Modelling the clusters of critical success factors of Six Sigma for non-formal service sectors using interpretive structural modelling

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Abstract: Critical success factors (CSFs) are the essential ingredients which are case specific and vital for the successful deployment of Six Sigma which must be achieved in hierarchical manner to accomplish the objective associated with it. CSFs for Six Sigma implementation in non-formal service sectors are grouped in to clusters. The purpose of this research is to develop relationship amongst the identified clusters using interpretive structural modelling (ISM). On the basis of the driving and dependence power of each CSF cluster, the ISM-based model indicates that 'Process ownership', 'Organisational Assessment', 'Customer Centric Approach' and 'Project Selection' are strategic requirements, further 'Awareness Program', 'Knowledge Sharing' and 'Servicescape' are the tactical requirements, on the other hand 'Human Resource Management', 'Database Management', 'Performance Assessment' and 'Reward' are the operational requirements of Six Sigma implementation program. Whilst the ISM model of CSF clusters gives a roadmap for their implementation in hierarchical manner.

Keywords: CSF; critical success factor; ISM; interpretive structural modelling; Six Sigma; modelling; non-formal service sectors.

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1 Introduction

Service quality is a competitive differentiator between the service providers in an environment of declining profit margins (Behara and Lemmink, 1997). To enhance efficiency, competitiveness and customer satisfaction, large number of companies are adopting various quality management systems (QMS) (Magd, 2008). To get the competitive leverage in the intense competition derived from the pressure of liberalisation, privatisation and globalisation, Six Sigma has been adopted by many service organisations. In 1980s, Six Sigma was designed by Motorola predominantly for reducing the defects in products as low as 3.4 defects per million opportunities (DPMO). In the last two decade, Six sigma has proliferated in non-manufacturing operations like transactional processes, call centres (Chakrabarty and Tan, 2006), utilities and public services, government organisations (Ho et al., 2006), etc. Six Sigma methodology has been applied in the formal sectors such as healthcare (Gowen et al., 2008), banking, insurance, marketing (Chakrabarty and Tan, 2006; Inozu et al., 2006), design (Hamza, 2008), construction operations (Han et al., 2008), etc. Talankar et al. (2011) suggested explore–establish–define–measure–analyse–improve–control (EEDMAIC) framework of Six Sigma for non-formal service sector.

It is a common myth, that Six Sigma is only applicable to large corporations having huge resources and budget (Antony, 2008). However, the purpose of Six Sigma is to assist companies of various sizes in any sector to implement and operate an effective QMS by enhancing the firm's ability to design, produce and deliver quality products and/or services (Banuelas et al., 2005; Linderman et al., 2003). In viewpoint-based research, Antony (2008) concluded that Six Sigma is appropriate for all kind of businesses regardless of their size.

Non-formal service sectors are more vulnerable to changes in the market because of their limited resources, lack of technological capabilities and less possibility to expand as compared to formal organisation. Facing the fierce competition in highly volatile market situation, they have to make compromise between low cost operations and value added operations (Talankar et al., 2011). Therefore, quality services and their consistent availability can provide them with the leverage to gain competitive advantage. Perhaps, Six Sigma may be the best suited QMS for this sector as the EEDMAIC framework helps in exploring and developing organisational structure.

Case studies of Six Sigma implementation in service organisations revealed that much of the discussion on implementation issues focuses on critical success factors (CSFs) (Chakrabarty and Tan, 2009). The organisation must build the competence to achieve the success through management of next level of cluster of CSFs (Soti et al., 2010). For the successful implementation of Six Sigma in non-formal service sector, therefore, it is important to identify CSFs of this sector and to develop hierarchy of their implementation.

This paper initially presents a brief literature review about the non-formal service sector, CSFs and their clustering and identification of clusters using Delphi. The latter part discuss about development of contextual relationship amongst the CSF clusters of system under consideration in hierarchical manner using ISM methodology to extract structured diagraph based on their driving and dependence power and MIC–MAC analysis to classify them into four clusters.

2 Literature review

Since inception of Six Sigma, much has been written about its implementation in manufacturing and formal service sector, however, less attention has been paid to non-formal service sector. Numerous researchers have explored Six Sigma on various issues and case-specific research based on frameworks of Six Sigma, critical to quality parameters, CSFs, key performance indices, tools and techniques, survey-based analysis and many more. The review of literature revealed the fact that the success of Six Sigma depends on certain success factors and their implementation in hierarchical manner. To accomplish the task, 11 clusters of CSFs of Six Sigma for non-formal service sectors, suggested by Talankar et al. (2014), have been considered for the analysis. For the present work, the literature can be divided in three sections: Non-formal service sectors, CSFs and process of clustering of CSFs.

