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Identification of Critical Success Factors in Non-Formal Service Sector Using Delphi Technique

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***Abstract*—**The purpose of this study is to identify the critical success factors (CSFs) for the effective implementation of Six Sigma in non-formal service Sectors.

Based on the survey of literature, the critical success factors (CSFs) for Six Sigma have been identified and are assessed for their importance in Non-formal service sector using Delphi Technique. These selected CSFs were put forth to the panel of expert to cluster them and prepare cognitive map to establish their relationship.

All the critical success factors examined and obtained from the review of literature have been assessed for their importance with respect to their contribution to Six Sigma effectiveness in non formal service sector.

The study is limited to the non-formal service sectors involved in the organization of religious festival only. However, the similar exercise can be conducted for broader sample of other non-formal service sectors like temple/ashram management, religious tours management etc.

The research suggests an approach to identify CSFs of Six Sigma for Non-formal service sector. All the CSFs of the formal service sector will not be applicable to Non-formal services, hence opinion of experts was sought to add or delete the CSFs. In the first round of Delphi, the panel of experts has suggested, two new CSFs- "competitive benchmarking (F19) and resident's involvement (F28)", which were added for assessment in the next round of Delphi. One of the CSFs-"fulltime six sigma personnel (F15)" has been omitted in proposed clusters of CSFs for non-formal organization, as it is practically impossible to deploy full time trained Six Sigma recruits.

***Keywords*—**Critical success factors (CSFs), Quality assurance, non-formal service sectors, Six Sigma.

I. Introduction

TO enhance efficiency, competitiveness, and customer satisfaction, an increasing number of companies are adopting a quality management system (QMS) [31]. Six Sigma is one of the quality management systems which can reduce the defect in process as low as 3.4 Defects per Million Opportunities (DPMO). Various researchers have argued that Six Sigma can increase organizational competitive capabilities and enhance the quality of products and/ or services [6], [30]. 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 services.

The successful implementation of Six Sigma depends on many factors, known as critical success factors of Six Sigma. The idea of identifying critical success factors was popularized by [36], as a basis for determining the information needs of managers. These success factors are the key parameters that make Six Sigma applications fruitful for an organization.

Non formal service sectors are more vulnerable to changes of market because of their limited resources, lack of technological capabilities and less possibility to expand as compare to formal organization. They have to face the fierce competition in highly volatile market situation and make compromise between low cost operation and value added operations [39]. Therefore, the quality of services provided by the non-formal sectors can provide them leverage to gain competitive advantage in this scenario.

The basic step for deployment of six sigma program is to identify the critical areas which affect the customer satisfaction. This paper looks at the critical success factors (CSFs) for Six Sigma initiatives, with an emphasis on the non-formal service sector.

This research is focused on the following three objectives:

(1) Identification of CSFs of Six Sigma in service sectors through literature review and experts opinion.
(2) Prepare the cognitive maps of select CSF for grouping them into clusters using Delphi Technique.
(3) CSFs clusters and cognitive maps depicting their inter-relationship for implementation of Six Sigma in Non-formal Services.

II. Methodology of Research

The research presented in this paper is conducted in four steps as shown in Fig. 1.

Step1. Identification of CSF from Literature: In order to determine the CSFs for Six Sigma, research paper of Six Sigma implementation have been thoroughly reviewed to identify CSF in various formal service sectors.

Step2. Delphi's 1st Round: The CSFs identified from the literature were discussed with the panel of experts to assess the applicability in Non-formal service sectors. The expert's opinion was sought to add or delete some of the CSFs for non-formal sector. Coding of finalized

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set of CSFs has been done before forwarding them to the next round of Delphi (Refer Table II).

Step3. Delphi's 2nd Round: Experts were asked to cluster the identified CSF using cognitive mapping technique. After second round of Delphi, personal interviews were conducted with individual experts to withdraw or modify their opinion. During this process the incomplete and ambiguous responses given by the experts were neglected.

