0	0	1
7	CFF 7	0	0	0	1	0	0	1	0	0	0	1	0
8	CFF 8	1	1	1	0	0	0	1	1	1	0	0	0
9	CFF 9	1	1	1	1	0	0	1	1	1	0	0	0
10	CFF 10	0	1	1	0	1	1	0	1	1	1	0	1
11	CFF 11	0	0	0	0	0	0	0	0	0	0	1	0
12	CFF 12	1	1	1	1	0	1	1	1	1	0	0	1

4.4 Development of final reachability Matrix (FRM)

The FRM has been developed after checking the transitivity which occurred during the development of IRM and removes that if there is any, the transitivity has been removed using the following rules. Check the appearance of zero in the IRM and check the transitivity e.g., if CFF 1 leads to CFF 2 is 1 and CFF 2 leads to CFF 3 is also 1 then this implies CFF 1 leads to CFF 3 is 1. If found any transitivity replace digit '0' with '1*'. The developed FRM is shown in Table 4.

Table 4. Final reachability matrix (FRM) for assessment of LSS-CFFs

		1	2	3	4	5	6	7	8	9	10	11	12	Driving Power	Rank
1	CFF 1	1	1	1	1	1	1*	1	1	0	1	1	1	11	6
2	CFF 2	1*	1	1	1	1	1	1	1	0	1	1*	1	11	6
3	CFF 3	0	1	1	1	0	1	1	0	1	1	0	1	8	3
4	CFF 4	1*	1	1	1	0	1	1*	1*	1	0	0	1*	9	4
5	CFF 5	1*	1	1*	0	1	1	0	1	0	1*	0	1	8	3
6	CFF 6	1*	0	1	1*	1*	1	1	1*	1	0	0	1	9	4
7	CFF 7	0	1*	1*	1	0	1*	1	0	0	0	1	1*	7	2
8	CFF 8	1	1	1	0	1*	1*	1	1	1	1*	0	1*	10	5
9	CFF 9	1	1	1	1	0	1*	1	1	1	0	0	0	8	3
10	CFF 10	1*	1	1	0	1	1	0	1	1	1	0	1	9	4
11	CFF 11	1*	1*	0	0	0	0	0	0	0	0	1	1*	4	1
12	CFF 12	1	1	1	1	0	1	1	1	1	0	1*	1	10	5
	Dependence Power	10	11	11	8	6	11	9	9	7	6	5	11		
	Rank	6	7	7	4	2	7	5	5	3	2	1	7		

4.5 Level partition

The partitions in different levels have been done based on the reachability and antecedent set. The reachability and antecedent set is obtained from the final reachability matrix FRM (Warfield, 1974). The reachability set contains the same LSS-CFF element and other LSS-CFF element having in the same row and the antecedent set containing the LSS-CFF itself and other LSS-CFF elements having in the same column. Thus in this case total, 6 iterations (6 levels) have been performed. Due to limit length of the paper, only one iteration is presented in this paper and iteration 1 for the assessment of LSS-CFFs is shown in Table 5.

Table 5. Iteration 1 for assessment of LSS-CFFs

		Reachability Set	Antecedent set	Intersection set	Level
1	CFF 1	1,2,3,4,5,6,7,8,10,11,12	1,2,4,5,6,8,9,10,11,12	1,24,5,6,8,10,11,12	
2	CFF 2	1,2,3,4,5,6,7,8,10,11,12	1,2,3,4,5,7,8,9,10,11,12	1,2,3,4,5,7,8,10,11,12	
3	CFF 3	2,3,4,6,7,9,10,12	1,2,3,4,5,6,7,8,9,10,12	2,3,4,6,7,9,10,12	I
4	CFF 4	1,2,3,4,6,7,8,9,12	1,2,3,4,6,7,9,12	1,2,3,4,6,7,9,12	
5	CFF 5	1,2,3,5,6,8,10,12	1,2,5,6,8,10	1,2,5,6,8,10	
6	CFF 6	1,3,4,5,6,7,8,9,12	1,2,3,4,5,6,7,8,9,10,12	1,3,4,5,6,7,8,9,12	I
7	CFF 7	2,3,4,6,7,11,12	1,2,3,4,6,7,8,9,12	2,3,4,6,7,12	
8	CFF 8	1,2,3,5,6,7,8,9,10,12	1,2,4,5,6,8,9,10,12	1,2,5,6,8,9,10,12	
9	CFF 9	1,2,3,4,6,7,8,9	3,4,6,8,9,10,12	3,4,6,8,9	
10	CFF 10	1,2,3,5,6,8,9,10,12	1,2,3,5,8,10	1,2,3,5,8,10	
11	CFF 11	1,2,11,12	1,2,7,11,12	1,2,11,12	I
12	CFF 12	1,2,3,4,6,7,8,9,11,12	1,2,3,4,5,6,7,8,10,11,12	1,2,34,6,7,8,11,12	

4.6 Development of conical Matrix

The conical matrix has been developed by clustering the CFFs of the same level across rows and column. The arrangement of those levels in the conical matrix based on their occurrence in the iteration steps. The conical matrix for assessing the LSS-CFFs is shown in Table 6.