2.1 Non-formal service sector

Whilst service literature is enriched in schemes of service classification, national statistician office (NSO) classified the services into two categories: formal and non-formal (Hussmanns and Mehran, 1998).

Non-formal service sectors are those having undefined work flow and supposed to follow sequence of operation as in earlier occurrences without evidence of documentation and theoretical knowledge base.

Non-formal service sectors have limited resources, dependent on personal skills and indigenous resources, need of immediate solutions to immediate problems are its few characteristics (Talankar et al., 2011). These organisations lack in adoption of quality

policy perhaps to maintain the loyalty and goodwill which are considered to be more important than increasing the productivity and quality of the service provided (Thakkar et al., 2008).

As the non-formal services sector is an unorganised enterprises having no quality consciousness or any measurable data that helps to elicit the quality of their services. Therefore, before implementation of Six Sigma, it is indispensable to identify CSFs and hierarchy of their implementation to ensure the success of project.

2.2 Critical success factors (CSF)

Six Sigma is a systematic, highly disciplined, customer-centric and profit-driven organisation-wide strategic business improvement initiative that is based on a rigorous process focused and data-driven methodology (Tang et al., 2007). The literature of Six Sigma implementation is full of case studies in manufacturing and services which focus on the identification of CSFs. Therefore, the prerequisite for deployment of Six Sigma in any organisation is to identify CSFs. The idea of identifying CSFs was popularised by Rockart (1979), as a basis for determining the information needs of managers. CSFs are those factors which are critical to the success of an organisation, if the objectives associated with the factors are not achieved, the project may fail (Rockart, 1979).

Chakrabarty and Tan (2009) argued that the literature lacks a rigorous research approach in identification and discussion of the implementation issues involving the wider range of service organisations. Therefore, the objective of present research is to establish the contextual relationship amongst CSF clusters for non-formal service organisations using ISM-based model which depicts the hierarchy of their implementation and to perform MIC-MAC analysis to classify them into four categories based on their driving and dependence power. Some select definitions of CSF by various researchers are summarised in Table 1.

Table 1 Select definitions of CSF from literature

Author (*year*)	*Definition*
Rockart (1979)	The limited numbers of areas in which results, if they are satisfactory, will ensure competitive performance for the organisation
Brotherton and Shaw (1996)	The essential things that must be achieved by the company or which areas will produce the greatest 'competitive leverage'
Boynton and Zmud (1984)	Those few things that must go well to ensure success
Henderson and Evans (2000)	Attributes that the customer considers having the impact on quality
Coronado and Antony (2002)	'Critical success factors' are best practices, or that are vital for Six Sigma to succeed

Source: Chakrabarty and Tan (2009)

CSFs are the essential ingredients for success of Six Sigma projects in any organisation (Coronado and Antony, 2002). Soti et al. (2010) argued that CSFs assure successful installation, functioning and sustainability of Six Sigma system; whereas, enablers assure

successful installation of a Six Sigma system. They have categorised CSF into three groups: functional success factors (enablers), operational success factors and the factors which monitors sustainability of Six Sigma. The importance of defining the CSF for implementation of QMS is to increase the success rate, reduce costs and prevent disillusionment associated with it. Brotherton and Shaw (1996) emphasise that CSFs are not objectives, but are the actions and processes that can be controlled/affected by management to achieve the organisation's goals. Moreover CSFs are not static, but depend on a combination of where the organisation is and where it wants to be.

Table 2 depicts various CSFs summarised from the literature. These are related to most of the function of business and form a general guideline to achieve success in Six Sigma implementation.