Step4. Delphi's 3rd Round: the experts were asked to determine the inter-relationship of the clusters in the first draft of cognitive map. The second round interview with experts was held to finalize the cognitive map for the inter-relationship of cluster and consensus for identity of cluster (i.e.name and code of cluster).

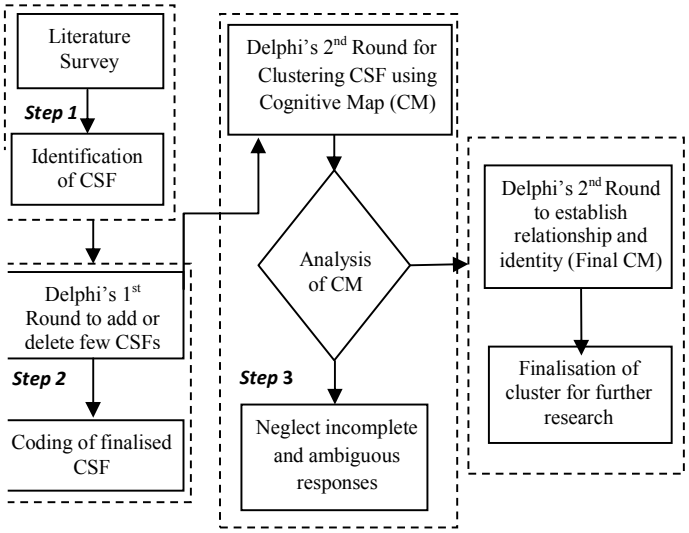

Fig. 1 Methodology of Research

III. Critical Success Factors (CSF)

Many papers presenting case studies of Six Sigma implementation in service sectors conclude that the useful exercise is to sort out various "Critical Success Factors" (CSF) of Six Sigma that form the foundation to successful deployment of Six Sigma program. CSFs are those factors which are critical to the success of an organization, if the objectives associated with the factors are not achieved, the organization will fail catastrophically [36]. Some select definitions of CSF by various researchers are summarized in Table I.

TABLE I
Select Definitions of CSF from Literature

Author	Definition
[36]	The limited numbers of areas in which results, if they are satisfactory, will ensure competitive performance for the organisation.
[11]	The essential things that must be achieved by the company or which areas will produce the greatest "competitive leverage".
[8]	Those few things that must go well to ensure success
[19]	"Critical Success Factors" are best practices, or that are vital for Six Sigma to succeed.

Soti [37] argued that Critical success factors assure successful installation, functioning and sustainability of Six Sigma system; whereas, enablers assure successful installation of a Six Sigma system. They have categorized CSF into three groups, functional success factors (enablers), operational success factors and the factors which monitor sustainability of Six Sigma. They have also argued that this CSF can be clustered and modeled to industry specific application.

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 [11] emphasize that CSFs are not objectives, but are the actions and processes that can be controlled/affected by management to achieve the organization's goals. They also state that the CSFs are not static, but depend on a combination of where the organization is and where it wants to be. The CSF defined by Boynton and Zmud [8] is a more universal definition which is equally applicable to both the public and private sectors and not restricted to a particular type of project.

Table II depicts various CSFs summarized from the literature; these are related to most of the business function and are useful database to identify CSFs for Six Sigma implementation.

IV. Clustering CSFs Using Delphi Methodology

Cluster may be defined as agglomeration of CSFs which are related to each other in their characteristics. The identified CSFs from literature are summarized into eleven clusters based on their relevant characteristics using Delphi Technique. The task has been accomplished by conducting two rounds of Delphi process to reach the consensus among experts.

With the purpose of determining the relation between clusters, advice was taken from a panel of 13 experts. These experts were selected based on their academic background and long time experiences in non-formal service sector, or consulting positions. This team composition guarantees the experts who are finally chosen having profound knowledge of Non-formal service industry.

Among the various methods [13], Delphi methodology has been adopted, which is used to structure the process of communication in a group of experts in order to reach a consensus regarding a complex problem. One of the main characteristics of the Delphi study is that, when the experts receive feedback reports; they have an opportunity of improving their own opinion [14]. This was done through consulting and questioning the experts with information about deviations from previous rounds to provide them with the chance to obtain consensus and get all experts to go toward the average.