Table 6. Conical matrix for assessment of LSS-CFFs

		3	6	11	2	7	1	8	4	9	12	5	10
3	CFF 3	1	1	0	1	1	0	0	1	1	1	0	1
6	CFF 6	1	1	0	0	1	0	0	0	1	1	0	0
11	CFF 11	0	0	1	1*	0	0	0	0	0	0	0	0
2	CFF 2	1	1	1*	1	1	1*	1	1	0	1	1	1
7	CFF 7	1*	1*	1	1*	1	0	0	1	0	0	0	0
1	CFF 1	1	0	1	1	1	1	1	1	0	1	1	1
8	CFF 8	1	0	0	1	1	1	1	0	1	0	0	0
4	CFF 4	1	1	0	1	1	1*	1	1	1	1*	0	0
9	CFF 9	1	1*	0	1	1	1	1	1	1	0	0	0
12	CFF 12	1	1	1	1	1	1	1	1	1	1	0	0
5	CFF 5	1	1	0	1	0	1	1	0	0	1	1	1*
10	CFF 10	1	1	0	1	0	1	1	0	1	1	1	1

4.7 Development of digraph for LSS-CFFs

The digraph has been developed by examining the direct relationship of identified various LSS critical failure factors that affect the successful implementation of LSS framework. The relationship has been developed using FRM value. The relationship between the identified variables in digraph for assessing the LSS-CFFs is shown in figure 2.

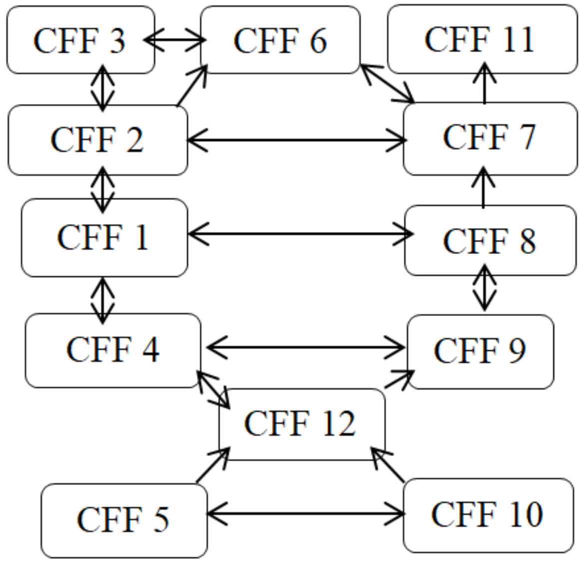

Figure 2. Diagraph of ISM model for assessing LSS-CFFs

4.8 Development of ISM based model for LSS-CFFs

The ISM based model has been developed after eliminating their transitivity from the FRM. The final ISM model has been developed from the conical matrix. If the relationship among all LSS-CFFs has occurred, Then the CFF 'j' and 'i' then the relationship arrow pointed out from 'i' to 'j'. The ISM based model for LSS-CFFs is shown in figure 3.

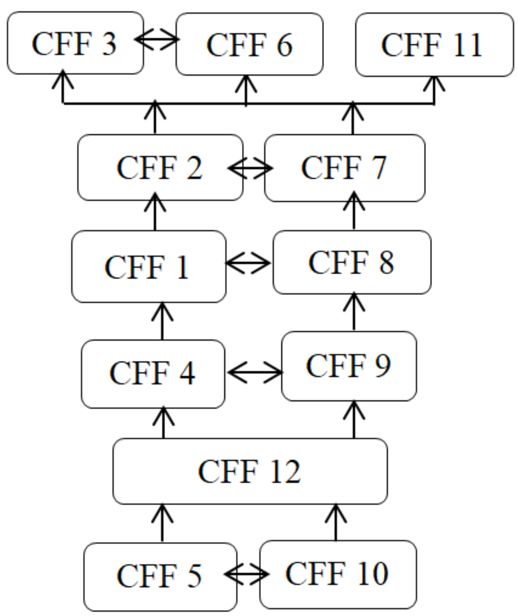

Figure 3. ISM based model for assessing LSS-CFFs

4.9 MICMAC analysis for assessing CFFs

The CFFs are categorized into four categories based on their driving and dependence power with the use of Matrices Impacts Croises Multiplication Appliquee a un Classement (MICMAC) analysis (Mandal and Deshmukh, 1994). The four categories were dependence, linkage, autonomous, and independent measure. The classification is presented in driving dependence diagram and is shown in figure 4.