Table 2 CSFs of Six Sigma implementation

Author (*year*)	*CSFs*
Harry and Schroeder (2000)	Management's leadership, training of employees at all levels, belt system, financial performance evaluation, compensation and incentives, project selection and evaluation
Henderson and Evans (2000)	Upper management support/involvement, organisational infrastructure, training, use of quality tools, link to human resources-based actions, information and analysis system
Goldstein (2001)	Active participation of senior executives, deployment plan, project reviews, technical support, full-time vs. part-time resources, training, communications, project selection, project tracking, incentive program, safe environment, supplier plan
Antony and Banuelas (2002)	Management involvement and commitment, understanding of Six Sigma methodology, linking Six Sigma to a business strategy, linking Six Sigma to customers, project prioritisation and selection, organisational infrastructure, cultural change, project management skills, linking Six Sigma to suppliers training, linking Six Sigma to employees
Bhote (2002)	Inspiring leadership, tools, total customer satisfaction, empowerment of people, robust designs, win–win partnership with suppliers, standardised metrics
Antony and Banuelas (2002)	Management leadership, project planning and management, linking Six Sigma to business strategy, understanding the Six Sigma methodology, project prioritisation and selection, employees commitment, suppliers involvement, organisational infrastructure, customer focus
Byrne (2003)	Establishment of initiative, participation of CEO, establishment of basic principles, selection of black belt for problem solving, wholehearted support system, training, project goal set up
Breyfogle (2003)	Selecting key players, selecting key projects, training and coaching, project report-outs
Pyzdek (2003)	Top management support and participation, providing process improvement teams sufficient resources, data-based decision making, processes are measured and feedback provided

Table 2 CSFs of Six Sigma implementation (continued)

Author (*year*)	*CSFs*
Antony (2004)	Top management commitment, education and training, cultural change, attaching success to financial benefits, organisational understanding of work processes, project management skill, organisational infrastructure/belt system, companywide commitment, project tracking and reviews, incentive program, compensation, linking Six Sigma to business strategy
Hahn (2005)	Financial performance, CEO's support and enthusiasm, improvement of scientific approach, understanding of customer requirement and satisfaction, HR development through training, specialised team for Six Sigma
Viseras et al. (2005)	Construction of infrastructure, participation of executives, training, project selection, application of new product development, collection of customer
	Information, connection with company strategy, encouragement and cooperation with affiliates, construction of specialised teams
Antony (2006)	Strong leadership and management commitment, organisational culture change, aligning Six Sigma to corporate business objectives, selection of team members and teamwork, Six Sigma training, understanding the DMAIC methodology, tools, techniques, and key metrics, selection of projects and project management skills, linking Six Sigma to customers, accountability
Brady and Allen (2006)	Top management commitment, team training, data system, structured
	Approach, forming the right team, bottom line focus, team involvement, project selection, customer focus, right project leadership, goal-based
	Approach, change management, adaptable system
Cho and Jang (2006)	Management commitment and leadership, belt system, training, Six Sigma implementation system, performance evaluation and compensation, corporate culture, project identification, operating organisation, customer cantered innovation efforts, performance maintenance
Chakrabarty and Tan (2007)	Top management commitment, education and training, cultural change, customer focus, clear performance metrics, attaching success to financial benefits, organisational readiness, organisational understanding of work processes
Nonthaleerak and Hendry (2008)	Inspiring leadership, technical support, full time vs. part time resources
Mahanti and Antony (2009)	Top management commitment, project planning and management, employees commitment, project prioritisation and selection, understanding the Six Sigma methodology, knowledge sharing, team communication, suppliers involvement, document management/ data system, linking Six Sigma to business strategy, organisational infrastructure, attaching success to financial benefits, cultural change
Brun (2011)	Education and training, change management, linking Six Sigma to business strategy, human resource management, project prioritisation and selection

Table 2 CSFs of Six Sigma implementation (continued)

Author (*year*)	*CSFs*
Suresh et al. (2012)	Education and training, cultural change, organisational understanding of work processes, management's leadership, understanding the Six Sigma methodology, mapping Six Sigma to suppliers
Manville et al. (2012)	Senior management commitment, support and enthusiasm, linking LSS to business strategy, linking LSS to the customer, understanding the tools and techniques, project selection and prioritisation, and training and education
Chakraborty and Tan (2013)	Organisational readiness, management of culture change, organisation-wide commitment, support of team members, clear performance metrics, customer focus, education and training, linking Six Sigma to business strategy, management commitment and involvement
Talankar et al. (2014)	Process ownership, awareness program, project selection, organisational assessment, customer centric approach, performance assessment, reward, human resource management, knowledge sharing, database management, Servicescape

2.3 Clustering CSFs using Delphi methodology

Cluster may be defined as an agglomeration of CSFs which are related to each other in their characteristics. The CSFs summarised in Table 2 were collected from the literature of case studies of different formal service sectors. Talankar et al. (2014) has carried out the task of cluster formation and finding interrelationship between them in three rounds of Delphi process and cognitive mapping technique using a panel of 13 experts. A mixed group of experts having knowledge of non-formal service industry were selected from academic background, professionals from non-formal service sector and Six Sigma consultants.