A. Delphi's First Round

To start with the Delphi's first round, CSFs identified from the literature of formal service sectors, have been discussed with the panel of experts. In the brainstorming session, the experts were asked to study the CSFs carefully and assess their applicability to non-formal service organizations.

TABLE II
CSFS APPROVED AND SUGGESTED BY EXPERTS

No	Critical Success Factors	Author	Measurement Aspect	CSF Code
1	Top management commitment	[16]-[18]; [1]; [3]; [4]; [9]; [28]; [32]	Qualitative and Quantitative	F1
2	Education and training	[16]-[18]; [1]; [3]; [4]; [27]; [10]; [12]; [15]; [24]; [28]; [32]; [38]; [40];	Qualitative	F2
3	Cultural change/ change management	[16]; [17]; [1]-[4]; [9]; [12]; [32]; [38]	Qualitative	F3
4	Customer focus/customer's satisfaction	[2]; [7]; [16]-[18]; [24]; [40]	Qualitative and Quantitative	F4
5	Clear performance metrics /evaluation; Standardised metrics	[1]; [7]; [16]-[18]	Quantitative	F5
6	Attaching success to financial benefits	[3]; [4]; [16]; [17]; [32]	Quantitative	F6
7	Organisational understanding of work processes	[3]; [4]; [16]; [17]; [38]	Qualitative and Quantitative	F7
8	Organisational readiness	[16]; [17]	Quantitative	F8
9	Project management skill	[1]; [3]; [4]	Qualitative	F9
10	Organisational infrastructure / Belt system	[2]-[4]; [15]; [18]; [27]; [28]; [32]; [40]	Qualitative and Quantitative	F10
11	Companywide commitment	[3]; [4]	Quantitative	F11
12	Project tracking and reviews	[3]; [4]; [23]	Quantitative	F12
13	Incentive program, Compensation	[3]; [4]; [23], [27]; [15]	Quantitative	F13
14	Linking Six Sigma to business strategy	[2]-[4]; [32]; [12]	Qualitative and Quantitative	F14
15	Full time versus part time resources Consultancy from academician*	[23]; [35]; [34]	Quantitative	F15*
16	Information and analysis systems	[28]	Quantitative	F16
17	Use of quality tools	[28]	Quantitative	F17
18	Human resource management	[28]; [24]; [12]	Qualitative and Quantitative	F18
19	Competitive benchmarking	*Suggested by the panel of experts	Qualitative and Quantitative	F19*
20	Management's leadership	[2]; [15]; [23]; [35]; [38]	Qualitative and Quantitative	F20
21	Project planning and management	[2]; [18]; [32]	Qualitative and Quantitative	F21
22	Understanding the six sigma methodology	[2]; [32]; [38]	Qualitative	F22
23	Project prioritisation and selection	[1]; [2]; [10]; [12]; [23]; [27]; [32]; [40];	Quantitative	F23
24	Employees commitment	[2]; [32]	Qualitative	F24
25	Knowledge sharing	[32]	Qualitative	F25
26	Team communication	[32]	Qualitative	F26
27	Document management/ Data System	[9]; [32]	Quantitative	F27
28	Suppliers involvement/Mapping Six Sigma to Suppliers/ Resident's involvement*	[2]; [12]; [23]; [32]; [38]	Quantitative	F28*
29	Financial performance evaluation	[24]; [27]	Quantitative	F29
30	Deployment plan	[23]	Qualitative and Quantitative	F30
31	Technical support	[23]; [34]	Qualitative	F31
32	Environment/adaptable system	[9]; [23]	Qualitative	F32
33	Empowerment of People	[7]	Qualitative	F33
34	Inspiring leadership	[7]; [24]; [27]; [33]; [34]; [40]	Qualitative and Quantitative	F34
35	Selecting key players / Construction of specialised team	[9]; [10]; [40]	Quantitative	F35
36	Project goal set ups	[15]	Quantitative	F36
37	Data based decision making	[35]	Quantitative	F37
38	Process measurement and feedback	[35]	Quantitative	F38
39	Structured approach	[9]	Qualitative	F39
40	Bottom line focus	[9]	Quantitative	F40
41	Six sigma implementation system	[18]	Qualitative	F41