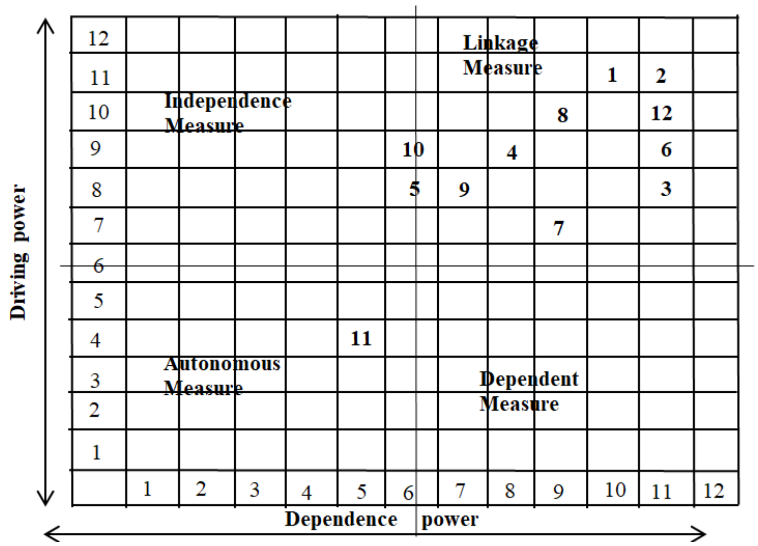

Figure 4. Driving-dependence diagram

5. Result and discussion

In order to assess the CFFs for LSS framework implementation in manufacturing organizations, the study uses the combined approach; this included identification of LSS-CFFs has been identified through literature review and experts opinion. Then ISM-MICMAC approach has been used to obtaining the relationship between those identified CFFs. The literature is evident that the assessment of CFFs for implementing the LSS framework has not been attempted by any author. The ISM model of LSS-CFFs has been developed for implementation of LSS framework which consists of six levels (figure 3). The first level included two factors 'CFF 5' and 'CFF 10', second level included one factor 'CFF 12', the third level included 'CFF 4' and 'CFF 9', the fourth level included 'CFF 1' and 'CFF 8', fifth level included CFF 2 and CFF 7, and the sixth level included three critical failure factors are 'CFF 3', 'CFF 6', 'CFF 11. The result of MICMAC analysis (figure 4) shows that the 'CFF 11' having low driving and dependence power so it comes under 'autonomous measure'. This measure is relatively disconnected from the system but their few links are connected to the system which might be representing very strong. The other remaining CFFs are having strong driving and dependence power and that comes under 'linkage measure'. These factors are unstable within nature, any action on this measure directly affects the other. In this study, there is no CFF considered under the dependent and independent measure. The manufacturing organizations must consider these critical failure factors before implementing LSS framework on their organization.

6. Conclusion

Lean Six Sigma is a continuing improvement methodology which eliminates waste from the process and reduces defects occurring in the product. The successful implementation of LSS in any manufacturing organization provides waste and defect-free environment which results in an improvement in quality, production capacity, key metrics, customer satisfaction, etc. The deficiency of proper implementation causes loss of capital, time, loss of a customer, lose the image, etc. To prevent such situation need to have knowledge about factors which affect the successful implementation of the LSS framework in a manufacturing organization. In this context, this study assesses the critical failure factors for implementing LSS framework in a manufacturing organization. Thus a total of 12 CFF has been identified and selected from the literature review and experts opinion. The relationship among selected CFFs has been identified through ISM-MICMAC methodology. ISM is a suitable approach to recognizing the interrelation between the variables, the inputs required in this approach were provided by the industrial experts. The developed ISM model (figure 3) clearly shows the CFFs prioritization based on their obtained six levels. The 'CFF 5','CFF 10' occupied the bottom level and 'CFF 3', 'CFF 6', 'CFF 11' occupied the top level. The MICMAC approach has been used to cluster the CFFs in four different parts based on their driving and dependence power. This study will help LSS practitioner, academician to consider such factors before deploying the LSS framework in their organization.

7. Limitation and future work

The ISM model for LSS-CFFs has been developed based on the input data gathered from experts from manufacturing organizations. The findings obtained from this study would differ in other organization. This study only 12 CFFs has been considered for assessment purpose. In future more no. of CFFs will be considered with different MCDM approaches. The model can also be validated through other tools and techniques.

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