The CSFs suggested by the panel of experts are grouped into 11 clusters which are summarised in Table 3.

Table 3 CSF clusters and their description for non formal service sectors

Cluster no.	*Cluster*	*CSFs*	*Description*
CL-1	Process ownership	Top management commitment; Management's leadership; inspiring leadership	Being unstructured organisation, in non-formal service organisation, process ownership indicates the responsibility of any quality initiative. For formal organisations it is top management involvement
CL-2	Awareness program	Education and training; cultural change/change management; organisational understanding of work processes; understanding the Six Sigma methodology	Awareness program is the process of informal training to be acquainted with the Six Sigma methodology, tools and techniques, framework and documentation which is vital for its successful implementation

Table 3 CSF clusters and their description for non formal service sectors (continued)

Cluster no.	*Cluster*	*CSFs*	*Description*
CL-3	Project selection	Attaching success to financial benefits; linking Six Sigma to business strategy; project goal set ups; project planning and management; deployment plan; structured approach; project prioritisation and selection	Project selection plays vital role in the success of Six Sigma as every process cannot be improved. Project should be selected on the basis of desired end result like financial gain, customer's satisfaction etc.
CL-4	Organisational assessment	Organisational readiness; financial performance evaluation; process measurement and feedback; Six Sigma implementation system	It is process of assessment of organisational readiness before implementing Six Sigma in terms of human resource, finance and organisational infrastructure
CL-5	Customer centric approach	Customer focus/customer's satisfaction; suppliers involvement; employees commitment; bottom line focus	Process selection for the improvement in the bottom and top line results should be based on customer's satisfaction on the utmost priority
CL-6	Performance Assessment	Clear performance metrics/ evaluation; standardised metrics; project tracking and reviews; use of quality tools	It is the process of continuous assessment, mentoring and controlling the service process under consideration
CL-7	Reward	Incentive program, compensation	It is the recognition to the contribution to enhance the quality service in terms of incentives, promotion or compensation
CL-8	Human resource management	Project management skill; Companywide commitment; full time vs. part time resources; human resource management; supplier involvement; technical support; empowerment of people; selecting key players/construction of specialised team	Deputing the right person to extract the work is the key to success of any program. Thus managing the personnel on full time/ part time, or to seek the consultancy, training is the most important decision in techno-economical aspect
CL-9	Knowledge sharing	Team communication	It is process of informal learning through interaction and communication amongst the team members
CL-10	Database management	Information and analysis systems; document management/data system; data based decision making	In non-formal sectors data collection is the biggest hurdle therefore for full blown success of Six Sigma database management is vital
CL-11	Servicescape	Environment/adaptable system	Servicescape illustrate the place where the service is being provided. The ambiance, cleanliness and layout give competitive leverage to achieve customer satisfaction

Source: Modified from Talankar et al. (2014)

2.4 Observations and gaps in literature

The discussion in the literature about non-formal service sectors and CSFs in particular is not case specific but is generic in nature. Therefore, there is need to explore this sector and identify case-specific CSFs and develop their implementation model. The paper attempts to address the following research gaps:

- although literature is full of case studies of Six Sigma implementation and CSF identification for formal service sector, but not much literature is available for non-formal service sectors except for Talankar et al. (2011, 2014)
- CSF clustering has been carried out by Talankar et al. (2014) but as such there is no formal model of CSF implementation exists.

The paper focuses on detailed methodology of ISM and development of hierarchical model of CSF clusters of Six Sigma implementation shown in Table 3.

3 ISM methodology, model development and ISM analysis of CSF clusters

First proposed by Warfield (1974), ISM is a well-accepted methodology for interactive learning to identify and to evaluate the relationship among case-specific variables (Thakkar et al., 2008). In this technique, a set of different directly and indirectly related elements are structured into a comprehensive systematic model with the help of expert's opinion. Expert's judgement decides whether and how the items are related to each other (Soti et al., 2010; Attri et al., 2013). The overall structure is extracted from the complex set of variables and portraits group's judgement in a structural diagraph based on their driving and dependence power. The important outcomes of the methodology are:

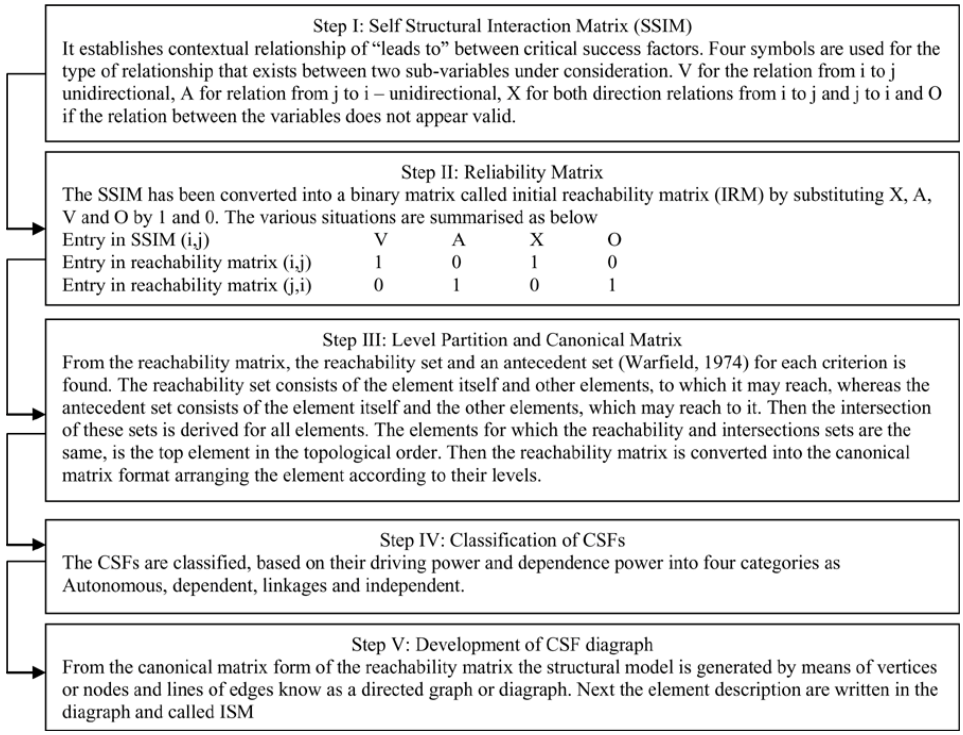
- it categorise the criteria into four groups: autonomous, dependent, independent and linkages
- ISM digraph helps in interpretation of the subjective knowledgebase of expert in structured manner with opportunity to revise the judgement in which the computational efforts are relatively less.

The various steps involved in the ISM technique are shown in Figure 1.

3.1 Structural self-interaction matrix (SSIM)

Eleven clusters of CSFs of Six Sigma for non-formal service sectors suggested by Talankar et al. (2014) have been selected for ISM analysis. As shown in Step 1 (Figure 1), contextual relationship is established amongst them using the panel of experts. Mohammed et al. (2008), suggested seeking experts' opinion in developing contextual relationship among the variables which has been recommended and used by Mandal and Deshmukh (1994) and Saxena et al. (1992). A structural self-interaction matrix (SSIM) is then developed for clusters as shown in Table 4, which indicates pair-wise relationship amongst the CSF clusters of the Six Sigma system. Four symbols, V, A, X and O, are used to denote the directional relationship amongst the clusters.

Figure 1 Algorithm for development of CSF diagraph



Source: Adopted from Thakkar et al. (2008)

Table 4 SSIM matrix

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

3.2 Reachability matrix

The SSIM has been converted into a binary matrix, called the initial reachability matrix (Table 5) by substituting V, A, X and O by 1 and 0 (Singh and Kant, 2008) as per the rules depicted in Figure 1.

Table 5 Initial reachability matrix

	CL-1	*CL-2*	*CL-3*	*CL-4*	*CL-5*	*CL-6*	*CL-7*	*CL-8*	*CL-9*	*CL-10*	*CL-11*
CL-1	1	1	1	1	1	1	1	1	1	1	1
CL-2	0	1	0	0	0	1	1	1	1	1	1
CL-3	0	1	1	0	0	0	1	1	1	1	1
CL-4	0	1	1	1	1	1	1	1	1	1	1
CL-5	0	1	1	1	1	1	1	1	1	1	1
CL-6	0	0	0	0	0	1	1	0	0	0	0
CL-7	0	0	0	0	0	0	1	0	0	0	0
CL-8	0	0	0	0	0	1	1	1	0	1	0
CL-9	0	1	0	0	0	1	1	1	1	1	1
CL-10	0	0	0	0	0	1	1	1	0	1	1
CL-11	0	0	0	0	0	1	0	1	0	1	1

The final reachability matrix is obtained by incorporating the transitivity (Table 6). The transitivity is checked, by checking if element *i* lead to element *j* and element *j* leads to element *k* then element *i* should lead to element *k*.