Moreover, the opinion of the experts was sought to add new CSFs, if any, applicable to event management and omit those which are extraneous. In this session, expert's revealed the fact that in non-formal sectors the financial crisis is the biggest barrier in implementation of any change. Appointing the full time Six Sigma certified manpower (Master Black Belt, Black Belt and Green Belt etc.) will be the costly affair for Non-formal sector, however, consultancy from academic institution can be solicited to solve the purpose. Therefore the CSF-"full time Six Sigma Personnel" has been neglected from the study.

Similarly, "resident's involvement" is an integral part of event management; their active participation is one of the most critical factors in the success of any event. Also various organizing agencies are separate business units and they have to manage their own supplier, and residents are the party in the organization of event hence the CSF-"resident's involvement" is taken in place of "supplier involvement"

In managing the events, similar events held worldwide, can be benchmarked so as to make the effective planning and execution of the event, so "competitive benchmarking" is the one of the CSF, taken into consideration as suggested by the experts.

B. Delphi's Second Round to Construct Cognitive Map

A cognitive map is a representation of thinking about the problem that follows from the process of mapping [22]. The maps are the network of nodes and arrows as links particular type of directed graphs [25], [26]. Cognitive maps (CM) were proposed and applied to ill-structured problem by [5]. The formal basis for cognitive maps derives from personal construct theory [29] which proposes an understanding of how humans "make sense of" their world by seeking to manage and control it. The map, as model also acts as a device for establishing a mutual understanding of the issue [20], [21].

In order to obtain the cluster of CSF, according to aforementioned factors retrieved from literature survey and in consultation with experts, initial draft of the CSFs have been prepared the in the first round of Delphi. In the second round the experts were given a brief introduction of cognitive mapping technique and were asked to study the characteristics of given CSFs.

Based on the characteristics of given CSFs experts have clubbed them into various clusters. The relationship of CSFs in expert's opinion and their graphical representation in the form of cognitive map is illustrated in Fig. 1.

In addition, some experts believed in new relations between some factors that had not been taken into account in the initial cognitive map (refer Table II).

TABLE III
NEW RELATION ESTABLISHED IN DELPHI'S FIRST ROUND

Cluster	CSF	Frequency
CL1-Process Ownership	F3- Cultural Change	2
CL1-Process Ownership	F13- Incentive Program	1
CL4-Organisational assessment	F10- Organisational Infrastructure	2

Results showed that majority of experts did not agree with the relations between "process ownership" and "cultural change" and/or "incentive program". Similarly, most of experts also agreed that the relation between "organizational infrastructure" and "human resource management" is more meaningful than the relation between "organizational infrastructures" and "organizational infrastructure". According to the results of second round of Delphi, separate interviews with each expert have been conducted and the vague opinions were neglected.

Before commencement of next session, necessary explanations for the neglected relationships have been given to entire team of expert. The objective of the third round is to develop the relationship among the finalized cluster, their identification and coding. In this session, with the consensus of all the experts the final draft of cognitive map was prepared as shown in Fig. 2, for their inter-relationship.