Table 6 Final reachability matrix

	CL-1	*CL-2*	*CL-3*	*CL-4*	*CL-5*	*CL-6*	*CL-7*	*CL-8*	*CL-9*	*CL-10*	*CL-11*	*Driving power*
CL-1	1	1	1	1	1	1	1	1	1	1	1	11
CL-2	0	1	0	0	0	1	1	1	1	1	1	7
CL-3	0	1	1	0	0	1*	1	1	1	1	1	8
CL-4	0	1	1	1	1	1	1	1	1	1	1	10
CL-5	0	1	1	1	1	1	1	1	1	1	1	10
CL-6	0	0	0	0	0	1	1	0	0	0	0	2
CL-7	0	0	0	0	0	0	1	0	0	0	0	1
CL-8	0	0	0	0	0	1	1	1	0	1	1*	5
CL-9	0	1	0	0	0	1	1	1	1	1	1	7
CL-10	0	0	0	0	0	1	1	1	0	1	1	5
CL-11	0	0	0	0	0	1	1*	1*	0	1	1	5
Dependence power	1	6	4	3	3	10	11	9	6	9	9	

*Transitivity.

The reachability set and antecedent set for each parameter were obtained from final reachability matrix (Warfield, 1974). The reachability set for a particular cluster consists of the cluster itself and the other clusters, which may help in achieving them. Then, the intersection sets of these sets are derived for all variables. The variables having the same reachability and the intersection sets are kept at the top level in ISM hierarchy.

The interactive procedure continues till the hierarchy of all the clusters is defined. The clusters, along with their reachability set, antecedent set, intersection set and the levels, are shown in Table 7. The identified levels aid in building the diagraph and the final model of ISM.

Table 7 Iterations for level partitions

CSF	*Reachability set*	*Antecedent set*	*Interaction*	*Level*
1	1,2,3,4,5,6,7,8,9,10,11	1	1	Level 7
2	2,6,7,8,9,10,11	1,2,3,4,5,9	2,9	Level 4
3	2,3,6,7,8,9,10,11	1,3,4,5	3	Level 5
4	2,3,4,5,6,7,8,9,10,11	1,4,5	4,5	Level 6
5	2,3,4,5,6,7,8,9,10,11	1,4,5	4,5	Level 6
6	6,7	1,2,3,4,5,6,8,9,10,11	6	Level 2
7	7	1,2,3,4,5,6,7,8,9,10,11	7	Level 1
8	6,7,8,10,11	1,2,3,4,5,8,9,10,11	8,10,11	Level 3
9	2,6,7,8,9,10,11	1,2,3,4,5,9	2,9	Level 4
10	6,7,8,10,11	1,2,3,4,5,8,9,10,11	6,8,10,11	Level 3
11	6,7,8,10,11	1,2,3,4,5,8,9,10,11	8,10,11	Level 3

3.3 Formation of ISM digraph and model

The structural model is developed from final reachability matrix (Table 6). The relationship between the clusters is presented by an arrow which points from *i* to *j*, if cluster *i* help to attain cluster *j*. This graph is called as an initially directed graph, or initial digraph. Figure 2 depicts the final digraph after confiscating the transitivities as stated earlier in ISM methodology. This final digraph is converted into the ISM-based model (Figure 3).