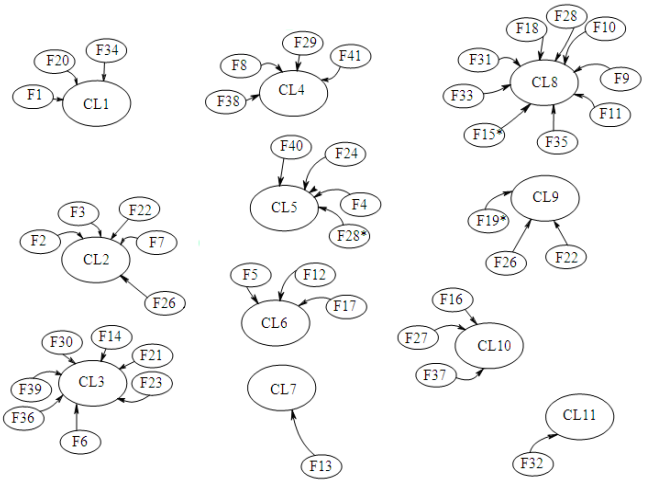

Fig. 2 CSF clusters formed at the end of Delphi's first round

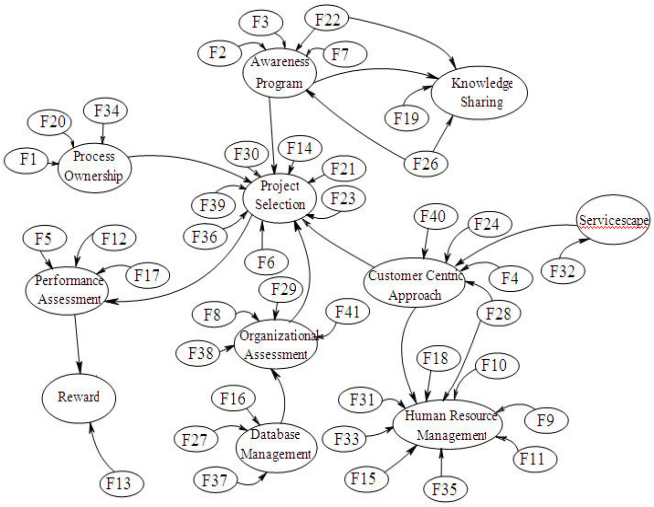

Fig. 3 Final Clusters with their identification and relationship (result of Delphi's second round)

C. Delphi's Third Round

In third round of Delphi the finalized 11CSFs clusters were named and coded for their identity; refer Table IV. These clusters covers almost all the CSFs of Six Sigma applicable to, formal service sectors and are helpful as resource to identify the CSFs for any other non-formal service.

TABLE IV
CSF CLUSTERS FOR NON FORMAL SERVICE SECTORS

Cluster No.	Cluster	CSFs
CL-1	Process ownership	Top management commitment/ Management's leadership/ inspiring leadership;
CL-2	Awareness Program	Education and training; Cultural Change/Change Management; Organisational understanding of work processes; Resident's involvement*; Understanding the six sigma methodology.
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.
CL-4	Organisational Assessment	Organisational readiness; Financial performance evaluation; Process Measurement and Feedback; Six sigma implementation system
CL-5	Customer Centric Approach	Customer focus/customer's satisfaction; Suppliers involvement; Employees commitment; Bottom line focus.
CL-6	Performance Assessment	Clear performance metrics /evaluation; Standardised metrics; Project tracking and reviews; Use of quality tools
CL-7	Reward	Incentive program, Compensation
CL-8	Human Resource Management	Project management skill; Consultancy from academicians*; Companywide commitment; Full time versus part time resources; Human resource management; supplier involvement; Technical Support; Empowerment of people; Selecting key players / Construction of specialised team
CL-9	Knowledge Sharing	Competitive benchmarking*; Team communication; Understanding Six Sigma methodology
CL-10	Database Management	Information and analysis systems; Document management/Data System; Data based decision making
CL-11	Servicescape	Environment/adaptable system

V. SUMMERY AND ANALYSIS

Non-formal sectors have no definite organizational structure; therefore, capturing their operation is the challenging task. Before implementation of any quality management system, it is necessary to establish the formal structure of the organization. The present research proposes an approach to assess the critical success factors which are vital for deployment of Six Sigma program in any non-formal organization. This study provides formal approach for implementation of Six Sigma in Non-formal sectors.

The CSFs for the non-formal service sector follow quite a different pattern from the manufacturing and service sectors. The caveat to this work is that there has been insufficient published work in non-formal service sectors to draw any statistically significant conclusions.