Figure 2 ISM diagraph

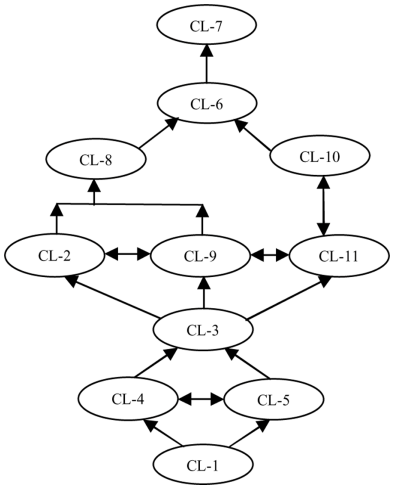
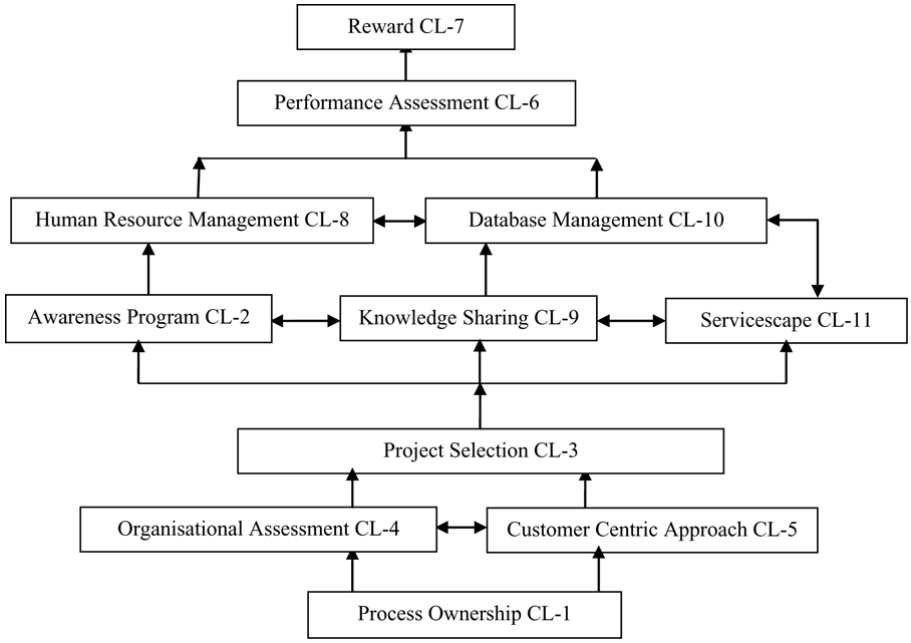


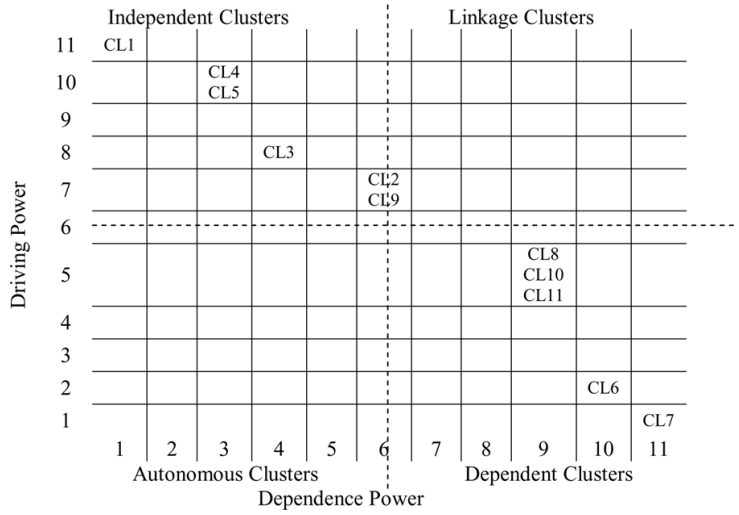
Figure 3 ISM model



4 Classification of CSF clusters

The MIC–MAC analysis has been done to evaluate the driver power and dependency of each CSF cluster. Thus, CSF clusters are classified into four categories based on their driving and dependence power (Mandal and Deshmukh, 1994; Singh and Kant, 2008; Soti et al., 2010; Mehta et al., 2014). Four quarters are obtained by drawing average driver line and average dependence line as shown in Figure 4.

Figure 4 MIC MAC analysis



Quarter I: It shows the first group of the CSF clusters with weak driver and dependence power, which are referred as 'autonomous clusters'. These clusters are relatively disconnected from the system because of their weak driving and weak dependence power therefore they cannot influence the process of Six Sigma implementation. In our case, there are no CSF clusters in this quarter.

Quarter II: It shows the second group of CSF clusters with weak driver-power but strong dependence power known as the 'dependent clusters'. These clusters are strongly dependent on the clusters which are driving them. To attain these clusters their drivers must be successfully implemented. CSF clusters CL6, CL7, CL8, CL10 and CL11 are in the category of dependant clusters.