Following are the major conclusions:

- This review provides a list of 41 CSFs which can be used as a reference to identify CSFs for non-formal organizations.
- The proposed approach is an instrument for identification of CSFs for non-formal organizations which are planning for Six Sigma implementation.
- CSFs are case specific hence, in future, Industry specific CSF clusters can also be developed and validated using interpretive and data-based modeling approach.

REFERENCES

[1] Antony, J., "Six Sigma for Service Processes", Business Process Management Journal, Vol. 12 No. 2, 2006, pp. 234-48.
[2] Antony, J. and Banuelas, R., "Key Ingredients for the Effective Implementation of a Six Sigma Program", Measuring Business Excellence, Vol. 6 No. 4, 2002, pp. 20-7.
[3] Antony, J., "Six Sigma in the UK Service Organisations: Results from a Pilot Survey" Managerial Auditing Journal, Vol. 19 No. 8, 2004, pp. 1006-1013.
[4] Antony, J., Kumar, M. and Madu, C.N., "Six Sigma in Small and Medium Size UK Manufacturing Enterprises", International Journal of Quality & Reliability Management, Vol. 22 No. 8, 2005, pp. 860-74.
[5] Axelrod, R., "Structure of Decision", University of Princeton Press, Princeton, 1976.
[6] Banuelas, R., Antony, J. and Brace, M., "An Application of Six Sigma to Reduce Waste", Quality and Reliability Engineering International, Vol. 21 No. 6, 2005, pp. 553-70.
[7] Bhote, K.R., "The Ultimate Six Sigma: Beyond Quality Excellence to Total Business Excellence", AMACOM/American Management Association, New York, NY, 2002.
[8] Boynton, A. and Zmud, R., "An Assessment of Critical Success Factors", Sloan Management Review, Vol. 25 No. 4, 1984, pp. 17-27.
[9] Brady, J.E. & Allen, T.T., "Six Sigma Literature: A Review and Agenda for Future Research" Quality & Reliability Engineering International, Vol.22, No. 3, 2006, pp. 335–367.
[10] Breyfogle, F.W. III , "Better Fostering Innovation: 9 Steps that Improve Lean Six Sigma", Business Performance Management Magazine, Vol. 6 No. 3, 2008, pp. 16-20.
[11] Brotherton, B. and Shaw, J., "Towards an Identification and Classification of Critical Success Factors in UK Hotels Plc", International Journal of Hospitality Management, Vol. 15 No. 2, 1996, pp. 113-35.
[12] Brun, A., "Critical Success Factors of Six Sigma Implementations in Italian Companies", International Journal of Production Economics, Vol.5, No. 8, 2011, pp.158-164
[13] Bryson N., Mobolurin A., Joseph A., "Generating Consensus Fuzzy Cognitive Maps", Intelligent Information Systems Vol. 8, No.10, 1997, pp. 231–235.
[14] Bueno S., Salmeron J.L., "Fuzzy Modeling Enterprise Resource Planning Tool Selection", Computer Standards & Interfaces, Vol. 30, No. 3, 2008, pp. 137- 147
[15] Byrne, G., "Ensuring Optimal Success with Six Sigma Implementations", Journal of Organizational Excellence, Vol. 22 No. 2, 2003, pp. 43-50.
[16] Chakrabarty, A. and Tan, K., "The Current State of Six Sigma Application in Services", Managing Service Quality, Vol. 17 No. 2, 2007, pp. 194-208.
[17] Chakrabarty, A. and Tan, K. C., "An Exploratory Qualitative and Quantitative Analysis of Six Sigma in Service Organizations in Singapore", Management Research News, Vol. 32, No. 7, 2009, pp. 614-632.
[18] Cho, J. H. and Jang, J. S., ''Six Sigma Key Ingredients for Successful Implementation of Six Sigma in Korean Companies'', 4th ANQ Congress Proceedings, 2006, pp. 1-10.
[19] Coronado, R.B. and Antony, J., "Critical Success Factors for the Successful Implementation of Six Sigma Projects in Organisations", The TQM Magazine, Vol. 14, No. 2, 2002, pp. 92-99.
[20] Eden, C. And Sims, D., "On the Nature of Problem in Consulting Practice", Omega, Vol. 7, 1979, pp. 119-127.
[21] Eden, C., "Cognitive Mapping and Problem Structuring for System Dynamics Model Building", System Dynamics Review, Vol.10, 1994, pp. 257-276.
[22] Eden, C., "Analysing Cognitive Maps to Help Structure Issues or Problems", European Journal of Operational Research, 2004, pp. 673-686.
[23] Goldstein, M. D., "Six Sigma Program Success Factors", Six Sigma Forum Magazine, Vol. 1, No. 1, 2001, pp.:36–45.

[24] Hahn, G.J., "Six Sigma: 20 Key Lessons Learned: Experience Shows What Works and Does Not Work", Quality and Reliability Engineering International, Vol. 21 No. 3, 2005, pp. 225-33.
[25] Harary, F., "Graph Theory", Addison Wesley Reading, 1972.
[26] Harary, F., Norman, R., Catwright, D., (1965), "Structural Models: An Introduction to the Theory of Directed Graphs", Willey, New York.
[27] Harry, M. and Schroeder, R., "Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Companies", Currency/Doubleday, New York, NY, 2000.
[28] Henderson, K, and Evans, J., "Successful Implementation of Six Sigma: Benchmarking General Electric Company", Benchmarking and International Journal Vol. 7, No. 4, 2000, pp. 260–281.
[29] Kelly, G.A., "The Psychology of Personal Construct", Norton, New York, 1955.
[30] Linderman, K., Schroeder, R.G., Zaheer, S. and Choo, A.S., "Six Sigma: a Goal-Theoretic Perspective", Journal of Operation Management, Vol. 21, No. 2, 2003, pp. 193-203.
[31] Magd, H., "ISO 9001:2000 in the Egyptian Manufacturing Sector: Perceptions and Perspectives", International Journal of Quality & Reliability Management, Vol. 25 No. 2, 2008, pp. 173-200.
[32] Mahanti, R. and Antony, J., "Six Sigma in the Indian Software Industry: Some Observations and Results from a Pilot Survey" The TQM Journal, Vol. 2, No. 6, 2009, pp. 549-564.
[33] Mittal, D., Singla, V., Goyal, A., "Comparison of TQM Success Factors in Northern India in Manufacturing and Service Industries: A Survey", International Journal of Engineering Science and Technology, Vol. 3 No. 2, 2011, pp. 1368-1377.
[34] Nonthaleerak, P. and Hendry, L., ''Exploring the Six Sigma Phenomenon Using Multiple Case Study Evidence'', International Journal of Operations and Production Management, Vol. 28 No. 3, 2008, pp. 279-303.
[35] Pyzdek, T., "The Six Sigma Handbook: A Complete Guide for Greenbelts, Blackbelts, and Managers at All Levels", McGraw-Hill, New York, NY, 2003.
[36] Rockart, J., "Chief Executives Define Their Own Data Needs", Harvard Business Review, Vol. 57, No.2, 1979, pp. 238-241.
[37] Soti, A., Shankar, R., Kaushal, O.P., "Modeling the Enablers of Six Sigma Using Interpreting Structural Modeling", Journal of Modeling in Management, Vol. 5 No. 2, 2010, pp. 124-141
[38] Suresh, S., Antony, J., Kumar M., Douglas, A., "Six Sigma and Leadership: Some Observations and Agenda for Future Research", The TQM Journal Vol. 24 No. 3, 2012, pp. 231-247
[39] Talankar, A., Verma, P., Seth, N., "A Conceptual Framework for Application of Six Sigma Improvement Methodology in Non-Formal Service Sector", Int. J. Six Sigma and Competitive Advantage, Vol. 6, No. 4, 2011, pp. 321-338.
[40] Viseras, E.M., Baines, T. and Sweeney, M., "Key Success Factors When Implementing Strategic Manufacturing Initiatives", International Journal of Operations and Production Management, Vol. 25 No. 2, 2005, pp. 151-79.

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