Quarter III: It represents the third category of CSF clusters with strong driver-power and strong dependence called as 'linkage clusters'. These clusters are unstable because of the fact that any action taken on these clusters will have an effect on other clusters and also a feedback affect on itself. CSF clusters, CL2 and CL9, with driver power (7) and dependence power (6), are placed in this quarter.

Quadrant IV: It shows the fourth category of CSF clusters having strong driving power but weak dependence known as 'independent clusters'. These clusters are drivers for the remaining CSF clusters therefore careful attentions must be paid to them. CSF clusters CL1, CL3, CL4 and CL5 have strong driving power and weak dependence power, hence placed in quarter IV.

5 Discussion and conclusion

There is no doubt that the organisations are bound to finalise the CSFs before implementation of Six Sigma and their order of implementation of CSFs. The main challenge is to deal with the non-formal organisations, which are different as far as their strategies, work culture, organisational structure and technology are concerned. The present research has following practical implications for the researchers and professionals working in the field of non-formal services:

- it gives a methodological approach that helps in identifying CSFs of the organisation prepared to implement Six Sigma
- it gives ISM model based on driving and dependence power of CSF clusters depicting the hierarchy of implementation
- it also categories the CSF cluster into three categories: strategic requirement, tactical requirement and operational requirement
- this framework helps many non-formal organisations to built Six Sigma competence.

For critical examination and validation of data, limitations of any research must be recognised (Jankowics, 2005). The present research has following limitations:

- paucity of literature on the application of Six Sigma in non-formal service sectors, presenting huge scope for future research
- owing to paucity of literature no competitor data could be accessed for research to benchmark against. In future such a research can be conducted in this domain.

Eleven clusters of CSFs of Six Sigma have been selected for ISM analysis to establish their hierarchy of implementation. Classification of CSF clusters in a hierarchical manner will help in successful implementation of Six Sigma.

The key finding of this paper is that in pursuit of Six Sigma implementation, the CSF clusters possessing higher driving power should be given more attention as compared to those having dependencies. 'Process Ownership' is the most important CSF cluster due to its high driving power and low dependence among all the clusters. This can be validated by using the previous surveys results (Soti et al., 2010). This cluster is positioned at the lowest level in the hierarchy of the ISM model. The CSF cluster-'Reward' is at the highest level in the ISM model due to its high dependence power and low driving power.

Those clusters which are at the middle level, i.e., at third, fourth and fifth levels in the model with the highest driving power are known as 'strategic CSF clusters'. These clusters play a vital role in sharing knowledge, information, strategic decisions to achieve the customer's satisfaction. These clusters require greater attention from the process owner.

The MIC–MAC analysis diagram (Figure 4) gives valuable insights about the importance and dependencies of the clusters with one other as stated below:

- There are no autonomous variables in the process of Six Sigma implementation. The absence of autonomous clusters indicates that all the identified CSF clusters influence the process of Six Sigma implementation and all the clusters are important for the successful implementation of Six Sigma.

The findings of this research are very crucial for the decision makers, consultants and researchers of non-formal service organisations to build Six Sigma competent organisation. The levels of clusters are important in Six Sigma implementation process to set the priorities of actions.

- The MIC–MAC analysis conducted shows: CL1, CL-3, CL-4 and CL-5 are independent variables, CL-2 and CL-9 are linkage variables and CL-6, CL-7, CL-8, CL-10 and CL-11 are the dependent variables.
- It can be observed from Figure 4 that four CSF clusters: namely, process ownership (CL-1), project selection (CL3), organisational assessment (CL-4) and customer centric approach (CL-5) are strategic requirement and have high driving power and less dependence power. Therefore, these CSFs can be treated as key variables.
- Awareness program (CL-2), knowledge sharing (CL-9) and servicescape (CL-11) are the tactical requirements.
- Human resource management (CL-8), database management (CL-10), performance assessment (CL6) and reward (CL-7) are the operational requirements of Six Sigma implementation program having weak driving power and weak dependence power.

On the basis of above discussion, it can conclude that all the 11 clusters of CSF are important (although in varying degrees) for the purpose of successful implementation of Six Sigma in non-formal service sector.

In this research, 11 clusters of CSFs, under consideration are applicable for event management and they have been used to develop the ISM model. Similar approach can be followed to identify CSFs for other non-formal services and establish their hierarchy using the ISM methodology. Furthermore, in this research, the relationship model among

the identified CSFs clusters has not been statistically validated. Thus, the model needs to be statistically tested and validated using different structural approaches like structural equation modelling (SEM).

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